Attitudes towards Road Safety and Aberrant Behaviour of Drivers in Pakistan

by

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

Acknowledgements

This thesis is dedicated to my mother who has worked all her life to make me what I am today. Thank you, Ammi, for your endless love, trust and confidence in me. Without your support I would not have come so far...

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Abstract

The aberrant behaviour of drivers is regarded as the most significant contributory factor in road traffic accidents in Pakistan. This research is founded on the premise that personal attitudes are key determinant of driving behaviours, and aims to identify the key socio-cognitive determinants of aberrant driving in response to the lack of road safety research in the country. A multi-method approach is taken and three studies have been carried out. Study 1, a qualitative study, based on interviews, provides a common understanding of the road safety issues in Pakistan. Study 2, a quantitative study, used the results of Study 1 to generate an Attitudinal Questionnaire (AQ) which was inspired by the Ajzen's Theory of Planned Behaviour (TPB: Ajzen 1991), and a modified Driver Behaviour Questionnaire (DBQ: Lawton *et al.* 1997) focusing on intentional traffic violations. The study obtained self-reports of attitudes, norms, perceived control and opinion of drivers regarding a number of road traffic violations and enforcement as well as their aberrant behaviours. The responses to the statements in the questionnaires were first factor analysed to identify underlying attitudinal and behavioural constructs. Later, Cluster Analysis used attitudinal constructs to group drivers into four distinct clusters, namely the *autonomous*, *opportunists*, *regulators* and *risk-averse*. In Study 3, the real-world driving behaviours of a sample of the drivers in each of the four clusters were observed using the Wiener Fahrprobe (WF: Risser 1985) technique. The collective results from the studies indicate that the behaviours of drivers are interpretable in relation to their attitudes, and are partly influenced by their socio-demographic characteristics and driving environment. Specifically, attitudes towards enforcement and rule-compliance appear to be the strongest determinant of behaviours of drivers in Pakistan. Results in particular indicate that being affluent, female and student negatively influence driving behaviours in the country. The research also examines the suitability and applicability of the AQ, DBQ, and the WF techniques and methods within a Pakistani context. Finally, the research findings are used to recommend targeted as well as general information-based road safety solutions.

Publications

The following publications and conference papers are prepared during the course of this research.

1. Batool, Z. O. Carsten, *et al.* (2012). "Road safety issues in Pakistan: a case study of Lahore." Transportation Planning and Technology 35(1): 31-48.

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Batool, Z. (2011). Road safety issues of Pakistan: an exploratory qualitative study Universities' Transport Study Group (UTSG) 43rd Annual Conference 2011. Milton Keynes, unpublished proceedings.

2. Batool, Z. (2012). Self-reported dimensions of aberrant driving behaviours among Pakistani drivers. Universities' Transport Study Group (UTSG) 44th Annual Conference 2012. University of Aberdeen, unpublished proceedings.

3. Batool, Z. and O. Carsten (2012). Driver observations contrasted with self-reported driving behaviours: a case study from Pakistan. 5th International Conference on Traffic and Transport Psychology 2012. Groningen, The Netherlands, forthcoming.

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Abbreviations

ADB	Asian development bank
ANOVA	Analysis of Variance
AQ	Attitudinal Questionnaire
CA	Cluster analysis
DAQ	Driver Attitudinal Questionnaire
DBQ	Driver Behaviour Questionnaire
FA	Factor Analysis
GEMS	Generic Error Modelling System
GOP	Government of Pakistan
GTKP	Global Transport Knowledge Partnership
MOC	Ministry of Communication Pakistan
RTA	Road Traffic Accident
RTI	Road Traffic Injuries
RTV	Road Traffic Violations
SPSS	Statistical Package for Social Sciences
TPB	Theory of Planned Behaviour
WF	Wiener Fahrprobe

SECTION I

INTRODUCTION

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Road crashes are an increasing problem throughout the world, which have immense sectoral and economic impacts besides the irreplaceable loss of life. Every year an estimated 1.2 million people are killed and up to 50 million are injured or disabled on the world's roads (Bliss 2004), and a further 3,500 people are added to this huge fatality figure every day (UNECE 2008, p. 35). The problem of deaths and injury as a result of road accidents is now acknowledged to be a global phenomenon. The International Federation of Red Cross and Red Crescent Societies have described the situation as "a worsening global disaster destroying lives and livelihoods, hampering development and leaving millions in greater vulnerability" (Jacobs *et al.* 2000; Ameratunga *et al.* 2006). In 1990, road crashes as a cause of death or disability were in ninth place out of a total of over 100 separately identified causes. However, forecasts suggest that by the year 2020 as a cause of death, road crashes will move up to sixth place (Jacobs *et al.* 2000, p. 3). Furthermore, without appropriate action, road traffic injuries (RTIs) are predicted to escalate from the ninth leading contributor to the global burden of disease[1] in 1990 to the third by 2020 (Kopits and Cropper 2005, cited in Ameratunga *et al.* 2006, p. 1).

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[1] Burden of diseases is measured in the disability adjusted life years (DALYs). DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for incident cases of the health condition. One DALY can be thought of as one lost year of 'healthy' life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability (WHO 2011a).

1.1.1 Developing countries and road accidents

Evidence suggests that the present and projected global burden of RTIs is disproportionately borne by countries that can least afford to meet the health service, economic, and societal challenges posed (Ameratunga *et al.* 2006). For instance, in some cases traffic accidents in developing countries have become more deadly than the diseases that historically affected the population (Eduardo 1995, p. 263). Trend data (between 1987-1995) show that the total number of people killed in road crashes in regions of the developing world continued to increase, whereas in the West there has been a steady decrease over the last fifteen years or so (Jacobs *et al.* 2000, p. 26). By 2020, in low-income and middle-income countries[2] deaths are expected to increase by as much as 80%, and decline by almost 30% in high-income countries (Peden *et al.* 2004, p. 12). The projected rise is approximately 2 per 10,000 persons in developing countries, while it will fall to less than 1 per 10,000 in high-income countries (Kopits and Cropper 2005).

According to Jacobs *et al.* (2000) on a regional basis, statistics suggest that road deaths take the greatest toll on the Asia-Pacific region where 44% of the world's road deaths occur and only 16% of the total motor vehicles are found. They report that between 1987-1995 deaths in the Asia-Pacific rose by 40%. Conversely, road deaths in developed countries fell by about 10%. They further report that in 1999, between 750,000 and 880,000 people died from road crashes across the world. The majority of these deaths occurred in developing and transitional nations (85%) with approximately half in the Asia-Pacific region (pp. 14-24). Table 1 indicates projected fatalities in the different regions of the world, where the greatest percentage increase in traffic deaths can also be seen in the South-Asia region i.e. 144% (Kopits and Cropper 2005, p. 176). United Nations Economic and Social Commission for Asia-Pacific (UNESCAP) secretariat estimates that, unless additional measures are taken, about 610,000 road deaths might occur in the UNESCAP region by 2020 (UNECE 2008, p. 97). The situation is considered to be even more serious than the statistics

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[2] Economies are divided as per the classification on the World Bank website (WHO 2011b). According to classification, high-income countries, in which most people have a high standard of living, are equated as developed countries whilst the countries with low or middle levels of GNP per capita are equated as developing countries (WHO 2011c).

suggest as only a fraction of injury road crashes are reported in many less developing countries (Jacobs *et al.* 2000).

Table 1: Predicted road traffic fatalities by region (000s), 1990-2020

World Bank Region	% Change (2000-2020)	Fatality risk (deaths/100,000 persons)	
		2000	2020
South-Asia	143.9%	10.2	18.9
Sub-Saharan Africa	79.8%	12.3	14.9
East Asia & Pacific	79.8%	10.9	16.8
Middle East & North Africa	67.5%	19.2	22.3
Latin America & Caribbean	48.1%	26.1	31.0
Europe & Central Asia	18.2%	19.0	21.2
Sub-total	83.3%	13.3	19.0
High-income countries	-27.8%	11.8	7.8
World total	66.4%	13.0	17.4

Source: Kopits and Cropper (2005, p. 176)

1.1.2 The health, social and economic impacts of accidents

Road traffic accidents (RTA) have adverse social, physical and psychological effects. These are the leading cause of traumatic brain injury in the world (GRSP 2011b) and, in some cases low-income and middle-income countries account for 30-86% of trauma admissions (Peden *et al.* 2004, p. 14). A study on psycho-social impact of accidents in Sweden has reported a high rate of complication where half of the respondents were found to have travel anxiety for two years after an accident. Results showed that 16% of people injured in RTAs could not return to their ordinary jobs, while a third reported a reduction in the leisure-time activities (Peden *et al.* 2004). More recently, the UNECE (2008, p. 36) revealed human suffering is aggravated by the way people's tragedies were treated. They found up to 3 years after bereavement resulting from an RTA, 64% suffered depression and 37% suicidal feelings which hardly decreased later, 91%, declared they could not enjoy life as before, and between 70 – 97% claimed that justice was not done in their case.

In the case of developing countries, road crashes disproportionately affect the poorest groups in the society. For instance, in case of Bangladesh, it was found that 21%

of those killed in RTAs were heads of the household in relatively better off families versus 32% among poor families. Three-quarters of all poor families who had lost a member to road traffic death reported a decrease in their standard of living, and 61% reported that they had to borrow money to cover expenses following their loss. The less-privileged socio-economic groups are said to be at greater risk due to their greater exposure to it (Peden *et al.* 2004, pp. 4-16). The loss of the bread winner, particularly in developing countries, can be catastrophic as financial compensation offered generally is insufficient for the victim's family (GRSP 2011b).

Apart from humanitarian aspects, road accidents have devastating impacts on countries' economies as they consume massive financial resources. The resources that the low-income and transition economies particularly can ill afford to lose (Jacobs *et al.* 2000, p. 9). The global cost[3] of RTAs is estimated to be US$ 518 billion per year (Peden *et al.* 2004, p. 15). A study by the Transport Research Laboratory (TRL) reported that average annual cost of road crashes are 1% of GNP[4] in developing countries, 1.5% in transition economies and 2% in highly motorised countries (Jacobs *et al.* 2000, p. 10). These high costs indicate the potential for substantial returns on investments in road safety interventions (UNECE 2008, p. 97). Considering the severe health, social and economic consequences of RTAs, it becomes imperative to understand the reasons of their occurrence as losses due to these incidents are unacceptable. Thus, the following section discuses causing and contributing to accidents.

1.2 Road accidents - causes and contributing factors

RTAs are attributed to many factors including road, vehicle and human factors. These contributory factors combine in a way that leads to a road user failing to cope in a particular situation (Casbard and Accidents 2003, p. 2). The research

[3] The cost incurred due to RTAs is calculated in terms of property damage, pain, grief, permanent disability and medical and health expenditures.

[4] GNP is Gross National Product and GNP per capita is the dollar value of a country's final output of goods and services in a year (its GNP), divided by its population. It reflects the average income of a country's citizens. Since 2001, the World Bank refers to the GNP per capita as the GNI per capita i.e. gross national income per capita (WHO 2011c).

literature generally agrees that human factors are one of the most dominant factors in understanding the chain of events leading to an accident and indicates driver malfunctioning as the prime contributory factor in road accidents (e.g. Christ *et al.* 2004; UNECE 2008; GRSP 2011a). Concomitantly, a study carried out by Monash University Accident Research Centre has also reported that driver error contributes to as much as 75% of all roadway crashes (Salmon *et al.* 2005, p. 1). The Sustainable Safety Vision of the Netherlands also takes 'man as the measure of all things' and a starting point, in a balanced combination of the elements 'road', 'vehicle', and 'man' (Wegman *et al.* 2008, p. 12).

For developing countries such as Pakistan, road user error is identified as the main cause in at least 70% of RTAs (Jacobs *et al.* 1981; Jacobs and Sayer 1984). The literature suggests that along with individual knowledge and skills, behaviours are also found to be influenced by the environment in which they take place. For instance, indirect influences such as design and layout of the road, the nature of the vehicle and, traffic laws and their enforcement, all affect drivers' behaviour in important ways (Peden *et al.* 2004, p. 4). Therefore, the present research is undertaken to contribute to the understanding of driving behaviours in Pakistan and the factors influencing them. The following section sheds some light on the need for research.

1.3 Need for research

Transport systems and infrastructure have expanded rapidly in developing countries, while little has been achieved in preventing accidents or lessening their severity (Almqvist and Hydén 1994, p. 4). Unlike the developed world where extensive research and technological innovation, a vivid safety culture, and successful law enforcement have generally reduced causalities and road accidents. There is an impressive body of studies demonstrating causes and effects of accidents per se but are relatively few relating to developing countries. The scarcity of road safety research activities in developing countries has also been emphasised by Downing (1991). His study estimates that there may be 20 person years of research effort each year in developing countries compared with over 500 in developed countries (p. 10). In the Asian Pacific region, apart from a few notable exceptions, relatively little research has been undertaken by the various countries (ADB 1998). To add, motorization is increasing dramatically in many Asian countries. As a result, road accident numbers are bound to increase and the need for road safety research will become stronger. Concurrently, measures that have been successful in developed countries may not always be as successful in the developing world (ADB 1998, p. 2).

Findings of road safety research in developed countries may not be transferable to the developing country context, as profiles of developed and developing countries widely differ in terms of culture, resources, road and traffic conditions, socio-economic levels and in behaviour, attitudes and knowledge of road users. Consequently, as said by Baguley and Jacob (2000) the effectiveness of transferring some developed country solutions to developing countries is uncertain and their appropriateness needs to be considered in relation to the problems and conditions prevailing in individual countries. (p. 8). Therefore, considering how little is known about the effectiveness of local safety measures, particularly the generality of results for different countries and "traffic cultures," Almqvist and Hydén (1994, p. 4) suggest the main contribution of researchers from a country with a relatively high safety standard could be to provide tools to assess and evaluate such safety measures.

For example, observations in Pakistan (by Downing 1985) demonstrated relatively high proportions of drivers crossing continuous "no-overtaking" lines (15%) and not stopping at stop signs even when traffic was near (52%). Although the relationship between these differences in behaviour and accidents has not been determined, the results suggest that road safety measures which are not self-enforcing, such as road signs and markings, may be much less effective unless they are integrated with publicity and enforcement campaigns (2000, pp. 7-8). Bener and Crundall (2005) recommend that some policies introduced to tackle specific accident factors in the developed world can be adapted for use in young nations struggling to come to terms with the extent of RTAs. However, it should be borne in mind that successful policies and media campaigns are culturally specific and the psychological factors of individuals based within a specific cultural setting must be understood, before planners can hope to influence driver behaviour (p. 10). Hence, it is imperative to carry out research and evaluation studies, which accommodate country specific conditions and suggest relevant interventions accordingly.

In the case of Pakistan much less is known about driver behaviour, although drivers are held responsible for the majority of RTAs. The study of Jacobs and

Baguley (1995, p. 7) estimated the proportion of road user error in accidents to be 91% for the country. However, the underlying factors which precede the deviant behaviours are not scientifically assessed for the country. The lack of such understanding is attributable to the difficulty of designing and implementing behaviour changing interventions in Pakistan. Over the years, it has been established that changes in driver behaviour offer the largest opportunities for harm reduction. This also exacerbates the difficulties in achieving sustainable results through on-going road safety campaigns and projects at local levels.

1.3.1 Brief summary of aims of the thesis

The above discussion has demonstrated the need for extensive research in developing countries, particularly in Pakistan which could lead to a common understanding of the country specific issues, and could contribute to road safety policies. Facts and figures emphasise the need for research in every aspect of road safety in Pakistan but specifically with reference to drivers[5]. For instance, a cross-sectional study conducted by Shah *et al.* (2007, p. 238) in the Sindh province has demonstrated that the population, number of motor vehicles and motorization level have no overall positive relationship with the total Road Traffic Crashes (RTC), deaths in RTCs, road traffic fatality rate and ratio of deaths to RTC. This suggests that the population and/or motorisation level are not the direct causes of RTC, and there may be some other factors, such as the behaviour of commuters and drivers, and environmental and human issues that contribute towards the occurrence of fatal RTCs in Pakistan. Therefore, this research examines pre-crash phenomenon, focusing on human factors in accidents. It attempts to understand the underlying factors which result in poor driving behaviour in the country with the help of traffic psychology. While taking into account sociological and psychological factors, many researchers including Underwood *et al.* (1997) have studied particular factors, in relation to their association with a driver's accident liability in road safety. These factors include:

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[5] An introduction to country of study and a discussion on its road safety profile has been made in the Chapter 2.

a. Propensity to commit driving errors and violations

b. Attitudes of the driver towards both their own and other road users' driving

c. Attitudes of the driver towards the vehicle they drive

d. Actual driving behaviours observed on the road such as speed limit observation and overtaking judgements

e. General personality variables such as mild social deviance and decision making thoroughness

This thesis investigates most of these factors (a, b, c, d) in the context of Pakistan. It attempts to identify key psychological predicators of aberrant behaviours by deploying various methods and techniques including self-reported questionnaire studies and direct observation of driving behaviours. There has been no evidence noted for this kind of research in the country since the time of commencement of this thesis. The rationale and specific aims of the thesis are listed in Chapter 5, after providing a literature review and a methodology.

1.4 An overview of the thesis

This thesis is broadly organised in five sections. Section 1 includes Chapters 1 and 2. Chapter 1 gives a brief description of the background to the research and Chapter 2 familiarises the reader with Pakistan, its traffic and transport system, road safety profile and, the need for research in the light of the facts and figures. Section 2 consists of Chapters 3-5. Chapter 3 covers a review of the literature on attitudinal and behavioural research in road safety. Chapter 4 evaluates methodologies to explore driving behaviours including multivariate analysis techniques. It also discusses approaches usually adopted around the world to improve road safety and their utility for this research. Chapter 5 provides rationale, specific aims and overview of the methodology designed for this thesis. Section 3 reports research studies conducted during the research and comprises of Chapters 6-8. Chapter 6 reports qualitative findings about the road safety issues of Pakistan. Chapter 7 reports attitudinal and behavioural characteristics of drivers in Pakistan, and Chapter 8 further explores deviant behaviours in the country. Finally in Section 4, Chapter 9 discusses the implications of this research and recommendations for future research.

CHAPTER TWO

ROAD SAFETY PROFILE OF PAKISTAN

2.1 Introduction

The Islamic Republic of Pakistan, one of seven countries in the South-Asia region, is the world's sixth most populated country, with an estimated population of over 170 million[6] (Government of Pakistan 2011a). Strategically, it is located in the north-western part of South-Asia and shares borders with Afghanistan and Iran in the west, India to the east, and China in the far north-east (The Urban Unit 2008). It is a country at the crossroads of economic progress, although it is still struggling to find a path towards sustainable development (Hyder *et al.* 2000, p. 199). It has a land area of 796,095 sq.km and is nearly four times the size of the United Kingdom (Government of Pakistan 2011c). Pakistan is divided into four provinces namely Punjab, Sindh, Baluchistan, and Khyber-Phukhtoonkhwa (KP) along with federally administrated tribal areas and the Federal Capital Territory of Islamabad. Punjab has the highest population and is home to more than half of the country's total population (ESCAP 2011). However, it makes up only 26% of the total area of Pakistan (Government of Punjab 2011, p. 276). The provinces of Sindh and KP have 23% and 15% of Pakistan's inhabitants respectively, and Baluchistan has around 5% (The Urban Unit 2008). The biggest city in Pakistan is Karachi (Sindh) which has a population of over ten million (ESCAP 2011). According to the 1998 census, the average population density in Pakistan is 166 persons/sq.km, and Punjab is the most densely populated province in the country with 359 persons/sq.km (Federal Bureau of Statistics 2011).

This chapter attempts to familiarise the reader with the state of the art road safety practices in Pakistan. It broadly covers aspects such as the constitutional and institutional frameworks of the country, provides an overview of transport policies

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[6] Pakistan-population distribution in 2009: children population (15 or less year aged) - 36.7%; primary youth (15-29 year aged) - 29.6%; secondary youth (30-59 year aged) - 27.9%; and elderly (60+ year of aged) - 5.9% (Government of Pakistan 2009).

(section 2.2). it then discusses a profile of RTAs for the country (section 2.3). The last section concentrates on driving behaviours in Lahore, chosen as a case study area (section 2.4).

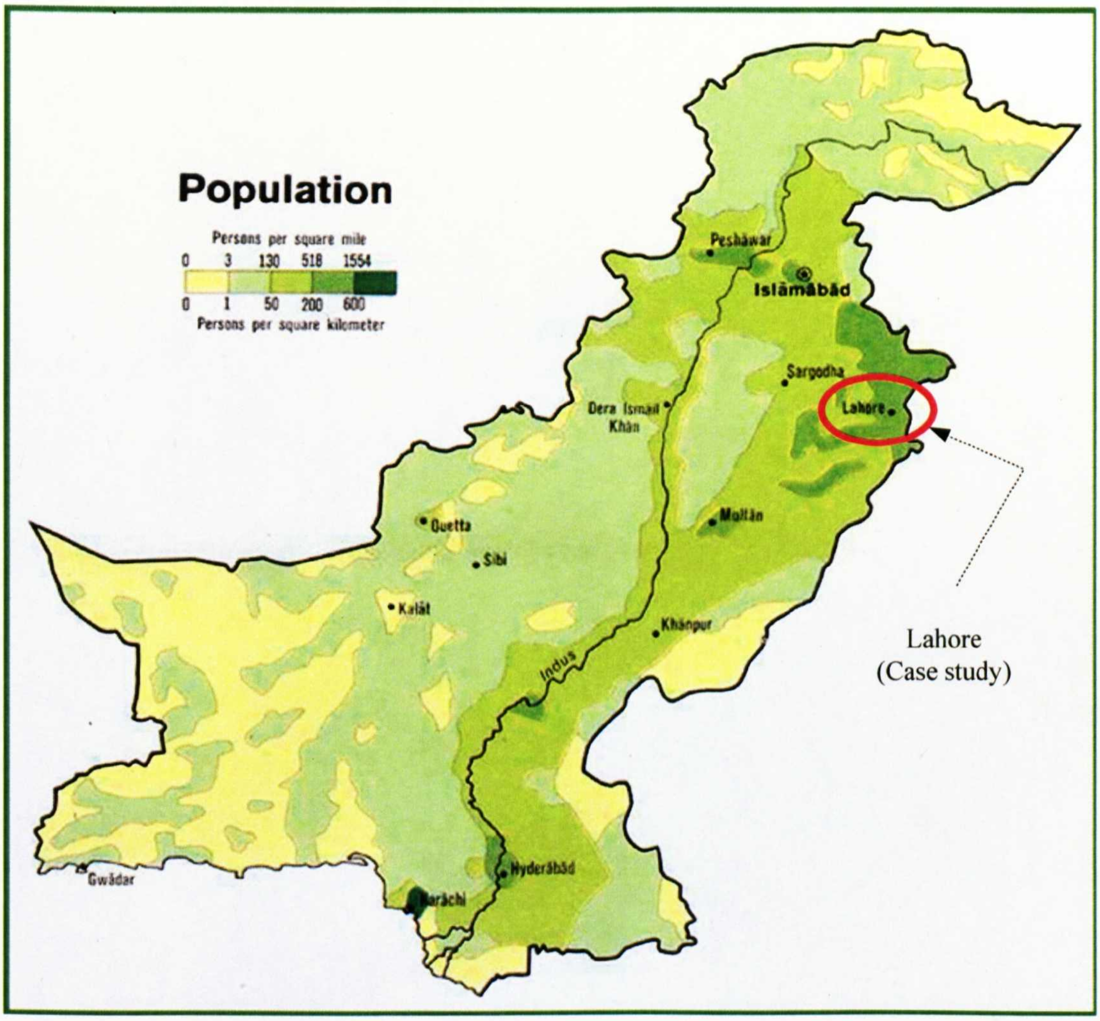

Figure 1: Pakistan population density map (source: Pakistan Pedia 2011)

2.1.1 Dynamics of urban population of Pakistan

The dramatic socio-economic changes and an un equal distribution of resources geographically have led to rapid urbanization in Pakistan. Since its independence in 1947, the geographic population distribution between the provinces has remained almost stable, indicating little or no regional migration. However, the level of urbanization has been on the rise (The Urban Unit 2008). It has increased rapidly from 28.3% in 1981 to 32.5% in 1998 which means that every third person now lives in a city or town (Imran and Low 2005, p. 516). Currently urban dwellers constitute 36% of the total population (IndexMundi 2011), and are growing at a much faster rate per year (3.53) than the rural population (2.33) of the country (Federal Bureau of Statistics 2011). It is important to note that urban settlements occupy less than 0.75% of Pakistan's land area (Imran and Low 2005, p. 516). By the year 2020, over 50% of the total population is expected to reside in urban areas (Imran 2010). The urbanization has remained concentrated in less than a dozen historic urban centres, and with the exception of Islamabad no new towns have emerged (The Urban Unit 2008). According to statistics, there are seven cities[7] of Pakistan with a population of over a million (Federal Bureau of Statistics 2011), five of which are in the Punjab province. Interestingly, around 47% of the urban population of Punjab live in these five large cities (The Urban Unit 2008). The increase in the population and strong urbanization has resulted in an increased demand for mobility (The Urban Unit 2008), and consequently has raised road safety problems. In Figure 1, the map of Pakistan indicates major cities and also highlights the case study, 'city of Lahore'.

2.2 Traffic and transport system in Pakistan

The transport and communication sector in Pakistan accounts for about 11% of the GDP, 16% of fixed investment, 6% of employment and about 15% of the Public Sector Development Programme (The Urban Unit 2008). This section provides an overview of the constitutional and institutional set-up of the country with reference to the transport sector.

2.2.1 Constitutional framework

Federal Government: The Constitution of the Islamic Republic of Pakistan provides for a Federal Parliamentary System of government, with the President as Head of State and the popularly elected Prime Minister as Head of Government. The Federal Legislature is a bicameral Majlis-e-Shoora (Parliament), composed of the National Assembly and the Senate[8] (Government of Pakistan 2011d).

Provincial Government: As Pakistan is composed of four provinces, the authority is distributed between Federation and provinces. In the provinces, there is a

[7] Largest cities of Pakistan in descending order: Karachi (Sindh), Lahore (Punjab), Faisalabad (Punjab), Rawalpindi (Punjab), Multan (Punjab), Hyderabad (Sindh), Gujranwala (Punjab).

[8] The tribal areas and capital territory are administered by the national federal government.

unicameral system (Government Portal 2008), and they enjoy considerable autonomy. Each province has a Governor, a Council of Ministers headed by a Chief Minister appointed by the Governor, and a Provincial Assembly (Government of Pakistan 2011d). In the Constitution, the allocations of the functions of the Federal and Provincial Governments are clearly specified. There are some functions that are the exclusive responsibility of the Federal Government, while others according to the Constitution can either be performed by either the federal or provincial governments (ESCAP 2011).

City District Government: The Local Government Plan 2000 and the Local Government Ordinance 2001, provides for the establishment of a City District Government (CDG) to respond to the specific needs of the mega cities and largely urban districts of Pakistan. The plan envisages that large cities will be declared City Districts in a phased manner. Initially Karachi, Lahore, Peshawar and Quetta have been declared as city districts (CDL 2008). These governments exist under the supervision of the various provincial governments. However, the existence of local governments is not formally embodied in the Constitution. Therefore, provincial governments have merely delegated some of their functions and responsibilities to local governments by the promulgation of ordinances (ESCAP 2011).

2.2.2 Institutional arrangements for road transport

At a federal level: The Ministry of Communication (MOC) operates as the central policy-maker and administrative authority for the transport sector. The ministry operates through (1) the National Transport Research Centre (research and policy guidelines), (2) the National Highway and Motorway Police (implementation of rules), and (3) the National Highway Authority (infrastructure) (Hisam 2006, p. 2100).

The *National Transport Research Centre* (NTRC)[9] aims to provide much needed research and development support for planning and appraisal of transport projects/plans in a coordinated and cost effective manner. It is the only public sector research organization carrying out research in the transport sector to provide support

[9] To know about the research work the NTRC has produced, see e.g. NTRC (1999), NTRC and JICA (2006a, b).

in the areas of policy formulation, transport planning and road engineering to the various government transport and other related organizations (The Urban Unit 2008).

The *National Highway and Motorway Police* (NH&MP) was established in 1997 under the MOC for the enforcement of rules and regulations and improvement of traffic safety on the motorways. One of the important tasks of the force is to enforce axle load control.

The *National Highway Authority* (NHA) was established in 1991. It is a semi-autonomous organization to plan, promote, organize and implement programmes for construction, development, operation, repair and maintenance of national highways and strategic roads (Government of Pakistan 2007b, p. 209).

At a provincial level: The *Communications and Works Departments* (C&W) of the provincial governments are responsible for the construction and maintenance of the provincial roads within their respective provinces. In KP, the department is named as the Frontier Highway Authority (FHA). A typical example of functions carried out by C&W Punjab is given in Figure 7. The road transport services are regulated by the provincial governments through provincial transport departments. In 1971, *Provincial and Regional Transport Authorities* (PTA and RTA) were set up to devise rules and enforce implementation in Sindh, Punjab and KP, and additionally undertook operation of passenger bus services in competition with private operations. The authorities plan, allocate routes, regulate, enforce and collect revenues and generally assert day-to-day control over inter- and intra- city passenger transport services, which are dominated by the private sector. Furthermore, vehicles are registered by provincial *Excise & Taxation departments* and authority for the issuing of licences and renewal lies with provincial Home Departments (for more details, refer to Hisam 2006, p. 2100).

At a city district level: Several agencies are responsible for traffic and transport management at a district level in the country. Broadly, the engineering wings of the CDG or the Development Authorities in a loosely defined manner are simultaneously performing the road engineering and basic traffic engineering functions in an adhoc manner (The Urban Unit 2008). For example, in the case of Punjab, the *District Road Transport Authority* (DRTA) was set up in 2001 through a notification issued by the

Punjab Transport Department. The DRTA issues route permits for minibuses along with the PTA which has the power to award bus routes. It is chaired by the District Coordination Officer of CDG and includes the District Police Officer, the Executive District Officer (Works & Services), and the Secretary DRTA as members. Outside the CDG, there are Tehsil Municipal Administrations, equivalent to Town Municipal Administrations (TMAs) in city districts, with similar functions as defined for the TMAs. These include the management of roads and streets, traffic planning, engineering and management, including traffic signalling systems, road signs, street markings, parking places and transport stations, and facilities for public buses; they also handle the maintenance of minor streets (The Urban Unit 2008). In Figure 2, the institutional set-up and function of transport bodies is schematically described in more detail, using the Punjab province as an example. Section 2.5.2 further elaborates the institutional set-up and functions of different government departments involved at a district level with reference to Lahore.

2.2.3 Administrative classification of road network

In Pakistan, the roads are broadly classified into three categories; national highways and motorways, provincial roads, and district roads.

National Highways and Motorways: National Highways form inter-provincial networks together with Motorways. Their network connects four provinces along major national transport corridors. These roads comprise around 4% of Pakistan's total road network but carry 80% of the country's commercial traffic. The basic role of National Highways is to serve as inter-provincial and long-distance routes for freight transportation. Whereas, Motorways are tolled national highways with controlled access and high speed free flowing traffic lanes. The access control policy and designed speed are different between Motorways and National Highways. The NHA is currently the custodian and responsible for the function of these roads under the federal government i.e. MOC (Government of Pakistan 2007b, p. 209).

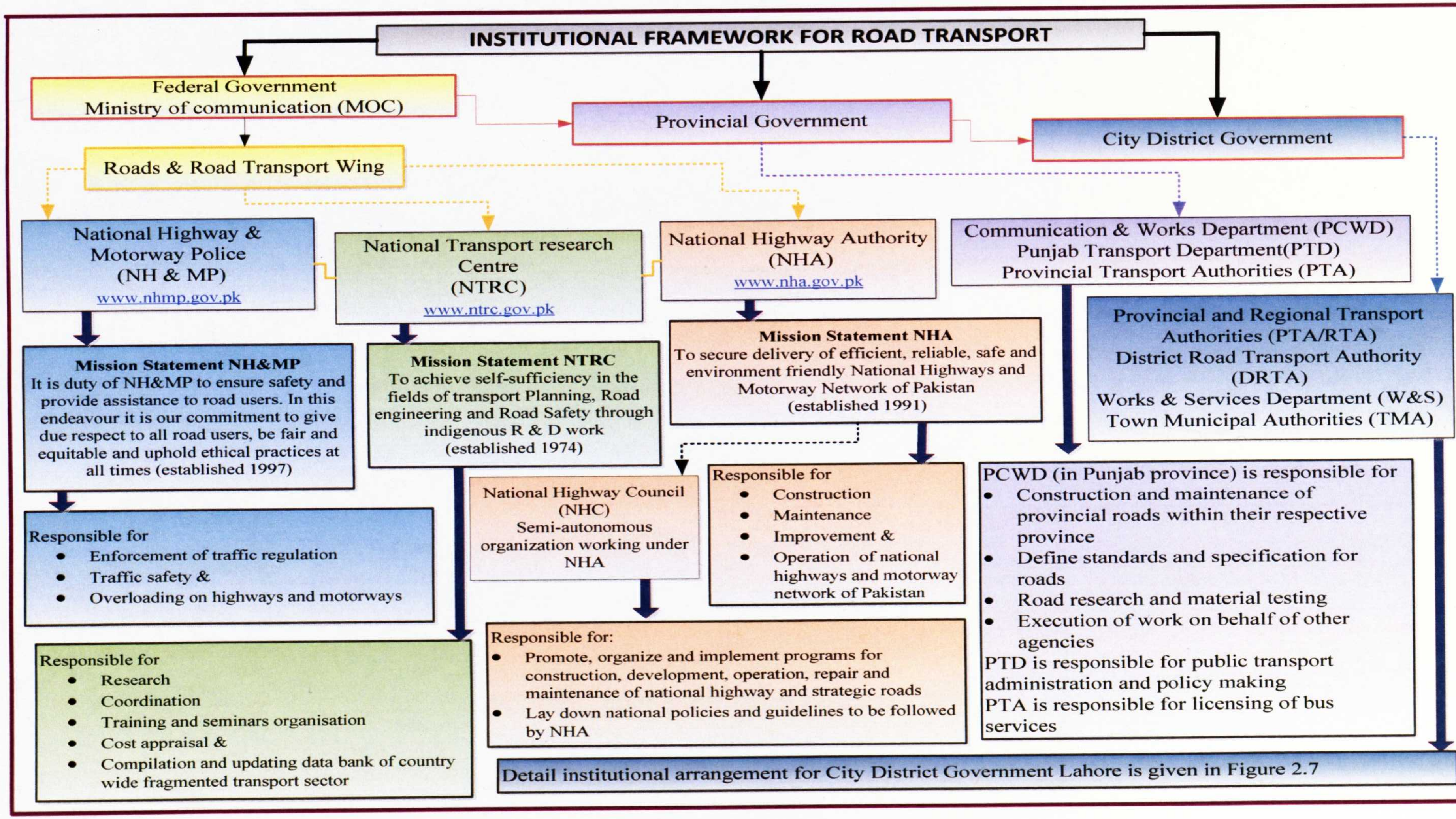

Figure 2: Generic overview of institutional framework of transport sector in Pakistan

Provincial roads: Provincial roads are the primary feeder roads for the National Highway and Motorways network and the district/local roads in terms of road hierarchy. These roads are managed by different systems and structures enforced by the provincial governments, and are controlled by C&W departments under the provincial governments.

District/local roads: The district roads connect small conurbations and provide access to the villages and the remote areas. The local authorities and the municipalities control the intra-urban roads of the cities and the towns for local travel (The Urban Unit 2008). With the devolution programme, portions of local roads have been transferred from the provincial C&W departments to the newly established CDGs (for more details, refer to NTRC and JICA 2006a).

2.2.4 An overview of transport policies

A review of road transport policies in Pakistan by Hyder *et al.* (2006, p. 134) revealed that there has never been an approved transport policy for the country at a national or local level. However, there are directions available both from federal and provincial governments for the development and preparation of a mid-term development framework[10] (The Urban Unit 2008). According to Hisam (2006), in 1977, the Chartered Institute of Transport drafted a National Integrated Transport Policy for Pakistan. Later, in 1998, the institute modified and updated that draft policy for the MOC but they did not receive any response from the ministry. Then in 2000, with the aid of the World Bank, a National Transport Policy was drafted and circulated to transport departments at the provincial level. The task was assigned to the NTRC to utilise the findings of a study to formulate a national transport policy. However, due to the lack of capacity, NTRC could not develop a policy that was acceptable to the government.

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[10] Planning for socio-economic development in Pakistan is usually classified in terms of time and organisational factor. In accordance with the time factor, plans are divided into three categories - short, medium and long. A short-term plan has a very brief and limited horizon. It is formulated with only one fiscal year in view. It is also called Annual Development Plan or simply Annual Plan. A medium-term plan covers four to seven years period with five years being the most popular choice. A long-term plan, more often called a "Perspective Plan", may have a 15-25 years tenure depending upon the peculiar economic compulsions and needs of a country.

In 2004, the Asian Development Bank (ADB) came forward and provided technical and financial assistance. The bank submitted a draft transport policy called the Technical Assistance Completion Report (TA) together with recommendations to the Government of Pakistan (GOP) in 2008. According to the report's findings, a strong capacity of the executing agency and implementing agency to coordinate all relevant government agencies is crucial to the successful implementation of a comprehensive inter-ministerial policy (ADB 2008).

Furthermore, the three National Health Policy documents (published in 1990, 1997, 2001) did not identify RTIs, motor vehicle emissions or road safety issues as a public health problem (for details, see Government of Pakistan 2001; Hyder *et al.* 2006, p. 134). However, in recent years, the GOP with the aid of the Government of Japan has conducted a Pakistan Transport Plan Study (PTPS). The study has proposed three long-term policies to achieve a safe, stable and sustainable transport system and network in Pakistan by the year 2025 (NTRC and JICA 2006b). In September 2006, the *National Road Safety Secretariat* (NRSS) was also established as lead road safety agency under the auspices of MOC to work on permanent footing. This secretariat is mandated to develop and undertake multi-sectoral road safety projects in collaboration with the NTRC (Government of Pakistan 2007b, p. 8).

At present, the National Highway Safety Ordinance is regulating road transport. The ordinance was approved in 2000 as a major breakthrough in road transport regulation, after 35 years of deliberations and redrafting (1965-2000). However, it is only applicable to vehicles on the national highway road network, with the 1965 Motor Vehicle Ordinance and provincial rules still governing all other roads in the country (Hisam 2006, Hyder *et al.* 2006, p. 134). According to the United Nations Development Programme, the ordinance has several anomalies and needs revision (UNDP 2002, Hisam 2006). In brief, the evidence available in the government and peer-reviewed literature highlights deficits and fragmentation in the institutional framework and transport policies for the country. Despite there being a clearly documented need by the researchers (e.g. Bishai *et al.* 2003; Hisam 2006; Government of Pakistan 2007a), no road safety or transport policy has been enacted to date in the country.

2.2.5 Road transport in Pakistan

Roads are the dominant mode of inland transportation in Pakistan; they carry 91% of all passenger traffic and 96% of freight traffic (WHO 2011d). The country has a road network of 260,000 km (Government of Pakistan 2011c) out of which 60% is paved (high type roads) while the rest is unpaved (low type roads). The road density is 0.32km/sq.km (Sindhu 2008, p. 3) which is lower than the average density of 0.50 km/square-km in developing countries (Hisam 2006). However, the country intends to double it to 0.64 km/sq. km gradually over the next 10 years (The Urban Unit 2008). Therefore, the percentage of money allocated to road development increased from 34.72% (1955-1960) to 60.73% (2001-2011) in Pakistan (Imran and Low 2005, p. 513).

In Punjab, 55% of the infrastructure development budget for 2010-11 was allocated to roads; which is 7.4% more than the previous budget presented in 2009-10 (Government of Punjab 2011, p. 372). However, at the moment, the development of road infrastructure is mainly concentrated in urban areas. For instance, in 1999-2000, only 7.5% of the total budget of transport sector infrastructure development was allocated to rural access roads (Hisam 2006, p. 2099). It is also important to note that although the road transport sector is functional; its inefficiencies with long waiting and travelling times, high costs, and low reliability are slowing down the country's economic growth. Over half of the national highways network is in poor condition, and the road safety record is poor. This poor performance of the sector is estimated to cost the economy 4-6% of GDP each year (The Urban Unit 2008). Almqvist and Hydén (1994) explain that in developing countries, it would seem that past attitudes still predominate, with planners and engineers still almost exclusively preoccupied with the problems of construction and maintenance. All too frequently, roads and road systems are being built or upgraded with little consideration being given to road safety; as a result black spots are still being created (p. 6). As a result of continued infrastructure development along with urbanization, road traffic is growing significantly faster in the big cities of Pakistan as discussed below, and therefore, is posing a constant threat to road safety.

2.2.6 Motorisation in Pakistan

In recent years, Pakistan has endured a motor vehicle boom. The motor vehicle fleet is growing at two to three times the rate of the population i.e. over 13% per annum (Ali *et al.* 2010; Imran 2010) with the increase being concentrated in urban areas (Hyder *et al.* 2006, p. 134). Data from Provincial Departments of Excise and Taxation indicate a 16-fold rise in registered vehicles between 1956 and 1996 (Hyder *et al.* 2006, p. 134). The World Bank estimates an increase of 711% in road traffic volume in Pakistan from 1990 to 2003 (WDI 2006). According to the NTRC, in 1991-92, the total number of vehicles on the road was 2,095,500 and by 2006-07 the number had reached to 80,636,000. This increase represents a 285% increase over the 16 year period compared to only 52% increase in the road length during the same period (Sindhu 2008, p. 2).

According to official statistics from the Government of Pakistan (2007a, p. 5), vehicle production including cars, trucks, motorcycles, tractors, buses and light commercial vehicles has sky rocketed from 195,791 units in 2001-02 to 998,592 units in 2005-06 (increase by 410%). Within that overall increase in vehicle production, passenger cars and light commercial vehicles saw an increase from 50,000 units/year to approximately about 200,000 units/year (increase by 300%). Motorcycles have had the highest growth, increasing from 120,000 to 750,000 units/year (increase by 525%). The rapid increase in level of motorization has also been confirmed by the NRSS as can be seen in Figure 3. To be specific, at a provincial level, according to the Punjab government statistics, the total number of registered vehicles in five major cities of Punjab was about 2.8 million in 2006, with an increase of more than 13% a year (The Urban Unit 2008). Furthermore, it is interesting to note that between 1980 and 1998, the growth in number of motor vehicles (per 1,000 people) in Pakistan has remained higher (from 2 to 8) in comparison to India (2 to 7) (UNEP 2001, p. 95). Table 2 provides different indicators of increasing motorisation in the country.

Table 2: Increase in vehicle volume over decade

Development Indicators	1990	2003	Increase (%)
Motor vehicle (per 1,000 people)	6	8	33
Motor vehicle (per kilometre of road)	4	5	25
Passenger cars (per 1,000 people)	4	7	75
Two-wheelers (per 1,000 people)	8	11	37.5
Road traffic (million vehicle kilometres)	25,317	205,385	711

Source: (WDI 2006)

It is suggested that this upsurge is a result of good macro-economic fundamentals, and the advent of car financing which has made the purchasing of cars more affordable, and increases in per capita income. The high economic growth has significantly increased the income level of the middle class, and as economic development takes place, the demand for mobility and vehicles increases. However, despite this rapid growth, motorization in Pakistan is still in the lowest quartile. Actually, the country is in the *pre-motorization* stage where 8 people out of a 1000 have cars (Government of Pakistan 2007a; The Urban Unit 2008).

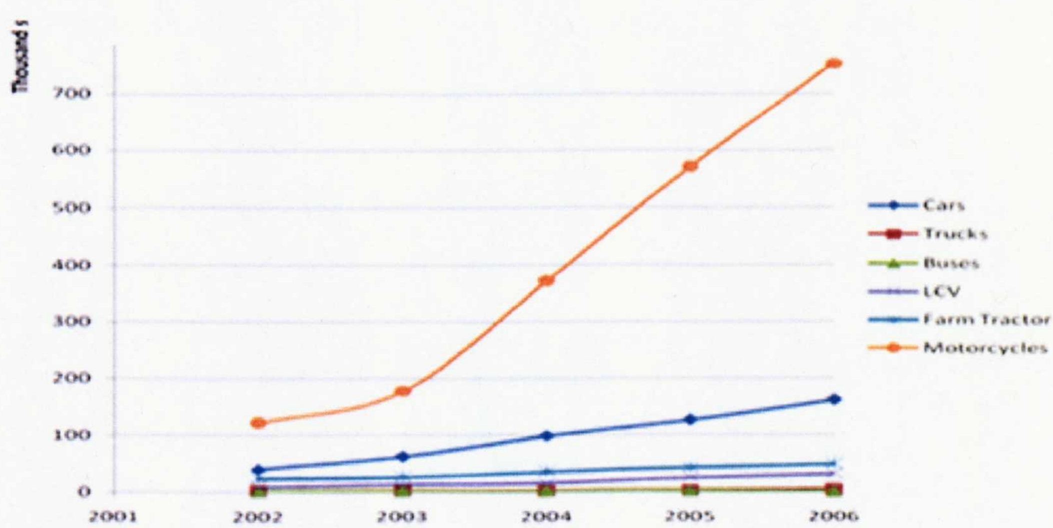

Figure 3: Motorization in Pakistan (source: Government of Pakistan 2007a, p. 5)

2.2.6.1 Future motorization

A traffic survey carried out by the NTRC and Japan International Cooperation Agency (JICA) in 2006 projected a trend in future motorization in Pakistan (Figure 4).

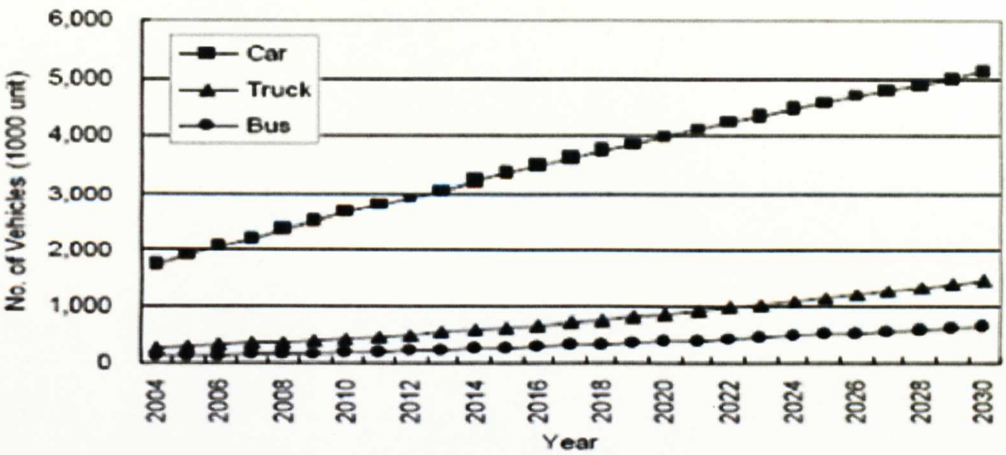

Figure 4: Future increase of vehicle fleet in Pakistan (source: NTRC and JICA 2006b)

The study estimated that in 2005, the number of cars used in Pakistan was 1.9 million and this is predicted to increase to 4.6 million, 2.4 times the present quantity, by 2025. In the same way, the number of trucks is predicted to increase by 3.9 times from 293,000 units to 1,152,000 units and the number of buses is predicted to increase by 4.0 times from 126,000 units to 511,000 units (NTRC and JICA 2006b, p. 20).

2.3 Road traffic accidents in Pakistan

The fatality rate on the road network in Pakistan remains among the highest in the world at around 5,565 fatalities per year (over 30 accidents per 10,000 registered vehicles). This is considerably higher than the countries with the lowest number of fatalities, such as the UK (3,298 reported fatalities per year); despite the fact that Pakistan is six times less motorised than the UK (WHO 2009a, pp. 162-215). Overall, RTIs also make up the largest proportion of injuries in the country (36%), as can be seen in Figure 5. It is important to note that there is no central data bank in the country which can record and provide the latest information and statistics about RTAs. This raises the concern about the unreliability and under-reporting of the available data (for details, refer to section 2.3.2).

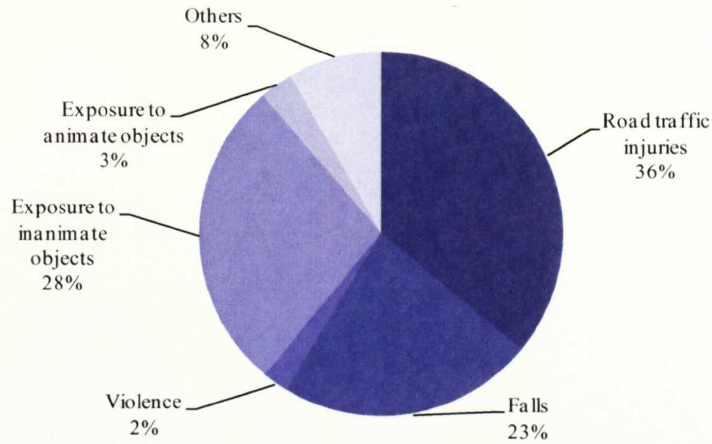

Figure 5: Distribution of injuries by causes in Pakistan (adapted from Ahmed 2007)

Table 3 further provides estimated increases in several motor vehicle injury risk factors for the country. A fivefold increase in vehicles (per kilometre) on the road between 1956 and 1996, indicative of vehicle density can be seen. During the same period, there was a 14-fold increase in the total number of motor vehicle crashes, while the number of deaths due to road traffic crashes increased 16 times (Hyder *et al.* 2000, p. 200).

Table 3: Change in motor vehicle injury risk factors between 1956 and 1996

Year	Motor vehicle crashes (n)	Deaths in motor vehicle crashes (n)	Motorization level (vehicles/1000 people)	Vehicle Density (Vehicle/km)
1956	796	302	13.25	1.7
1996	12,626	5,280	25.08	11.2
% increase	1486	1648	89	559

Source: Hyder *et al.* (2000, p. 200)

More importantly, it has been found that the probability of a RTI in urban populations is 19% more likely compared to rural populations, and 16% higher than in semi-urban settings (Bishai *et al.* 2003, cited in Ghaffar *et al.* 2004, p. 214). Big cities like Karachi and Lahore are particularly suffering from RTAs due to their continued expansion and motorisation. For instance, in the first half of 2011, about 90 RTIs were reported every day in the city of Karachi on average, during which 565 victims lost their lives (a 6% increase in fatalities relative to the previous year), which means three people lost their lives each day (Ilyas 2011).

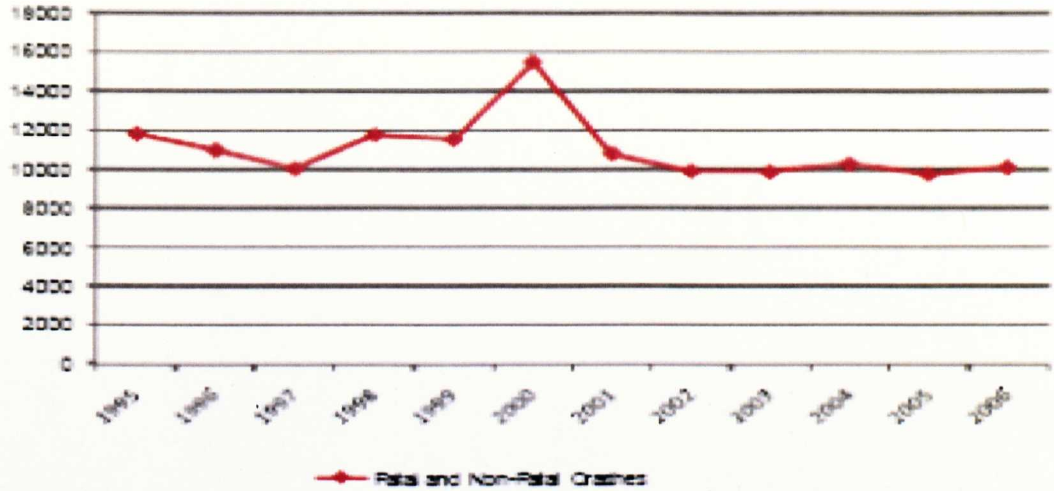

Figure 6: Reported fatal and non-fatal accidents in Pakistan (source: Government of Pakistan 2007a, p. 3)

The first national injury survey in Pakistan (NISP) revealed an RTI incidence of 15.1 per 1000 in 1997 with 34% (a majority) being public service vehicle occupants and 12% involving pedestrians (Ghaffar *et al.* 2004; Hyder *et al.* 2006, p. 134). In 1995, government data reported that there were 7,377 deaths and 16,465 injuries, reflecting an injury to fatality ratio of 2.2:1, far lower than the 10-15:1 ratio reported in other countries (Bishai *et al.* 2003; Hyder *et al.* 2006, p. 134). However, it is important to note that different studies show that there may be substantial under-reporting in road accident data (e.g. Government of Pakistan 2007a; Hyder *et al.* 2000). For instance, in Table 4 road accident statistics from 1996 to 2005 are provided whilst Figure 6 further elaborates the trend of accidents during the same time. Despite a massive rise in the number of vehicles, as indicated in the statistics provided in Table 2 and trends shown in Figure 3, it seems doubtful that the number of accidents and fatalities, in Table 4, remain almost the same over a ten year period. The statistics also contradict the independent findings in earlier years of a massive increase in motor vehicle risk factors (see Table 3). This implies that road accident statistics are not reliable in Pakistan, an issue which is discussed in section 2.3.2.

Table 4: Road accident statistics (1996-2005)

Year	Type of accident		Person	
	Fatal	Non-fatal	Killed	Injured
1996-97	**4,383**	**5,369**	**5,301**	**11,697**
1997-98	4,407	5,249	5,141	11,229
1998-99	3,620	4,317	4,196	9,817
1999-00	4,637	5,635	5,371	11,797
2000-01	4,629	6,114	5,627	13,479
2001-02	4,527	6,060	5,421	12,942
2002-03	4,379	5,654	5,248	11,922
2003-04	4,045	5,332	4,813	10,643
2004-05	**4,184**	**6,124**	**5,199**	**12,927**

Source: NTRC and JICA (2006a)

2.3.1 Consequences of accidents

The greatest measured impact from road transport in Pakistan is the loss of life and disability caused by vehicular crashes (Brandon 1995, cited in Hyder *et al.* 2006, p. 138). It is estimated that more than a half of the victims of RTAs are between the ages of 15 and 44 years (Government of Pakistan 2007a, p. 2). This NISP reflects the growing impact of injuries, especially RTIs in Pakistan and portends a challenge for the national health system (Ghaffar *et al.* 2004, p. 211). For instance, specific case reports (Ghani *et al.* 2003) such as neurosurgical mortality, have documented the impact of RTIs (from July 2007 to June 2008) where 100% of the cause was RTI. A significant percentage of these fatalities were less than 40 years old, with a male to female ratio of 7:1. Another study of mortality patterns from verbal autopsies in the slums of Karachi from 1990 to 1993 cited RTIs as the second leading cause of death among men at 30 per 100,000, tied with tuberculosis. In the study pedestrians and motorcyclists accounted for the majority of all injuries and deaths from RTIs, with commercial vehicles being the most common striking vehicle even though they only represent 4% of the total vehicle distribution (Ghani *et al.* 2003; Hyder *et al.* 2006, p. 134).

RTAs also disproportionately affect the poor class of Pakistani society and are pushing many families deeper into poverty by the loss of their breadwinners. Injuries not only result in financial and productive loss, but also inflict a tremendous continuous burden on disabled victims and their families. For instance, the risk of road traffic injury has been found 7–10 times higher for labourers and vendors in comparison to other road users including students and businessmen; showing that these productive (and often young) groups are extremely vulnerable to RTIs (Ghaffar *et al.* 2004, p. 214). The economic cost of road crashes and injuries for the country is estimated to be over 100 billion rupees ($1.6 billion approximately) i.e. over 2% of GDP. However, in 1998, the GOP was only spending $0.07 per capita (0.015% of GDP/capita) on road safety (ADB 2007; Government of Pakistan 2007a, p. 2). Table 5 provides further breakdown of road safety expenditures in the country.

Table 5: Road safety expenditure in Pakistan (fiscal year 1998)

Total spending ($1998 per capita: PPP*)	$5,800, 000 ($0.07)
Percentage of total	
Traffic police budget	13%
Driver licensing	2%
Vehicle inspection budget	5%
Road safety design and safety upgrade	80%
Bilateral aid for road safety	0%
Pre-hospital care of RTI victims	0%

Source: Bishai *et al.* (2003, p. 233). Note * PPP indicates Purchasing Power Parity adjustment

2.3.2 Crash injury reporting system

The differences in statistics provided by the official and independent bodies earlier in this section, has pointed towards issues of under-reporting and unreliability of RTA data in the country. The road safety literature has consistently recognised these issues for developing countries including Pakistan (e.g. Jacobs *et al.* 2000; Ameratunga *et al.* 2006). Police agencies mainly record the data for legislative purposes and, as reported by Hyder *et al.* (2006, p. 140), there are no recognised protocols for collecting regular information about injuries. Research work conducted by the NTRC in collaboration with Finnroad [11] further report that the estimation of RTCs based on police records is likely to be an underestimation because of inherent systems and practices within the police reporting process that lead to under-reporting. The police report an accident only when a fatality has occurred; this results in under-estimation of crashes. Finnroad estimated that less than 10% of the RTCs are reported in the country (NTRC 1999; Nishtar 2004; Government of Pakistan 2007a). The NRSS also compared the crash statistics obtained from police and health sector in order to measure the extent of under-reporting. It was found that in 2006 in Karachi, 16,825 RTC injuries were reported to police (Forensic Investigation Report (FIR) based data).

However, a research project which was underway at that time, in collaboration with Jinnah Post Medical College (JPMC) and NED engineering university, revealed 93,586 RTC injury cases were admitted in five hospitals of Karachi during the last four month of the same year. Considering the culture and health sector practices in Pakistan, the NRSS considered it safe to assume that those 93,586 cases represent fatal and serious injury crashes only; as Minor Injury Crashes and Property Damage Only (PDO) are typically not reported in the country. Assuming an equal distribution of police data over a 12 month period, the secretariat declared that police data was representing only 6% of fatal and serious injury crash data (Government of Pakistan 2007a, p. 4). The issue has also been seriously discussed in the popular press. For instance, an official at the Road Traffic Injuries and Prevention centre in Jinnah Hospital Karachi said, “we have seen that the figures are under reported due to legal issues; most of the people do not report accidents when they happen,” (Mussadaq 2010).

Earlier studies on the injuries reporting system in Pakistan, also noted that 61% to 86% of such injuries may go uncounted in official police statistics as can be seen in Table 6. The statistics are based on interviews with motor vehicle crash survivors. Hyder *et al.* (2000) shows that 39% of crashes were investigated and registered by the police. Whereas a previous study by Razzak and Luby (1998) found that only 14% were investigated by the local city police. It is also noted that while police records

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[11] Finland-based international road design and safety consultants; member of the International Road Federation (IRF).

identified a large number of deaths (56%), most of the severe injuries (18 out of 19) remained unaccounted for. This results in an over-representation of fatal crashes. This is evidenced by a reported fatal accident ratio of 40% for Pakistan in the same study. The NTRC reports a fatality rate of 28% based on its independent assessments. Clearly, this trend in reporting fatal accidents seems to be rather high when compared with data from other parts of the world which averages around 3% (Razzak and Luby 1998; Nishtar 2004, p. 93). Therefore, the quality and reliability of accident data is questioned frequently.

Table 6: Capture of motor vehicle injuries in police records

Studies on accident reporting System	Total number of accident	Reported accident	Representation of accidents in police records (%)
Razzak and Luby (1998)	35	5	14.28
Hayder *et al.* (2000)	2048	793	38.7

2.3.3 Regional and cross-cultural comparison

The nature of road safety issues in developing countries and transition economies are significantly different from that in the developed countries and other regions of the world (as can be seen in Table 1). The objective of this section is to consolidate data in order to make a comparison and to provide an overview of the magnitude of the problem in Pakistan with reference to South-Asian countries (low-income economies) and highly motorized countries (high-income economies) of the world. In Table 7, a regional and cross-cultural comparison of development indicators and road safety related indicators is provided. It can be seen that the level of motorization in all of the low-income economies is far less than the high-income countries. However, road safety related indicators demonstrate the adverse safety profile of low-income countries. For instance, in 1992 Pakistan had 17.4 fatalities per 10,000 vehicles. This was lower than India (20.3) and Bangladesh (44.5) but far higher than the countries with the lowest number of fatalities, such as the United Kingdom (1.5) and Japan (1.2). The projected fatalities for the South-Asian region by 2020 are notably higher (18.9) than high-income economies (7.8).

Table 7: Regional and cross-cultural comparison of development and road safety indicators

Development & Road safety Indicators	Year	Regional Classification				
		Asia-Pacific (Low-income Economies)			Highly Motorised (High-income Economies)	
		Pakistan	India	Bangladesh	Japan	UK
Population [a] (million)	2006	159	1,100	156	127.8	60.6
GNI/capita [a] (USD)		800	820	450	40,560	38,630
Motor Vehicle [b] (Per 1,000 people)	2003	8	9	1	582	442
Motor Vehicle [b] (Per km of road)		5	3	1	63	42
Paved Road [c] (%)		59	57	9.5	100	100
Fatality Definition [d]	1996	30	30	7	1	30
Fatalities [d]		4,288	59,927	2,041	9,942	3,598
Injuries [d]		8,986	307,089	3,301	942,203	316,704
Fatality index [d]		0.32	0.16	0.38	0.01	0.01
Fatality rate [d] (per 10,000 vehicle)		17.4	20.3	44.5	1.2	1.5
Projected fatalities [e] (per 10,000 vehicles)	2020	18.9			7.8	

Sources: a: WDI (2006), b: The World Bank (2006), c: Kwon *et al.* (2006), d: Jacobs *et al.* (2000), e: Kopits and Cropper (2003, pp. 38-39).

To conclude, the increase in the number of road fatalities and injuries, not only in Pakistan but other South-Asian countries is a grim reality which is negatively affecting the general public and restraining the economic development of the region.

2.4 Driving scene in Lahore - a case study context

The above discussion has attempted to provide a glimpse of road safety issues of Pakistan. This section concentrates on the case study for this PhD research, the city of Lahore in the Punjab province. The city profile, its traffic and transport system and, institutional framework are presented as well as consideration of driver behaviour. The main reason for selecting Lahore as a case study is its rapidly declining safety standards due to the increase in level of motorisation and urbanisation, as discussed below. Moreover, the city population is considered to be a good representative of other urban areas in Pakistan particularly in Punjab. Siddiqi (2004) reports that 64.8% of the population contributing to urbanization of Lahore district is migrated from various parts of the Punjab province. The migrants from KP are 5.7% while from Sindh and AJ&K (Azad Jammu and Kashmir) are 2.7% and 1.4% respectively. Therefore, although Lahore is taken as a case study, the findings of this research are possibly transferable to other cities of Pakistan (particularly in Punjab), and are may be found relevant to countries with a similar environment in terms of social and cultural factors and traffic situation e.g. India, Bangladesh. The extent to which findings of this research can be generalised is discussed in detail in Chapter 9.

2.4.1 Profile of Lahore

Lahore is used to constitute the kernel of Pakistan for its rich art and architecture, glorious heritage and never ending delights. Located in the most populous province, Punjab, the city is regarded as the Heart of Pakistan. It is a provincial capital with a large concentration of urban population. The crowded habitat is ranked the second largest city of Pakistan and 40^{th} largest in the world. The busy metropolis with an estimated population of ten million in mid-2006 is also the educational and cultural capital of the country. It is a hub of commercial activities and contributes 13% of the national economy (CDL 2008). In the early years of independence (1947), Lahore was known as the City of Gardens and was famous for its beautiful, romantic roads which were never traffic-infested.

However, due to the growing population and boom in level of motorization, Lahore's roads have begun to lose their character (ADB 2001). From 1981 to 1998, the city has grown at an average rate of 3.32% (Federal Bureau of Statistics 2011) with a 78% increase in population. Consequently, the population density rose from 2,001 to 3,566 persons/sq.km (Government of Punjab 2011, p. 298). As expected, reported RTAs (751) and causlaities (1,021) in the city are also the highest in Punjab with the loss of 428 lives (Government of Punjab 2011, p. 379). According to Barter and Raad (2000), the present image of Lahore is:

> A city, where roads and haphazard vehicles seem to be everywhere, a city where shops, schools and parks are far apart and require a vehicle to reach them, where roads act as barriers between communities, where traffic dominates the streets making them difficult to cross, where walking and cycling are unsafe and unpleasant, where public transport is infrequent and hard to get, where air pollution is visible, pungent health hazard and where honking and road rage are the main forms of social exchange. (Barter and Raad 2000)

2.4.2 Institutional framework of City District Government of Lahore

In setting up the city district government, some planning and macro-municipal functions are managed centrally by a City District Government Lahore (CDGL), in addition to all the common district functions. The government is headed by the City Nazim (Mayor) and all the departments are grouped and placed under the Executive District Officers. For traffic and transport systems, city administration primarily has three tiers; Traffic Engineering and Planning Authority (TEPA), Regional Transport Authority (RTA) and the Traffic Police of Lahore (CDL 2008). The *TEPA* was created as a subsidiary agency for the planning, designing and development of the traffic and transport system under the Lahore Development authority (LDA). The *RTA* operates under Transport Department of Government of Punjab and is responsible for the compensation payments of accidents and preparation of transport budgets (The Urban Unit 2008).

The *Traffic Police Lahore* (TPL) is responsible for regulating the traffic in the city, issuing driving licences and the registration of motor vehicles. Its Traffic education unit is responsible for educating the subjects of city. The TPL has also initiated a program named as RASTA (Road and Street Traffic Awareness) which informed citizens about traffic rules, security matters and immediate traffic conditions. In order to revamp the traffic management system, 1,500 trained wardens became a part of a new cadre of Traffic Police Lahore in 2007. The CDGL office also holds the Works and Service department (W&S), which is conceived as the main agency responsible for the management of the urban street system. It also carries the responsibility for the construction, implementation and maintenance of all roads and public buildings in the city (The Urban Unit 2008). Figure 7 shows the institutional arrangements of all the departments.

2.4.3 Traffic in the city

There is a mix of traffic in the city such as buses, cars, vans, bikes, cycles, rickshaws and animal drawn carts. The city of Lahore has one of the highest annual vehicle growth rates in the country, with a rate of approximately 16% (The Urban Unit 2008). The modal spilt for Lahore is shown in Table 8**Error! Reference source not found.**. From 2006 to 2010, traffic in the city has increased massively (63%) with the number of registered vehicles increasing from 1.5 million to nearly 2.5 million. For the same period, a constant decrease in percentage proportion of different public transport modes (buses, taxi, and rickshaws) can also be observed in the table.

Table 8: Modal split in Lahore

Type of vehicle	Total registered vehicles	Split (%)					
		Cars, jeeps, station wagons	Motor cycles and scooters	Trucks, delivery vans	Buses	Taxis	Rickshaws
2006	1,464,344	32	56	3	1.9	0.7	3.96
2010	2,387,993	30	60	2.6	1.4	0.5	3.66

Source: Government of Punjab (2007, 2011)

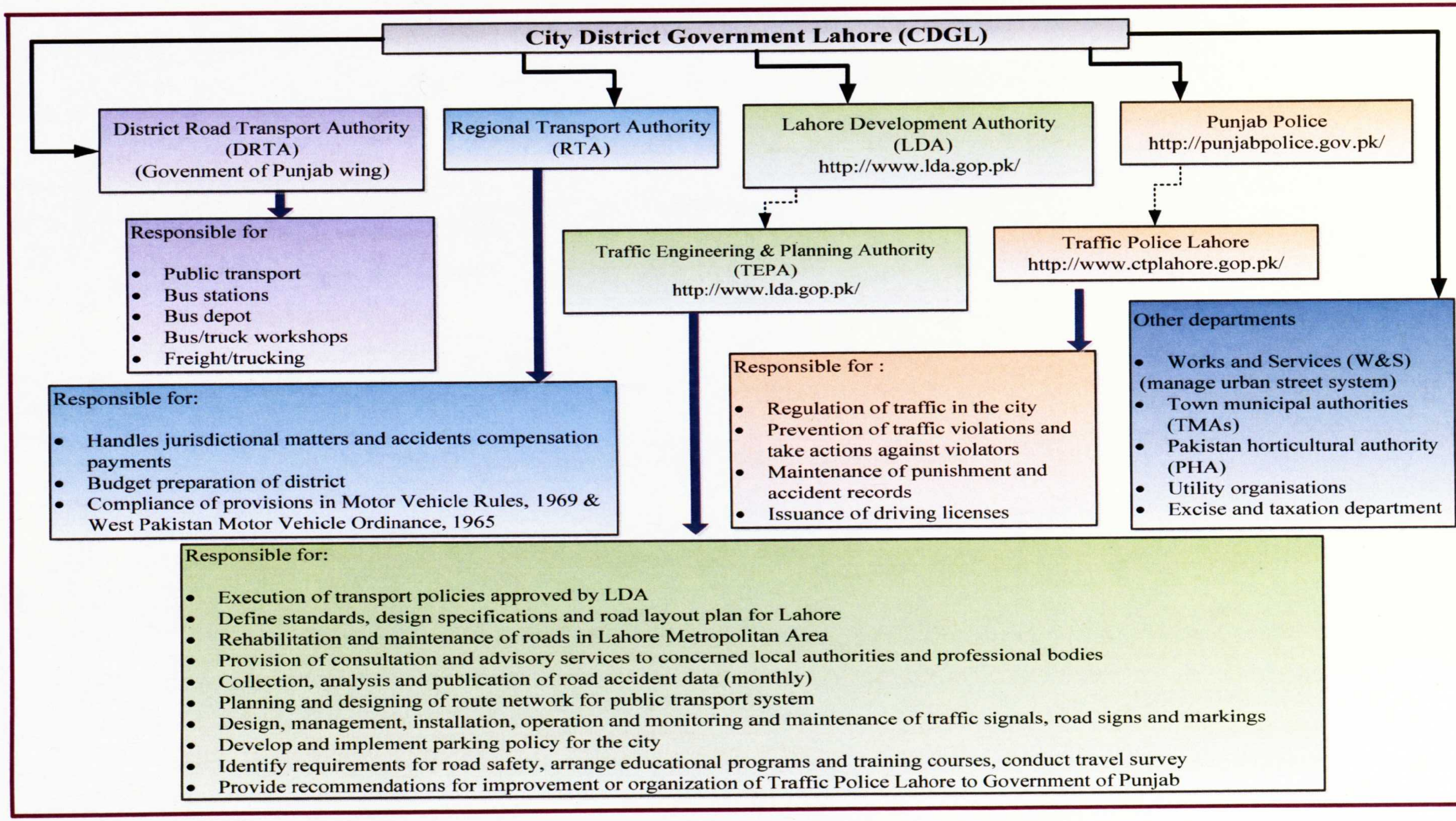

Figure 7: Transportation administrative and institutional network in City District Government Lahore

Table 9 indicates Lahore urban transport indicators. It is worth noting that, rather than moving towards sustainable transport, there is an alarming rise of private motor vehicle ownership in the city. Consequently, private vehicle trips are almost double the number of trips taken on public transport. This means more and more drivers are using the roads every year. Therefore, it can be anticipated that the chances of aberrant behaviours of drivers leading to an accident are increasing.

Table 9: Lahore urban transport indicators

Median Travel Time[12]	Expenditure on Road Infrastructure	Road Congestion	Automobile Ownership	Transport Fatalities	
				Transport related Deaths	Pedestrian Deaths
(minutes)	($)	(%)	(per 1,000population)		
40	2.22	3	240	0.02	0.01

Source: ADB (2001)

The class structure of the city, in the words of Shirazi (2006) is reflected in its different types of roads and modes used on the roads. Whilst the more affluent areas in Lahore have some excellent international standard roads, older areas have much lower quality roads. Similarly, on these roads one can witness big, sleek cars and land cruisers through to old and 'coughing' smaller cars, noisy rickshaws, small motorbikes and animal drawn carts. Consequently, travelling on these mixed modal roads, especially the poor quality, unkempt roads is becoming dangerous.

Table 10: An estimation of daily passenger travelling in Lahore

Public transport million trips/day	Private vehicle million trips/day	Motorbike/pedal cycle (two wheeler) million trips/day	Pedestrian million trips/day	Total million trips/day
3.409	6.208	3.314	8.050	17.667

Source: The Urban Unit (2008)

[12] This indicates the average time in minutes for a work trip, over all modes. Train and bus times should include average walking and waiting times, and car times should include parking and walking to the workplace.

The city is also facing a severe environmental and logistical challenge due to its poor traffic and transport system. Table 10 provides further details of the traffic situation in Lahore. In brief, the increase in number of vehicles along-with the increased number of traffic problems has made travelling in the city risky (The Urban Unit 2008).

2.4.4 A brief perspective of driving behaviours in the city

The driving scene in Lahore is like a real-life video game (Shirazi 2006). The city struggles for safety on its roads as millions of citizens' travel in disorganized patterns and the number of vehicles exceeds the road capacity. It is commonly observable that drivers in Lahore purposely intimidate other drivers and pedestrians. Many drivers violate universal traffic rules, negate the rights of way of cyclists and pedestrians, and lack courtesy and manners on the road (see Figure 8). Press stories consistently emphasise the phenomena of aggressive driving and rule violations on the roads such as tailgating, light flashing, ignoring traffic lights, slow driving in the fast moving lane and ignoring lane marking. The statistics for 2010 revealed that 332 people lost their lives while 27,264 were injured in less than a year due to careless driving, speeding or wrong-turns. Over 47% of these accidents were reportedly caused by motorcyclists, 30% caused by cars, 19% due to rickshaws, 6% due to commercial vans, 0.7% caused by trucks and 0.5% resulted from buses (Bashir 2010)[13]. There is a massive aggressiveness amongst the public not only against the bad behaviour of drivers but also to law enforcement and traffic regulatory bodies, as apparent in the following opinions extracted from online discussion forums and press releases:

> People try to sneak into the main road while making u-turns or entering the roads and the driver in the incoming car always tries to speed up to not to let enter anyone in front of him. Everyone tries to be superior to other especially while on the road. (Lah-darwaish 2006)

> Being experienced a lot of rash driving around Lahore these days, I must say I have to save myself from being in an accident quite a number of times and always the one at mistake tried to oppress me with a bad attitude after the mistake. (Lah-darwaish 2006)

[13] The data was collected from Lahore Emergency Service (Rescue 1122).

Few drivers have this well-known style: they will always drive at a speed less than 40 kilometres per hour along the middle of recently beautified, widened Lahore roads, and forget the distinctly marked speed lanes. They drive without looking left or right as if mesmerized by the taillights or whatever is written on the back screens of the vehicles they are following closely. (Shirazi 2006)

Figure 8: Driving scenes in different areas of Lahore (source: author's own)

Moreover, congestion in the city transport system are caused by poor enforcement of road traffic rules and regulations; the mix of traffic and absence of pedestrians crossings. One of the citizens expressed his anger about the traffic regulatory system of the city as:

> "...in fact the City Traffic Police Lahore have not only failed to maintain the smooth flow of traffic at trouble points in the city but also remained incompetent to implement the traffic rules and regulations. There is no check on speeding, overloading, line and lane violation which is causing frequent accidents and claiming the lives of innocent people." (Dogar 2008)

In brief, it is very often highlighted in public discussions, media and government publications that the city of Lahore has poor traffic and transport systems and drivers in the city have notably bad attitudes towards road safety. They excessively violate road traffic rules and regulations and lack in road courtesy and manners, as reflected in a few of the opinions quoted above. However there is no survey data to confirm this.

2.5 Conclusions

After reviewing the government and peer-reviewed literature for Pakistan, this chapter concludes that the road safety records for the country are worsening. A continued expansion of the transport sector and rapid urbanisation mainly in mega cities like Lahore are greatly aggravating the situation. It is noted that traffic problems are intensified and consequently posing a threat to road safety because of poor driving practices and the ever increasing number of vehicles on the city's roads. Unarguably, urban areas particularly in Punjab will keep on suffering the most due to these unavoidable increases in population densities along with motorisation.

The statistics also reflect that the overall burden of RTAs on Pakistan's society is very high. However, the evidence also suggests that accurate, reliable and complete road accident data are scarce. For that reason, it can be expected that the magnitude of the problem is much more substantial than is evident from the official statistics. On the other hand, unfortunately little research work has been done to quantify the prevalence of aberrant driving behaviours and to evaluate the underlying reasons. Therefore, this PhD research attempts to empirically understand the causes of accidents while focusing on drivers in Lahore to be able to contribute to road safety polices. For this reason, a review of road safety literature with reference to drivers and their driving behaviours is reported in Chapter 3[14].

[14] Although Lahore is taken as a case study in this research, from now onwards, the case study is generally termed as 'Pakistan' or 'urban Pakistan' so as the sample of drivers recruited from Lahore are interchangeably termed as 'driving population of Pakistan', 'urban population of Pakistan' or 'sample population'.

SECTION II

LITEATURE REVIEW AND METHODOLOGY

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

The previous chapters set the context for this PhD research by identifying the continuous threat that the developing world including Pakistan is facing due to poor road safety standards and the contribution of human failures to these problems. The purpose of this chapter is to offer insight into the road safety literature – particularly with respect to the attitudes and behaviour of drivers – to understand what motivates drivers to engage in risky driving practices on the roads. Chow (2002) says that success of the research process depends on a confluence of conceptual, meta-theoretical, methodological, and statistical skills. This chapter first looks into two parameters while Chapter 4 focuses on methodology. It also outlines the main approaches devised around the world to improve road safety standards. Finally, it presents the main conceptual framework for conducting this research that has been developed from the review.

The traffic and road transport system as a whole is composed of three interactive parts which are the vehicles, the road environment and the road users. Any traffic situation is the result of the interaction between these three systems and in certain circumstances this interaction generates a critical situation or a crash (Panou *et al.* 2007). Extensive research work has been done to estimate the importance of causal factors in accidents and, human error has been consistently implicated as a major contributor (e.g. see Evans 1996; Parker *et al.* 1995a, b; Iversen and Rundmo 2004).

In the 1970s, major studies on identifying the factors associated with crashes were done in the United Kingdom (Sabey and Staughton 1975) and United States (Treat 1980). Both of these studies obtained remarkably similar findings. The UK study found road users to be the sole factor in 65% of crashes whereas the roadway and the vehicle each were identified as the sole factors in 2% of cases. The corresponding values from the US study were 57%, 3% and 2% respectively. In nearly all cases involving a vehicular cause, the issue was a vehicle maintenance problem, such as bald tires or worn brake linings. The road user was identified as a sole or contributing factor in 95% of crashes in the UK study and in 94% of crashes in the US study (Evans 1996, p. 784). Table 11 summarises the findings of some other studies that investigated the involvement of human error in accident causation around the world. In these studies, 75-95% of RTA occurrence is attributed to human error.

Table 11: Contribution of human error in road accidents

Research Studies	Human Error Contribution in Accidents (%)
Laboratory (1972)	88
Finnish Insurance Information Centre (1974)	89
Sabey and Staughton (1975)	95
Treat (1980)	94
Verwey *et al.* (1993)	88
Department of the Environment (2004)	95
Salmon *et al.* (2006)	75

Given that risky driving is a major contributor to road trauma, reducing levels of risky driving should reduce the incidence of crashes and injury on the roads. However, the successful manipulation of risky driving requires a good understanding of its contributing factors (Fernandes *et al.* 2006, p. 21). A large volume of research has therefore been conducted into aberrant driving behaviours to provide a better understanding of why they are carried out and how they can be changed to improve safety (Elliot 2002, p. 226).

From one such initial attempt, Treat *et al.* (1977, cited in Stanton and Salmon 2009, pp. 230-31) identify four primary groups of incident causation factors. These are (1) human conditions and states (physical/physiological, mental/emotional, experience/exposure), (2) human direct causes (recognition errors, decision errors, performance errors), (3) environmental factors (highway related, ambient condition), and (4) vehicular factors.

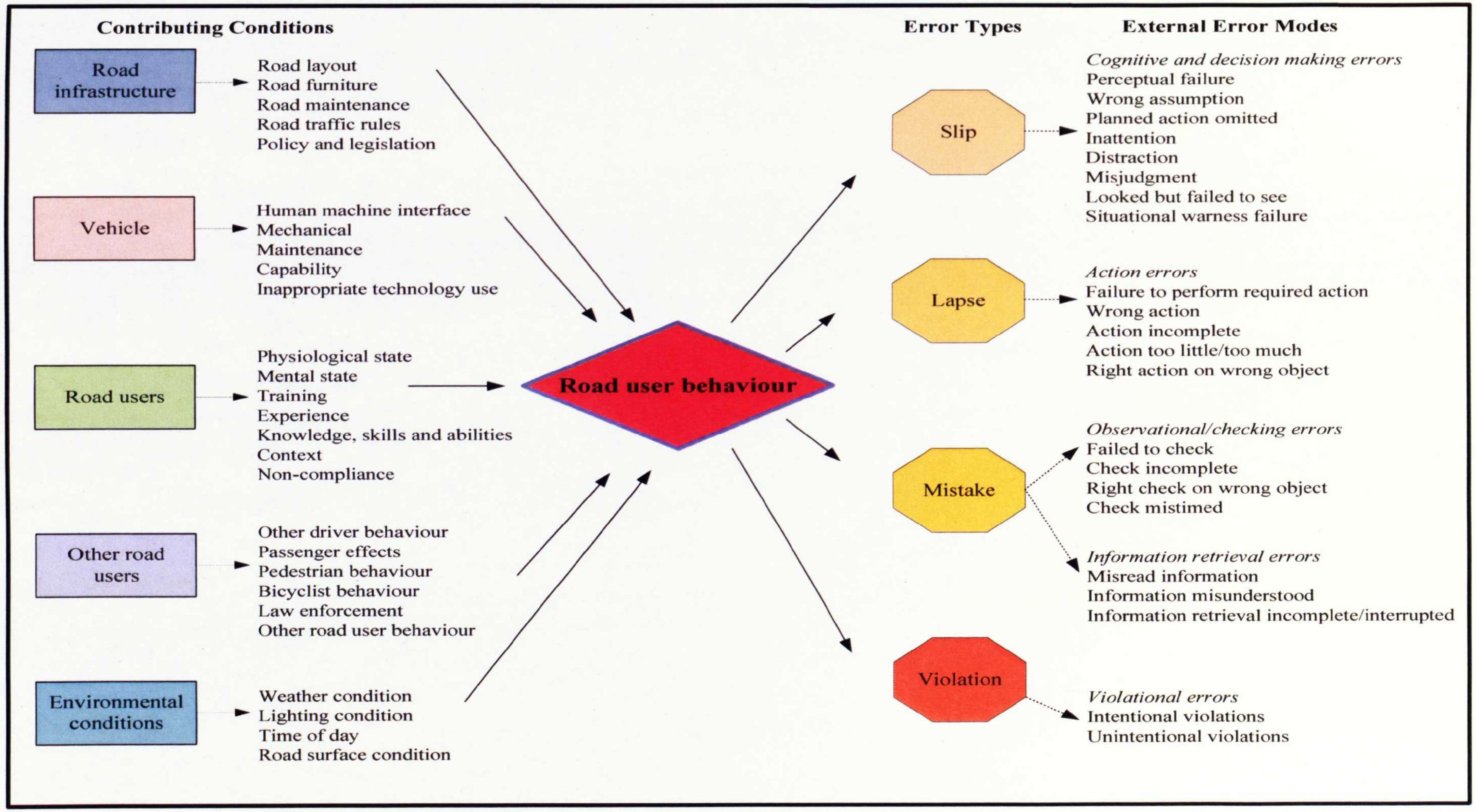

Figure 9: Prototype road user error and contributing conditions model (adapted from Salmon *et al.* 2006, p. 20)

Summing up the existing latent conditions and error classification schemes available in the literature, Salmon *et al.* (2006) has produced a prototype model of road user error, presented in Figure 9. The figure visually demonstrates how inadequate conditions within the road transport system can impact road user behaviour in a way that leads to erroneous behaviours being performed. The model breaks down different contributing factors into five groups i.e. road infrastructure, vehicle, road user, other road users and environmental contributing conditions.

Among human factors, as reported by Evans (1996), driver behaviour (what the driver chooses to do) has a much greater influence on safety than driver performance (what the driver can do). Evans (1991) further explains that the problem of traffic crashes is more due to the drivers doing things that they know they ought not to do, than of drivers not knowing what to do. After evaluating extensive traffic safety research, he concludes that changes in driver behaviour offer, by far, the largest opportunities for harm reduction. He has cited the results of some initiatives that were introduced with the aim to influence the behaviour of drivers to reduce accidents. For instance, on US roads, reducing the speed limit from 70 to 55 miles/hour decreased fatality rates by 34%, mandatory seat-belt wearing in the UK reduced front-seat occupant fatalities by 20%, and random breath testing for alcohol in the Australian state of New South Wales reduced driver fatalities by 19% (Evans 1996, p. 784). It is, therefore, important to understand the human factor and its link to RTAs particularly in the context of Pakistan in order to reduce risks and improve safety on the roads. Here, traffic psychology plays its part which is:

> Traffic Psychology is the study of the behaviour of road users and the psychological processes underlying that behaviour, attempts to identify determinants of road user behaviour with the aim of developing effective accident countermeasure. (Rothengatter 1997, p. 223)

In order to understand driver behaviour, traffic psychology focuses on many aspects (Lenne *et al.* 2004, p. 1) which can be outlined as:

- The social psychology of driving
- The state of the driver (e.g. arousal, stress, fatigue)
- Individual differences
- Education
- Driver training
- Public information campaigns
- Traffic law enforcement
- Driver improvement and rehabilitation, and
- Road and vehicle design

The drivers involved in accidents may be classified by age, sex, driving experience, social or occupational status. The driving behaviour (or aberrant driving behaviour) of these individuals can be influenced by temporary states such as those induced by alcohol or drugs, or by psychological and/or physiological factors such as mood, stress fatigue or sleepiness, as well as more permanent cognitive, attitudinal and motivational factors (Maycock 1997). A growing body of opinion in road safety research emphasises the importance of changing the attitudes and beliefs of drivers in order to improve and promote the safety culture (e.g. Parker 2004; Glendon 2007). In parallel to this approach, researchers have also started to look at the external factors that mediate deviant driving behaviours such as the road environment, the design of vehicle or traffic rules and regulations. The Swedish Vision Zero and the Dutch Sustainable Safety Programme are examples of such system-based approaches (see detail in section 3.4).

From the previous chapter, the importance of safe driving behaviour to prevent RTIs and RTAs is evident. In this chapter, the literature is reviewed with the aim of developing a comprehensive understanding of driver behaviour. In the subsequent section 3.2, a theoretical taxonomy of aberrant driving behaviour is presented. Section 3.3 discusses the determinants of aberrant behaviour including attitudinal and motivational factors, situational and cultural factors. It also explores the influences of socio-economic and demographic characteristics on unsafe driving practices. The subsequent section 3.4 concentrates on different types of approaches available to treat aberrant behaviour. Finally, section 3.5 concludes the review with the implications of this literature for the present research.

3.2 Theoretical taxonomy of aberrant driving behaviour

There are different classification schemes, theories and models available in traffic psychology to understand types of human failure. The three predominant are: Treat *et al.*'s (1977) driver error and incident causation factors; Sabey and Taylor's (1980) human errors and causal factors taxonomy, and Reason's (1990) slips, lapses, mistakes and violations taxonomy. The studies by Treat *et al.* (1977) and Sabey and Taylor (1980) are regarded as the first attempts to identify and classify driver errors and contributory road system features (Salmon *et al.* 2005).

Treat *et al.* (1977, cited in Stanton and Salmon 2009, pp. 230-32) categorise driver error into errors of recognition, errors of decision and errors of performance. According to the authors these categories may broadly be aligned to the stages of information processing where perception and interpretation can be identified as recognition, plan and intention can be identified as decision, and action execution can be identified as performance. *Recognition errors* include inattention, distraction and looked-but-failed-to-see errors. *Decision errors* include misjudgement, false assumption, improper manoeuvre, excessive speed, inadequate signalling and driving too close. *Performance errors* include over-compensation, panic, freezing, and inadequate directional control.

Sabey and Staughton (1975) conducted an analysis of 2130 accidents that took place in the UK involving 3757 drivers led them to their error classifications. Later in 1980, they describe the results in more detail. According to their human errors and causal factors taxonomy, drivers' errors can be classified into perceptual errors, lack of skill, manner of execution and impairment. However, Stanton and Salmon (2009, pp. 230-32) criticise their error analysis for being mainly based upon verbal reports of the drivers involved, which may not have been entirely reliable.

In comparison to the two aforementioned driver error classification schemes, the work of James Reason features prominently in the recent road safety research and represents the error classification scheme that is most commonly referred to (e.g. see Lenne *et al.* 2004; Salmon *et al.* 2005; Stanton and Salmon 2009). Reason's (1990) taxonomy of errors and violations is a conceptual extension of Rasmussen's skill-rule-knowledge (SRK) framework (for details, see Rasmussen 1982; Reason 1990). He attempted to understand the psychological processes that cause human error and provided a formal definition of several categories within it (see Figure 10). He emphasised the need to understand the activities of the individual in order to identify what may go wrong and noted that accidents can be predicted, based on the analysis of the individual's activities. An overview of Reason's (1990) theory of errors and violations is presented below.

3.2.1 Errors

According to Reason (1990), errors are failures of planned actions to achieve their intended consequences. To locate the origin of basic human error types, he developed a Generic Error Modelling System (GEMS). The model provides the following working definition of error:

> *Error* will be taken as a generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the intervention of some chance agency. (Reason 1990, p. 9)

3.2.1.1 Classification of errors

The model further classifies error and yields its two basic error types i.e. slips and lapses, and mistakes. Reason (1990) states these are two psychologically distinct kinds of 'straying'; slips and lapses - the unintentional deviation of action from intention, and mistakes - the departure of planned action from some satisfactory path towards a desired goal. He suggests that these different types of error occur at different cognitive stages. For example, slips occur at the execution stage, lapses occur at the storage stage and mistakes occur at the planning stage of human action.

> *Slips and lapses* are errors which result from some failure in execution and/or storage stage of an action sequence, regardless of whether or not the plan which guided them was adequate to achieve its objective. (Reason 1990, p. 9)

> *Mistakes* are deficiencies or failures in the judgemental and/or inferential processes involved in the selection of an objective or in the specification of the means to achieve it, irrespective of whether or not the actions directed by this decision-scheme run according to plan. (Reason 1990, p. 9)

Slips are the most common form of human error and are categorised as those errors in which the intention or plan was correct but the execution of the required action was incorrect. In the driving context, an example of slip would be when a driver who plans to push the brake pedal to slow down inadvertently pushes the accelerator pedal or when a driver intending to signal to take the next turning off the freeway activates the windshield wipers instead of the side indicators. In both cases the intention was correct, but the physical execution of the required action was incorrect (Salmon *et al.* 2005, p. 6).

Lapses typically involve a failure to perform an intended action or forgetting of the next action required in a particular sequence. While slip-based errors are observable errors involving an incorrect execution of a correct plan, lapses are a more covert form of error that involve a failure of memory that may not manifest itself in actual behaviour (Reason 1990). Examples of lapses include a person forgetting to turn off the lights when departing the car, even though they fully intended to do so and also forgetting to lock their car even though they fully intended to do so (Salmon *et al.* 2005, p. 7).

Mistakes are unobservable plans and intentions that are formed by an operator. They are categorised as an inappropriate intention or wrong decision followed by execution, and occurs when an actor performs a wrong action and this originates at planning level (also termed as planning failures). Examples of mistakes include when a driver decides to accelerate when the appropriate action would have been to brake or slow down. According to Reason (1990), mistakes involve a mismatch between the prior intention and the intended consequences and are likely to be more subtle, more complex, less well understood, and harder to detect than slips (Salmon *et al.* 2005).

The research evidence on cognitive control further suggests that all these different kinds of errors occur at different stages of performance (see Table 12). According to Rasmussen (1982), human action can be highly automatic (i.e. skill-based), associative (i.e. rule-based), and analogous or exploratory (i.e. knowledge-based). By using this classification, Reason (1990) has further divided mistakes into two categories based on Rasmussen's SRK framework i.e. *rule-based* mistakes, in which an established but inappropriate condition-action rule is applied; and *knowledge-based* mistakes, in which the individual is forced by novel circumstances to resort to resource-limited, 'on-line' reasoning as a result of an imperfect or incomplete mental model of the problem situation. It should also be noted that slips and lapses are identified within the *skill-based* level of Rasmussen's tripartite classification (Reason *et al.* 1990, p. 1316). The categorisation suggests that increased skill does not guarantee error-free performance, just different types of error (Stanton and Salmon 2009, p. 229).

Table 12: Distinguishing three error types at different performance levels

Error Type	Performance Level
Skill-based level	Slips and lapses
Rule-based Level	Rule-based mistakes
Knowledge-based level	Knowledge-based mistakes

Source: adapted from Reason (1990, p. 56)

3.2.2 Violations

A *violation* is defined as the deliberate infringement of some regulated or socially accepted code of behaviour (Parker *et al.* 1995a, p. 1036). Within the domain of road transport, it is also termed as an infringement of traffic rules (Biecheler-Fretel and Moget-Monseur 1984) or an actual traffic offence conviction in some studies (Peck *et al.* 1971). In the GEMS, it is defined as:

> Violations are deliberate - but not necessarily reprehensible - deviations from those practices deemed necessary to maintain the safe operation of a potentially hazardous system. (Reason 1990, p. 195)

Unlike errors which are related to the cognitive processes of the individuals, violations require additional explanation in terms of motivational factors and the social context in which behaviour is governed by operating procedures, codes of practice, rules, norms and such like (Reason *et al.* 1990, p. 1316). They are explained as a conscious decision to drive in an unsafe manner (Hennessy and Wiesenthal 2005, p.71). Typical examples of road traffic violations (RTVs) include speeding, drink driving and non-use of seat belts.

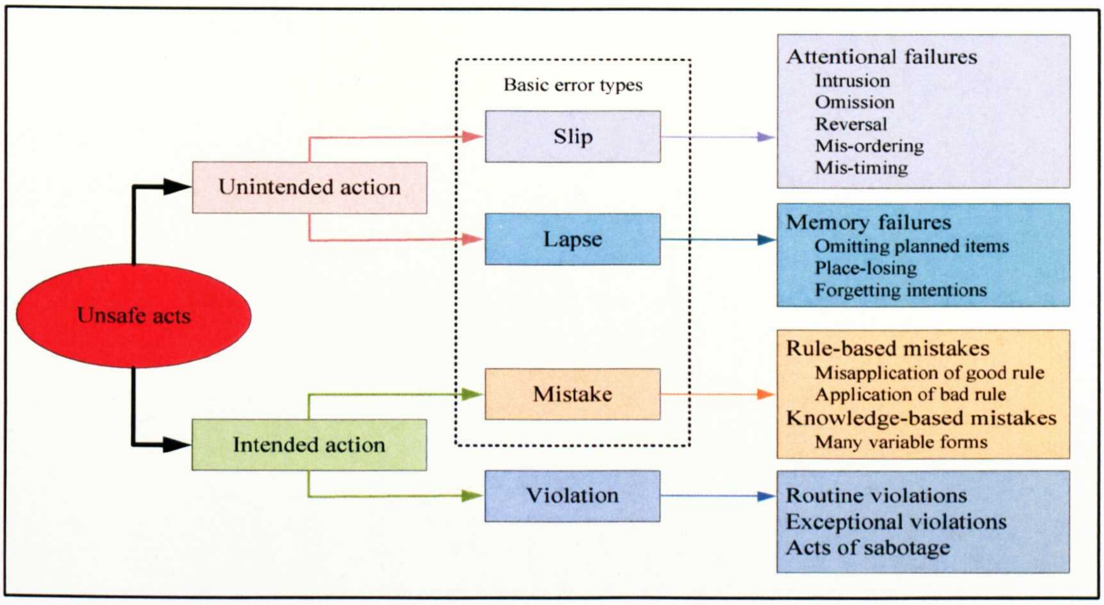

Figure 10: Reason's slips, lapses, mistakes and violations taxonomy (adapted from Reason 1990)

3.2.3 Distinction between errors and violations

In considering the human contribution to accidents, it seems necessary to make a distinction between errors and violations; two forms of aberration which may have different psychological origins and demand different modes of remediation (Reason *et al.* 1990). To observe this distinction, the first attempt had been made by Reason *et al.* in 1990 who applied Reason's theory of errors and violations in the construction of a 50-item questionnaire, namely the Driver Behaviour Questionnaire (DBQ). The questionnaire covered five classes of aberrant driving behaviour: slips, lapses, mistakes, unintended violations and deliberate violations. Conceptually, RTVs can be either *deliberate* or *erroneous* with the former occurring when an actor deliberately deviates from a set of rules or procedures. Erroneous or unintentional violations occur when an actor unintentionally deviates from a set of rules or procedures (Reason *et al.* 1990; Reason 1997).

Examples of the deliberate violations can be a driver who becomes impatient with a slower driver in the outer lane and overtakes on the inside or who get involved in unofficial 'races' with other drivers. Examples of unintended violations can be when a driver forgets when their road tax/insurance expires and drives illegally, or after checking the speedometer, the driver discovers that he is unknowingly in excess of the legal speed limit (Reason *et al.* 1990). In psychological terms, an unintended infringement is more likely to be an error. However, deliberate violations may be *malevolent* or *non-malevolent*. The former is committed when there is an intention to bring some negative outcome (i.e. sabotage) whereas the latter involves no such intention (Parker *et al.* 1995a, p. 1036). The investigators asked drivers to self-report the frequency with which they committed different types of errors and violations, and identified three fairly robust factors: deliberate violations, dangerous errors, and relatively harmless lapses respectively (see Reason *et al.* 1990).

The researchers found that violations are the most crucial component in RTAs, involve definite risk to other road users and differences in frequency of RTAs between drivers could be explained by their propensity to violate. Conversely, errors were not found to be significantly associated with accident involvement (Parker *et al.* 1995a, p. 1037). These findings were consistent with the view that errors and violations are indeed mediated by different psychological mechanisms (Reason *et al.* 1990, p. 1315). Parker and Stradling (2001, p. 11) suggest that errors and lapses may be improved through training and supervised practice. While, violations, as suggested which are deliberate and are driven by 'bad attitudes', are less amenable to change and are commonly targeted through propaganda, persuasion, peer-group pressure, and punishment (for detail, see section 3.4).

Subsequently, Parker *et al.* (1995a) re-confirmed the distinction between these two major forms of 'bad' behaviour i.e. erroneous bad behaviour (error and lapses) and intentional bad behaviour (violations) made by Reason *et al.* (1990) by using both a larger sample and an empirically-refined, modified version of the DBQ. To further define the error-violation distinction, they report that the commission of violations is predictive of both future and past accident involvement, and over and above other variables such as the driver's age, gender and annual mileage driven, and that intentional driving violation made an independent significant contribution to traffic accident involvement (Xie and Parker 2002, p. 294).

Stradling and Meadows (2000) in their self-reported study of aberrant driving behaviour had similar results with high-violation score drivers being found to be more involved in accidents in the past and more likely to be involved again in future. They report that frequent violators are not only more likely to run into others or to run off the road (active accidents), but to put themselves in situations where others run into them (passive accidents). They termed violating drivers 'crash magnets'. Thus, studies show that it is the propensity to violate, rather than the tendency to make errors or actions while driving, which is associated with involvement in accidents (Iversen and Rundmo 2004, p. 555). Nevertheless, high scores on the error and lapse factor were also found to be predictive of involvement in active accidents among elderly, while passive accidents was associated with high scores on the lapse factor (Parker *et al.* 2000, cited in Iversen and Rundmo 2004, p. 556).

At the same time, Carsten (2008) argues that cognitive and perceptual problems (i.e. errors) are predominantly involved in accident causation not violations. He cites the results of the study on urban injury accidents (Carsten *et al.* 1990) where violations in the form of attitudinal problems were found to constitute only a small proportion of the factors that were coded as explaining the events that immediately preceded the investigated accidents. Nevertheless, he reports that cognitive and perceptual errors are far more frequent in accident causation and suggests using inclination to violate as a strong predictor of accident proneness. He proposes that violations are highly risky and likely to be a factor in more serious accidents (Carsten 2008).

Research has not only linked violations to the increased frequency of traffic collisions (Parker *et al.* 1995a, b) but also to driver violence and aggression (Hennessy and Wiesenthal 2005). Perhaps the strongest *a-priori* case for a direct link between behavioural characteristics and accident risk arises with driving violations (Reason *et al.* 1991; Parker *et al.* 1995a). Such behaviour (e.g. running red lights and giving chase to other drivers) is outlawed precisely because it is dangerous. Parker *et al.* (1992b) say indeed, there are clearly cases of accidents preceded by outright disregard for driving regulations. There is evidence that drivers who report that they are more disposed to committing violations regard the potentially negative consequences of such violations as less important, perceive less social disapproval for the commission of violations, and feel that such behaviour is less under voluntary control. Furthermore, these drivers show evidence of a false consensus bias, making estimates of the number of other road users who commit violations that are higher than those made by drivers who do not commit violations (Manstead *et al.* 1992, cited in Parker *et al.* 1995b, p. 572).

To conclude, as said by Parker *et al.* (1998), the error-violation distinction has proved reliable with replication of the DBQ factor structure in Germany, Sweden and Australia, as well as several times within the UK driving population. Most importantly, it has been demonstarted that self-reported comission of violations is significantly predictive of accident involvement, both retrospectively and propsectively and driver who have accidents tend to commit relatively high levels of violations, but are no more error prone than other drivers (p. 12). Therefore, it is suggested that violations are the behaviours that drivers must be dissuaded from committing (Parker *et al.* 1995a, cited in Parker 2004). The subsequent section 3.2.4 further elaborates the adverse consequences of different types of RTVs on road safety.

3.2.4 Examples of violations

As mentioned earlier, acts such as speeding, drink driving and non-use of seat belts are considered to be a particularly dangerous set of violations in a number of studies (e.g. Reason 1990; Parker *et al.* 1995a; Stradling and Meadows 2000; Parker 2004). In the following section, a brief discussion is made on a few of the most notable dangerous driving behaviours and their respective consequences for road safety.

a. Speeding encompasses excessive speed, driving above the speed limit or selecting an inappropriate speed, and driving too fast for the conditions but within the posted limits (GTKP 2008d). It makes a major contribution to road trauma (Hatfield *et al.* 2008) which not only has positive association between speed and the frequency of crashes (West and Hall 1997; Hatfield *et al.* 2008) but also the severity of road crashes (Moore *et al.* 1995; Laapotti *et al.* 2001; Peden *et al.* 2004). According to statistics, if a road user is hit by a car travelling at a speed of 50km/h, he would die. An increase of 1km/h in speed results in a 3% increase in the incidence of injury crashes or a 4-5% increase in the incidence of fatal crashes (Finch *et al.* 1994; Peden *et al.* 2004).

Elvik *et al.* (2004) states the statistical relationship between speed and road safety is very consistent. When speed goes down, the number of accidents or injured road users also goes down in 95% of the cases. When speed goes up, the number of accidents or injured road users goes up in 71% of the cases. While it may to some extent be possible to offset the impacts of higher speed by introducing other road safety measures, a reduction in speed will almost always improve road safety. With high speed, the risk of a crash is increased for a number of reasons including drivers losing control of the vehicle, failing to anticipate oncoming hazards in good time and the vehicle taking longer time to stop from higher speed. In the high-income countries, 30% of deaths in RTAs are due to speeding whereas in the low and middle-income countries, it is a contributory factor in almost half of all the RTAs (GTKP 2008d).

There is also a close association between speeding and other types of violations and therefore, drivers involve in speeding are also found to be involved more in the other types of violations (de Winter *et al.* 2007). It is reported that factors such as perceived risk of apprehension, the speed choice of others and the pleasure of driving fast are more likely to influence speed choice than the perceived likelihood of being involved in an accident (Rothengatter 1988, p. 606). A study on the intention to speed on the motorway further elucidates that persistent speeders do not miscalculate the risk, but take the risk deliberately after making judgements about the degree of speeding that is acceptable on the particular road (Iversen and Rundmo 2004, p. 557).

b. Drink driving – also referred to as 'driving under the influence' (DUI) or 'driving while impaired' (DWI) – is an evident and recognised type of aberrant behaviour that significantly contributes to motor vehicle crashes and mortality (Evans 1991; Iversen and Rundmo 2004). Drunk drivers are usually characterised as being male, aged 18-24 years, from a low socio-economic grouping, of low education and low self-esteem (GTKP 2008a). Drivers with any level of blood alcohol concentration (BAC) are reported to be at a higher risk of a crash than those with zero BAC (Peden *et al.* 2004).

In fact the risk of getting involved in a fatal crash increases 17 times for an alcohol-impaired driver compared to an unimpaired one. The consumption of alcohol even in modest amounts results in driver impairment, including poor judgement, increased reaction time, lower vigilance and decreased visual acuity. It also indirectly influences other aspects of driver safety such as seat-belt use or helmet wearing and speed choice. The legal BAC levels for driving vary from country to country, ranging from 0.00g/100 ml (Poland and some other European countries), 0.02 g/100 ml (Sweden) to 0.08 g/100 ml (the UK) (GTKP 2008a). In the United States, a 40% drop in traffic fatalities was estimated if drink driving were eradicated (Evans 1991).

Davis *et al.* (2003) report that in South-East Asia, use of drugs and alcohol is considered to be a contributory factor in 30% to 50% of RTAs, which in turn wastes almost 3% of the GDP every year (p. 33). They mention a study conducted in India which reports that nearly 90% of drivers, who were involved in RTIs at night, were found to be impaired by alcohol at the time of accident (p. 49). For Pakistan no estimated figures of drunk drivers' involvement in accidents are available. However, it is important to note that adult per capita consumption of alcohol in the country increased from 0.05 litres of absolute alcohol in 1970 to 0.13 litres in 1996 (p. 41). Due to this change, it is reasonable to assume that the country has seen an increase in the number of persons driving whilst alcohol-impaired.

c. Use of seat-belt or helmets contributes significantly to a reduction in the number of RTAs and the consequences of those that do occur. Peden *et al.* (2004) say that the non-use of seat-belts and child restraints more than doubles the risk of serious and fatal injuries. They have suggested that seat-belt usage contributes to a 40% to 65% reduction of fatal collisions and a 43% to 55% reduction in moderate and severe RTIs. In the case of lower and middle-income countries, it is estimated that the use of seat-belts and especially the use of child restraints on rear seats can reduce the rate of infant death in RTAs by 71% and toddler death by 54% (GTKP 2008c).

In case of Pakistan, it is mandatory to wear a helmet on a motorcycle, however, there is no law about the use of seat belts unless specified on particular roads e.g. motorways (Government of Pakistan 2007a). It is important to note that lack of seatbelt use can be a lapse when people occasionally forget to wear it. However systematic non-use of seatbelt in spite knowing that regulation exists, can be classified as violation. Studies have found that seat belt usage is related to legislation and enforcement (e.g. see Åberg, 1998; Forward 2008).

In light of the above mentioned examples, it is evident that RTVs significantly contribute to accident causation and if drivers stop practising these unsafe acts and comply with the road traffic rules and regulations much can be achieved that is beneficial for road safety. Therefore, in this present research, given the consistent themes through all of the previously mentioned studies, the focus is kept on the RTVs[15]. In the case of developing countries, the importance of studying violations reaches its peak as highlighted in the transport review conducted by UNECE. The commission reports that RTVs, the dangerous situations that precede a crash - which may result in a crash or near-miss unsafe condition and contribute to poor road user culture - are not scientifically studied for developing countries (UNECE 2008, p. 98). The discussion in section 3.3 looks more deeply into prominent explanations available in the literature for these risky behaviours.

3.3 Determinants of aberrant driving behaviour

The role of the human factor problem in accident causation is evident from the discussion so far. From the evidence available in road safety research (e.g. see section 3.1), it is obvious that a number of causal factors (which can be internal or external) can potentially impact on the behaviour of drivers either in isolation or combination. The following section 3.3.1 firstly reviews various socio-psychological conditions that contribute to driving behaviour, and the subsequent next section 3.3.2 provides an overview of prominent social-cognition models available in the road safety literature to understand the underlying mechanisms involved in the commission of violations. Section 3.3.3 follows on to explore the influences of external factors (e.g. road environment), and section 3.3.4 examines the influence of socio-demographic characteristics on propensity to violate.

3.3.1 Attitudinal and motivational factors

As violations have consistently been reported to predict RTAs, the crucial issue is therefore to understand what motivates drivers to commit an act, which puts both themselves and others at risk. This has led researchers to look at many different

[15] From now onwards, terms such as aberrant driving behaviour, risky driving or deviant driving are referred with respect to RTVs in this thesis.

factors including attitudes (Forward 2006, p. 413). Attitudes guide behaviour either through deliberate or spontaneous (automatic) processes. The former are activated by strong motivation and the opportunity to engage in conscious deliberation; activation of the latter depends on accessibility (Ajzen 2001; Crano and Prislin 2006, p. 361). The definition of an attitude varies. However, an attitude can broadly be defined as a "hypothetical mental structure which determines actions or prepares a person to act in a certain way" (OECD 1994, p.14, cited in Delaney *et al.* 2004, p. 3).

According to Manstead (1996, cited in Iversen and Rundmo 2004, p. 556) most social psychologists would accept the definition of attitude suggested by Eagly and Chaiken (1993); "attitudes are tendencies to evaluate an entity with some degree of favour or disfavour, ordinarily expressed in cognitive, affective and behavioural responses". Parker (2004) simply refers to attitudes as "the thoughts and feelings that impel humans to behave in one way and not in another". There has been increasing appreciation in recent years of the importance of social influences, and the need for remediation strategies that focus on motivations and attitudes rather than on skills. It is stated that RTV is a social phenomenon and has a large motivational component, and a change in attitudes is required to prevent violations rather than training and/or retraining programmes which are less effective to reduce violations (Parker *et al.* 1995a, pp. 1038-46).

Summala (1996 p. 104) explains that drivers look for opportunities to satisfy their motives in traffic, which basically means looking for sufficient gaps and for means to maintain e.g. their desired speed. Since traffic safety messages and programs are designed to change unsafe driving behaviours or enhance safe ones, understanding the reasons why these behaviours occur is necessary for helping to construct appropriate messages and programs (Eby and Molnar 1998, p. 35). Hennessey and Wiesenthal (2005) further cite that the act of driving not only involves manipulation of technical skills but can represent a venue for personal expression and individuality for many drivers. Thus, behaviour of drivers is seen as a reflection of their underlying personality, attitudinal, and motivational factors. As a result, when the manner of driving is based on 'bad attitude', the driver is dangerous (Stradling and Meadows 2000). Parker *et al.* (1992a) conclude that undesirable attitudes and beliefs lead drivers to commit driving violations.

Parker (2004) suggests that, if motivation is part of the road safety problem which tempts drivers to do risky things behind the wheel, a solution should be to persuade them not to do so. She concludes that the best way to affect long-lasting change in behaviour requires a change in beliefs, values and attitudes that underpin the decision to behave in that way. In concordance, Iversen and Rundmo (2004) mention that attitudes towards traffic safety are associated with the involvement in risky behaviour, especially attitudes concerning rule-violations, speeding and reckless driving. They cite a result of a meta-analysis of 88 attitude and behaviour studies conducted by Karus (1995). The analysis concludes that attitudes are a significant and substantial predictor of future behaviour. It is found that attitudes and behaviour are highly correlated when measured at corresponding levels of specificity; i.e. attitude and behaviour corresponded in their target and action elements. The researchers postulate that, as attitudes are assumed to exert direct influence on the traffic behaviour, consequently changing attitudes represents a potential method of bringing about behavioural change (pp. 569-70). For that, it is first important to understand the formation of attitudes of drivers; section 3.3.1.1 looks more into this aspect.

3.3.1.1 Attitude formation

Because appropriate traffic safety behaviours may be influenced by attitudes towards driving and traffic safety, knowledge about how attitudes develop, endure, and change is necessary for constructing effective messages and programs (Eby and Molnar 1998, p. 63). While there is no universally agreed upon definition of attitudes, Eby and Molnar (1998, pp. 63-64) state that there is widespread consensus that (1) evaluation constitutes a central and possibly predominant aspect of attitudes, (2) attitudes are represented in memory, and (3) both behavioural antecedents and consequences of attitudes have cognitive, affective and behavioural domains, although these domains will not necessarily all apply to a given attitude. They further elucidate that *cognitive evaluations* refer to thoughts that people have about the attitude object, *affective evaluations* refer to feelings or emotions people have in relation to the attitude object, and *behavioural evaluations* refer to people's actions with respect to the attitude object.

Given the evident intensity of research, Eby and Molnar (1998) have pooled together some prominent work in the past few decades and elucidate that although attitudes represent relatively stable attributes, they appear to be learned rather than innate. They may be formed directly through questioning, personal experience, or operant conditioning (i.e. positive reinforcement or punishment (Sdorow 1990; Fossey 1993). Direct experience is by far the most powerful influence determining the formation of attitudes, positive or negative. For example, while adolescents may not have strong attitudes about the effects of driving under the influence of alcohol when they first obtain their driver's license, their attitude will be dramatically influenced when they lose a friend or family member to death because of an intoxicated driver (LearnPortal 2012).

Attitudes may also be formed indirectly though classical conditioning (i.e. learning through association, such as pairing something desirable or undesirable with the attitude object), or through social learning and observation[16] (Sdorow1990; Fossey 1993). This last type of attitude formation is captured by social learning theory (see Bandura 1977) which highlights the process of acquisition of knowledge and attitudes from important others, such as parents, teachers, peers, and media figures (Eby and Molnar 1998, p. 64). In short, today most accept the view that an attitude represents an evaluative integration of cognitions and affects experienced in relation to an object. These evaluative abstractions vary in strength, which in turn has implications for persistence, resistance, and attitude-behaviour consistency (Holland *et al.* 2002; Crano and Prislin 2006, p. 347).

3.3.1.2 Two-way relationship between attitudes and behaviour

The utility of the attitude concept derives partly from its assumed ability to guide, influence, direct, shape, or predict actual behaviour (Iversen and Rundmo 2004, p. 556). However, as late as the 1970s, it was argued that the relationship between attitudes and behaviour was so weak that the concept of attitude should be

[16] In *operant conditioning*, an action occurs that is followed by some outcome. If the outcome is positive, then the action is likely to be repeated. If the outcome is aversive, the action that led to it will become less likely to be repeated. Thus, through both reinforcement and punishment, new behaviours are learned and others are extinguished. *Classical conditioning* involves the association between reflexive responses (such as many emotional responses) and a stimulus (such as food or a person). Humans can benefit from the experiences of others in order to learn behaviours and their consequences. Such learning is called *observational learning* (Eby and Molnar 1998).

abandoned (Santrock, 1991; Eby and Molnar 1998). However, Ajzen and Fishbein (1977) has addressed the criticism and provided the methodological explanation of low or non-significant relationship between attitudes and behaviour. They argued that the correlation between attitudes and behaviours would be higher if the measurement corresponds in their 'target' and 'action' elements (Wright and Klyn 1998, p. 46).

They explain that only when standard procedures are employed to scale attitudes and to select behaviours, and only when attention is paid to the correspondence between attitudinal and behavioural entities will the concept of attitude be able to resume the place it was accorded. They inform that measures of attitude will serve to explain the behaviours to the extent that they involve identical target, action, context, and time elements (Ajzen and Fishbein 1977, p. 917). Kraus (1995) confirmed this argument and stated that the weak relationship could be due to methodological problems. He found from his meta-analysis of 88 attitude behaviour studies that attitudes and behaviour were more highly correlated (with an average value greater than 0.50) when they were measured at corresponding levels of specificity.

While current thinking appears to favour a relationship between attitudes and behaviour, it is also recognized that the relationship is more complex than previously suggested. Thus researchers no longer question *if* attitudes predict behaviours; instead, they are interested in the circumstances under which attitudes predict behaviours (see Bentler and Speckart 1981; Eby and Molnar 1998, p. 65). Another interesting aspect of the attitudes and behaviour relationship to consider is that attitudes not only affect behaviour; they are also influenced by behaviour, i.e. by habit.

Eby and Molnar (1998, p. 67) provides two major explanations of the influence of behaviour on attitudes. The first is *dissonance reduction* (proposed by Festinger 1957). That is, because we have a strong need for cognitive consistency, we change our attitudes to make them more consistent with our behaviour. The second explanation of the influence of behaviour on attitudes is *self-perception theory* (proposed by Bem 1972), which posits that when internal states (e.g. attitudes) are weak or ambiguous, people must infer them from knowledge about their overt behaviour and the circumstances in which the behaviour occurred. That is, we look to our behaviour when our attitudes are not completely clear in order to figure out our attitudes.

Cherry (2011) sheds some more light on the interactive relationship between attitudes and behaviours and explains that we tend to assume that people behave in accordance with their attitudes. However, social psychologists have found that attitudes and actual behaviour are not always perfectly aligned. After all, plenty of people support a particular candidate or political party and yet fail to go out and vote. She says that people are more likely to behave according to their attitudes under certain conditions for instance; when your attitudes are the result of personal experience, when you are an expert in the subject, when you expect a favourable outcome, when the attitudes are repeatedly expressed, or when you stand to win or lose something due to the issue. Cherry (2011) further confirms the cognitive dissonance phenomenon and states that in some cases, people may actually alter their attitudes in order to better align them with their behaviour.

To sum up the discussion, regardless of criticism of a weak relationship with driving behaviour or how it is conceptualised, attitudes have long been recognised as having an important influence on driver performance, making this an important road safety issue. The construct continues to be a major focus of theory and research in the social and behavioural sciences (for more details, see OECD 1994; Ajzen 2001; Delaney *et al.* 2004). There is a consensus that attitudes towards traffic safety affect risky driving behaviour (Ulleberg and Rundmo 2003) and efforts can be made to change the attitudes that motivate certain drivers to commit a relatively high rate of violations (Parker *et al.* 1995). In the broadest sense of functionality, attitudes also facilitate behavioural adaptation to the environment (Eagly and Chaiken 1998, cited in Ajzen 2001, p. 40) e.g. changes in driving environment to improve driving behaviour or more generally road safety. The following section looks into different social-cognition models proposed over time to explain behaviours based on robust theoretical principles, with particular reference to attitudes.

3.3.2 Social cognition models to explain the attitude and behaviour relationship

3.3.2.1 The health belief model

In recent decades, the predominant focus of research into understanding the underlying psychological mechanisms leading to aberrant behaviour has been on cognitive behavioural models such as the Health Belief Model (HBM), the Theory of

Reasoned Action (TRA), and the Theory of Planned Behaviour (TPB). The HBM of Janz and Becker (1984) has been effectively applied to an extensive range of health contexts (see Conner and Sparks 1996) including risky driving (e.g. Yagil, 2000; Lajunen and Räsänen 2004).

The model proposes that a person's decision whether or not to engage in safe behaviour (i.e. not speeding, not drink-driving, not driving while fatigued, and wearing seat belts) is determined by four dimensions: the perceived susceptibility to, and perceived severity of, the consequences of a risky behaviour, as well as the perceived benefits and perceived costs of the alternative safety behaviour (Becker 1974; cited in Fernandes *et al.* 2006, p. 21). Chorlton (2007) states that, whilst the studies within the transport safety literature have shown some degree of success (e.g. Rutter and Quine 2002), the use of the model in transport safety is somewhat limited and those such as Yagil (2000) have suggested that normative motives contribute to the predicted behaviour more than the HBM components. Other research also suggests that although, components of the HBM are found to be significant predictors of behaviour, the effects are often small (for a full review, see Abraham and Sheeran 2005). Indeed, the theory is often criticised for its failure to adequately define the variables and the way in which they combine and, despite evidence of behaviour change following the HBM interventions, Abraham and Sheeran (2005) conclude that it is difficult to say whether behaviour changes have resulted from changing the HBM beliefs.

3.3.2.2 The theory of reasoned action

One of the most popular approaches for predicting behaviour from attitudes is the TRA (Tesser and Shaffer 1990, p. 512). Proposed by Fishbein and Ajzen (1975), the theory states that attitudes and cultural norms combine to determine behavioural intentions, which in turn produce a voluntary behaviour (Olson and Zanna, 1993; Eby and Molnar 1998, p. 65). The TRA assumes that one's intentions capture the motivational factors that influence one's behaviour. Essentially intentions provides the focal point that reflects how hard people are willing to try, and how much of an effort they are planning to exert in order to perform a behaviour. As such, the stronger an individual's intention to perform behaviour, the more likely the behaviour will be enacted.

Intention, in turn, is formed by two factors: 1) one's attitude which reflects feelings of favourableness or unfavourableness towards performing the behaviour, and 2) the subjective norm (SN) which reflects the influence (i.e., social pressure) of significant other referents' desire for the individual to perform or not perform the behaviour. An individual's attitude is further described as the summation of the strength of each salient belief multiplied by the subjective evaluation of the belief's attributes. SN, similarly, is considered the summation of the strength of each normative belief (i.e., how much each referent approves or disapproves of the behaviour) multiplied by the person's motivation to comply with the referent in question (Limayem *et al.* 2001, p. 275).

The theory has been used to predict intentions or behaviours in various domains including road safety e.g. use of seat belt (Stasson and Fishbein, 1990, cited in Eby and Molnar 1998, p. 65). The main criticism of the model is that it only managed to predict the behaviour which was under a person's own control. This led Ajzen (1991) to propose an extended version of the model known as the TPB including another variable, called "Perceived Behavioural Control" (Forward 2006, p. 413).

3.3.2.3 The theory of planned behaviour

In order to incorporate behaviours not fully under voluntary control, Ajzen (1991) added perceived behavioural control (PBC) to the reasoned action model as a third predictor of intentions, which is independent of attitudes and cultural norms (Eby and Molnar 1998, p. 65). In comparison to the HBM, the TPB model also recognizes social norms as a key influence of risk behaviour (Ajzen 1991). It assumes that people engage in behaviours if the expected outcome is perceived to be of benefit to the individual (Forward 2006, p. 413). The TPB postulates that intention is determined by independent determinants classified as attitude toward the behaviour, SN, and PBC. According to the model, an intention to perform behaviours of different kinds can be predicted with high accuracy from attitudes toward the behaviour, SN, and PBC; and these intentions, together with perceptions of behavioural control, account for considerable variance in actual behaviour (Ajzen 1991). Figure 11 shows the relationship between the components of the model.

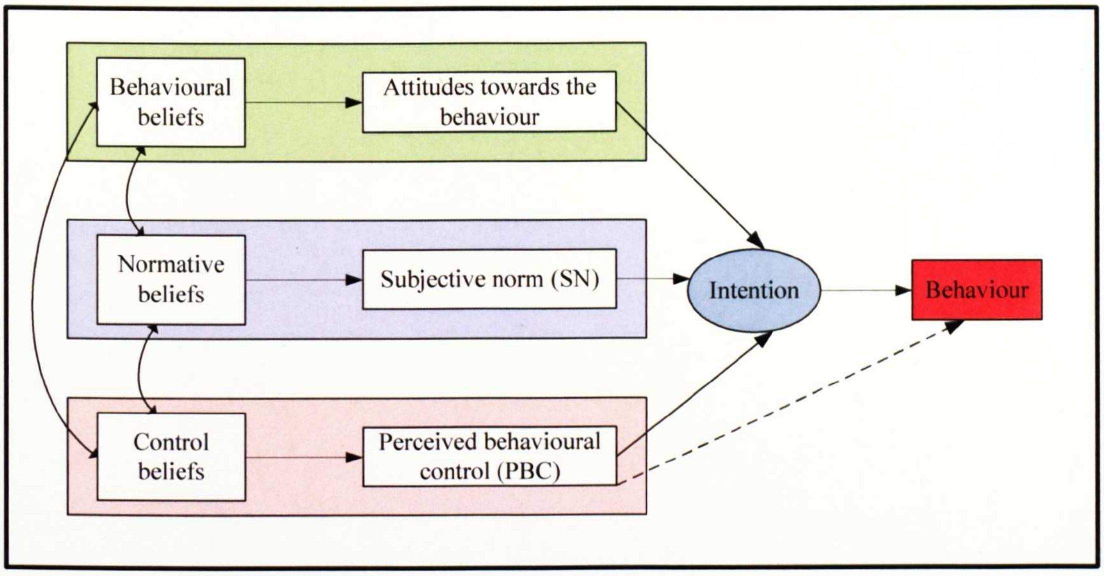

Figure 11: Theory of planned behaviour (source: Ajzen 1991)

The first variable of the model, *attitude toward the behaviour*, is the degree to which a person has a favourable or unfavourable affective (e.g. driving is pleasurable) or instrumental evaluation (e.g. driving is important) of the behaviour (Fernandes *et al.* 2006, p. 24). The second variable, *SN*, refers to the perceived injunctive (e.g. my friends think I shouldn't drive) and descriptive (e.g. all of my friends still drive) social pressures to perform (or not perform) the behaviour (for details, see 3.3.3.2). The third variable, *PBC*, refers to the perceived ability to perform the behaviour and is assumed to reflect the factors that may hinder or facilitate performance of the behaviour (Ajzen 1991; Lindstrom-Forneri *et al.* 2007). An individual's perception of control is assumed to be the product of the individual's evaluation of factors likely to facilitate/inhibit the performance of behaviour and the frequency of their occurrence (*control beliefs*) (Chorlton 2007).

Ajzen suggests that behaviour is influenced by control, particularly when volitional control is compromised by non-motivational factors such as time or money (Ajzen 1985). Actual control however is not amenable to assessment and Ajzen (1991) asserts that it is PBC and its effect upon behaviour which is of greater psychological significance. PBC describes the individual's perception of the ease or difficulty of performing any given behaviour. An individual's PBC over a behaviour can vary across behaviours and situations and has been likened to Bandura's (1986) concept of self-efficacy; the individual's self-appraisal of how well they can perform actions necessary to deal with a future situation. It is this idea that PBC can directly influence behaviour that extends and separates the TPB and TRA, providing an explanation of non-volitional behaviours. The explanation for the direct effect of individual's intentions and PBC upon behaviour is two-fold. First, when intentions are held constant, effort exerted to achieve behavioural enaction is said to increase with PBC. Moreover, when PBC approaches realistic measures of actual control, it will successfully predict behaviour. However, only when an individual has sufficient direct or indirect experience of the behaviour will s/he afford a realistic perception of control. Where perceptions of control are unrealistic or low, a measure of PBC will add little to the prediction of behaviour (Ajzen 1991, Chorlton 2007).

Briefly, the attitude towards the act, SN and PBC are described as direct measures, and who in turn are determined by three belief based or indirect measures namely; behavioural beliefs, normative beliefs and control beliefs (Forward 2009, p. 199). As with the exception of behaviour, the variables in the TPB model are psychological (internal) constructs. Therefore, each predictor variable may be measured directly e.g. by asking respondents about their overall attitude, or indirectly e.g. by asking respondents about specific behavioural beliefs and outcome evaluations (Francis *et al.* 2004, p. 9). Beside these three components, the TPB is sometimes supplemented with additional variables such as affect, past behaviour, self-identity, and moral norm, discussed further in section 3.3.3.4.

Put simply, the theory holds that volitional behaviour is based on intention and that intentions are based on three cognitive components: attitudes, SN and PBC. The attitudinal component is the evaluation of the likely outcomes of the behaviour (*what will happen if I do it?*), subjective norm is the perception of the social norm surrounding the behaviour (*what will people think if I do it?*) and PBC is the perceptions of control over the behaviour (*can I actually do it without too much trouble?*) (Parker 2004). The relative importance of intentions and PBC in predicting behaviour can differ across behaviours and situations and so can the importance of attitudes, SN and PBC in the prediction of intentions (Chorlton 2007). For instance with reference to traffic psychology, SN is found to make a greater contribution than attitudes in the prediction of overtaking on the inside in a study conducted by Parker *et al.* (1995a). In the same study, the reverse happened for a different event, where attitudes are found to be more important than SN with regard to cutting across traffic and weaving in and out of traffic.

However, in a number of RTV studies, attitudes in particular were found to be significantly correlated with aggressive driving behaviour, fast driving and self-reported accident involvement (Ulleberg and Rundmo 2003). The PBC construct has also been found to explain different forms of driving violations including drinking and driving, dangerous overtaking, speeding and lane discipline (e.g. Parker *et al.* 1992a; Parker *et al.* 1995a), and it is noted that non-violators have greater PBC than violators (Forward 2006). A voluminous TPB-inspired literature also testifies to the model's heuristic value (e.g. Ajzen 1991; Godin and Kok 1996; Hausenblas *et al.* 1997). For instance, a meta-analysis of 185 studies revealed that the constitutive elements of the theory explained significant variance in *intentions* (18%) and subsequent *behaviours* (13%); SN emerged as the weakest predictor (Armitage and Conner 2001, cited in Crano and Prislin 2006, p. 361). In another meta-analysis performed by Conner and Sparks (2005), intention and PBC are demonstrated to account for 25.6% of the variance in behaviour, and attitudes, SN and PBC explained 33.7% of the variance in intentions (Chorlton 2007).

Thus the constructs of the TPB have proven important in understanding the difference between safe and unsafe drivers (or violators and non-violators) within the traffic safety literature. However, in parallel it is argued that although the TPB has improved on the TRA, the improvement is not consistent with all behaviours. Most of the limitations suggested for the TRA, including lack of variables such as [attitudes towards] enforcement and emotion, also apply to the TPB (Delaney *et al.* 2004, p. 7). For instance, despite the support given to the new variable (PBC), various authors criticise it for lack of clarity concerning its meaning (Fishbein and Stasson, 1990, cited in Forward 2006, p. 413). Terry and O'Leary (1995) point out that Ajzen is making a mistake when he claims that the concept of PBC includes both a control factor and a factor which can be described as self-efficacy. It is quite possible for a person to feel few external barriers (control factor) but at the same time lack confidence in his/her ability to carry out the behaviour (self-efficacy) and thus, they argue that these are two separate components rather than one single component. A number of studies have also criticized the SN variable since its relationship with intentions tends to be rather weak (e.g. Ajzen1991; Godin and Kok 1996; Conner and Armitage 1998).

To explain this, different propositions have been put forward including Ajzen's (1991), who says that social factors might be less influential than personal factors. Another reason would be that only a minority of people are under normative control (Trafimow and Finlay 1996, cited in Forward 2006, p. 413). In addition, for behavioural intention, the most immediate predictor of behaviour in the TPB, Sheeran's (2002, cited in Crano and Prislin 2006, p. 361) meta-analysis of 10 studies reveals that, on average, intentions explained 28% of variance in subsequent behaviour. Quite a sizeable portion of unexplained variance is problematic, regardless of whether intentions are conceptualized as causes of actions, as is the case in the TPB or as focal constitutive conditions of actions. Thus researchers suggest there could be other factors that can provide potentially additional explanatory power towards driver behaviour, as discussed in the following section 3.3.2.4.

3.3.2.4 Additional moderators of attitudes and behaviour relations in the TPB

Many studies challenge the assumption that the predictors in the TPB are sufficient to account for intentions and behaviour. This is done by including measures of additional variables in the prediction equation and showing significant improvement in the prediction of intentions or behaviour (see Conner and Armitage 1998 for a review). For instance, there is an interesting debate in the literature suggesting that driver behaviour is not only a consequence of intention but also of *habit*. It is stated that past behaviour[17], and the frequency with which it has been performed, tends to correlate well with later actions. Based on the assumption that frequent performance of a behaviour leads to the formation of a habit, and that habits can influence behaviour independent of attitudes and intentions, theorists have proposed that frequency of past behaviour be added to the TPB model (Ajzen 2001, pp. 44-46).

[17] Some investigators such as Bentler and Speckart (1979), and Fredricks and Dossett (1983) have suggested that past behaviour be included as a substantive predictor of later behaviour, equivalent to the other independent variables in the model. According to these theorists, prior behaviour has an impact on later behaviour that is independent of the effects of beliefs, attitudes, subjective norms, and intentions (Ajzen 1991, p. 203).

In discussing the importance of habits versus intentions, Triandis (1980, p. 216) notes that as long as a behaviour is new to a person, the person's intention to perform the behaviour clearly influences his or her actual behaviour. However, as the person gains more experience with the behaviour over time, i.e. "as an act occurs more frequently", we should be able to observe a shift in importance from consciously-driven behaviour towards habitual behaviour (Limayem *et al.* 2001, p. 283). Forward (2006, p. 413) argues that variables not included in the model are supposed to act indirectly on behaviour although this assumption has been questioned. She reports that in a meta-analysis conducted by Conner and Armitage (1998), past behaviour increased the models predictive ability by another 7%.

However, Ajzen (1988, cited in Ajzen 2002), who did not find this concept very useful, advocates that PBC mediated the effect of past behaviour. He further debates that residual effects of past behaviour cannot be attributed to habit. Rather, he calls for further explorations of factors responsible for translations of beliefs into actions. Nevertheless, subsequent research does not always support this assumption. Given that habit may have a strong influence on the potential to influence drivers' behaviour via their attitudes, Elliot (2002, p. 230) suggests that further investigation into the role of habit is required to better understand how it affects the attitude and behaviour relationship. Crano and Prislin (2006, pp. 362-63) state that far from being settled, this debate on habits will likely generate new insight into automaticity versus reasoning in the field of human action.

Other than habit, investigators continue to identify factors that moderate the effects of attitudes and intentions on overt actions. For example, some studies demonstrate improved prediction of environmentally relevant behaviour with the addition of personal or moral norms (Harland *et al.* 1999). Another factor that has been found to mediate the relationship between attitudes and behaviour is the degree of *direct experience* with the attitude object. For example, with reference to road safety, knowing someone personally who drove when drunk and subsequently died in a car crash will be more likely to affect our behaviour than reading about crash statistics in the newspaper. Findings from Fazio *et al.* (1978, cited in Eby and Molnar 1998, p. 66) support the idea that attitudes formed through direct experience with an attitude object are better predictors of later behaviour than attitudes formed through indirect experience.

Ajzen himself has addressed some of the objections on the theory (e.g. see Ajzen 1999) by stating that the TPB is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account (Ajzen 1991, pp. 199-201). For example, while measuring attitudes towards an act, Ajzen and Driver (1991) examined distinction between evaluative judgments (i.e. perceived cost and benefit of performing a given activity) and affective judgements (i.e. positive or negative feelings of performing a given activity). Thus, the attitudes scale now includes instrumental (i.e. harmful-beneficial, useless-useful) and affective attitudes (i.e. enjoyable-unenjoyable and boring-interesting). In Ajzens' latest guide from 2006 a third measure of good and bad presenting an overall evaluation is also included as a measure of attitudes (Ajzen 2006; Forward 2008).

However, in general, after reviewing relevant studies and literature, Ajzen (1991) concludes that the evidence supports the TPB and that adding further variables to the model would not significantly enhance its predictive power (Eby and Molnar 1998, p. 65). In later years, he has further claimed that, even when improvements were found, for the most part the improvements in prediction of intentions or behaviour were relatively minor, and their generalisability to other behavioural domains has yet to be demonstrated (Ajzen 2001, p. 46). As the significance and empirical values of the basic constructs of the TPB have already been established in a number of studies, this research primarily takes into account these constructs to look into risky behaviour of drivers.[18]

3.3.2.5 Application of the TPB in road safety

The model has generated a great deal of interest within contemporary literature (Iversen and Rundmo 2004, p. 556). Since its development, the model has also been

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[18] For the sake of brevity and because of the notable importance of attitudes, from now onwards the term '*attitudes*' or '*attitudes toward road safety*' is used to take into account other internal cognitive components including SN and PBC. This is to illustrate the overall underlying socio-psychological mechanism involved to perform behaviour.

widely adopted within the road safety field. With its help, researchers have examined drivers' propensity to speed (e.g. Parker *et al.* 1992a; Parker *et al.* 1992b; Elliott *et al.* 2003; De Pelsmacker and Janssens, 2007; Chorlton 2007), overtake dangerously (Parker *et al.* 1992a; Parker *et al.* 1992b; Parker *et al.* 1995a), drink drive (Parker *et al.* 1992a; Parker *et al.* 1992b), follow closely (Parker *et al.* 199a, b), recklessly weave (Parker *et al.* 1995a), recklessly cut in (Parker *et al.* 1995a), run red traffic lights (DfT 2000), flash at vehicles in front (DfT 2000), and engage in retaliatory/initiatory violations (Parker *et al.* 1998). By and large, these studies have found support for the theory, and therefore, as in the words of Ajzen (2001, p. 44), little can be gained at this point by further demonstrations of the theory's applicability to particular domains.

For instance, the TPB has been used to predict speeding in two different contexts; rural areas (e.g. Letirand and Delhomme 2005; Wallén *et al.* 2008) and urban areas (e.g. Elliott *et al.* 2003; Elliott *et al.* 2005; Parker *et al.* 1992a, b; Wallén *et al.* 2008; Forward 2009). In the studies by Parker *et al.* (1992a) and Wallén *et al.* (2008), which both used indirect measures, the model explained 47% and 31%, respectively, of the intention to speed in an urban area (Forward 2009). The most important variable was either PBC (Parker *et al.* 1992a) or SN (Wallén *et al.* 2008; Forward 2009). Hatfield *et al.* (2008) say the theory explains that the proximal cause of speeding is an intention to speed, with one of the determinants being a positive attitude towards speeding. This positive attitude essentially results from high perceived benefits and low perceived costs of the behaviour, both of which are influenced by the perceived number, likelihood and value of expected outcomes of the behaviour. Attitudes are taken here to mean "evaluative judgements". In simple terms, a negative attitude to speeding means that speed is believed to be "bad", whereas a positive attitude to speeding means that speed is believed to be "good" (p. 616).

While Elliot *et al.* (2003), who used a direct measure of attitude, demonstrated that intenders believed that it would be more beneficial, pleasant and positive to speed as compared with non-intenders. In a later study by Elliot *et al.* (2005) specific beliefs underpinning speeding in a built-up area (20 mph, 30 mph and 40 mph) were assessed. The results showed that complying with the speed limit in a built-up area would make it more difficult to keep up with the traffic but on the other hand it would make them more relaxed and it would be easier to detect hazards. To comply with the rule also became more problematic if other motorists exceeded the speed limit, if they were driving on a long straight road and if they were in a rush (Forward 2008, p. 32). Forward (2008) also reports that speeding is related to positive feelings, that speeders derived more pleasure from driving, that it would take them to the destination quicker, be more comfortable and more in tune with the surrounding traffic. These findings not only highlight the importance of the TPB in explaining speeding behaviour but how it conforms to the traffic environment (section 3.3.3 looks more into the role of traffic environment).

Whilst investigating the attitudes towards drink driving using the TPB construct, Åberg (1993) found that intentions to drive after alcohol consumption are influenced by attitudes, social norms, evaluation of sanctions and drinking habit. He said that factors like possibility of detection, accidents and the need for transport are important in making a decision whether to drive or not after alcohol consumption (Åberg 1993; Iversen and Rundmo 2004). Parker *et al.* (1992a) used the TPB to predict the intention to drink and drive. The results showed that the model predicted 42% of the variance. PBC was the most important single factor in the prediction followed by SN and attitude (Forward 2008, p. 33). Parker *et al.* 1992 (a, b) also looked at the underlying mechanism involved in overtaking. They found that young drivers believe that dangerous overtaking would take them to their destination quicker whereas older drivers tended to believe that it would annoy other drivers. Parker *et al.* (1992a) report that the model explained 32% of the variance and the most important predictor in determining dangerous overtaking was SN followed by PBC.

3.3.3 Situational and cultural factors

The literature sheds light not only on internal cognitive psychological factors but also on external factors which can affect or moderate the behaviour of drivers. Factors such as the road environment, the vehicle and other road users contribute significantly to the risky behaviour of drivers, as highlighted at the beginning of this section. Hennessy and Wiesenthal (2005) clarify the problem of driving attitudes, e.g. wilful violations do not occur in isolation, but are determined partially by aspects within the instigating environment such as traffic congestion and provocation from other drivers.

For example, studies have also found that the seat belt usage is not always consistent and that it is related to trip purpose, driving situations and road conditions (Forward 2008, p. 32). For instance, Stasson and Fishbein (1990) found that actual seat belt usage varied across different driving situations. Seat belt usage was most likely on long trips, on a highway, under wet conditions and during the night. This is also consistent with other findings which also found that it was most common on long trips (Svensson *et al.* 1985; Fockler and Cooper 1988) and on highways (Forward *et al.* 2000). Furthermore, Fockler and Cooper (1988) also found that it was most common when driving at higher speeds. The importance of context would then suggest that the same driver can be a user in one context but a nonuser in another.

It is also important to note that RTVs and accident involvement should not only be studied under the inherent social context but take into account cultural factors in which these actions take place. As argued by Iversen and Rundmo (2004), societal norms and pressure influence calculations and shape attitudes towards risk-taking and rule-breaking behaviour. In accordance with their study, Vereeck and Vrolix (2007) confirm that social willingness to comply with the law has a significant effect in reducing violations and in turn traffic fatalities. They say that social norms prevail over laws and a strong, widely shared willingness to comply with the traffic rules leads to strict compliance and in turn to a safer traffic, while a safer environment makes any violation more visible and less tolerated. The road user error model, presented in Figure 9 takes into account these above mentioned factors and indicates their contribution in occurrence of specific errors.

Regarding the influence of the road environment, in the recent WHO report on road traffic injury prevention, it is acknowledged that driver behaviour is governed not only by the individual's knowledge and skills, but also by the environment in which the behaviour takes place, and that indirect influences, such as road design and layout, vehicle nature and traffic laws and enforcement can affect driver behaviour (WHO 2004). The WHO (2009a) further elaborates that road-related factors can include such factors as a road defect directly triggering a crash, some element of the road environment misleading a road user and thereby creating error, or where some feasible physical alteration to the road would have made the crash less likely.

Similarly, while assessing the phenomenon of speeding using the TPB, Wallén Warner and Åberg (2008, cited in Forward 2008, p. 32) found that the most important determinant was control beliefs. While, the assessment of control beliefs indicated that being in a hurry would make it easier to speed but also the road layout, such as straight and wide roads and roads having a central median barrier. Sato and Akamatsu (2007) state that drivers perceive the road traffic environment, including road structures, the road surface, and the movement of other vehicles or pedestrians, as well as their own vehicle status. They then interpret the relations between their vehicle and the external circumstances, and execute appropriate manoeuvres. Glendon (2007, p. 1171) summarises that greater environmental diversity is likely to produce greater variability in driver behaviours. Thus, it is important to study the influences of these external factors particularly in the context of local culture when investigating driver behaviour.

3.3.4 Influence of socio-economic and demographic characteristics

The literature argues that road safety is a social problem and that personal factors play a vital role in guiding and shaping driver behaviour. Research in the psychological sciences has found a close association between driver behaviour and an individual's socio-economic and demographic characteristics. Variables such as age, gender and exposure are all known to be correlated with accident involvement (e.g. see Rothengatter 1997; Ward and Lancaster 2003; Iversen and Rundmo 2004). For example, it has been noted that a high rate of RTVs is significantly associated with young, male drivers who have high annual mileage i.e. exposure (Parker *et al.* 1995a; Hennessy and Wiesenthal 2005).

According to the TPB; demographic factors are more distal predictors of behaviour through the individual's beliefs (Forward 2010, p. 224). However, a number of studies predicting drivers' intention to violate have confirmed the significant effect of socio-demographic variables with regard to intentions to violate. For example, a study conducted by Forward (2010) indicates that variables such as age, sex and annual mileage increased the explained variance about intention to speed in rural areas with 2%. The finding is in agreement with other results within the field of transportation, although the effect is generally rather low, around 1–4% (Parker *et* *al.* 1992a; Forward, 2009). This section briefly explores the influences of socio-demographic characteristics on law violating behaviour of drivers.

a. Gender: A number of studies have shown that men commit more violations and women make more errors (Reason *et al.* 1990; Stradling and Meadows 2000; de Winter *et al.* 2007). Hennessey and Wiesenthal (2005) inform that male drivers commit more wilful violations compared to female drivers. Male drivers have also been observed to engage in greater speeding behaviour and greater tailgating behaviour, compared to female drivers. Nonetheless, some researchers suggest that the risky driving behaviour of females is becoming increasingly similar to that of male drivers (Moore 1994, cited in Fernandes *et al.* 2006, p. 24).

While determining what motivates road violations using the TPB, Forward (2008) not only assessed the effect of significant others on unsafe driving in general but was able to state who these significant others are. Her results showed that both men and women, regardless of context, believed that men of the same age as themselves were more accepting of the violations. However, their perception of other men was different with the women believing that other men would be more accepting. The results also showed that it was a person of the same age and gender as themselves who had the greatest effect on their own intention. However, the latter would not appear to apply to females who intended to violate since they believed that it was men of the same age as themselves who were most in agreement with their intentions.

b. Age: A study based on Californian drivers' reports that age brings with it marked changes in the commission of different types of violations. For the middle-age group, speeding is found to be the most common offence, followed by the failure to stop at traffic signal/signs. For elderly drivers, the most common type of infringement is found to be sign-related, followed by turning and precedence transgressions (Reason *et al.* 1990, p. 1317). Studies have shown that younger drivers are more likely to be killed in single-vehicle, rollover crashes; whereas older drivers are at relatively greater risk of injury from multi-vehicle, side-impact collisions. This is consistent with the former type of accident being associated with a tendency to drive too fast and the latter type being associated with a failure in observation (Parker *et al.* 1995b, p. 573).

Parker and Stradling (2001) reports that a large part of the reason why young males in particular are over-represented in the traffic accident statistics is that male drivers and young drivers over-represent high Violator group. In their study, they divided drivers into three equal-sized groups of high, medium and low violators. They found that around 40% of male drivers were high Violators as opposed to 20% of female drivers; and over 50% of male drivers aged 17-25, and approaching 40% of female drivers aged 17-25 were high Violators.

Laapotti *et al.* (2001) also confirm that the number of accidents and offences are highest among the young males and that their accidents tend to take place more often at night. A key reason for the high level of involvement of young drivers in traffic offences and accidents is thought to be due to inexperience, risk taking behaviour and risk exposure. Besides, young drivers are considered to have extra motives such as showing-off their driving skills in traffic (Naatanen and Summala 1976) which lead them to commit RTVs excessively. In low-income countries, on the basis of expected demographic evolution, it is suggested that young road users will continue to be the predominant group involved in road crashes (Peden *et al.* 2004).

Yagil (1998) examined both gender and age-related differences in drivers' normative motives for compliance with the traffic laws and report that young and male drivers have a lower level of normative motivation to comply with the law in comparison to females and older drivers. Similarly, Iversen and Rundmo (2004) report from a study based on attitudes towards traffic safety, that women, older respondents and those who hold a licence for a long time are more likely to report positive attitudes towards traffic safety than other drivers.

c. Income: Road safety research has also looked into the influences of socio-economic level on attitudes and behaviour of drivers. For instance, an international comparative study of 19 European countries on self-reported driving behaviour has analysed the association between level of income and attitudes towards road safety and found that higher personal income, in general, leads to less law-abiding driving behaviour (Golias and Karlaftis 2001). In another study, English car drivers were asked to rate the usefulness and acceptability of systems to warn about or to override driver preferences for speed and headway. It is found that drivers from higher social classes and from medium and high-income groups rated the telematic devices least favourably as they limit the drivers' freedom to violate the rules of the road (Stradling 2006).

On the contrary, a study conducted in Australia on drink driving offenders reported that unemployed drivers from low socio-economic status record higher rates of drink driving offences (Baum 1999). Another piece of research which has examined the relationship between driver's socio-demographic characteristics and their comprehension of posted signs in five Arabian Gulf countries claims that high-income drivers comprehend the signs significantly better than the low-income drivers (Al-Madani and Al-Janahi 2002). A study based on Lahore bus drivers' also report a similar trend in which 70% of the drivers admitted that their attitudes towards driving are significantly influenced by their economic conditions. The study noted that all respondents were involved in active type accidents and belonged to low-income groups (Aziz and Saeed 2005).

In light of the above discussion, it can be concluded that the commission of violations significantly correlates with certain socio-economic characteristics of drivers. However, the impact of income profile (both low and high) on RTVs varies in intriguing ways in different parts of the world. Contradictory findings about the factor's influence on driving behaviour imply that it would be interesting to look into the relationship between different income levels and RTVs in different regions of the world, including Pakistan.

3.4 Treatment of aberrant driving behaviour – road safety interventions

So far, this chapter has focused on types and causes of aberrant driving behaviour. This section now looks at the potential ways to improve these behaviours. In this regard, the work of William Haddon is prominent. He was the first head of the US Federal National Highway Traffic Safety Administration and a public health physician, who has contributed considerably to the understanding of injury occurrence (Lett *et al.* 2002) and its control. He constructed the Haddon matrix (Table 13) which explains the role of human, vehicle and road environment factors in preventing injury using the motorcycle as an example (GRSP 2011a).

Table 13: Haddon matrix for injury control: example of motorcycle safety

	Personal	Vehicle	Road Environment
Pre-event	Avoid alcohol consumption Obey traffic laws Supervised training	Daytime headlamps Good tyre, brakes	One-way streets Special lanes for motorcycling Clear road signs and signals
Event	Wear fastened helmet Physical fitness; exercise, bone strength	Good-quality, well-fitting helmet Leg guards on cycle Heavy boots and clothing	Energy absorbing barriers Roadsides clear of fixed obstructions Guardrail along cliff
Post-event	Rehabilitation	First aid kit Emergency radio	Communication network Transportation network Emergency services

Source: GRSP (2011a)

Traditionally, the most common areas in which safety actions are taken include education (driver training, training at schools, retraining programme), information (mass media campaigns, roadside information), law practice (laws concerning drinking and driving, speed limits, give way rules), law enforcement (speed, drinking and driving, rules at traffic signals, stop signs), planning (organization of the road network, modal split measures), occupant and road user safety (restraint systems), and traffic engineering measures (design of roads, intersections) (Almqvist and Hydén 1994, p. 4).

Broadly, it can be said that two principal approaches are considered in order to improve and influence driving behaviour: adjusting the traffic system to the driver (system-based) or adjusting driver to the system (person-based). The system-centred approach aims at creating those road conditions that reduce the chance of accidents in advance whereas the individual-centred approach directly focuses on the traffic relevant performance and personality aspects as well as on the attitudes and behaviours of single drivers (Christ *et al.* 2004). The following sections 3.4.1 and 3.4.2 further concentrate on both of these approaches to the treatment of violations.

3.4.1 The person-based perspective

The discussion in the first half of this chapter has demonstrated a clear association between driving behaviour and socio-psychological characteristics of drivers in RTAs. Such understanding is useful for development of effective road safety countermeasures. The literature suggests that violations (which are intentional acts) should probably be dealt with by attempting to change attitudes, beliefs and norms, and by improving the overall safety culture (see Reason 1990; Parker *et al.* 1995a; Hatakka *et al.* 2002; de Winter *et al.* 2007). The person approach focuses upon the identification and classification of the deviant behaviours that operators make at the so-called 'sharp-end' of system operation (Reason 2000), and seeks to identify the internal or psychological factors involved in it. In this approach, behaviour of drivers is treated as the cause of most RTAs; while the system in which people work is assumed to be safe. It considers human unreliability as the main threat to safety and suggests protecting the system through automation, training, discipline, selection and proceduralisation to improve system safety (Dekker 2002; Salmon *et al.* 2005).

Forward and Kazemi (2007, p. 14) highlights the importance of theoretical models (e.g. the TPB) in improving behaviour of drivers. They advise that before carrying out a detailed design of the means of road safety interventions or mass media campaigns, it is important to gather as much information as possible about the target group. In this instance a theoretical approach is needed in order to determine what factors predict their behaviour and decide which elements of the same should be targeted by a traffic safety campaign. This approach has also been substantiated by a number of meta-analyses which have shown that traffic safety campaigns which are grounded into a theory are substantially more effective in reaching their goals when compared to campaigns where no such theoretical background supports the intervention. (e.g. Delhomme *et al.* 1999; Delaney *et al.* 2004). For example, a meta-analysis of 35 studies, namely the GADGET project, informs that the effects were greater for road safety campaigns that relied on an explicit theoretical framework. Concerning the results obtained from evaluations carried out during the campaign, campaigns based on a theory resulted in a significantly higher accident reduction (20.1%) than did ones without a theoretical base (3.5%) (see Delhomme *et al.* 1999 and Delhomme *et al.* 2009a).

Person-based approaches can be particularly useful in the case of developing countries. Parker *et al.* (1995b, p. 571) say that designing global accident countermeasures with more focused action in terms of enforcement or changes to vehicle and road characteristics are not possible. For example, it may be difficult to legislate adequately to prevent drivers from driving too fast in the current traffic conditions but within the posted speed limit or from moving into the path of other vehicles. They suggest that a more global change in driver behaviour fostered through improved training or a different set of attitudes might reduce accidents. To change those attitudes that motivate drivers to commit a RTV, different kinds of efforts have been made. Quimby and Downing (1991, cited in Parker *et al.* 1995a, p. 1046) state that advances in road safety in the future will only be achieved when road safety is treated as a social issue, and research focuses on road users' attitudes and beliefs, and how the latter might be changed. Cherry (2011) says that while attitudes can have a powerful effect on behaviour, they are not set in stone. The same influences that lead to attitude formation can also create attitude change, as discussed below:

i. Learning theory of attitude change: *Learning* has been defined as any relatively permanent change in behaviour or thinking that results from past experiences. An understanding of learning processes is considered important for developing messages and programs that attempt to improve on unsafe driving practices. Most traffic safety messages are designed to either change how people think about a traffic safety issue or to change people's safety behaviour. In other words, they are designed to educate people. Therefore, a comprehensive understanding of learning processes is central to the development of effective traffic safety messages and programs. Three learning processes are particularly relevant: classical conditioning, operant conditioning and observational learning (Eby and Molnar 1998, pp. 20-24) and can be used to bring about attitude change. Classical conditioning can be used to create positive emotional reactions to an object, person or event by associating positive feelings with the target object. Operant conditioning can be used to strengthen desirable attitudes and weaken undesirable ones. In addition, people can also change their attitudes after observing the behaviour of others (Cherry 2011).

ii. Elaboration likelihood theory of attitude change: As attitudes are learned rather than being innate, they are susceptible to change through persuasion. *Persuasion refers to the intentional attempt to influence or change the attitudes of other people* (Eby and Molnar 1998). This theory of persuasion suggests that people can alter their attitudes in two ways. One method is to motivate them to listen and think about the message, which can thus lead to an attitude shift. Another way is to be influenced by characteristics of the speaker, leading to a temporary or surface shift in attitude. Messages that are thought-provoking and that appeal to logic are more likely to lead to permanent changes in attitudes (Cherry 2011). The persuasion process involves three components: communicator or source, message, and audience or target population. Factors related to each of these components affect the chances and extent of any attitude change that results from the persuasion process.

1) *Communicator or Source*: Source credibility, to a large extent, is characterized by expertise and trustworthiness. In general, communications will be more persuasive if they are perceived to come from a highly credible and respected source, the source states an opinion that is contrary to what would be expected, the source is attractive, or the source is seen as being similar to the recipient.

2) *Message:* One-sided messages are more persuasive when audiences already favour the source's position; two-sided messages (both sides of an issue) are more persuasive when they oppose the issue. Messages that play on an individual's fear are generally only effective when the presented threat is severe, the likelihood of it occurring is high, and the audience have the capabilities to do something to prevent or eliminate it.

3) *Audience or Target Population:* There is evidence that audience involvement with an issue (often measured by personal importance) moderates the effects of communicator (source) and message factors, as well as the persistence of attitude change. The motivation level and ability of the recipients influences the cues that they will be most likely to attend to during the persuasion process (Eby and Molnar 1998, pp. 67-69).

iii. Dissonance theory of attitude change: According to this theory, people can also change their attitudes when they have conflicting beliefs about a topic. In order to reduce the tension created by these incompatible beliefs, people often shift their attitudes (Cherry 2011).

While talking about how attitudes and behaviour change campaigns should be designed, Delaney *et al.* (2004) highlight three key elements to be associated with potential improvements in road safety outcomes. *First,* campaigns with a persuasive orientation and those that use emotional rather than rational appeals tend to have a greater effect on the relevant measure of effect. In contrast, information-based and educational campaigns have been associated with less effective campaigns. *Secondly,* the use of explicit theoretical models and prior qualitative or quantitative research to inform the development of the campaign message and execution has been found to increase its effectiveness. Consistent slogans, new information and realistic, credible messages are all recommended in order to increase the campaign impact. Guidelines for effective campaign management include recommending a responsible key agency, a limited number of messages, development decisions based on research, and community support. *Thirdly,* the use of public relations and any unintentionally associated publicity (i.e. unpaid media activity or public relations relating to the campaign) appears to be more important to the outcome of the campaign than the use of enforcement.

However, as there has been little research on the effectiveness of improved driver training in developing countries and accident savings as a direct result of training are, of course, very difficult to prove. A study of a retraining course for bus drivers in Pakistan (Downing, 1988) failed to demonstrate any accident savings, although there was evidence of an improvement in knowledge test scores (13% on average) and a reduction in driving test errors (67% on average). It was also shown that the training had no effect on the drivers' behaviour when they were observed unobtrusively and they clearly returned to their old habits when driving in normal conditions. Therefore, to bring about a general improvement in driver behaviour it will usually be necessary to ensure that drivers are sufficiently motivated, and training courses will probably need to be integrated with publicity campaigns, incentive schemes and enforcement (Baguley and Jacob 2000, p. 13).

3.4.2 The system perspective

Section 3.3.3 has highlighted the influence of external factors including driving environment, traffic condition or situations on commission of road violations. In the system perspective approach, aberrant driver behaviour is treated as a result of system failure, rather than an individual's failure and takes into account the combined role of latent conditions (e.g. poor design, manufacturing defects and maintenance failures) and behaviour of drivers (Salmon *et al.* 2005).

It is argued that the vast majority of RTAs are the result of mistakes by any of the road users involved, but more important are the reasons that lie behind these mistakes (Almqvist and Hydén 1994, p.6). There is a criticism that the majority of research to date within the road transport domain has been conducted from the person-based perspective. It has attempted to identify and classify the nature and frequency of the aberrant behaviours made by drivers and also person-based causal factors that contributed to these behaviours. However, attention towards the system-based approach has increased in the recent years. It is apparent that the relevant research communities are beginning to adopt this approach within the road transport domain (Salmon *et al.* 2005).

Almqvist and Hydén (1994, p. 6) elaborate that it is very clear that road design and planning play important roles, either directly by giving the road users incorrect information, or indirectly by producing a situation where the road users misinterpret the situation consciously or unconsciously. Peden *et al.* (2004) also highlight the significance of the system-oriented approach to tackling the road trauma problem. They adopted the approach for doing a risk analysis in the World Report on Road Traffic Injury Prevention while taking into account road user, vehicle and environmental components. In recent times, The Swedish Vision Zero approach to traffic safety management is one of the most prominent risk management approaches based on the premise that the traffic management system should be error-tolerant (Lenne *et al.* 2004). It is based on the shared responsibility concept and has changed the approach to allocating responsibility for road safety to the extent that it is the individual person who is responsible for abiding by the laws and regulations, while it is the system designers who are responsible for the safety that should be built into the system (for more details, see Whitelegg and Haq 2006).

In the context of developing countries, the need for developing system-based road safety solutions is gaining more strength. For instance, Eduardo (1995, p. 266) highlights that the built environment in developing countries is dangerous for the driver. The researcher criticises that most of these countries committed themselves to extensive road building programs, following the automotive-oriented development model. This investment was not followed by appropriate operational and maintenance efforts, leading to fast physical deterioration and unsafe traffic conditions. Thus, such a risky environment poses serious questions about the attempt to place most of the blame on the human factor. He further states that the bias in analysing developing countries' accident problems has been enhanced somehow unwittingly by the influence of studies conducted in developed countries, especially in the Europe, most of which emphasize the human factor as the primary cause of accidents. Although disregard for traffic rules, speeding, poor vehicle maintenance and drinking and driving can be said to account for a significant proportion of accidents in developing countries, the built environment has a very important effect. Thus, this review emphasises the importance of applying the system-based approach when designing or recommending road safety solutions for developing countries such as Pakistan.

3.4.3 The combined person and system-based approach

Based on the person approach, a number of traffic safety campaigns have been designed to change and improve the attitudes of drivers. However, Iversen and Rundmo (2004) indicates that a number of evaluations of effects from traffic safety campaigns indicate that only small changes are found in the target behaviour when trying to change attitudes (e.g. Aarø and Rise 1996; Elvik *et al.* 1997). This has led to the current debate in road safety as to whether attitude change techniques can be effectively used to reduce the commission of aberrant driving behaviours. A counter-argument is that it is not necessarily the case that attitudes have minimal influence on driving behaviour. It might just be the case that, in previous empirical studies, a change in behaviour as a result of attitude change interventions has not been observed because the evaluated interventions have not brought about substantial and long-lasting changes in attitudes (Elliot 2002, p. 230).

Recent studies show that a combination of different measures can give more significant improvements in driver behaviour (e.g. Delhomme *et al.* 2003; Delaney 2004). For instance, an instructive example (see Cliff *et al.* 1980) involving changing attitudes to driving practices through education and higher-profile enforcement in the UK, suggests that health education campaigns designed to encourage the wearing of seatbelts (before this became mandatory) were largely unsuccessful in bringing about behavioural change. However, when the wearing of seatbelts became a legal requirement in the UK, the level of compliance with the new law was very high. Thus it can be inferred that health education campaigns played a valuable role in bringing about sufficient attitude change to make the subsequent legislation acceptable to the public (Parker *et al.* 1995a, pp. 1045-46).

Studies have found that a combination of education and enforcement increase the success of a campaigns. The result from a meta-analysis was able to demonstrate that 8.5% of crashes could be reduced if traffic safety campaigns were combined with traffic enforcements. If this was followed by yet another campaign then this figure increased to 15% (Delhomme *et al.* 1999). This would then be in agreement with the deterrence theory which states that persons will avoid an illegal act if they believe that it will result in sanctions (see Freeman *et al.* 2006; Forward 2008).

A meta-analysis of effects of road safety media campaigns in Europe provides empirical evidence for the statement; road safety campaigns can help prevent accidents especially when combined with other measures. The analysis included 35 studies with 72 results, and only explored RTAs. The investigators report that the overall effect of safety campaigns was estimated to reduce the number of accidents by 8.5% during the campaign period. After conclusion of the campaigns, the effect was nearly doubled: (14.8%). They attributed the results to all components of the campaign such as enforcement, reward, legislation, educational programmes etc. and not only to the campaign itself (Delhomme *et al.* 2003, cited in Iversen and Rundmo, 2007, p. 558). To conclude, in light of the above discussion, both psychological and physical measures should be taken into account in combination to make the effect of road safety measures longer lasting.

3.5 Conclusions

The review has highlighted that intentional RTVs are the riskiest type of aberrant driving behaviour. They are mediated by the attitudinal and motivational factors and make a significant contribution to the accident toll on the roads. Various social-cognition models have been utilised in road safety research to theoretically explain the underlying psychological mechanism involve in commission of violations. The TPB model has emerged to be the most successful. In a number of studies, the model has successfully explained variation in driving behaviour with the help of its three components (attitudes, PBC and SN).

The review also concludes that although attitudes are generally recognised as the most relevant for understanding and predicting driver behaviour, there are many other factors which can influence it. For instance, situational and cultural factors, level of enforcement as well as demographic and socio-economic characteristics of drivers are found to be associated with the frequency that violations are committed. In order to prevent these deviant driving practices, person-based or system-based road safety measures are usually developed. The review concludes that these approaches can achieve much more effective results when used in combination, particularly in the case of developing countries. The key points drawn from the review are:

- Intentional violations are a highly risky type of aberrant behaviour that pose a definite risk to other road users and can lead to serious RTAs.
- This deviant behaviour has strong attitudinal and motivational components and change in attitudes is required to bring about a change in behaviour.
- Socio-economic and demographic characteristics of drivers influence commission of violations so as the driving environment.
- To prevent commission of violations, road safety interventions should be developed using both person and system-based approaches.

A systematic information collection and analyses procedure is required to explore the phenomenon of RTVs in the context of Pakistan. The following chapter provides a review of the current methodological and analytical practices to explore all of the aforementioned key aspects relating to attitudes and driver behaviour.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The methodology reviews in this thesis evolve directly from the discussion made in Chapter 3 which reveals multiple factors (including attitudes, socio-demographic characteristics, driving environment) shape driver behaviour. Keeping in mind the lessons learnt from the literature review and overarching aim of this research i.e. to investigate the attitudes towards roads safety and aberrant behaviour of drivers in Pakistan, the nature of the present research methodology is exploratory. It is important to understand the contribution of these factors in a systematic and meaningful way to understand the low profile of road safety in Pakistan. To do so a sophisticated, conceptual and analytic methodological framework is needed to expose and explain '*which*' group of drivers are most likely to engage in unsafe driving acts; '*why*' they tend to do so, and '*what*' factors made a significant contribution in provoking these behaviours. As mentioned earlier in Chapter 2, by selecting 'Lahore' for investigation, a case study approach has been adopted in this thesis.

A case study approach is a method for learning about a complex instance (i.e. behaviour of drivers) through extensive description and contextual analysis. Rather than using large samples and following a rigid protocol to examine a limited number of variables, case study methods involve an in-depth, longitudinal examination of a single instance or event (in present case aberrant driving behaviour in Lahore). It is a systematic way of looking at what is happening, collecting data, analysing information, and reporting the results. However, the specific focus on Lahore might be susceptible to criticism when it comes to general applicability of research findings[19]. The issue of generalization has appeared in the literature with regularity (Yin 1984).

[19] Final Chapter 9 provides conclusive results of this research and also assesses the extent to which these can be generalised.

However, in the context of countries such as Pakistan where not much is conceptually and analytically known about driving behaviours, this approach can prove highly suitable as it allows collecting richer information with limited resources. While refuting the criticism, Tellis (1997) advocates that a case study approach is an ideal methodology when a holistic, in-depth investigation is needed. These are designed to bring out the details from the viewpoint of the participants by using multiple sources of data and should not be confused as a sampling research. It is known as a triangulated research strategy and researchers assert that triangulation can occur with data, investigators, theories, and even methodologies[20].

Yin (1984) says that the need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this could be done by using multiple sources of data. Yin (1994) identifies six primary sources of evidence for case study research: documentation, archival records, interviews, direct observation, participant observation, and physical artefacts. Not all sources are essential in every case study, but the importance of multiple sources of data to the reliability of the study is well established.

The objective to identify and evaluate the relationship between attitudes towards road safety and aberrant behaviour of drivers serves as a guideline to develop the research design in this thesis. The purpose of this chapter is to broadly outline state-of-the-art methodological practices in road safety research of relevance to Pakistan. Subsequent section 4.2 reviews multiple sources of data acquisition and the most adaptable theories to *measure* subjective qualities highlighted in Chapter 3. Section 4.3 looks into common multivariate analyses techniques utilised in behavioural sciences to infer data. Section 4.4 concludes the chapter with the methodological implications drawn for this thesis.

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[20] *Data source triangulation*, when the researcher looks for the data to remain the same in different contexts; *Investigator triangulation*, when several investigators examine the same phenomenon; *Theory triangulation*, when investigators with different viewpoints interpret the same results; and *Methodological triangulation*, when one approach is followed by another, to increase confidence in the interpretation.

4.2 Data acquisition methodologies

Appropriation between research paradigm, type of data, and collection methods has significant implications upon the research findings (Limpanitgul 2009, p. 4). There are several quantitative or qualitative data acquisition strategies available in behavioural research. In most cases, researchers fall into one of these two camps - either relying exclusively upon "objective" survey questionnaires and statistical analyses and eschewing qualitative methods, or using only qualitative methodologies, rejecting the quantitative approach as decontextualizing human behaviour (Weinreich 2012). Berg (2007, p. 286) argues no single measurement class - qualitative or quantitative - is perfect. But neither is any data collecting procedure scientifically useless.

To select the most suitable measuring instrument, Sommer and Sommer (2002) advise it is important to know that research is careful, patient and methodical inquiry done according to certain rules. It is not simply an exchange of views among friends, colleagues, or experts. Anyone whose job depends on information about what people do or want should know how to obtain that information in a valid and systematic manner. Specifically, they should know how to interview, construct a questionnaire, observe natural behaviour, and conduct an experiment. They emphasise that range of questions that can be examined using the methods of behavioural research is enormous. It is the task of the researcher to set priorities for the questions to be asked, as well as to identify the best methods to be used. The researchers further identfiy that experimentation is limited by artificiality, observation by unreliability, interviews by interviewer bias, and so on.

They suggest that the goal of the researcher should not be to find the single best method. For most problems, several procedures will be better than one. Even though each has its limitations, these tend not to be the same limitations. For instance, the artificiality of the *laboratory* can be supplemented by *observation*, which is high on naturalness but low on reliability; the *questionnaire*, which can be given to many people quickly, can be supplemented by detailed *interviews* with a few people to probe more deeply into significant issues. The researchers emphasise that the multi-method approach provides flexibility in dealing with obstacles encountered in carrying out a project. Having a variety of methods available, even when they are not all used, provides flexibility beyond what is possible with a single procedure.

The utility of the multi-method approach to develop comprehensive understandings of complex issues in transport studies have also been demonstrated widely (see Ribbens *et al.* 2008; Hawley 2010; Lenné *et al.* 2011). For example, according to Ribbens *et al.* (2008) a multi-source multi-method approach facilitate a comprehensive perspective on risk factors. Forward and Kazemi (2009) highlight importance of multi-method approach in order to assess effectiveness of road safety campaign. After reviewing studies from seven European countries, they concluded that combine quantitative (questionnaires) with qualitative strategies (in-depth interviews) helps designing the campaigns in ways that target groups can identify with, and as a result recall better.

Thus, this thesis adopts a multi-method approach to identify and explain underlying causal factors which bring about the phenomenon of risky driving practices in Pakistan. By utilising different sets of data for comparative purposes, the approach also helps to increase validity and reliability of research findings. Under the scope of qualitative and quantitative research paradigms, observation, experiment, questionnaire, and interview are the four most prominent data acquisition strategies. Sommer and Sommer (2002, p. 5) estimate these techniques account for more than nine-tenths of the articles in social science journals. They recommend that with opinions and attitudes, the *interview* and *questionnaire* are very efficient while *observation* is well suited for discovering what people do in public. Starting with strengths and weaknesses of interview based qualitative study; the following sections consecutively evaluate the utility of all these methods in the context of present research.

4.2.1 Qualitative data

Qualitative research techniques can complement traditional quantitative approaches but also stand as a legitimate mode of inquiry in their own right (Clifton and Handy 2001, p. 3). These methodologies are designed to provide the researcher with the perspective of target audience members through immersion in a culture or situation and direct interaction with the people under study (Weinreich 2012). The strength of qualitative research is its ability to provide complex textual descriptions of how people experience a given research issue. It provides information about the "human" side of an issue – i.e. the often contradictory behaviours, beliefs, opinions, emotions, and relationships of individuals. Qualitative methods are also effective in identifying intangible factors, such as social norms, socio-economic status, gender roles, ethnicity, and religion, whose role in the research issue may not be readily apparent (Mack *et al.* 2005). Focus groups and interviews are different forms of qualitative study.

An *interview* based qualiative study gives a respondent an opportunity to explore the questions in an indirect way and to express ambivalence and contradictions (Banister *et al.* 1994, cited in Forward 2006, p. 414), because informants are interviewed individually, the confidentiality issues and normative pressures that often plague focus groups are not as problematic. The interview format provides a more intimate setting for discussion of sensitive issues or very personal matters, and more detailed information about the individual or household circumstance can be relayed. Interviews allow for flexibility in the type of information being collected. Researchers can mix attitudes, options, and preferences with information that is typically quantified from a questionnaire. Guides and filters can be used to tailor subsequent questions based on previous responses. Finally, because the respondent is answering questions in the presence of an interviewer, there is an opportunity for clarification, explanation, and elaboration of questions and responses (Clifton and Handy 2001, p. 8).

Interviews can be unstructured, structured or semi-structured. In an *unstructured* interview the main goals are to explore all the alternatives in order to pick up information, to define areas of importance that might not have been thought of ahead of time, and to allow the respondent to take the lead to a greater extent. The interviewer has a general topic in mind and may want to ask specific questions. However, there is no predetermined order or specified wording to the questions. If information from a number of respondents is to be combined, as in an attitude survey or opinion poll, then a structured or standardized interview is desirable. While, semi-structure interviews with a cross-section of the population may require adaptation of wording and sentence structure to better fit the respondent's age or social background.

This arrangement may be more suitable for obtaining in-depth information where the interviewer does not want to be restricted by a prescribed question order but would like the advantage of having asked the same questions of all respondents (Sommer and Sommer 2002, pp. 108-09).

Clifton and Handy (2001, p. 17) highlight the utility of the technique in context of transport studies and state many current and emerging issues in transportation demand a qualitative approach e.g. aging populations in car-dependent environments, growing levels of motorization in developing countries, planning contexts that are increasingly multi-cultural, the impact of telecommunications and information technology on travel, growing levels of non-work travel, and so on. The utility of qualitative methods as an effective tool to design and evaluate road safety campaigns has also been demonstrated in number of studies. For example, while designing awareness campaign regarding risk associated with drunk driving, Król (2007) reports that the in-depth qualitative study helped to design good evaluation tool and gathered necessary information to understand motivations and reasoning of drinking and driving. Such data collection provided a base for effective communication design which applied exactly to information formulated by respondents during the qualitative study. It is recommended to follow the same in-depth research path before any forthcoming road safety campaigns (p. 291). Another meta-analysis that provided important insight into the key elements of successful road safety communication campaigns also found that when combined with enforcement, campaigns had statistically significant accident reductions during the campaign, lowering the number of accidents by 6.9%.

Chapter 2 highlights the lack of comprehensive databases and understanding of road safety issues in Pakistan. Given this consideration, employment of an interview technique in present research can offer a good number of advantages. As Tewksbury (2009, p. 38) says the knowledge gained through qualitative investigations is more informative, richer and offers enhanced understandings compared to that which can be obtained via quantitative research. Furthermore, the technique has proven particularly useful in areas where opportunities for observation are limited (Sommer and Sommer 2002). Therefore, a qualitative set of interviews are used in the formation stage of this research to gain a richer insight of both external and internal issues that plague safe driving practices in Pakistan by gauging local opinion. The information generated is then used to develop instruments to achieve more quantified responses[21].

However, besides its advantages, qualitative data pose some challenges for researchers. For example, the data cannot be used to perform multivariate analysis and thus, it is criticised that the information obtained in interviews is limited to the spoken content and to inferences made by the interviewer. Moreover, the need for training to avoid bias introduced by the human interaction of the interview process, coupled with the time-consuming aspects of the interview itself, creates an economic disadvantage. They recommend that the ideal situation is not to rely strictly on interviews or on any single source of information, but to combine information from different sources (Sommer and Sommer 2002, pp. 106-22). Following the same principle, the subsequent section assesses advantages of generating quantitative responses in this thesis.

4.2.2 Quantitative data

Quantitative research is typically considered a more "scientific" approach to doing social science. It focuses on using specific definitions and carefully operationalizing what particular concepts and variables mean (Tewksbury 2009, p. 39). These methods are designed to ensure objectivity, generalisability and reliability. Quantitative techniques cover the ways research *participants* are selected from the study population in an unbiased manner, the standardized *questionnaire* or *intervention* they receive and the *statistical methods* used to test predetermined hypotheses regarding the relationships between specific variables. The researcher is considered external to the actual research, and results are expected to be replicable (Weinreich 2012). In comparison to *interview* based qualitative study, a *questionnaire* based survey usually enables researchers to examine and explain relationships between constructs, in particular cause-and-effect relationships (Limpanitgul 2009). Furthermore, a written questionnaire distributed to a hundred people takes a small fraction of the time required for individual interviews (Sommer and Sommer 2002, p. 122).

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[21] Further details of theoretical and methodological considerations taken into account while conducting interview-based qualitative study are provided in Chapter 6.

From the literature review, it is evident that understanding of internal social-cognitive factors is mandatory to understand aberrant behaviour of drivers. To tap these concepts, self-assessment based questionnaires are widely used (e.g. see Xie and Parker 2002; Iversen and Rundmo 2004; Hatfield *et al.* 2008). Lajunen *et al.* (2004) elucidate that self-report based questionnaires can be a very useful and efficient means of studying aberrant driving behaviour. At their best, anonymous surveys can provide reliable in-depth information about behaviour, as well as about the motives and attitudes leading to risky driving (p. 236). Some examples of questionnaires which have been developed to explore attitudes in road safety are Parker *et al.*'s Driver Attitude Questionnaire (Parker *et al.* 1996), Assum's attitudinal questionnaire (Assum 1997), attitudes to driving violation scale (West and Hall 1997), Yagil's questionnaire to explore gender and age related differences in attitudes towards traffic law and traffic violations (Yagil 1998), or Ulleberg and Rundmo's risk-taking attitudes scales (Ulleberg and Rundmo 2003). To assess the dimensions of aberrant behaviour of drivers through questionnaire, the DBQ (Reason *et al.* 1990) is one of the most widely used self-reported measurement tools (see Parker *et al.* 1995a, b; Stradling *et al.* 1999; Stradling and Meadows 2000; Wills *et al.* 2006) that measures the relative frequencies with which drivers engage in different types of risky behaviour (for details, refer to section 4.2.2.2).

This research also acknowledges the importance of structuring quantitative questionnaires to investigate the dimensions and relationship between attitudes towards road safety and aberrant behaviour of drivers in Pakistan. However, to select the best instrument, road safety researchers emphasise the utility of attitudinal and behavioural measures based on theoretical framework. Delaney *et al.* (2004) state that utilising theories to guide campaign development is effective because the theories help to maintain focus on determinants underlying the decisions to perform (or not perform) a behaviour, and hence the campaign is more likely to influence the behaviour. The following section assesses the most suitable instrument to measure attitudes in this thesis.

4.2.2.1 Attitudinal measure

The literature review has acknowledged the correspondence between attitudes and behaviour of drivers. To modify or change aberrant driving behaviour, it is important to understand how best the attitudes of drivers towards these behaviours are assessed. To do so, the TPB model provides a clear framework to develop the structure and content of any tool for measuring attitudes to driving (Johnson *et al.* 2009, p. 5). The review has already established the significance of the model to explain the risky driving behaviour within traffic psychology. It is proven to have the greatest applicability and validity to understand the phenomenon by utilising its concepts including attitudes, SN and PBC.

A voluminous TPB-inspired literature testifies the model's heuristic value, and provides strong support for the use of the TPB as a reliable attitudinal measure that can be applied successfully to explore factors underlying the deviant driving behaviour (for reference, see section 3.3.3.3). Therefore, this PhD does not purport to test the efficacy of the TPB construct or predictive power of the model. It rather aims to develop a questionnaire with its help to determine attitudes and motivational factors involved in the commission of RTVs. To understand which attitudinal dimensions significantly correlate with deviant driving practices, it is important to comprehensively measure these subjective constructs. Parker (2004) says the TPB model is without doubt the most widely used model of its kind that has been successfully applied to road user behaviour several times. It provides a useful framework for considering the attitudes of road users to any issue, and studies involved in looking at the attitudes should use the theory as a starting point.

In order to develop a measurement tool with the help of the model, the main concerning issue to look at is which aspects of the model to include and where to draw the line on content. Johnson *et al.* (2009) ask if you have good coverage of personal attitudes to behaviours, subjective social norms and PBC, do you also need to have separate coverage of intentions or can they be predicted from the other factors? Likewise, if you have sufficient information on background factors, can you predict the more specific attitudes and beliefs with sufficient accuracy? The literature review suggests that contribution of attitudes, SN and PBC, intention to explain different types of driving behaviours vary. Therefore researchers advocate it is desirable to at least assess all four of the higher order factors in the TPB model if good prediction of driver behaviour is to be achieved (Johnson *et al.* 2009, p. 5).

As different predictors emerge in different situations and different research studies so that it is not clear that any combination of factors effectively predicts any higher order factor. Typically, for construction of any TPB-based questionnaire, the behaviour of interest is defined in terms of its *Target* (e.g. driving population in Lahore), *Action* (e.g. speeding, drink driving), *Context* (e.g. road environment), and *Time* (e.g. day, evening) elements. All the manifest indicators of the intentions and behaviour in the questionnaire have two factors i.e. attitude has *instrumental* and *affective* component; SN has *injunctive* and *descriptive* quality; and PBC has *self-efficacy* and *controllability* items (for detail guideline, see Ajzen 2006).

While a number of measurement tools have recently been developed to examine individuals' driving behaviours, the Driver Attitude Questionnaire (DAQ; Parker *et al.* 1996) based on the theoretical account of the TPB remains the predominant tool to assess general motorists' driving attitudes and outcomes (Rowland *et al.* 2010, p. 448). It is a 20-item self-report questionnaire designed to tap attitudes towards various aspects of driving including drink driving, close-following, dangerous overtaking and speeding (Parker *et al.* 1996). Respondents are required to indicate on a ''six-point scale'' (from 0 = ''strongly disagree'' to 5 = ''strongly agree'') their agreement with statements regarding the appropriateness of various driving behaviours (Davey *et al.* 2006, p. 3). An overall score and scores on each of the sub-scales can be computed (Conner and Lai 2005, p. 17).

The drink driving factor consists of items such as the perceived seriousness of drinking more than the legal limit and then driving, while the close-following factor focuses on attitudes towards the acceptability of driving very closely to vehicles in front. The overtaking factor concentrates on whether it is safe to overtake in risky situations and the speeding factor focuses on identifying whether respondents believe it is safe to drive above the speed limit (Wishart *et al.* 2006, p. 2). The reliability, construct and criterion related validity of the DAQ has been proven in number of studies (see Parker *et al.* 1996; Conner and Lai 2005; Wishart *et al.* 2006; Rowland *et al.* 2010).

Road safety research has also begun to utilise the DAQ within a number of different applied settings such as: speed awareness training (Meadows 2002), general driver training programs (Burgess and Webley 2000), bicycle interventions (Anderson and Summala 2004), as well as fleet programs (Davey *et al.* 2006). Burgess and Webley (2000, cited in Davey *et al.* 2006, p. 2) incorporated the DAQ as a measurement scale into a driver education program and reported that for the 1,439 participants, individuals were most likely to indicate the highest level of intolerance towards drink driving behaviours, followed by close following, and then dangerous overtaking, while participants were least concerned about speeding violations.

Meadows (2002) found the DAQ to be a reliable measurement tool to examine the impact of a speed awareness program. Davey *et al.* (2006) utilised the DAQ in combination with a number of self-reported driving assessment questionnaires (e.g. DBQ, Climate Safety Questionnaire) to investigate the driving behaviours of 4,195 fleet motorists in a large telecommunication organisation. The researchers found that participants reported the highest level of acceptance for speeding above the limit, while close following and risky overtaking procedures were reported as less acceptable. Interestingly, risky overtaking procedures were reported as a significant predictor of incurring demerit point loss [22] while driving for work purposes (Davey *et al.* 2006, p. 2).

The above mentioned studies indicate that the DAQ has potential to be implemented and to examine attitudes of drivers towards road safety successfully. Thus, in this research preliminary guideline to develop an attitudinal questionnaire has been borrowed from the DAQ. As the questionnaire has already developed, established and can ensure measurement reliability in operationalizing the TPB constructs[23]. However the lessons learnt from the literature review put emphasis on fulfilling the research deficits in developing countries and strongly encourages conducting country specific research. Thus, the incorporation of local factors in

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[22] As a part of the wider traffic law sanctioning system, a DPS issues penalty or demerit points to drivers or owner of vehicles after driver or vehicle has been identified in a traffic offence. The aim of a DPS is to deter drivers from re-offending in traffic and to increase road safety by using the threat of extra sanctions in addition to regular sanctions if collected points exceed certain limits (see Goldenbeld *et al.* 2011).

[23] More methodological details about the research studies carried out in this research are discussed in Chapters 5, 6, 7 and 8.

already established instruments such as the DAQ can make research findings the most relevant and applicable in the context of a particular case study.

However, due to lack of comprehensive databases in Pakistan, less is known about the elements which can help to design the TPB-based questionnaire (e.g. characteristics, types and frequency of RTVs/RTAs). The review suggests that speeding; drink driving and non-use of seat belt are few of the most aberrant types of driving behaviours which play a significant role in the causation of RTAs. Initially, these risky behaviours can be used as *action*. Yet to make the questionnaire more relevant and specific to driving population of Pakistan; a qualitative study conducted in the exploratory stage of this research used to overcome this knowledge deficits, and to identify the most deviant types of behaviours prevalent among drivers' in the country. Later these identified behaviours are used as measure of attitudes towards road safety (for details, see Chapter 7).

4.2.2.2 Behavioural measure

The literature review demonstates Reason's (1990) theoertical taxonmoy of errors and violations as the most widely used classification schemes. Using its theoretical principles, Reason *et al.* (1990) developed the DBQ in response to a call for better classification systems for accident investigators, and made a distinction between errors and violations while regarding violations as the immediate precursor of RTAs (refer to section 3.2.3). Since then, the questionnaire has remained one of the most widely used measures of aberrant driving behaviours in a number of studies (e.g. Parker *et al.* 1998; Stradling *et al.* 1999; Stradling and Meadows 2000; Wills *et al.* 2006). However, as behaviour of committing RTVs - the most deviant driving behaviours - is under investigation in this research, therefore, the focus would remain, on the modified version of the DBQ produced by Lawton *et al.* (1997).

Having consistently found that driving errors are unrelated to accident involvement (e.g. Parker *et al.* 1995a, b), Lawton *et al.* (1997) did not measure errors in their study. They further suggested a distinction between two kinds of violations i.e. *Highway Code violations* (HCV) and *interpersonally aggressive violations* (AV). Behaviours like speeding and running a red light fall under the first category, whereas sounding one's horn or giving chase to another driver when angered are the type of interpersonally aggressive violations. In their 12-item shortened version of the DBQ (hereafter referred as the DBQ), Lawton *et al.* (1997) extended the original DBQ violation scale by adding four interpersonally AV items and empirically distinguished these from HCVs[24]. The analysis on these items revealed fast driving; maintaining progress and anger/hostility as three main factors for the UK driving population. The first two factors came from the original 'ordinary' violations (HCV) and the third one, termed as interpersonally AV, is embraced the kinds of behaviour seen as increasingly prevalent (such as indicating hostility, angry chasing, sounding horn), perhaps as a result of increasing congestion and frustration on the roads (Parker *et al.* 1998).

From then onwards, the questionnaire has been deployed in a number of studies (e.g. by Parker *et al.* 1998; Stradling *et al.* 1999; Stradling and Meadows 2000; Lajunen *et al.* 2004). For example, Stradling and Meadows (2000) assess the relationship between getting angry and these two types of violations. They reveal that the drivers with a higher rate of HCV are more likely to get angered when their progress is impeded. However, interpersonally aggressive drivers act on their anger by showing hostility or giving chase or sounding horns. Fernandes *et al.* (2006, p. 23) further explain the phneomenon and state that driver anger is conceptualised as a personality trait similar to trait anger which reflects a broad predisposition to experience anger more frequently and intensely across a range of driving situations. They report that anger is the only mood state associated with increased risky driving. These studies have also confirmed the distinction between HCVs and AVs. The replication, thus, makes the questionnaire a validated measure to monitor a range of disrespectful driving behaviours (Conner 2007).

A number of international studies support the universal nature of the DBQ. For instance, it has been applied in Finland, the UK, Greece, Iran, The Netherlands, Turkey (Özkan *et al.* 2006), Spain (Eugenia *et al.* 2006), and China (Xie and Parker 2002). However, at the same time, researchers emphasise the importance of taking cultural factors into account when applying an instrument in another country and language in all these studies. For instance, Blockey and Hartley's (1995) say that an instrument may function differently even in two countries using the same language. To add, Lajunen *et al.* (2004, p. 236) conducted a study in Finland, The Netherlands, and the UK and made a cross-cultural comparison of the findings. The results of the

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[24] For complete list of items in the modified DBQ, see Appendix E.

factor comparisons show that the DBQ four-factor structures (which include AVs and HCVs) found in Finland and The Netherlands were fairly congruent with the one found with the British data. However, they noted that the factorial agreement was satisfactory rather than perfect. They concluded the factor structure of the DBQ can be used in studies using Finnish and Dutch versions of the DBQ.

On the other hand, they also highlighted the fact that the agreement between the structures was not perfect emphasises the importance of taking cultural factors into account when applying an instrument in another country and language. They further pointed out that in their study; all three countries were industrialised Western European countries with relatively safe traffic and superficially similar traffic cultures. The small differences in the DBQ structure show that different behaviours in general, and questionnaire items in particular, can be interpreted slightly differently even in countries as culturally similar as Finland, The Netherlands and the UK.

This finding emphasises the importance of thorough knowledge of the countries and cultures involved and great care in the translation procedure. Therefore, like attitudinal questionnaire, this research looks into utilising the DBQ while taking into account Pakistan's specific factors, in order to adapt it in relevance to behaviour of local population. However, there is also an issue regarding validity of self-reported behavioural data which needs to be addressed. Although self-report is often employed to measure driving behaviour, attitudes and beliefs, it is argued that researchers cannot confidently know whether the self-report data they have gained are valid (Fernandes *et al.* 2006, p. 32). The following section 4.2.2.3 evaluates the limitations of this technique.

4.2.2.3 Problems of subjective behavioural data

Despite their many advantages, self-reports of risky driving have certain limitations and are criticised for being influenced by certain biases. Ulleberg and Rundmo (2002) suggest that behaviours like violating traffic rules represents sensitive information about the individual and in order to present themselves in a socially desirable way, the respondents may choose not to report such behaviours i.e. socially desirable responding bias. Most simply, socially desirable responding can be described as a tendency to give the "right" answers. Participants' responses may be influenced by their beliefs and perceptions of the researchers' expectations, and further by the desire to protect their own image. The possibility that participants may engage in socially desirable responding is particularly pronounced when there are clear social norms attached to the factor that is being measured, and this appears relevant to road-safety behaviours (Fernandes *et al.* 2006, p. 32).

Iversen and Rundmo (2004) explain that aberrant behaviour are motivationally based; some people will choose to present themselves as drivers who commit driving violations while others may show a deliberate tendency to give favourable self-descriptions to make the best possible impression. Elliot *et al.* (2007) mention that self-reported measures are also susceptible to cognitive biases (e.g. primacy and recency effects), affective biases (e.g. mood and emotional states) and self-presentational biases (e.g. self-deception). However Hatfield *et al.* (2008, p. 617) say that of all these biases, socially desirable responding has arguably been of most concern in the context of road safety research.

Nonetheless, many studies have also supported the validity of self-report data for investigating road safety issues (e.g. see Parker *et al.* 1995a; Ulleberg and Rundmo 2002; Fernandes *et al.* 2006). Fernandes *et al.* (2006, p. 32) report that in a study investigating the effects of fatigue on driving performance and crash involvement among taxi drivers (by Dalziel and Job 1997), participants were asked to complete a questionnaire examining attitudes and behaviours related to taxi driving. Self-reported crash details were checked against company insurance records, and results showed that 90% of all recorded crashes were reported in the questionnaire. Parker *et al.* (1995a) also support the validity of self-report data based on a review of studies which assessed the relationship between self-reported crash involvement and actual crash involvement (as determined from police records). Earlier, Parker *et al.* (1992b) also cite a positive correlation between self-reported RTVs and involvement in RTAs.

To sum up, the utility of the DAQ and DBQ to successfully measure attitudes and behaviour of drivers is evident in the above discussion. The reliability and validity of these instruments are widely acknowledged in a number of research studies. While to make these instruments relevant to Pakistan, the review highlights that incorporation of local cultural specific factors is also mandatory. Hence, an interview based qualitative study is conducted in this thesis as a substitute to knowledge deficits, and to gain richer understanding of current driving practices and issues. At the same time, the arguments are put forward against vulnerability of these instruments to biases when it comes to measuring risky driving behaviours. Therefore, it is also decided to measure actual behaviour of drivers in this research to avoid criticism and to address these potential issues especially given the novelty of such research in Pakistan.

4.2.3 Observed behavioural measure

As there can be a difference in the reported and actual behaviour of drivers, several methods to observe driving behaviours on roads, in line with subjective methods, have been devised to get better idea of driving behaviour. In these methods, data is collected either by conducting on-road observational studies, using driving simulators or instrumented cars, or by simply observing behaviour on the standardised route using techniques such as the Wiener Fahrprobe (WF). These methods are regarded as a valuable addition to the research arsenal (Hatfield *et al.* 2008, p. 617). For this research, the WF technique is considered the most suitable and applicable method to tap actual behaviour of drivers. It is due to the unavailability of advanced technologies e.g. driving simulators, unfavourable conditions for on-road observations, and limited access to traffic monitoring equipment in Pakistan. Therefore, the discussion in the following proceeds with reference to the WF.

The WF technique is an in-car observation method, developed by Risser (1985) to study real life driver behaviour in different traffic situations. It is said to act as a 'verbal movie' of behaviours. The literature review suggests that external factors such as road condition and/or traffic environment also influence the behaviour of drivers (e.g. Sato and Akamatsu 2007; WHO 2009; Török 2011). The technique has an ability to assess performance of drivers in different traffic conditions by selecting sections of a test-route with varying characteritristics. Thus, it not only offers an opportunity to alleviate issues of reporting biases of subjective methods but can also assess influences of external factors; by tapping changes in behaviour of drivers with changes in driving conditions of different sections of a test-route.

It records four sets of variables: standardised variables, errors, interaction/communication processes, and traffic conflicts. *Standardised variables* are the types of behaviours that are likely to appear during the drive and can be predicted e.g. speed adaptation at junctions/obstacles, lane change, interaction with other road users, and driving above the limit, The Highway Code of a country can be used to identify these erroneous behaviours. *Errors* are events that represent a severe offence of the law and/or cause danger. *Interaction/communication process* mean deliberate neglect of rules, thus offending others' rights and/ or feelings which might lead to dangerous situations and it also covers one's own right with the aim to be cooperative and/or polite. Lastly, *traffic conflicts* are defined as situations where at least two road users are on a collision course and it could only be avoided through an evasive action by at least one of them. As accidents are rare events, in a WF study, traffic conflicts not accidents are used to judge a driver's performance and as criteria for traffic safety.

On a specified test route two observers, *free observer* and *coding observer* record driver's performance on standardised observation sheets. The *coding observer* sits in the rear seat of the car and registers behaviour on a standardised coding sheet. The *free observer* sits in the front passenger seat and records errors; interaction/communication and traffic conflicts via a free observer coding sheet (for details, refer Chaloupka and Risser 1995; Turetschek 2009). The technique has been applied world-wide in a number of studies including Austria, Germany, Switzerland, Sweden (refer to Roskam *et al.* 2002; Brusque 2008), the UK (Carsten *et al.* 2008). It is also validated in the countries considered to have a lower safety profile in the European Union such as Italy, Spain and the Czech Republic (European Transport Safety Council 2006; Saroldi 2008; Turetschek 2008).

The reason for selecting the WF as an observational technique for the present research is its proven reliability and validity. By using a reliable instrument, as discussed previously, consistent results can be achieved in the course of repeated measurements. *Reliability* refers to the extent to which a test or other instrument is consistent in its measures (Turetschek 2008). In order to test the reliability of the data collection method of the WF via counting errors, Risser and Brandstatter (1985) used Cronbach's alpha ($\alpha = 0,84$) and the split half method of Spearman-Brown ($r = 0,81$) and Guttman ($r = 0,80$). Hjalmdahl and Varhelyi (2004) considers a very high congruence of observers with the "key" observation (90%) not so much as evidence for objectivity but for reliability, as the effect remained on the same level in follow-up tests.

Likewise, an instrument that measures the concept it is supposed to measure, can be described as *valid*. If the test does indeed measure what it is intended to measure, then it can be said that the test is valid or has validity (Turetschek 2008). Concerning the WF, Risser and Brandstatter (1985, cited in Turetschek 2008) compared the amount of recorded errors of a driver with the amount of critical incidents he/she was involved in. They found a significant correlation of $r = 0.52$. This result means that the more errors a driver made the more often he/she was involved in critical incidents and vice versa. According to this study, the same is true for the involvement in conflicts ($r = 0.65$). Moreover the authors could find a significant correlation between the amount of errors and the accident history of drivers ($r = 0.14$). Another validation study was conducted by Chaloupka and Risser (1995). In this study the data of the behaviour observation was correlated with accident data of 51 road sections.

Despite having some advantages over self-reports, the observational studies such as the WF also have some restricted implications. Glendon (2007, p. 1174) highlights that an observational study cannot access a number of performance variables that are known to be important to driving. These include cognitions, motivations to violate, driving experience, driver stress, alcohol/other drug use, fatigue, medical conditions, listening to radio/CD or using hands-free mobile phone. These techniques may also prove costly in terms of both time and money.

To conclude, research methodologies either qualitative or quantitative (subjective or observed) have some weaknesses along with their strengths. In order to avail the best of both worlds, these weaknesses or limitations can be alleviated by triangulating research methods. It is concluded that multiple data acquisition methods can be used to complement each other. Thus, a qualitative paradigm is used to see the bigger picture regarding the road safety profile of Pakistan in this research. For this, interviews with the targeted driving population are used to provide baseline at the exploratory formative stage of this research. Information learnt particularly in context of RTVs from the qualitative study is then used to generate context relevant adaptations of the self-reported attitudinal and behavioural questionnaires. Later, an observational study is also conducted not only to collect richer information about driving behaviours in Pakistan but to assess influence of external factors on them.

4.3 Statistical methods for analysing attitudinal and behavioural data

Qualitative data typically need to undergo a process of reduction that selects, distils, simplifies, and transforms them into a format that can be more readily managed (Clifton and Handy 2001, p. 14). Chapter 6 discusses in detail the analysis of interview data in current research. This section focuses more on conventional techniques to analyse quantitative attitudinal and behavioural data. Statistics is an essential research tool whose utility differs in different types of research. In socio-psychological investigation like this, researchers mostly use various significance tests (e.g. t-test, F-test, etc.) and correlation test (e.g. Factor Analysis) to establish the validity and reliability of psychometric tests (Chow 2002, p. 8).

For magnitude techniques (rating scales) such as the DAQ and DBQ, the commonly used statistical methods include principal components analysis (PCA), factor analysis (FA), regression analysis (RA), and cluster analysis (CA). By far, PCA, FA, and RA are more often used, all of which assume a linear relationship among the items (Fabrigar 1999, cited in Hassad and International 2007). These analyses produce groups of highly interrelated variables known as *factor/components/dependent variable* (or composite variable) which represent dimensions within the data. Both PCA and FA are data reduction techniques (Hair *et al.* 2006) with PCA, all sources of variance (unique, shared, and error) are analysed for each measured item. In other words, total variance is analysed. With FA techniques, only shared or common variance is analysed. That is, covariance is examined (Hassad and International 2007, p. 31).

It is criticised that although statistical techniques are a major tool for data analysis in the social science research however, most of multivariate techniques including PCA and FA share a common limitation: each technique can only investigate one relationship at one time (Hair *et al.* 2006; Limpanitgul 2009). Whilst the review of literature suggests that driving behaviour is a function of complex interaction between driver's social-cognitive factors, socio-demographic characteristics and many other external factors. Iversen and Rundmo (2004, p. 570) also highlight this limitation; they say many different factors influence behaviour in traffic. It might be optimistic to indicate that only (certain) attitudes can predict certain behaviours, and results are sensitive to forces other than those in the explicit defined theoretical system. For example, corresponding level of specificity is highly important to study the relationship between attitudes and behaviour i.e. measures of attitude will effectively serve to explain the behaviours to the extent that they involve identical target, action, context, and time elements (for details, refer to section 3.3.1.2).

Another criticism is the usual practice of analysing the effect of socio-demographic characteristics on driving behaviour by performing *a-priori* classification (e.g. male driver vs. female driver; higher-income driver vs. lower-income driver). For comparative purposes, attitudinal (or behavioural) results are averaged out for people of each group under investigation. This generalisation by attributing a set of characteristics to a group of people can lead to stereotyping and can also result in manipulation of findings by researchers. Carey (2011) says that a leading concern about psychological research these days is the manipulation of the results by the researchers to find what they want to find.

Another limitation of current statistical techniques is interlinked with failure of intervention studies based on the assumption that attitudes influence behaviour to show any consistently significant effects. Iversen and Rundmo (2004, p. 570) suggest that one of the reasons can be that they tend to cover too large and varied groups of drivers. They say that a major challenge is to find measures that influence the groups of high-risk recipients more efficiently. Thus, *identification of groups representing specific attitudes associated with specific risk behaviour more than others can help develop more adjusted and effective traffic safety interventions with the potential of changing behavioural practices*. They recommend that key determinants of risk behaviour and accident involvement should be identified and modified and studied more closely to influence these specific groups.

To address these limitations, more recently, researchers in behavioural sciences have started augmenting these conventional techniques with cluster analysis (CA), multi-dimensional scaling (MDS), or structural equation modelling (SEM). These techniques allow the researcher to assess combined effects of multiple factors (for further read, see Hair *et al.* 2006; Norušis 2008). Fernandes *et al.* (2006, p. 27) support the use of unconventional tecnhiques in road safety research. They say given the range of factors implicated in the prediction of risky driving, it is necessary to examine such factors together, in order to tease apart the roles of different factors, and identify which factors best predict which *individual* risky driving behaviour. Clearly, identifying the causal factors associated with road crashes must remain the optimal goal – however, the investigation of predictive factors worthy of experimental manipulation for specific risky driving behaviours is an important first step to realising this goal.

More recently, CA started receiving attention in transport studies research (e.g. EKOS 2007; Collins *et al.* 2008). The technique allows exploring the combined effect of different variables (i.e. attitudes towards road safety) on phenomenon under investigation (i.e. driving behaviour). The method does not make prior assumptions about important differences in the population. It reduces the number of entities being dealt with into a manageable number of groups (of drivers) that are mutually exclusive and share well defined characteristics (Anable 2002). It also provides socio-demographic profiling of extracted groups (for details, see section 7.5). This collective information facilitates comprehensive and pragmatic understanding of combination of underlying factors provoking deviant driving practices.

To sum-up, road safety strategies, findings are traditionally drawn based on univariate segmentation based on data reduction correlational techniques. Rather than investigating effect of one (e.g. attitudinal) dimension on one type of driving behaviour at a time or pre-classifying groups based on personal circumstances or socio-demographic characteristics which cannot be changed. This research takes a step further by using CA and aims to classify groups of people (or drivers) based on combined effect of multiple socio-cognitive factors involve in shaping driving behaviour, and which can be changed through persuasion.

4.4 Conclusions

The methodology reviews in this thesis evolve directly from the discussion made in Chapter 3 which has revealed that multiple factors shape behaviour of drivers. The review concludes that a qualitative study can provide a deep understanding of road safety issues; however a quantitative study can provide analytical patterns of responses. It concludes that in order to understand the complexity of aberrant driving behaviour, it is necessary to utlise a systematic information gathering and analysis procedure. Therefore, the ontological position of this PhD research is to adopt a multi-method approach including interviews, questionnaires (using scales), and observational study to measure subjective qualities highlighted in the literature review.

To begin the process, it is decided to conduct an *interview* based qualitative study. The study helps to identify Pakistan's specific social and cultural factors which could influence driving behaviours in the country and are used for item generation in attitudinal and behavioural questionnaires. To assess attitudes towards road safety in Pakistan, this PhD research develops a questionnaire with the help of the DAQ. To measure dimensions of aberrant driving behaviour in the country, it uses the DBQ. Both of the instruments are selected due to their universal nature, proven reliability, and construct validity.

However, the review highlights that a number of biases can distort self-reporting of aberrant driving behaviour. Therefore, this thesis also conducts an observational behavioural study. Later, both subjective and observed sets of behavioural data are used for comparison purposes and served as a reliability check. The review has also addressed the inadequacies of conventional analyses techniques. This research seeks to move beyond these techniques. It proposes that adoption of segmentation techniques such as CA can bring more in-depth and realistic understanding to a phenomenon of driving behaviour. This can also alleviate the dogmatic stereotyping and facilitate to look at multiple-faceted driving behaviour in combination not in isolation. The following Chapter 5 provides rationales and research methodology devised for this thesis in the light of discussion made in Chapters 3 and 4.

CHAPTER FIVE

RATIONALE AND OVERVIEW OF THE RESEARCH

5.1 Introduction

The rationale for this thesis has mainly come from a lack of research in four distinct but related areas of road safety, in the light of discussion made in Chapters 3 and 4.

5.1.1 The lack of research on drivers' attitudes and behaviours in Pakistan

The literature review has clearly established the relationship between attitudes, driving behaviours and accidents. The socio-psychological research within the domain of road safety suggests that attitudinal and motivational components attached to aberrant behaviours must first be understood before drivers' behaviours can be improved. However, Pakistan lacks adequate empirical research related to road safety, and no work has been identified in the country that explored attitudes and behaviours of drivers with the help of a comprehensive theoretical framework. It is apparent from the literature that the TPB is a useful tool when researching drivers' attitudes. Therefore, this thesis takes guidelines from the TPB framework to evaluate Pakistani drivers' attitudes towards road safety. It develops an attitudinal questionnaire (AQ), inspired by the TPB, relevant to Pakistan and it aims to identify key attitudinal determinants of aberrant driving behaviours in the country. However, it is not within the scope of this thesis to assess the predictive utility of each TPB construct to behaviours as the theory is not applied rigidly.

The literature review also identified that intentional road traffic violations are the most risky type of aberrant behaviours. They are based on motivational factors, contribute to the most risky road safety situations, and are committed due to drivers' attitudes. It is, therefore, important to determine the distinct types and frequency of intentional violations executed by Pakistani drivers on the roads. Only intentional violations not errors are studied due to exploratory nature of this research. With this specific focus, it was intended to collect maximum information about the most deviant type of aberrant behaviour. On the basis of the evidence reviewed, the DBQ has emerged to be one of the most widely accepted and valid methods for measuring drivers' behaviours in a number of countries. Consequently, to measure HCVs and AVs, this thesis utilises the DBQ with a modification to take into account local aspects. As it also provides the first application of a TPB inspired attitudinal questionnaire and a modified DBQ in Pakistan, it also assesses the acceptability and applicability of these multidimensional scales to the country.

5.1.2 Reliance on subjective behavioural data

The review has identified the dominance of self-reports as a means to tap aberrant behaviours of drivers in road safety. It argues that questions concerning the reliability of subjective data can be raised, as self-reports are vulnerable to a number of biases and should not be taken as the only measure of driving behaviours. It concludes that the stated responses of drivers may differ from their actual behaviour due to social desirability responding, memory constraints etc. and can generate over or under reported sets of data.

Therefore, this research goes one step further and observes behaviours of drivers using the WF. This technique, as discussed earlier in the review, has a comparatively short history but has emerged as a successful tool when recording the actual behaviours of drivers. There are two advantages associated with the deployment of both of these techniques. Firstly, in an attempt to avoid the potential problems associated with subjective data, it is expected to collect richer information about dimensions of deviant driving behaviours in the country. Secondly, from a methodological perspective, this thesis systematically inspects and compares the results of both of the techniques with the intention of increasing the understanding of the advantages and disadvantages of the subjective and observed behavioural methods.

5.1.3 The need to understand the influence of external factors on attitudes and behaviours of drivers

It is apparent from the literature review that factors such as the driving environment and the socio-economic and demographic characteristics of drivers themselves influence their attitudes towards driving and in turn this may increase the tendency to commit risky behaviours such as violations. For instance, a number of studies have identified that factors such as age, gender and income have significant impacts on drivers' behaviours (e.g. Yagil 1998; Lourens, *et al.* 1999; Shinar *et al.* 2001). However, the review also argued that the influence of these factors on driver attitudes and law-violating driving behaviours, in the context of developing countries, have been less well explored. Therefore, this thesis also examines the influences of external factors (road condition, traffic environment, and interaction and conflicts with other road users) on drivers' attitudes and behaviours.

The motivation to investigate the effect of these latent characteristics on Pakistani drivers is further stimulated by (1) the unequal distribution of resources in affluent and impoverished areas of the country (e.g. in terms of road maintenance, rules and regulations enforcement), and (2) a marked difference among various social classes (e.g. in terms of education, income, occupational status). These differences are easily observable on the public roads used by drivers of various classes of society and the act of driving and the vehicle one drives can be used as medium for displaying personal status. Therefore, this research not only aims to explore which socio-demographic groups or driving conditions exacerbate risky attitudes and behaviours but also to assess the type of violations committed by various groups, under certain driving conditions. The assessment is believed to help in suggesting targeted interventions.

5.1.4 Reliance on *a-priori* drivers classification or aggregated analysis to design targeted road safety interventions

The review highlighted that one of the significant methodological discrepancies in attitude behaviour research is an excessive dependence on *average* responses of drivers on certain attitudinal or behavioural dimensions or *a-priori* classification. However, this research argues against averaging the responses of a sample group of drivers or categorising them based on well-defined similar characteristics; as the possibility of drivers holding disparate attitudes and behaviours within these groups cannot be ruled out. Furthermore drivers classified conventionally may have similar (or different) behaviours for various underlying attitudinal reasons and falsify the assumption of homogeneity. As argued by Anable (2002), it is quite possible that response tendencies in one subgroup are opposed to and act to average out response tendencies in another group. Thus, without examining these differences and distinguishing between disparate segments with different attitudes and motivations, the resulting analysis or models may entirely miss important relationships between, for example, attitudes and behaviours.

Therefore, instead of aggregating responses or performing univariate segmentation, this research projects the idea of combining drivers who hold similar attitudes which is then hypothesised to provide a more useful link to aberrant behaviours. It suggests that road safety policies can benefit more from the incorporation of a market segmentation approach, such as CA. Only a few empirical studies within the domain of road safety have employed a segmentation approach (e.g. by EKOS. 2007; Collins *et al.* 2008). Another rationale for deploying segmentation in this research is that, although road safety literature provides evidence that socio-demographic characteristics influence attitudes and behaviours, these characteristics cannot be changed. Therefore instead of grouping drivers based on their socio-demographic characteristics in order to design targeted interventions, it would seem instead to be of more benefit to understand and group drivers based on their attitudes, as these can be influenced. Thus, by bringing change or modification in the attitudes of drivers, their behaviours can be improved interactively over time.

To summarise, this thesis aims to treat the sample of the driving population of Pakistan altogether without any preconceived notions. It then, with the help of segmentation, classifies drivers into different groups based on their unique distinguishable combinations of attitudes towards road safety. Once groups are identified, it assesses the influence of drivers' attitudes on behaviours and evaluates their socio-demographic profile. It is expected that the results of this segmentation process will help policy makers to design more effective and targeted road safety interventions without the need to stereotype individuals.

5.2 Aims and objectives

Having established the gaps within the domain of road safety research, the aims of this thesis are:

1. To contribute to an understanding of the attitudinal and behavioural dimensions of Pakistani drivers' towards road safety in the context of road traffic violations along with the assessment of a causal link between attitudes and behaviours together with the underlying influence of socio-demographic factors and the driving environment.

2. To discuss possible theoretical, methodological and policy implications of research findings useful not only with reference to Pakistan but overall attitude behaviour research in road safety.

The stated aims of this research have been realised through the following approaches:

1. To review relevant road safety literature on drivers' attitudes and behaviours in order to develop a better understanding of the area.
2. To identify social and cultural factors specific to drivers' attitudes and behaviours in Pakistan.
3. To develop attitudinal questionnaire based on the conceptual framework of the TPB with relevance to Pakistan.
4. To modify the self-reported Driver Behaviour Questionnaire and observational Wiener Fahrprobe technique with relevance to Pakistan.
5. To conduct attitudinal and behavioural studies, and to collect information about socio-demographic characteristics of drivers.
6. To model drivers' attitudes and behaviours in order to assess whether the sample population of urban Pakistan falls into distinct attitudinal segments, differs in terms of driving behaviours, and is influenced by its socio-demographic characteristics and driving environment.

5.3 Proposed hypotheses

In order to shape the boundary of this research, the following set of hypotheses has been constructed.

5.3.1 Attitudes towards road safety

The goal of this research is to typify the groups of drivers with varying attitudes by adopting a market-segmentation approach. Therefore, the first hypothesis (H1) is interrelated to both the segmentation of drivers into groups and the attitudes of those drivers in Pakistan.

> Hypothesis 1: The driving population of Pakistan has unfavourable attitudes towards road safety and is likely to fall into distinct segments or subgroups in accord with their attitudes.

Thus, the research not only sets out to explore dimensions of attitudes towards road safety in the Pakistani population but the range of variations on these dimensions within it. The hypothesis is investigated by conducting 'segmentation' on the responses to the AQ.

5.3.2 Aberrant driving behaviours

The second hypothesis is behaviour-based and is designed to assess the dimensions and extent of aberrant driving behaviours in Pakistan. Chapter 2 has noted that RTA statistics for the country are alarmingly high in comparison to both other low-income Asian countries, e.g. India, and also to high-income countries e.g. Japan and the United Kingdom. Drivers are held solely responsible for RTAs in more than 90% cases. As the rate of RTAs is substantially higher for the country, this thesis assumes that Pakistani drivers are different from the developed country drivers and have high level of aberrant behaviours. This assumption leads to the following hypothesis:

> Hypothesis 2: A substantial proportion of the driving population of Pakistan (a developing country) has unsafe driving behaviours; and Pakistani drivers are likely to be significantly different from drivers in the UK (a developed country) in terms of behavioural characteristics.

To confirm hypothesis 2 (H2), the DBQ results for Pakistani drivers will be compared with an earlier UK-based DBQ study (Lawton *et al.* 1997). By comparing Pakistani drivers with the drivers of another country that has a good road safety profile (the UK), it is anticipated that it will be possible to obtain an overview of the magnitude and extent of road safety problem in the country. It further assesses whether Pakistani drivers have a unique behavioural profile and whether the current practice of simply transferring and implementing road safety solutions from developed countries is appropriate in addressing local needs. The assessment is believed to provide policy-makers with another perspective to design future policies.

The next hypothesis established in this thesis is also behaviour-based, as one of the rationales for conducting this research comes from utilisation of both self-reported and observational behavioural techniques. The hypothesis evaluates:

> Hypothesis 3: Direct observation of behaviours is a more reliable approach to tap aberrant behaviours of drivers than subjective reporting.

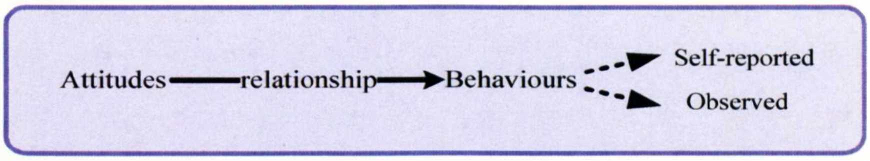
To provide support for hypothesis 3 (H3), the results of the DBQ and are compared with error and conflict counts from the WF.

5.3.3 Attitude and behaviour relationship

Drivers' attitudes and their underlying motivation plays a significant role in the engagement in risky driving behaviours and a causal link between attitudes and behaviour has already been discussed in the literature review. Thus, these findings lead to the fourth hypothesis (H4) which is designed to support and extend the existing literature related to attitudes and behaviours particularly with respect to Pakistan.

> Hypothesis 4: Aberrant driving behaviours are a function of unfavourable attitudes such that the drivers who have unfavourable attitudes are likely to commit more road traffic violations.

To confirm this hypothesis, the relationship between attitudes toward road safety[25] and behaviours is examined with the help of the AQ, inspired by the TPB framework, and behavioural data collected through subjective and observed measures.



5.3.4 Factors influencing attitudes and behaviours of drivers

So far, the research hypotheses are set to evaluate attitudinal and behavioural dimensions of drivers in Pakistan, established their causal relationship, and to test the utility of a market segmentation approach and observed data. Considering the information about attitudes behaviour research concluded from the literature review, the last two hypotheses are constructed. The hypotheses gauge the impact of socio-demographic characteristics and driving environment on drivers' attitudes and behaviours and lead to the following two research questions i.e. hypothesis 5 (H5) and hypothesis 6 (H6).

> Hypothesis 5: Differences in attitudes of drivers (segments of drivers) towards road safety are attributable to their socio-demographic characteristics.
>
> Hypothesis 6: Changes in the driving environment (e.g. physical characteristics, traffic conditions) substantially influence behaviours of drivers in Pakistan.

5.4 Stages of the research

In order to meet the aims of this research and to confirm the proposed hypotheses, the research methodology is split into three stages. In *Stage One*, an

[25] This research has assessed 26 different types of behaviours by tapping attitudes, PBC, subjective and personal norms as well as opinions of drivers about enforcement. However, For the sake of brevity and because of the notable importance of attitudes, from now onwards the term '*attitudes*' or '*attitudes toward road safety*' is used in order to illustrate the overall underlying socio-psychological mechanism involved to perform behaviour.

exploratory semi-structure qualitative study, coupled with structured quantitative questions, will be conducted to gain acquaintance the emerging road safety issues of Pakistan. The findings of the study help to take into account country specific factors and to develop multidimensional attitudinal and behavioural scales relevant to Pakistan. In *Stage Two*, the main survey of this research will be carried out. Using the AQ and DBQ, the survey measures self-reported attitudes and behaviours of drivers in the country and collects information about their socio-demographic characteristics. Consequently, by adopting various analysis techniques including segmentation, four central hypotheses of this thesis (H1, H2, H4, and H5), have been investigated. Lastly, in *Stage Three*, an observational study using the WF technique is carried out in accord with the findings of the main survey. The findings of the study are mainly used to inform H3 and H6 and also to reassess H1. Figure 12 provides a schematic overview of the research methodology and shows how the stages involved in it are linked to prove or disprove proposed hypotheses.

5.5 Conclusions

To summarise, this thesis provides the first known and comprehensive evaluation of attitudes and behaviours of drivers in Pakistan. It also has topical and methodological dimensions. It puts forward the idea of grouping drivers with similar attitudinal profiles towards road safety, rather than stereotyping them with an *a-priori* classification. The approach is anticipated to offer new insight into underlying psycho-sociological motives which provoke deviant driving behaviours. Another methodological issue addressed by this thesis is the reliability of self-reported behavioural data. It also aims to identify the impact of latent factors such as socio-demographic characteristics and driving environment on drivers' attitudes and behaviours. Thus, to begin, the following Chapter 6 extends the existing understanding of road safety profile of Pakistan and discusses its emerging road safety issues. The chapter provides the qualitative attitudinal and behavioural facets of drivers in the country, which are then used to design the main survey, as discussed in Chapter 7. Finally Chapter 8 provides the results of observed driving behaviours in the country using the WF.

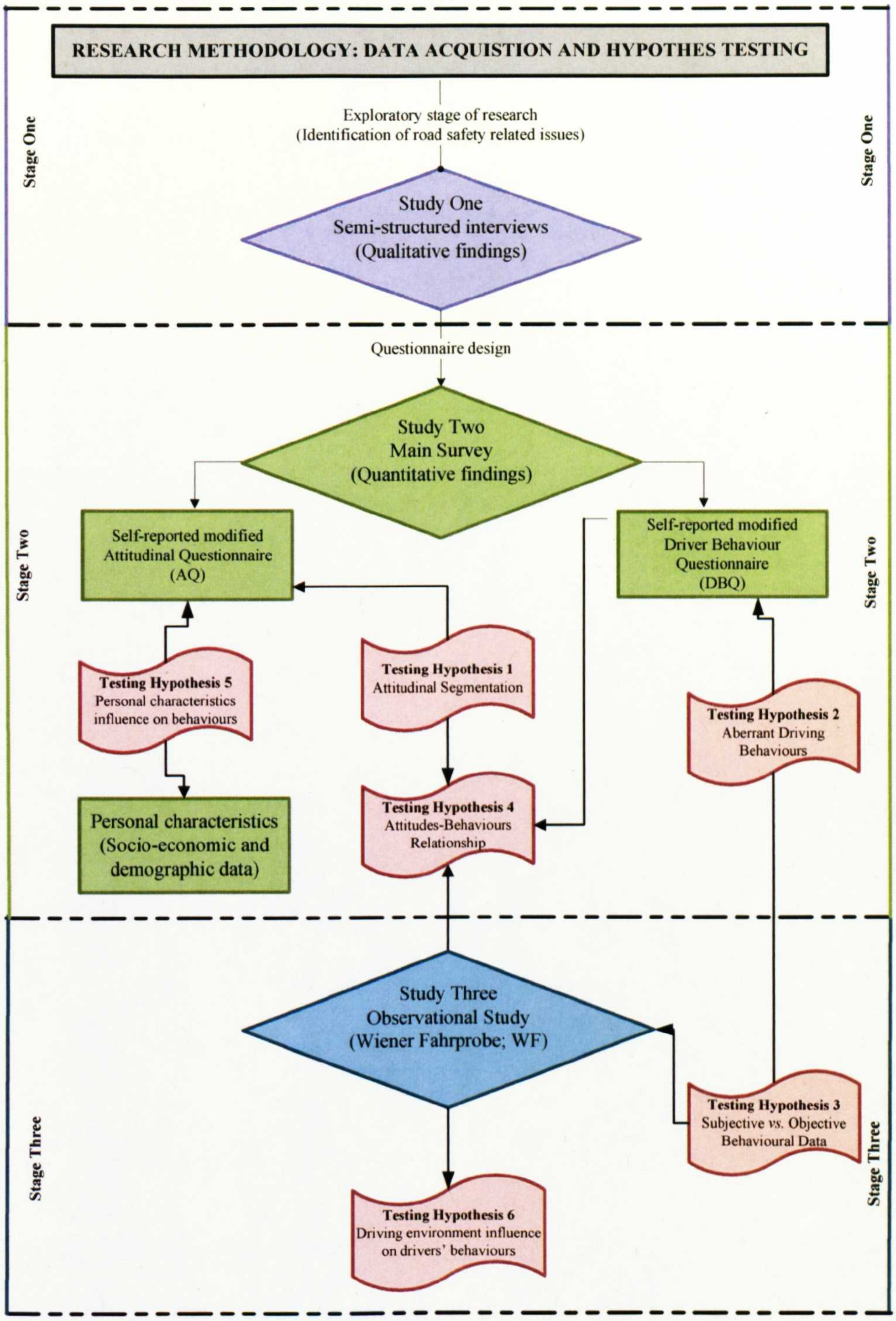


Figure 12: Schematic representation of research methodology

SECTION III
RESEARCH STUDIES

CHAPTER SIX

STUDY 1: ROAD SAFETY ISSUES OF PAKISTAN

6.1 Overview

This chapter presents the results of a qualitative study, carried out at the beginning of this research with the intent of developing a better understanding of the road safety profile in Pakistan and to elicit salient issues inhibiting safe driving in the country. Based on semi-structured interviews, the study targeted the opinions of government officials, academics and the general driving population. In parallel with highlighting road safety issues, the study assesses their opinions about the seriousness of different road traffic offences and the effectiveness of different road safety interventions. The chapter is concluded with the recommendations suggested by the participants of the study.

6.2 Introduction

As discussed in Chapter 2, despite the alarmingly poor road safety profile of Pakistan, there have been few studies demonstrating the causes and effects of accidents. Considering the gravity of the situation, an exploratory qualitative study was perceived as being a well-suited approach to examine the situation and to begin the present research. As described in Chapter 5, the study forms the first of a three-phase PhD research investigation, designed to explore the *attitudes towards road safety and the aberrant behaviour of drivers in Pakistan.* The other two planned studies are a large scale main survey and an observational study. This study aims to provide an overview of the magnitude of the problem and is intended to provide an understanding of the reasons for the poor road safety standards in the country by an identification of the factors aggravating the situation. It was decided to carry out an interview-based study with a mixed population from Pakistan to ascertain the country's problems.

Thus the study explores the opinions of participants broadly under four themes: road safety issues, accident contributory factors, drivers' roles in accident causation, and recommendations for suitable road safety interventions for the country. During the interviews, quantitative questions were also included to add further rigour to the qualitative findings. This approach was anticipated to lead to more meaningful explanations of the low safety standards in the country. Whilst the study was carried out to explore the status of road safety in Pakistan, a methodological aspect was also attached to it. (1) The extraction of the opinions of research study participants which assisted the design of the main survey questionnaires, and (2) to gather information and experience about suitable survey locations, targeting of the appropriate driving population and learning of rapport-building skills prior to the main survey in order to maximise response rates.

6.3 Method

6.3.1 Procedure

The interviews for the study were undertaken between March 2009 and April 2009. Government officials, academics involved in road safety related projects, and drivers from the general public were recruited. At the beginning of each interview, participants were asked to sign a consent form to indicate their willingness to participate in the study and to allow the recording and transcription of their interviews. The interviewees were assured confidentiality would be kept. They were given the option to either go by their actual job/profession title or opt to remain anonymous. They were also advised about their right to withdraw from the study at any time. The interview consent form is included in Appendix A[26].

6.3.2 Participants

In total, thirty-one interviews were conducted with government officials, academics (experts) and drivers from the general driving population of Lahore. Eight officials from different traffic and transport related departments at a national and provincial level were interviewed. The officials were selected based on their involvement in any road safety related project. Three academics from the University of Engineering & Technology Lahore (UET) were selected based on their

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[26] A digital voice recorder was used for recording and hand-written notes were also taken. At the end of the interviews, participants were thanked for their cooperation and time and chocolate bars were presented as a token of appreciation.

experience and knowledge of the field. Twenty drivers from the city of Lahore were also interviewed.

The officials and academics were contacted before carrying out the study and a letter of invitation was sent to brief them about the intent and outline of the study. All of the intended participants responded positively to the invitation letter. The letter is included in Appendix B. To reasonably depict the driving population of the city and to ensure maximum variation, the sample included professional drivers (three), housewives (two), business men (two), office employees (nine) and students (four). In the sample, ten participants were car drivers, seven were motorbike riders, and three were drivers of public transport vehicles (van, qinqi[27]). Overall, the sample consisted of eleven male and nine female drivers. All of them had a valid driving license. Each interview in the study lasted on average forty minutes[28].

6.3.3 Interview template

6.3.3.1 Qualitative measures

The interview template was devised and varied for the general public. It began with very basic questions asking participants their opinion about the status of road safety in Pakistan, emerging road safety issues in the country, road safety policies operational at the national, provincial or district level and recent research undertaken within the domain. This was followed by questions concerning the share of responsibility between government and drivers to improve the situation. At the next stage (of the interview), interviewees were questioned about accident causation factors and were asked to address the topic particularly in relation to the role played by the traffic and transport system of the country and by drivers. The next set of questions in the interview was more sensitive, asking participants to identify any socio-economic and demographic characteristics associated with safe and unsafe

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[27] Van: four-wheeler public transport vehicle with seating capacity up to 30 passengers. Qingqi: three-wheeler auto rickshaw, named after the Chinese company who first introduced it in Pakistan.

[28] Interviews with experts were arranged in their offices. Interviews with drivers from general public were mostly arranged in the UET. Alternatively, participants were reached at their offices and houses.

drivers. The interview was concluded by asking them to recommend the measures that could improve the status of road safety in Pakistan.

For the general public, a slight amendment to the template was made so as to make it more specific to the group, e.g. questions on road safety policy and recent research works were excluded. The discussion followed a semi-structured format of open-ended questions. The complete interview template is included in Appendix C.

6.3.3.2 Quantitative measures

As mentioned earlier, quantitative questions were included in the interview template to strengthen the qualitative findings of the research[29]. Participants were asked to rate the provided list of twenty traffic offences on a scale of seriousness; adapted from Brown and Copeman (1975). The scale used ranged from extremely minor (0) to extremely serious (5). Not all the offences mentioned in the questionnaire were regarded as 'violations' by the Traffic Police Lahore but they were included because they were considered as dangerous driving behaviours e.g. driving a car with illegally tinted window glass. The purpose of using the scale was to compare the differences between *experts* (government officials and academics) and the driver participants regarding the practice of certain unsafe behaviours. Participants were also asked to rank four road safety measures in order of their effectiveness including (1) road safety education and training, (2) use of advanced technology such as safety cameras, (3) changes in the road environment such as road layout, and (4) enforcement of traffic regulations such as fines and penalties.

6.4 Analysis

6.4.1 Qualitative data analysis

A template analysis technique was adopted to explore the data. The term refers to a particular way of thematically analysing the qualitative data and is a widely used approach in qualitative research (see King 2004; Cassell *et al.* 2005; Priestman 2005). It is often referred to by other terms such as 'codebook analysis' or 'thematic

[29] The sets of quantitative questions were presented in the form of show cards to participants during the interview with intention (1) to reduce the effect of monotony due to the long length of interview, and (2) to actively engage participants by asking them to fill in the given show card.

coding' (King 1998). In the procedure, a list of codes is produced by the researcher that represents themes identified in the textual data. A *Code* is a label attached to a section of text to index it as relating to a *theme* or *issue* in the data which the researcher has identified as important to his or her interpretation. Some of the codes are usually defined *a-priori* but are modified or added by the researcher later in the ongoing analysis. The method allows the researcher the flexibility of tailoring the technique to their own needs (King 1998; Priestman 2005).

For the present study, participants were numbered to provide anonymity. First of all interviews were transcribed and all the relevant information within the scope of the research was identified to develop an initial coding list. Coding was done by identifying and highlighting the meaningful passages within the text and applying labels to them. The list helped to formulate a provisional template which was used to mark up the rest of the transcripts. Then, the codes that linked together were grouped to underpin the same theme or category and were structured hierarchically into three levels. Hierarchical coding, according to King (2004), allows the researcher to analyse the texts at varying levels of specificity and is a key feature of template analysis where groups of similar codes are clustered together to produce more general higher-order codes. It works particularly well when the aim is to compare the perspectives of different groups within a specific context, in this case experts and drivers.

Thus, during the analysis, the adoption of a structured hierarchy approach allowed coded data associated with each theme to fall into distinct dimensions. The set of common themes that emerged in response to data analysis were placed at Level One i.e. a macro level. The lower coding levels two and three were used to reflect the sub-categories of issues within each theme. After completing the data analysis, a cross-group comparison was made of the themes emerging from the experts and driver participants. It helped to determine the common as well as unique concepts to each group and indicated which themes were more apparent in one group than the other.

6.4.2 Quantitative data analysis

The quantitative responses generated from the scale of seriousness questionnaire were collated and analysed using Statistical Package for Social Sciences (SPSS). Univariate descriptives including mean (M) and standard deviation (SD) were generated to determine the seriousness of each traffic offence in the views of experts and drivers. Independent-samples *t* tests were run to determine whether the differences in mean scores of both the groups were statistically significant or not. The test, which assumes no relation between people or objects of the groups, and is suitable to run in case of two independent groups of subjects (Norušis 2008, p. 131). For multiple responses generated to the questions about the most effective road safety measures, frequency counts were made.

6.5 Results

6.5.1 Qualitative findings

Analysis of the interview data led to five explanations, or combinations of explanations for the issues faced by road safety in Pakistan. The themes that emerged at a higher level included: 'institutional issues', 'execution issues', 'physical and operational issues', 'attitudinal and behavioural issues', and those related to 'road safety research and accident data bank'. To further define the results, the themes have been sub-divided into level two and level three.

The first level one code of 'institutional issues' was the key theme in much of the discussion with government officials and academics. This could be due to experts being part of road safety related institutions, and therefore having a heightened awareness of these issues. The theme embraced the two key issues of '*low valuation of road safety*' and '*institutional weaknesses*'. The issue of low valuation of road safety consisted of seven third-level codes including 'absence of a dedicated road safety department', 'low prioritisation and commitment', 'short term policies', 'more aesthetic less practical innovations', 'personal or business reasons', 'no road safety audits', and 'no proactive but reactive approach'. The issue of institutional weaknesses is composed of three third level codes including 'no interdepartmental resource sharing', 'duplication and overlapping of functions', and 'poor coordination mechanism'.

The second level-one code of 'execution issues' theorizes two key explanations for the large number of RTA in the country, namely a 'lack of human resources' and 'lack of timely implementation'. The issue of timely implementation had been consistently raised by the government officials and further sub-divided into two third-level codes describing constraining influence of 'political instability' and 'fluctuating economy'.

The third level-one code of 'physical and operational issues' emerged as one of the most important safety issues in the interviews with both experts and driver participants. The theme indexed eleven second-order contributory factors including 'increasing motorisation and urbanisation', 'traffic mix on roads', 'non-standardised driving practices', 'poor public transport system', 'poor licensing and penalties system', 'social injustice', 'on-road encroachments and capacity issues', 'pressure of freight transport', 'out-dated traffic management system', 'roads and infrastructure related safety hazards', and 'poor roads and vehicle maintenance standards'.

The fourth level-one code of 'attitudinal and behavioural issue' encompasses issues for the study including types and characteristics of unsafe drivers, their attitudinal and behavioural problems, and the influence of societal and cultural factors on them.

The fifth level-one code of 'road safety research and accident data bank' neatly breakdown into 'poor accident reporting and recording system', 'absence of comprehensive road accident data bank', 'inaccessible and inadequate dissemination of road safety research work' and 'reliance on old research work and studies'. Figure 13 illustrates the findings and more detailed results of the themes at level two and level three are reported in section 6.6.

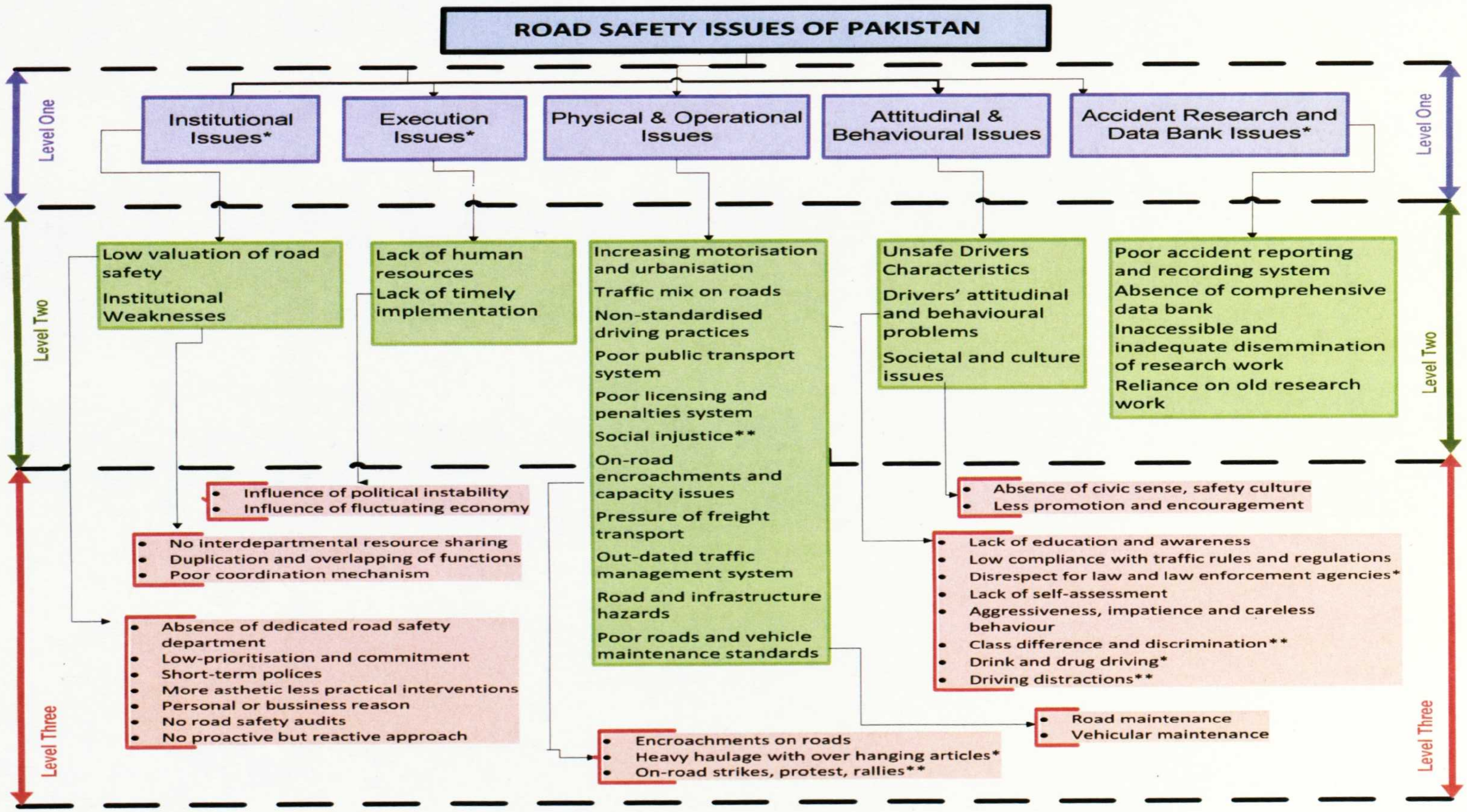
A comparative analysis of responses has demonstrated that most of the themes generated from experts and driver participants coincided, especially those falling into the category of 'physical and operational issues' and 'attitudinal and behavioural issues'. However, themes unique to each group of study participants also surfaced e.g. the 'institutional issues' theme was exclusive to officials and academics. Based on the possible areas of improvement that emerged in the course of discussion, the study's participants also recommend 'institutional reforms', 'physical and operational reforms', 'intensive traffic monitoring and law enforcement', 'road safety research and accident data bank', and 'behavioural transformation at the societal level'.

6.5.2 Quantitative findings

6.5.2.1 Seriousness of offenses scale

Table 14 below compares experts and driver participants in their rating of the seriousness of the listed behaviours. Rank orders for given traffic offences in relation to each group have also been derived based on their mean scores. The comparison shows that the offences which drivers considered to be serious were different to what experts thought were serious. For instance, 'exceeding the speed limit' is ranked top by experts but only thirteenth by the drivers. A similar trend was observed across other dangerous behaviours including 'carrying passengers higher than capacity', 'carrying goods higher than capacity', 'driving with illegally tinted windows glasses', 'violation of line/lane/zebra crossing', 'using a horn in silent zone', and 'parking rules violations'. Experts ranked all of these offences more seriously than drivers.

Another notable difference in the rankings of the two groups relates to 'drink driving' and 'use of mobile phones'. Drivers' average ratings placed the offences as the first and second most unsafe behaviours unlike the ratings of experts at the sixth and ninth position respectively. However, 'driving under drug influence', 'emitting excessive smoke' and 'driving without a license' received the same rankings in both of the groups. The groups were also in close agreement on the seriousness of offences such as 'driving at night without proper lights', 'driving on wrong side of the road', 'obstructing traffic', and 'non-use of seatbelt'.



Note: * indicates officials and academics (experts) specific theme and, ** indicates driver participants specific theme

Figure 13: Possible road safety issues of Pakistan that emerged from the data analysis

Table 14: Government officials, academics (experts) and drivers' perception of the seriousness of different traffic violations

	Rating*				Sig. (p)	Ranking	
	Experts (N=8)		Drivers (N=20)			Experts (N=8)	Drivers (N=18)
	M	SD	M	SD			
Exceeding speed limit	4.38	1.06	2.78	1.89	.012	1	13
Violation of traffic signals	4.25	1.75	3.28	1.60	-	2	6
Driving at night without proper lights	3.75	1.83	3.67	1.74	-	6	5
Driving on wrong side of road	3.87	1.72	3.89	1.36	-	5	4
Carrying passenger higher than capacity	3.50	1.19	2.00	1.60	.027	8	15
Carrying goods higher than capacity	3.88	1.72	2.83	1.42	-	4	12
Drink and driving	3.75	1.90	4.28	1.44	-	6	1
Driving with illegally tinted windows glasses	3.50	1.60	1.78	1.80	.029	8	17
Violation of line/lane/zebra crossing	3.88	1.45	2.89	1.36	-	4	11
Obstructing traffic	3.62	1.40	3.67	1.49	-	7	5
Reckless and negligent driving	4.25	1.16	3.67	1.60	-	2	5
Driving without a license	3.00	2.00	2.83	2.17	-	12	12
Using a horn in silent zone	3.25	1.48	1.94	1.83	-	10	16
Emitting excessive smoke	3.50	1.30	3.17	1.50	-	8	8
Driving un unregistered vehicle	3.25	1.90	2.67	1.87	-	10	14
Driving below age limit	3.88	1.72	3.22	1.70	-	4	7
Driving under drug influence	4.00	1.77	4.06	1.66	-	3	3
Use of mobile phone	3.38	.91	4.11	1.36	-	9	2
Parking rules violations	4.00	1.41	3.00	1.49	-	3	10
Non-use of seatbelts	3.13	1.81	3.11	1.74	-	11	9

Note: * Scale ranged from *extremely minor* (0) to *extremely serious* (5).

6.5.2.2 Road safety measures

Participants also ranked four road safety measures based on their effectiveness to reduce road traffic accidents in Pakistan. Figure 14 summarises the overall results by combining the responses of both the groups. Out of the four options, it is relatively clear that road safety education and training (option 1) was ranked by participants as the most effective measure (48.16%). However, participants almost jointly placed use of advanced technology and enforcement of traffic rules and regulations as the second most effective measure (29.63%). Use of advanced technology (option 3) was emerged as the third most effective measure (40.70%), and changes in the road environment (option 3) as the least effective road safety measure (40.75%).

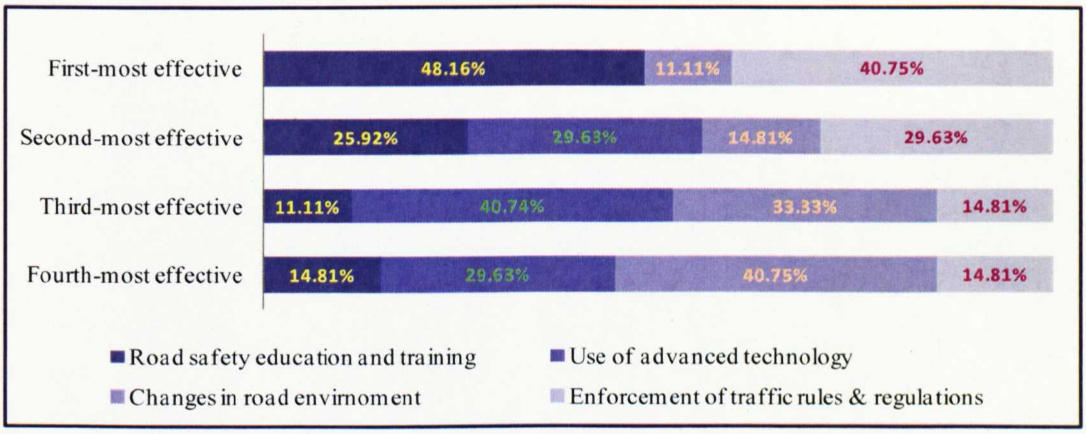


Figure 14: Effectiveness of different road safety measures in Pakistan

Table 15 specifically compares ratings of both the groups and shows differences in the opinions of experts and driver participants. The majority of experts (89%) considered 'road safety education and training' as the most effective intervention unlike driver participants who considered 'enforcement of traffic rules and regulations' the most effective (56%). Interestingly, both the groups ranked 'changes in the road environment' the least effective option.

Table 15: Different road safety measures effectiveness in the views of experts and drivers' participants

Road safety measures effectiveness	Road safety measures							
	Road safety education and training (option 1)		Use of advanced technology (option 2)		Changes in the road environment (option 3)		Enforcement of traffic regulations (option 4)	
	Experts (N = 9)	Drivers (N = 18)	Experts (N = 9)	Drivers (N = 18)	Experts (N = 9)	Drivers (N = 18)	Experts (N = 9)	Drivers (N =18)
First most effective	8 (89%)	5 (28%)	-	-	-	3 (17%)	1 (11%)	10 (56%)
Second most effective	1 (11%)	6 (33%)	2 (23%)	6 (33%)	1 (11%)	3 (17%)	5 (56%)	3 (17%)
Third most effective	-	3 (17%)	3 (33%)	8 (44%)	3 (33%)	6 (33%)	3 (33%)	1 (5%)
Fourth most effective	-	4 (22%)	4 (44%)	4 (23%)	5 (56%)	6 (33%)	-	4 (22%)
Total Responses	9	18	9	18	9	18	9	18

6.6 Discussion

In this section, a detailed discussion of the results categorised by the themes has been made with the aid of direct quotes from the study participants. Where possible quantitative support has also been provided.

6.6.1 Institutional issues

6.6.1.1 Low valuation of road safety

Experts believed that the government has a low priority for procuring sound road safety measures. They said it does not take the responsibility to formulate road safety polices with a long-term vision seriously. Despite being clearly documented in several transport research studies relating to Pakistan (e.g. Hyder *et al.* 2006; Government of Pakistan 2007a), the issue still remained unaddressed. To date, there is no integrated transport or road safety policy that could be enacted in the country. Although, many policies, such as the Pakistan Transport Plan Study (NTRC and JICA 2006b) have been drafted, no transport policy in Pakistan has either been formally approved or successfully implemented to date.

Further, in corroboration of previous studies (by Hisam 2006; Ali *et al.* 2010), the present research concludes that the regulatory and governance mechanism of road transportation in Pakistan could not be brought under a unified central policy-making body due to government's lack of concern. As such, road safety is left to the responsibility of many transport planning departments including the MOC at a federal level and provincial and regional transport authorities at provincial and local levels, whereas, implementation is left to the traffic police or traffic wardens. At present, there is no department in the country dedicated solely to dealing with road safety issues or involved in the formulation of policies, research work or pooling and managing of resources for its development. The only known effort to establish a dedicated road safety department was made in 2006 when the National Road Safety Secretariat (NRSS) was created under the auspices of the MOC with the assistance of the World Bank (Government of Pakistan 2007a).

Unfortunately, during the time of this study (March-April 2009), not a single participant was found to be aware of the working status of the secretariat. Several attempts had been made to get in touch with any member of the NRSS but all were unsuccessful. Later in the year, one of the local newspapers reported: 'the NRSS created with the World Bank assistance is learnt to have been shelved due to lack of funds and the poor interest on the part of the government, while its executive director, an expert in road safety, left the country dejected by the poor response from the Ministry of Communications' (Ahmed 2009). Experts also strongly criticised the inability to generate sustainable funding from internal resources and excessive reliance on international donor agencies for road safety work.

> This issue [low valuation of road safety] is not given a priority. When funds from donor agencies dry up we don't put our own efforts in. (Official)

This opinion is corroborated by the findings of an earlier study (Imran and Low 2005) on sustainable urban transport in Pakistan in which researchers concluded that "Pakistan transport development, including urban transport planning, has become both 'resource dependent' and 'path dependent' upon international agencies which have been providing financial and technical assistance throughout the history of nation". A majority of experts said that, in recent years, more focus has been put on the development of road engineering and construction whereas very little or no progress has been made in the area of safety. Unfortunately, there is no emergence of an idea that road safety is part of traffic management. It has only come to the attention of the regulatory bodies temporarily with the intention of gaining personal or business benefits. Therefore, minimal consideration has been paid to it, with significant resources being deployed in developing the infrastructure in order to foster all round development in the major cities of Pakistan.

> In Pakistan, any improvement in the transport system has taken place as a result of government initiatives that have been undertaken as part of engineering projects. In these projects, the objective was the smooth flow of traffic rather than the safety of roadway design or operation. (Academic)

> Political parties in the government have carried out short-term [road safety] projects with the intention of getting immediate results to gain public support without keeping in mind a long-term vision to solve the actual problems. (Academic)

Experts said that research, if at all, conducted in the country was always reactive in nature, addressed at a certain issue. The current practice relating to any improvement or modification in the road environment, e.g. the introduction of new lanes, provision of speed humps or the location of signs and signals, is carried out without any systematic checks to evaluate its impact on the safe operation of traffic. There is no specific allocation of any department to carry out sustained Safety Audits for existing and new projects. They further added that most of the road safety measures are introduced to enhance the aesthetics of the urban environment, rather than to increase safe travel on roads. Roads are often enhanced with various roundabouts, signposts and signal boards and the overriding goal of any such so-called traffic and transport related measure is to make roads seem more aesthetically pleasing.

> No analysis is done before construction and designing of roads, no attention is paid to cyclists or pedestrians. Only origin destination surveys are carried out for motorised traffic, nothing else is done to identify what are the key accidents locations...no pedestrians' counts are carried out to know how much pedestrians' mobility will be there. (Official)

6.6.1.2 Institutional weaknesses

Apart from the *low valuation of road safety*, the study has concluded that the *institutional weakness* adds to the cause of negligence towards road safety. Participants complained that a number of different departments at the federal, provincial and district levels are involved in the management of road safety related work. The unclear distribution of responsibilities across the agencies leads to inadequate resource sharing. On the whole this results in poor coordination between the agencies, resulting in a malfunctioning and less than optimal utilization of resources.

The same opinion was shared by Hisam (2006, p. 2100), who stated that in Pakistan 'each ministry formulates its plans independently and they have negligible coordination with each other...regulatory and governance mechanisms of road transportation have not been brought under a unified, central authority'.

> Government departments' responsibilities [towards road safety] are not clearly defined. Within departments, they are not sure about their powers, authorities, and resources. They keep transferring blame [in terms of road safety failure] to each other. So as there is no clear structure, no accountability, it seems that the blame game will never end. (Academic)

> There is a lack of professionalism in institutions responsible for ensuring road safety...as a matter of fact all the agencies does not get along well with each other. (Official)

To conclude, road safety has remained a low political priority over many years and the deficits in the institutional framework have compounded the issue for the country.

6.6.2 Execution issues

6.6.2.1 Lack of human resources

The issue of an inadequate human resource base has been repeatedly identified by experts as one of the specific constraints which delay processes in general in Pakistan and explicitly in the traffic and transport sector. Skilled individuals, with the right attitude and quality professionalism are reported to be either few in number or often confused about their roles because of the ambiguity at the institutional levels.

> You have introduced traffic wardens. That's it. Beyond traffic warden, I mean on top of traffic wardens, do we have any professionals? These are the same deputy superintendent or superintendent of police doing traffic management in the city [Lahore], who are trained in crime fighting and all that things. They are not professionals in road traffic management. (Official)

> We do have the concepts but we do not have the implementing authorities. Why I say we have the concepts is because we know exactly what areas need what type of improvements…so the biggest issue is we do have the knowledge, information but we don't have people, human resources to understand and implement that. (Academic)

In agreement with the present study finding, the research work of Imran and Low (2005, p. 514) has also criticised the issue of scarcity of human capital. They said, '…in spite of massive spending of resources on the road and railway systems, the transport sector budget allocated in different Five-Year Plans spent less than one percent of allocated money on research and institutional capacity building throughout the history of Pakistan. The result is that Pakistan still has to rely on foreign technical assistance to formulate its transport policies and programs'.

6.6.2.2 Lack of timely implementation

A failure of timely implementation is another factor that participants believed has hampered the effectiveness of any road safety related project in Pakistan. The issues such as time consuming administrative formalities, lack of coordination among departments, emerged as factors that definitely influence the efficiency of any road safety related project by the time it reaches the ground. Experts said that, in the past, attempts had been made at the federal and provincial level to formulate a road safety policy for the country as a whole. However, all those efforts remained on paper and could not be implemented due to lengthy procedures.

For instance, in one such case, a foreign experts team reported that a total of 23.5 person-months of consultant services were consumed in the preparation of a transport related Technical Assistance Completion Report compared with the estimated 18 person-months. It was been reported that meetings with the government and stakeholders were postponed quite a number of times during the preparation of the report as the transport policy involved many government agencies in Pakistan (Kawawaki 2008). Hence, the implementations of certain plans that are approved at the grass-root level rarely take place. This has been exacerbated by the lack of sustained interest from the government.

> The whole setup is so badly organised that even if a government official wants to do something, implementation would always remain a problem. (Official)

In short, road safety based projects and schemes are often impeded either due to a lack of professionals, resources or timely implementation. To add to the above, political instability in Pakistan has also resulted in projects never attaining actualization.

6.6.3 Physical and operational issues

6.6.3.1 Increasing motorisation and urbanisation

The analysis highlights the fact that rapid urbanisation and motorisation has worsened the situation for road safety in the country. Pakistan, like many other developing countries has witnessed increased motorization and urbanization in the recent past, as discussed earlier in Chapter 2. As a result of this, the major urban areas of Lahore, Karachi and Islamabad are suffering from heavy traffic congestion and lack of regulation. According to the study participants, one of the reasons for unprecedented motorisation is vehicle leasing schemes that have been introduced by Pakistani banks in the recent past without any strict accountability. Rapid motorisation in the country is regarded as the key problem responsible for harming the safe operations of traffic on roads.

One of the country's leading newspapers, The News, sheds further light on the issue that lenient car financing schemes and weak monetary policies have caused major traffic problems. The article asserted that economic growth and the low interest rate regime which followed the year 2000-01, started a furious lending race between the banks in Pakistan. It is estimated that in Karachi, the biggest and the most populous city of Pakistan, when money was cheap at the peak of economic growth in the fiscal year 2006-07, more than 69,000 extra cars were coming out onto the roads in a year. However, in 2009, car financing has almost stopped as banks recover from losses caused by huge non-performing loans. It is believed by the banking industry people that banks will jump in the fray again as it would be hard for the bankers to forget the taste of quick money (Hassan 2010).

Participants also considered poor and inadequate public transport services as a driver for increased motorisation. The other studies (e.g. by Imran 2010) have also raised concerns over both road safety and efficient use of road space due to the sharp increase in motorized transport and growing urban population. According to ADB, it will get even harder for developing countries such as Pakistan to make transport safer due to the adverse effects of rising traffic on roads (ADB 2010).

6.6.3.2 Traffic mix on roads

Most of the interviewees identified the fact that roads are used by a mix of traffic including pedestrians, bicycles, and animal-driven carts; no effort has been made to segregate slow-moving or animal-driven carts from motorised traffic. Thus, the possibility of an unexpected incident has always remained high. Participants said that pedestrians' mobility needs are often overlooked. The poorly designed pedestrians facilities, insufficient lane markings and encroached footpaths add to the discomfort of pedestrians. However, participants were also of the opinion that, when provided, pedestrians do not make appropriate use of many of these facilities. This could be due to a lack of knowledge and awareness as to the correct use of pedestrian facilities and a lazy attitude towards using such facilities.

Khan *et al.* (1999) also observed the behaviour of inadequate utilisation of road safety facilities in their study about pedestrian environment and behaviour in Karachi. They found that 82% of the observed pedestrians did not use sidewalks. A total of 33% of these were found to be walking more than one foot away from the sidewalk out of which 35% caused traffic to change its trajectory. They reported 62% of pedestrians walking at the street edge did not look out for oncoming traffic and 24% caused traffic to swerve. In addition, three-quarters of the pedestrians in their study, who had a zebra-crossing available to them, did not use it. It is important to note that in 1991, 60% of the annual trips in Lahore were non-motorized, out of which, pedestrians were primarily generating 51% and bicycles 8% of total trips (Lahore Development Authority 1997; Imran and Low 2005).

It is likely that the percentage of non-motorised trips has fallen since 1991 due to rapid motorisation and those remaining will be even more vulnerable – not only is there poor provision for them, there are even more cars around to cause accidents.

> There are no zebra crossings in the city but should be called as camel crossings. As every zebra crossing is intercepted by some kind of greenbelt or bump, pole or trench and only camels can cross them not humans. (Official)

> I do not use zebra crossings or bridges as I am not used to these things. It is difficult for me to cross that high, steel bridge in such hot weather and when I know I can cross road quickly. (Female, housewife, driver)

6.6.3.3 Non-standardised driving practices

The issue of non-standardised driving practices emerged as another most important physical and operational weakness. According to participants, the absence of a comprehensive road safety policy at a national level and the involvement of too many fragmented traffic and transport related government agencies resulted in varying rules and regulations. These are reported to change with geographical boundaries and cause great confusion for drivers from outside the local area. Interviewees stated that any road safety effort carried out in the country is based on international standards that hardly consider local aspects.

6.6.3.4 Poor public transport system

The situation has been exacerbated due to the absence of an integrated public transport system. Every public transport company in the country operates individually. There is no overall policy to operate services and no check and balance; therefore, travel standards are set very low. A couple of experts said that except for a few prime locations in the big cities, proper bus stops are either not provided or poorly designed. It is common for the drivers of passenger vehicles; that include vans, qinqi and rickshaws, to stop in the middle of the road or even at intersections to drop off or take passengers. Due to all these factors, people do not like to travel on public transport and are tempted to move to private vehicles. It is important to note that the share of private vehicle trips in the two big cities of Pakistan - Lahore at 24% and Karachi at 27% - is higher than for public transport trips, 16% and 23%, respectively (Imran 2009).

6.6.3.5 On-road encroachments and capacity issues

Another overlooked component that raised participants concerns related to encroachments and heavy haulage on roads that give no due consideration to safety. They said that the culture of blatant encroachments has created undue inconvenience for many road traffic operations. The roads are encroached on by giant hoardings, billboards, uncontrolled parking, shopkeepers and street vendors. In residential areas, it is common for local residents to block roads to celebrate festivals or personal events. This theme also incorporates the issue of on-road strikes, protests and rallies which create a great amount of chaos, inconvenience and annoyance among road users. Further, participants said that commercial vehicles transport unwieldy articles in bulk without proper precautionary measures. These vehicles not only damage the road surface but also increase the risk of accidents by occupying most of the viewing space of the following driver.

6.6.3.6 Out-dated traffic management and poor licensing and penalties system

The issue of out-dated traffic management systems has also been raised and the failing of traffic controlling devices and unnecessary delays due to non-actuated signals were regarded as a big source of disruption for traffic movement. There are a few national studies (e.g. Mirza *et al.* 1999; Hyder *et al.* 2000) which have reported the ineffectiveness of law enforcement agencies in Pakistan. Interestingly, in one such study it was reported that bus drivers exhibited more unsafe behaviours in the presence of police, than when police were absent. Behaviours included intimidation (11% versus 5%, $p=0.11$), cutting off (13% versus 2%, $p=0.001$) or racing with vehicles (9% versus 3%, $p=0.05$); not stopping completely (53% versus 22%, $p<0.001$), and stopping without a bus stop in sight (8% versus 2%, $p=0.05$).

The possibility that police may actively promote dangerous behaviour was suggested by the study researchers (Mirza *et al.* 1999) as they might receive bribes from the drivers. For example, in another study in Karachi, it was found that 51% of bus drivers reported paying police a monthly bribe and then being given a sign board to hang on their windshield to communicate to other traffic police that they were not to be stopped (Khan *et al.* unpublished data, cited in Mirza *et al.* 1999). However, it is important to note that the findings of these studies are limited to professional drivers and their relation with law enforcement agencies cannot be generalised for all types of driving population in Pakistan.

> Traffic signals timings are unnecessarily long. For me, it is very hard to stand at the intersection with no traffic especially in such high temperatures. (Male, student, driver)

Respondents also identified the poor licensing and penalties system as another major contributor to unsafe driving practices. Despite remaining a public concern over the years, they believed the issue is still seemingly neglected by the policy makers and experts. The system is reported to be constantly abused through the use of power and influence and petty bribes. Interviewees said whilst progress has been made in major cities and comprehensive driver training programs and computerised licensing systems have been introduced, it is still very easy and convenient for people to get a license from those cities where the system remains outdated. It is important to note that in the list of seriousness of different offences by experts and driver participants, 'driving without a license', came out at twelfth rank. It is a very low ranking especially considering that the issue has been consistently highlighted by the majority of the participants during the interviews, and it is ranking perhaps indicates an underestimation of its importance in Pakistan.

> If you are a student [< 18 years], wearing uniform and have a vehicle, you can drive on the roads no matter if you are under age, have no driving license or break the rules as you can't be taken to the prison or can't be fined, at least in Lahore[30].

> Government has allowed students to bring their vehicles on roads mainly because of two reasons: first, to avoid the significant delays that incurred due to inefficient public transport system and congestion on roads. Second, there are not adequate school bus services to pick up the students. (Official)

> No system to avoid repeat offenders to come on roads… Here [in Pakistan] if you are being refused to issue license in Punjab, you can get it in Khyber-Pakhtoonkhwa province by giving a very minimal amount as bribe. (Official)

[30] According to current legislation, students of any age cannot be fined in Lahore.

The results of the present study corresponds with a recent survey, carried out in Pakistan where 68 out of 76 respondents said they easily avoided any penalty for violating traffic laws, while 48 admitted bribing the police to escape any penalty (SZABIST 2009). It is considered that an important barrier to enforcement is the restricted jurisdiction of the National Highway Safety Ordinance to only national highways in the country, leaving major road and provincial routes uncovered by federal law (Hyder *et al.* 2006, p. 138).

6.6.3.7 Social injustice

Another separate factor exclusively cited by driver interviewees, was a concern about unfair law enforcement, status discrimination and unequal resource distribution between low-income and high-income group areas. Whilst this issue was not prominent in the discussion with experts, driver participants were found to be consistently vocal about 'social injustice' and regarded it as a major constraint to safe driving practices. They complained about the unfair treatment of offenders, where higher status or influential drivers are more likely to receive softer treatment from law enforcement personnel and would easily avoid punishment. The interviewees also identified the problem of unequal distribution of resources and stated that the discrimination against poorer areas has shown no signs of improvement.

> Even Princess Anne were fined for speeding in the UK but here if you are influential, some big shot e.g. in army, police officer will salute you and ask you to leave. The justice, rules should be equal for everyone...This is unfortunately something we are lacking. (Male, office working, driver)

> It is common to find no speed breakers [speed humps] in old Lahore [low-income group areas], you will see no traffic warden there, if by chance you found a signal, it would be out of order. (Male, professional driver)

6.6.3.8 Poor roads and vehicle maintenance standards

In conjunction with the above mentioned factors, poor standards of road and vehicular maintenance were cited as issues causing an enormous number of road traffic problems. There is no concept of scheduling regular maintenance for urban roads with poor surface quality and numerous potholes. Poor visibility standards, inadequate and improper sign installation and virtually disappearing road markings were regarded as constant safety hazards by the participants. To make the situation worse, just as with the driving license, it is possible, with small bribes, to get a vehicle fitness certificate in the country without proper inspection.

> In Lahore, for example, you take 100 cars. Out of these 100, you will find that the life of 25 cars has already ended. But those 25 are still running on roads and because of that the other 75 also have to face damages, losses [such as air and noise pollution, breaking down in the middle of the road causing hold-ups etc]. Commercial vehicles of government which are operating on routes are even worse. Out of 100, 75 rickshaws you will find not fit for service, similarly 80 out of 100 taxis are not fit, whereas, 99% of buses are ramshackle. (Male, professional driver)

6.6.3.9 Other safety hazards

The last sub-theme of road- and infrastructure-related safety hazards embraced all those small but extensively important factors introduced by the participants during interviews. For example, construction and maintenance work on the roads without any clear warning sign was regarded as a big problem to safe manoeuvrability on roads. The irresponsible behaviour of public services departments including electricity and gas providers was cited as generating unnecessary delays, traffic jams, fatigue and anger among drivers. They were reported to start digging main roads to lay gas pipes or power cables without any prior notification to members of public and were accused of leaving excavated roads unattended after they finished their work. Adverse weather conditions in the country including high temperature in summers were indicated as another safety hazard especially for the drivers of non-air conditioned cars.

In addition, a poor drainage system, open manholes in the middle of the roads, mounds of mud left after municipal service work, construction of speed humps without approval in the residential colonies by locals, poorly painted road dividers, invisible road kerbs and driving with high beam at night were some other annoying factors identified by the participants related to the poor and risky driving environment of the country. In conjunction with these factors, too much pressure of freight transport due to a massive shift of logistics transport from rail to road was also cited as responsible for an in increase in RTA. Imran and Low (2005) noted that in Pakistan, development in the transport sector has always remained strongly biased towards road development. Road length in the country has increased more than four times over what it was in 1947 (the time of independence of British India), in contrast to the railway which is approximately the same length in kilometres as in 1947.

> At the time of independence, 95 to 96% freight transport operations were carried out by train and now it is done via roads. At that time rails were the major source of freight transport and now are the roads. (Official)

The theme concludes that the prominent role of the private sector, a mix of traffic on roads, increasing motorisation as well as out-dated traffic management systems, and neglecting to build high-capacity, reliable and efficient public transport are the major factors responsible for road safety failure.

6.6.4 Attitudinal and behavioural issues

6.6.4.1 Characteristics of unsafe drivers and their attitudinal and behavioural problems

The study has found that various negative driving behaviours in the country are practised by individuals coming from various backgrounds. It is important to note that the study focused more on identification of the most frequent types of aberrant behaviours commissioned on the roads, as well as socio-cultural and physiological factors which mediate or exacerbate these behaviours. As the study was exploratory in nature, therefore no theoretical approach was applied in it to explore the attitudes, and discussion with drivers about their attitudes towards these behaviours had been made at a very generic level. The main idea was to recognize those types of aberrant behaviours, which were important and needed to be studied more comprehensively for their underlying socio-cognitive mechanism in Study 2.

A majority of participants cited professional drivers as the most unsafe drivers. They were reported to drive aggressively with a carefree attitude towards other traffic in order to compete with each other and collect passengers. The extent of the issue can be understood when an earlier study in Karachi found that buses, which constitute only 1.8% of the registered vehicles in the city, were responsible for 27% of injuries and 43% of road traffic accident deaths (Luby *et al.* 1997, cited in Mirza *et al.* 1999). The main reason for rivalry between drivers is competition for cash earnings at the end of the day. One of the possible explanations for this behaviour could be the liberalization of the road transport market in Pakistan in 1970, which is now based on the residual income principle.

Here, the worker retains whatever amount is left after paying a contractually fixed amount to the vehicle owner. The worker is thus tempted to maximise returns in order to maximise his income (Hisam 2006) and compete for more passengers. Yet another reason participants stated for the unsafe behaviour of professional drivers was vehicle ownership. As they drive company vehicles they are not liable to pay fines, penalties or vehicle maintenance, and therefore tend to have a more carefree attitude. Driving for long hours was regarded as another important factor as both public transport and commercial vehicle drivers had to meet stringent deadlines and often need to work long shifts without taking adequate rest breaks.

> Accidents on main roads primarily occur because of van drivers. They are the worst drivers. Bus drivers are also not good but a van driver can even overtake him to collect a passenger. He does so as he has to earn his daily wage unlike a bus driver who is on fixed salary. (Male, professional driver)

> We are not facilitating professional drivers. There are so many factors influencing his [driving] behaviour e.g. he has no resources, no money, no respect, no relaxation, no facilities, and long duty hours but he is still providing his services in such harsh conditions. (Official)

There was a slight difference among participants' opinions relating to the socio-economic and demographic characteristics of unsafe drivers. However, most of the participants shared their thoughts that different income groups hold different attitudes towards road safety which affects their behaviour on the roads. The majority in just about all of the groups agreed that income levels do affect attitudes. Similarly, a combination of affluence and young males was found to be an important factor.

> An uneducated higher-income group driver is a guy who thinks that he has a right to override anybody because he has money and [because he] has no civic sense. (Academic)

The interviewees were of the view that every driver on the road more or less exhibits similar behaviour irrespective of socio-economic or demographic characteristics. They also revealed that a lack of self-assessment and over-confidence on one's driving skill has nurtured a 'blame culture' in the country. This phenomenon, where everyone justifies their own behaviour, can be explained with the aid of optimism bias. Optimism bias is defined as a systematic error in perception of an individual's own standing relative to group averages, in which negative events are seen as less likely to occur to the individual on average compared with the group, and positive events as more likely to occur than average compared with the group (Weinstein 1980; Sundström 2008). This exaggerated confidence in their abilities is a characteristic of the drivers who believe that they are more skilful than others (Matthews and Moran 1986, cited in Karlaftis *et al.* 2003), and could motivate the road users not only to display dangerous behaviours but also to persist in these behaviours (Delhomme 1991; Karlaftis *et al.* 2003).

There is a possibility that the phenomena of optimism bias could be truly applicable to Pakistani drivers but at present, there is no empirical evidence available to support it. Interviewees further considered negligent behaviour a result of a low level of education and awareness. There is no legal or cultural recognition of some of the inappropriate driving behaviour as offences or obstacles, for example horn blowing, tailgating or driving an unregistered vehicle. The seriousness scale ranking indicates that drivers take offences such as speeding (13 *versus* 1 (drivers versus experts)), carrying passengers higher than capacity (15 versus 8), carrying good higher than capacity (12 versus 4), violation of line/lane/zebra crossing (11 versus 4) much less seriously than experts. The finding indicates the low level of drivers' awareness of some of the very risky behaviours and reveals their vulnerability to encountering accidents at any time due to personal negligence and under-estimation of the seriousness of offences.

> Drivers are mainly responsible in the happening of road crashes as they are over-confident. They think they can take their car from any nook and corner to the other place. There has always prevailed an urge to lead the traffic. (Female, office-working, driver)

Driving under the influence of alcohol and drugs were also noted as a gradually emerging cause of exacerbating aberrant behaviours by a few participants but only with respect to other drivers on the road, not themselves. In fact, driver participants of the study ranked drink driving as the most serious offence. Driving under the influence of drugs also received a high level ranking from both the experts and drivers (3) in its seriousness. However, during the interviews, this subject rarely came up without prompting from the interviewer. It should be noted that in Pakistan, predominantly a Muslim country, the use of drugs or alcoholic drinks is illegal, but still evidence is available to suggest that drugs and especially alcohol are widely consumed by various sections of the society, most notably by the affluent and the impoverished (Shafiq *et al.* 2006). The officials from the local traffic police authority reported excessive use of drugs as more common among commercial and public transport drivers.

6.6.4.2 Societal and cultural issues

Last but not least, the societal and cultural issues bring up the issues of an absence of civic sense and safety culture among the masses as well as the lack of promotion and encouragement of improving behaviour with regard to road safety in society.

> There are examples where people even amongst the more educated ones have realised that driving less aggressively is more hazardous. So they also joined the bandwagon. (Official)

> If your elders have told you that you have to obey the laws then you definitely follow them but if everybody say doesn't matter; when the culture is about doesn't matter then it would definitely doesn't matter to you. (Female, office-working, driver)

It has also been discussed how the behaviour of drivers changed in line with the conditions of driving areas. This can be interlinked with the social injustice issue raised earlier under the theme of 'physical and operational issue'. A separate discrimination issue, which is frequently cited by female participants, was the aggressive behaviours of their fellow male drivers towards them. Theses phenomenon of social injustice and discrimination can be explained with the help of two of the Geert Hofstede Cultural Dimensions: Power Distance Index (PDI) and

Masculinity (MAS). For Pakistan, the scores of PDI (55) and MAS (50) are very high. PDI represents inequality; more versus less.

It shows the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally. Hence, a high PDI score for Pakistan can be related to the findings of the present study where most of the driver participants complained about the unfair treatment and unequal resource distribution in impoverished areas. MAS refers to the distribution of roles between the genders. For instance, the women in feminine countries have the same modest, caring values as the men; however, in the masculine countries women are somewhat assertive and competitive, but not as much as the men, so that these countries show a gap between men's values and women's values (for more details, see Hofstede 2001). This elaboration can provide a justification as to why female drivers in the study appeared to be competitive, aggressive and much concerned about their driving skills. The assertiveness was particularly dominant in a few of the young female participants.

> I try my best to abide the traffic rules and regulation, but can do nothing when I stop at red light and start receiving horns from other drivers behind me to break the signal. They do it more to realise that I am a female driver with lesser competency and skills to drive. (Female, student, driver)

> I do rash driving and am not ashamed for that. It gives me a sense of pride when I pass some male driver who thinks of himself more competent than me. (Female, office-working, driver)

> There is a difference in behaviour of drivers at Multan Road [lower-income area] and Ferozpur Road [higher-income area]. I don't break law at Mall or Jail Road because I know traffic wardens are there and monitoring system is quite strict. I don't blow horn in a civilised area because I know other drivers will give me a disgusting look and would think as if I don't have any manners. But if I am on Multan Road, I know I have to give horns again and again to get some way. Otherwise I can't cross it. Even pedestrians in these areas, stick on the roads without bothering about the traffic passing on their right or left hand side. (Male, businessman, driver)

To summarise, the study noted no inclination among the population in Pakistan towards safe driving habits. The main point of contention here is the kind of safety culture that allows bad driving habits to develop. In the opinion of study participants, if you have to drive in the country, you have to blow your horn, and you must overtake fellow drivers or neglect their right of way. Even if people try to follow the rules, society forces them to be involved in unsafe practices.

6.6.5 Road safety research and accident data bank

Most of the experts were found to be concerned about the poor accident recording and lack of a reporting mechanism. They mentioned that the police do very few on-the-spot investigations of accidents. The data is usually collected for legal purposes and is not analysed to diagnose the actual causes of accidents.

> Most of the policemen don't fill accident report form completely as they have no idea about the basic sections of the form and have also never received any training to fill it in. (Academic)

A number of studies have also reported the problem of unreliability of road accident data in Pakistan (see Razzak and Luby 1998; Hyder *et al.* 2000; Khan *et al.* 2001). It was also revealed that even if the accident recording officer is provided with a standardised accident reporting form, he will not fill it in. Experts commented that research, if at all, conducted in the country was always reactive in nature, to only address a certain issue. Moreover, an inadequate dissemination of research work, if there is any at all, caused a lack of understanding and knowledge about any sort of development that has been made in the field. Academics frequently cited the difficulty in getting access to any research work or accident data from government departments for research purposes. Here, it is important to note that when asked about knowing of any on-going research work, two-third of the experts replied either 'no' or 'don't know'.

6.7 Recommendations

The section of 'recommendations' emerged from the response to the final set of questions related to what improvement measures the participants thought were appropriate to raise the level of road safety in Pakistan. Briefly, interviewees recommended 'institutional reforms', 'physical and operational reforms', 'intensive traffic monitoring and law enforcement', 'road safety research and accident data bank', and behavioural transformation at the societal level. This study emphasises that a serious and a sustained interest from government along with enhanced interdepartmental coordination among government departments is urgently required in order to reduce the number and severity of road accidents.

The quantitative findings have revealed that there was a consensus among participants that strict and fair law enforcement along with a well-integrated traffic management system can improve road safety. Participants stated that the careless attitude among drivers would continue unless they know their behaviour is being monitored. Further, road maintenance and vehicle safety standards need to be implemented further to reduce road traffic accidents. The theme further highlights that the safety and convenience of road users would improve by segregation of motorised and non-motorised traffic on the roads and with provision of well-planned and designed pedestrian facilities. There should be standardised driving practices throughout the country and stringent measures need to be taken when issuing driving licenses.

> We are getting better in major urban areas such as Karachi, Lahore, and Islamabad. Where the emphasis of recent efforts of district governments are towards traffic management and some initial steps such as lane marking on the road networks, introduction of computerised licensing system and road safety education in curriculum of some schools has been undertaken. (Official)

The interviewees also highlighted a dire need for mapping and disseminating the research work carried out in the country. Last but not the least, the behavioural transformation of drivers was regarded as imperative especially in terms of road sense, discipline, and patience in order to integrate road safety into the Pakistani culture. A change was identified to be brought at a societal level by sensitising people at a community level through media communication, NGOs involvement, running nationwide road safety education campaigns, and by encouraging and promoting responsible road user behaviour.

> If each and every one of us promise and make a concerted effort that you will improve just one person, things would definitely improve and that one person is yourself. (Official)

To summarise, the study participants suggested a need for reforms at the institutional, physical and operational levels and the need to bring change at a societal level through behavioural transformation, intensive traffic monitoring and law enforcement, along with a programme of road safety related research work.

6.8 Conclusions

This qualitative study has explored a number of serious issues that require further investigation. The key findings indicate that road safety based projects and schemes are often impeded due to lack of government concern and involvement in Pakistan. The gaps in the institutional framework of the country have created a situation in which effort is disjointed due to duplication and overlapping of functions. The study has also explored attitudes towards safe driving which is one of the major deciding factors that influence driving behaviour among individuals in Pakistan. Issues such as a lack of self-assessment, patience, and aggressiveness among drivers emerged as consistent attitudinal problems. The study demonstrates that drivers' social status has a distinct influence on their driving behaviours and definitely requires a better understanding. It highlights that there are certain demographic and socio-economic segments in the country which have a carefree attitude towards safe driving. Additionally, the inadequate research work within the domain of road safety in Pakistan has remained the principal factor undermining the formulation of a comprehensive national road safety policy. Due to the lack of knowledge and understanding of local road safety issues, the country has no other option except to rely solely on international agencies and therefore it is still struggling to achieve a better road safety arena. The study findings not only helped to gain a broader perspective on the road safety issues of the country but also to develop a conceptual based attitudinal and behavioural questionnaire for the successive main survey.

6.9 Limitations of the study

Although, the study achieved its set aims, there are few limitation attached to it. Firstly, it is important to note that political instability and safety risks in the country at the time of study prevented a more ideal and balanced sample size being obtained. Further, more empirical support is needed to provide conclusive policy recommendations.

CHAPTER SEVEN

STUDY 2: ATTITUDES AND BEHAVIOURS OF DRIVERS IN PAKISTAN - A MARKET SEGMENTATION APPROACH

7.1 Overview

This chapter presents the findings of Study 2. The study was carried out to extend the qualitative findings of Study 1, and used a quantitative approach to examine the attitudes and behaviours of drivers in Pakistan. The study segmented the driving population of Pakistan based on their attitudes towards road safety using multivariate analysis techniques (FA and CA). It then explored behavioural dimensions of population segments and identified key attitudinal factors which shape the behaviours. The study also explored the socio-demographic composition of population segments and investigated how drivers' attitudes and behaviours are related to their socio-demographic characteristics. Finally, the results are pooled across the segments, and discussed. The chapter is concluded with the limitations of the study.

7.2 Introduction

Study 1 findings set the context for the quantitative investigation of the attitudes and behaviours of drivers in Pakistan. Discussion of the study concluded that drivers majorly held responsible for RTAs in the country. However, there is a paucity of research work and no empirical evidence to be found to understand the underlying socio-psychological constructs which provoke deviant driving styles. Earlier, the literature review identified that drivers' behaviours are dependent on their attitudes, and Ajzen's TPB is a powerful model to explain the underlying socio-psychological constructs of drivers' attitudes. The review also established the efficacy of the TPB model to explain a causal link between drivers' attitudes and behaviours (Parker *et al.* 1992; Parker *et al.* 1995; Parker *et al.* 1998). It examines how a person's attitudes about behaviour influence the person's intention to perform that behaviour (Lindstrom-Forneri *et al.* 2007).

As stated by Reason *et al.* (1990), the TPB is an ideal vehicle for investigating the underlying motivational factors involved in the commission of violations and to uncover any systematic differences between the attitudes of various subgroups of drivers towards these behaviours. Although the efficacy of the TPB model is well documented, no known attempts had been made to utilise it in Pakistan. In the present research, the TPB model was used as a guide to design the AQ. Hence, the initial aim of this study was to investigate the attitudes which underpin good or bad driving behaviours. At the same time, it was hypothesised that the driving population in Pakistan hold different attitudes towards road safety which could be classified into distinct attitudinal groups with the help of a market segmentation approach (H1). Thus, this study has also made the first known attempt to segment the driving population based on their attitudes towards road safety (the rationale for adopting segmentation can be further noted in sections 5.1.4 and 7.5.3).

A further aim of this study was to determine the types of aberrant behaviours exhibited by drivers in Pakistan and to assess how these behaviours are linked with their attitudes. The literature review has demonstrated the DBQ is one of the most widely used and reliable measures of aberrant driving behaviours (e.g. Lawton *et al.* 1997; Lajunen *et al.* 2004; Eugenia *et al.* 2006; Özkan *et al.* 2006). Therefore, a modified version of the DBQ, devised by Lawton *et al.* (1997) was used to assess driving behaviours with the inclusion of Pakistan-specific behavioural items identified in Study 1. Subsequently, the study has also attempted to look at key attitudinal determinants guide and shape drivers' behaviours in the country. It was anticipated that less favourable attitudes towards road safety would lead to more aberrant driving behaviours (H4).

As discussed in Study 1, poor driving attitudes and behaviours are also strongly linked with the socio-demographics characteristics of drivers and are aggravated by societal and cultural factors. However, the study gave somewhat mixed results about the influence of socio-demographic characteristics on drivers' behaviours. The interviewees were of the view that every driver on the road more or less exhibits similar behaviour irrespective of his socio-economic or demographic characteristics. Thus, the final aim of this study was to explore the influence of socio-demographic characteristics on drivers' attitudes and behaviours.

7.3 Aims

Broadly speaking, the aims of the study were set out such as to inform the central hypotheses of this research (H1, H2, H4, and H5). The principal aims of this study were (1) to contribute to an understanding of Pakistani drivers' road-safety-related attitudes with the identification of the underlying socio-psychological constructs, and (2) to explore whether the population is divided into distinct attitudinal segments. The study also aimed (3) to assess the behavioural dimensions of the segmented population, (4) the relationship between attitudes and behaviours, and (5) the influence of socio-demographic variables on drivers' attitudes and behaviours. In parallel, it was also a concern to validate multidimensional attitudinal (AQ) and behavioural (DBQ) scales with reference to Pakistan.

7.4 Method

7.4.1 Study procedure

The literature review and results of Study 1 not only helped to recognize which deviant behaviours (e.g. violations of line/lane, overloading, use of mobile phone while driving) in the country should be studied for their underlying cognitive mechanism. It also identified various country specific socio-physiological factors which influence deviant driving behaviours, and needed to be studied. For example, an issue of poor and unfair law enforcement in the country (refer to sections 6.6.3.6 and 6.6.3.7). In order to assess influence of this factor on driver's behaviour, the AQ included questions regarding attitudes of drivers towards enforcement (e.g. *it would be easy for you to break traffic rules in absence of traffic police warden; it is easy for you to get rid of fines, penalties by using your status or personal connections*). Similarly, influences of various other road safety issues on driving behaviours are also assessed such as social injustices (e.g. *it is too difficult to comply with traffic rules and regulations in low-income areas*), poor traffic conditions (e.g. *traffic conditions on Pakistani roads are often so bad that it is acceptable to drive in an unsafe manner*), social norms (e.g. *to be able to get place on Pakistani roads, taking a chance now and then is necessary*), and personal norms (e.g. *for me to speed, blow horn or overtake to get ahead of female drivers is satisfying*).

Therefore, Study 2 measures attitudes, norms, PBC of drivers towards different types of intentional road violations as well as their opinion regarding enforcement and different socio-culture and physiological factors (which are collectively termed as 'attitudes', or 'attitudes toward road safety' in this thesis). The study asked drivers to complete self-reported questionnaires measuring their attitudes towards road safety and aberrant driving behaviours in the context of RTVs, along with socio-demographic characteristics and driving-related variables[31]. A pre-test study exercise was carried out to assess the efficacy and design of the questionnaire.

The testing on a sample of twenty drivers helped (1) to identify potential problems stemming from the planned data collection procedure, and (2) to couch questions in a language understandable and relevant to the potential participants. The feedback received was then applied to create a final version of the questionnaire to make it suitable for the general population. The study was conducted in Urdu and recruited drivers from different densely populated locations of Lahore, Pakistan. Ten student surveyors from Punjab College University (PCU) and University of Engineering & Technology Lahore (UET) who had been trained and informed about the intent of study conducted the survey.

7.4.2 Participants

In total, 438 driver participants took part in the study. A quota sampling procedure had been adopted to recruit participants. In quota sampling, the population is stratified according to particular categories relevant to the research; a number to be selected from each stratum is decided, reflecting the relative proportion of each group to the whole population, and field workers are sent into the streets to fulfil their quota (McQueen and Knussen 2006). The six major groups attempted to be covered in this survey, while taking into account findings of Study 1, were (1) professional drivers[32], (2) business and (3) leisure commuters, (4) young drivers (< 19 years), (5) housewives and (6) elderly people (55+ years).

[31] Surveyors helped participants to complete the questionnaires in case they found it difficult to understand either due to their low level of education or unfamiliarity with such exercise.

[32] Professional drivers are composed of those who drive qinqi, rickshaw, taxi, van or bus.

For each category, a quota of 80 drivers (8 drivers for each of the 10 surveyor) was assigned, except for housewives and elderly people (40 each) due to their comparatively less presence on roads. The required sample was achieved by adopting an on-street intercept technique where target groups of drivers e.g. business and leisure commuters were approached at business and shopping centres (Anarkali Bazar, Ichra Bazar, Liberty market), students in universities (PCU and UET), professional drivers at public transport stands (Lahore railway station, Sandha road, Multan chungi and Bhati chowk), and housewives and elderly people in residential areas (Sandha, UET Staff colony and Allama Iqbal Town).

It is important to note that as the prime rational of this thesis was to avoid *a-priori* classification, therefore, participants were approached 'randomly' in above mentioned locations of the city. The categorisation of drivers (e.g. professional drivers, students etc.) was only meant (1) to fairly represent the diverse driving population of Lahore, and (2) to examine the extent of attitudinal and behavioural differences within substrata of the society without restricting it with respect to socio-demographic composition in accordance with the central rationale of this thesis. Before starting the survey, participants were asked if they drive or not. The questionnaires were coded according to each survey location. The refusal rate was not quantified but overall it was noted to be high among businessmen and very low among public transport drivers.

7.4.3 Self-reported measures

7.4.3.1 Attitudinal measures

To measure drivers' attitudes towards road safety in Pakistan, the AQ was developed by adapting the framework of the DAQ. Based on the insight of Study 1, a 58-item AQ was developed inspired by attitudes, SN, PBC constructs of the TPB. A copy of the AQ is included in Appendix D[33] (part b). The content of the questionnaire attempted to cover drivers' attitudes towards speeding (items 1, 2),

[33] Briefly, the AQ tap attitudes towards various aspects of driving covered in the original DAQ (i.e. speeding, close-following, overtaking, drink driving) along with the Pakistan-specific issues identified in Study 1 (for details, refer to section 7.4.1). It is important to note that only five items in the AQ were taken as it is from the DAQ (item number 2, 28, 29, 30, 31). Rest of the items were phrased by adapting wording of the DAQ.

seatbelt/helmet use (items 3, 4, 5), lane change/stop lines violations (items 6, 7, 8, 9, 10), red light running (items 15, 16, 17), one-way driving (items 18, 19, 20), close following (items 28, 29, 30), drink and drugs driving (items 26, 27), and overtaking (items 31, 32). It also tapped drivers' attitudes about physical and operational issues such as driving distractions (items 22, 23, 24, 25), vehicle fitness (items 11, 12, 13, 14), stringent enforcement and respect for rules and regulations (items 38, 39), aggressive driving (items 40, 41, 42, 43, 44), driver self-assessment (45, 46, 47), and other basic traffic rules violations (items 33, 34, 48, 53, 54, 55, 56, 57, 58) reported in Study 1. The influence of local factors, driving environment (items 35, 36, 37, 49), social norms and peer-pressure (items 21, 50, 51, 52) on drivers' attitudes were also recorded. A five-point Likert scale was used to record the responses with end points 1 *(strongly disagree)* to 5 *(strongly agree)* such that a higher score on any item indicates a safer attitude.

7.4.3.2 Behavioural measures

Drivers' behaviours were assessed with the help of modified version of the DBQ, focused on HCVs and AVs, taken from Lawton *et al.* (1997). Based on the insight of Study 1, a 29-item extended version of the original 12-item DBQ assessed intentional violation behaviours while incorporating local, Pakistan-specific factors. A copy of the DBQ used can be found in Appendix D (part c). The aim was, with the inclusion of the new items (13 to 29), to cover all the inappropriate behaviours targeted in the AQ so as to make the findings of both the data sets relevant and comparable in the later stages. Participants were asked to indicate how frequently they engaged in performing behaviours mentioned in the questionnaire by rating on a six point scale with endpoints *never* (0) and *nearly all the time* (6), such that higher scores on any item indicates aberrant behaviours. The questions could logically be divided into HCVs (items 2, 4, 6, 7, 11, 12, and 15 to 29), and AVs (items 1, 3, 5, 8, 9, 10, 13, 14). For a complete list of attitudes and behaviours tapped in the main survey, see Appendix D[34].

7.4.3.3 Socio-demographic measures

The questionnaire also collected information related to the socio-economic and demographic characteristics of participants such as: age, gender, and income. It also

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[34] The 20-item version of DAQ taken from Conner and Lai (2005), and the 12-item version of Lawton *et al.* (1997) DBQ was translated and revised in Urdu with the help of bilingual expert.

collected information related to participants' driving including the number of years driving license had been held, weekly mileage, and frequency of accidents and near misses in the last six months.

7.5 Analysis

7.5.1 Data screening

The questionnaires data was analysed using SPSS. However, before running analysis, a quality check was carried out by applying various validation rules[35]. The data validation helped to identify invalid or unusual cases[36], incorrectly entered data, and outliers. Similarly, checks for duplicate cases have been run on the data set and case summaries were also produced. The cases with irrelevant/doubtful answers have been removed. The screening reduced the sample size from 438 to 428.

7.5.2 Sample characteristics

After cleaning the data, a univariate descriptive analysis was made to identify the socio-economic and demographic characteristics of the study's sample. Table 16 shows the composition of the sample which helped to assess the representativeness of different groups in it.

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[35] SPSS provides a means of checking the validity of data within the **Validation** item in the **DATA** menu where various rules can be specified either for individual variables or across all variables. The procedure includes defining as many rules as possible and then applying these rules to specified variables (for details refer Kinnear and Gray (2010, p. 63). For example, it was checked that no score greater than 5 for the AQ variables was entered into data set.

[36] In SPSS term, unusual cases are defined as cases which tend to skew overall results. For example, it is possible that a participant may have given same responses to all the items in the AQ or DBQ to save his time (e.g. circled number 1 in Likert scale for all items).

Table 16: Demographic and socio-economic characteristics of the sample population of drivers

Variables	Sample (%)	Variables	Sample (%)
1.Age		*7.Education*	
< 19	12.4	Up to Intermediate	60.8
19-34	64.5	Graduates	20.6
35-55	17.5	Postgraduates	12.4
55+	2.8		
2.Income group		*8.Driving vehicle type*	
Lower-income	37.6	Motorcyclists	40.7
Middle-income	22.7	Car drivers	40
Higher-income	22	Professional drivers	19.2
3.Gender		*9.Occupation type*	
Male	86.2	Self-employed	24.1
Female	13.6	Part-time employed	3
		Full-time employed	29.2
4.Housing tenure type		Unemployed/retired	3.7
Own/buying	47.2	Student	30.6
Rent	24.6	Looking after family	2.8
Living in joint family	21.7		
		10. Occupation category	
5.Marital status		Government employee	16.6
Single	56.1	Semi-government	3
Married	40	Private	42.8
Separated/divorced	1.9		
6. Kids at home	35.5		

On some indicators the sample characteristics appeared to be somewhat similar or comparable to the general characteristics of urban population of Pakistan[37]. For example, the sample was predominantly composed of the young age group drivers (up to 34 years) just like the national population (76.9% versus 64%[38] respectively). Similarly, the types of vehicles driven by the sample population was also comparable to general statistics e.g. car drivers (40% versus 37%), motorcyclists (40.7% versus 50%[39]) and professional drivers (19.2% versus 16% [40]).

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[37] It is important to note that the surveyors received instructions to approach drivers from different walks of life randomly in order to ensure maximal variation in the population but they had not been told to recruit drivers e.g. under certain age bracket, income or education level. This had been done to avoid *a-priori* classification of drivers, as mentioned earlier in section 7.4.2.

[38] For detail statistics, refer to Government of Pakistan (2010b).

[39] Statistics are taken from NTRC and JICA (2006b).

[40] Statistics are taken from Imran (2009).

However, females were under-represented in the sample in comparison to general statistics (13.6% versus 49%) which could be linked with a lower number of female drivers in the country. Furthermore, 17.7% of the drivers did not reveal their income-level. Whilst, the middle-income and higher-income drivers were almost in an equal proportion in the sample (22.7% and 22% respectively), those with a lower-income were more (37.6%)[41].

Participants also informed about their employment status. Nearly 31% were students and the same percentage was full-time employed (29.2%), closely followed by self-employed drivers (24.1%). Drivers working part-time (3%), unemployed/retired (3.7%), or looking after family (2.8%) were in lesser percentages. Collectively, the percentage of working population in the sample is comparable to general population statistics (56.3% versus 57.5% [42]respectively). Further, nearly two-thirds of the drivers had attained education up to intermediate (60.8%), around 21% were graduates and 12.4% were postgraduates[43]. It is important to note that literacy in the country rose from 45 to 54% between 2002 and 2006, and net primary enrolment rates increased from 42 to 52%. Only 30% of Pakistan's children receive secondary education and only 19% attend upper secondary schools (The World Bank 2012).

The study also recorded information about participants' marital status and household structure. The statistics are found generally comparable to the general population e.g. unmarried (56% versus 45.31%), married (40% versus 50.55%), separated/divorced (1.9% versus 4.10%). Nearly half of the drivers were living in their own property (47.2%) and 21. 7% were living in joint family. Collectively

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[41] Average monthly income of Urban Pakistan is 27663.81PKR i.e. 300.94 USD (Government of Pakistan 2010b). According to income-level framework developed in the study: lower-income is less than 25,000 PKR, middle-income is between 25,000-50,000 PKR, and higher-income is more than 50,000 PKR.

[42] For detail statistics, refer to Government of Pakistan (2009, p. 11).

[43] The educational system in Pakistan is divided into five major levels. The pre-university education consists of four levels: the primary level (grades one to five), the middle level (grades six to eight), the high level (grades nine and ten, culminating in matriculation), and the intermediate level (grades eleven and twelve, leading to a diploma in arts or science). There is also a university level, which leads to undergraduate and graduate degrees (BookRags 2012).

these statistics match percentage distribution of households by housing tenure type in urban areas of Pakistan (68.9% versus 82.53%). Percentage of those living on rent was also slightly comparable to general statistics (24.6% versus 17.4% [44]).

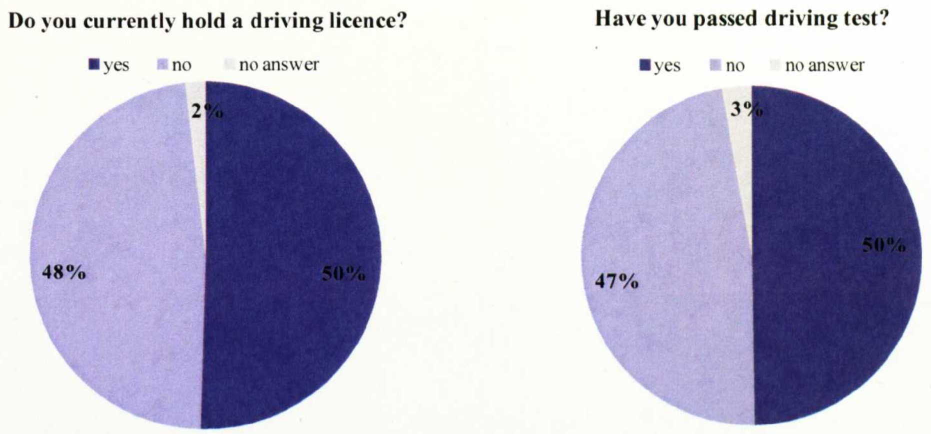

Figure 15: Percentage of respondents who passed driving test and had valid driving license

The study also measured general indictors of drivers' behaviours. The mean near misses and accidents for the study's driver in last six months were 2.72 and 1.98 respectively. On average, participants held a driving license for 8.43[45] years and had a weekly mileage 363.47km. Figure 15 shows that only half of the sample population had passed the driving test and equally only half a valid driving license. The situation is further assessed against the age, gender, education (Table 17) and income level of drivers as well types of vehicle they drive (Figure 16). It appears the number with a test and/or license gradually increases with age[46].

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[44] For detail statistics, refer to Government of Pakistan (2010a, pp. 18-30).

[45] The license holding years seems low for the population. However, given the high proportion of young people it has some logic as in Pakistan legal age to obtain driving license is 18 years.

[46] A very low percentage of young drivers (especially under 19 years of aged) had passed the test and were holding a license. It appears the number with a test and/or license gradually increases with age and by the time people are elder (55+ year of aged) most seem to have acquired a test and license. The statistic reflect that people are driving without passing driving test or obtaining driving licenses and may be buying one when needed or take the test after being pulled over by the police or some such.

Table 17: Age, gender and education composition of sample with respect to driving test and driving license holding

Driving indicators	Sample characteristics (N=428)								
	Age (%)				Gender (%)		Education (%)		
	< 19	19 to 34	35 to 55	55+	M	F	Up to inter-mediate	Grad-uates	Post-graduates
Driving test	18.8	48.2	69.3	83.3	49.6	50	46.2	50	79.2
License holder	13.2	50	74.7	83.3	50.4	51.7	48.2	48.9	77

Further, the statistics shows no differences with respect to gender such that only half of the males and females drivers reported passing the driving test and holding a valid driving license. The table and figure indicate that passing the driving test and holding a license are most in line for the higher education, high earning, and car owning group. This is to be expected since higher income tends to follow from higher education.

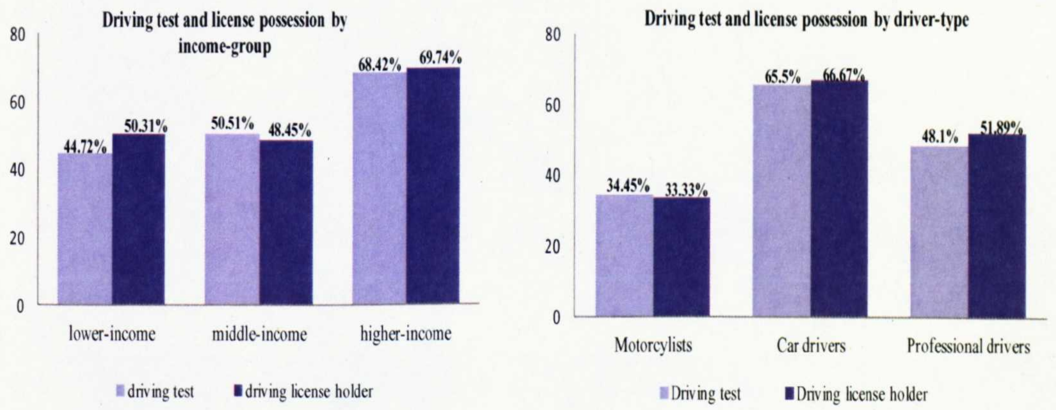

Figure 16: Percentage of respondents who passed driving test and had valid driving license by different income-groups and type of vehicle they drive

To summarise, the overview of the sample characteristics confirmed that it has a good mix of population with a reasonable representation of drivers from varying socio-demographic backgrounds. The data revealed half of the drivers had never passed driving test or held driving license. This preliminary finding about the sample empirically reaffirms the issue of a poor licensing and penalties system, highlighted earlier in Study 1.

It strengthens the believe that with petty bribes and influence peddling, it is very easy to get a driving license in Pakistan and most of the drivers, even then, are not bother about getting one. This further implies that a poorly coordinated monitoring system in parallel with a weak mechanism to avoid repeat offenders coming on the roads, have made drivers fearless about getting caught or receiving a severe punishment. However, it should also not be overlooked that as the system is improving in big cities such as Lahore, the trend of passing the test and then getting a license appeared somewhat higher for young drivers (18.8% versus 13.2% respectively). As the sample characteristics have been established now, the subsequent section describes the multivariate analysis performed on the attitudinal and subsequently on the behavioural data sets.

7.5.3 A market-segmentation approach; Rationale and Stages of Analysis

As discussed earlier, the overarching aim and rationale of this research is the classification of Pakistani drivers following the ideas of market segmentation, such that drivers who have similar attitudes towards road safety should be grouped together. This research anticipates that taking identified attitudinal segments and their behavioural dimensions into account, effective and lasting road safety campaigns and interventions can be designed. Segmentation, as stated by Anable (2002), is a key concept in market research. Its basic proposition is that, in any given population and whatever the organisational setting, there exists a variety of sub-groups that are relatively homogenous in terms of certain essential characteristics which are likely to respond in different ways to different promotional messages.

The premise for using segmentation in the present research was to avoid simply grouping similar variables (using FA) as a means to explore the attitudinal and behavioural dimensions in Pakistan. Therefore, CA was also used to yield different and richer results by combining individuals (not variables) who reported similar attitudes in the AQ into groups. With the adoption of this approach, Study 2 not only attempted to classify the sample driving population but later, it evaluated the behavioural profile and socio-demographic composition of the identified attitudinal segments and informed many central hypotheses of this PhD thesis.

There are a variety of ways to carry out segmentation[47]. However, on the basis of concepts derived from Hair *et al.* (2006); the three distinct stages in Figure 17 were adopted sequentially on the attitudinal data. Briefly, in *step one*, 58 attitudinal items (variables) were factor analysed to reduce the variables into smaller and manageable number of factors (dimensions). Then, in *step two*, cluster analysis was performed on the extracted attitudinal factors in order to identify naturally occurring homogenous groups of drivers in the sample (segments). Discriminant analysis was further used to validate the segments. Finally, in *step three*, the segments were interpreted and profiled in terms of their driving behaviours (using DBQ data) and socio-demographic characteristics. The analysis of variance (ANOVA) and chi-square tests were run to identify the significant differences between the segments. Details of the analysis are provided in the subsequent sections.

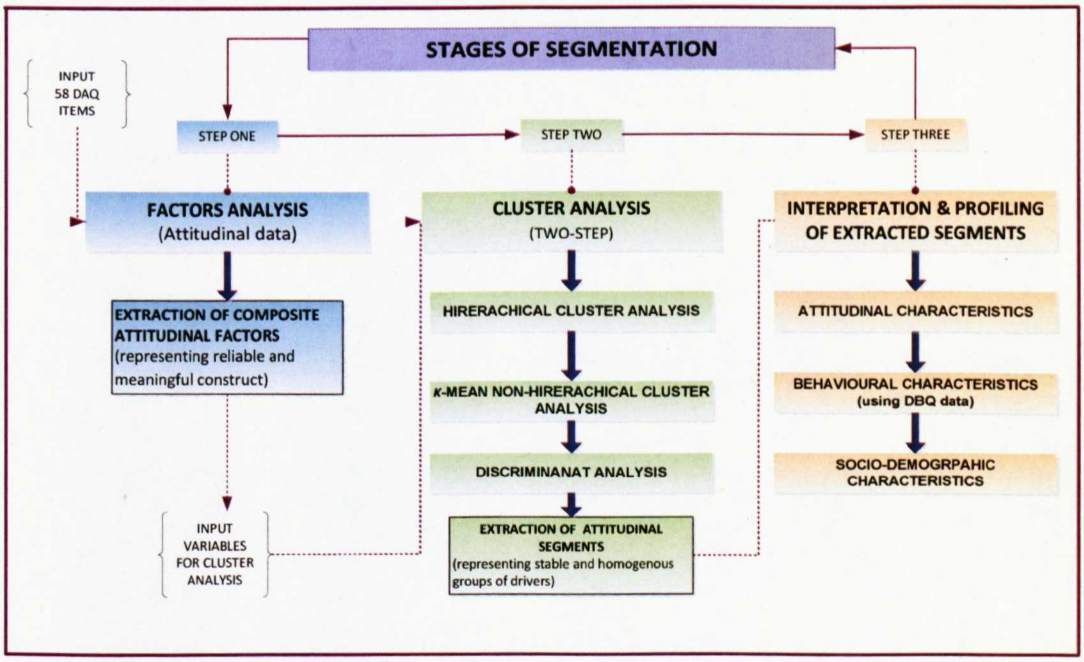

Figure 17: Schematic representation of segmentation

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[47] For instance, attitudinal, behavioural and socio-demographic data can be entered at once in the cluster analysis or running *a-priori* analysis where 'segments' are predefined e.g. based on previous researches.

7.6 Factor Analysis

This section explains the first step in the segmentation *i.e.* factor analysis (FA). It describes the objectives, prerequisites and steps followed to factor analyse the attitudinal data and discusses its final results.

7.6.1 Introduction

Factor analysis is a statistical technique used to identify a relatively small number of factors that explain observed correlations among variables and thus, helps to identify the constructs which are not directly observable (Norušis 2008, p. 389). It is an interdependence technique, whose primary purpose is to define the underlying structure among the variables by grouping highly correlated variables together, labelling or naming the groups, and perhaps even creating a new composite measure that can represent each group of variables. These groups of highly interrelated variables are known as *factors* (or composite variables) which represent dimensions within the data. Thus, as the first step of segmentation, attitudinal data was factor analysed using SPSS to produce a meaningful socio-psychological construct relevant to Pakistani drivers.

7.6.2 Objectives

The precise objectives of adopting FA for attitudinal data were (1) to facilitate data reduction by reducing a large number of attitudinal items (variables) into a more simple and manageable number of independent variables (factors), (2) to identify the underlying socio-psychological structure by assuming variables which showed similar patterns of variation across cases to be associated with the same construct and thus grouping them into a factor, and (3) to simplify the process of segmentation by replacing a large set of variables with composite variables.

7.6.3 Prerequisites

The suitability of running factor analysis on attitudinal data was established on three parameters.

a. Sample Size: The multivariate data analysis literature contains a variety of recommendations on appropriate sample size for FA. Mostly, these recommendations are presented as either a suggested minimum sample size or a suggested minimum ratio of sample size to number of variables. Typical, sample size guidelines are such as; 100=poor, 200=fair, 300=good, 500=very good, 1000 or more=excellent (Gorsuch 1983; Kline 1994; Mundfrom, Shaw et al. 2005; Zhao 2008). The subjects-to-variables ratio (STV) recommends that number of subjects should be five times larger than the number of variables (Hatcher 1994; Zhao 2008). The data set fulfilled both criteria with a *good* number of absolute cases (n=428) and appropriate STV ratio (7.38:1).

b. Suitability of the data: Two other approaches; Kaiser-Meyer Olkin measure of sampling adequacy[48] (KMO) & Bartlett's Test of Sphericity[49] (BTS), were adopted to determine the appropriateness of applying factor analysis on the data. The overall KMO ratio of .817 for the attitudinal data indicated a sampling adequacy to proceed with the analysis. Likewise, BTS result was also significant for the data (3972.686, p<.000).

c. Reverse scoring: The attitudinal statements were both *'positively'* and *'negatively'* keyed items. Therefore, in the last step to make the data suitable for the analysis, all negatively keyed items were reverse scored[50].

7.6.4 Analysis

After data screening, 58 attitudinal variables were subjected to FA to assess the presence of meaningful constructs within the data. Being iterative in nature, the

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[48] *Kaiser-Meyer Olkin measure of sampling adequacy (KMO)* is an index that compares the size of the observed correlation coefficients to the sizes of the partial correlation coefficients. Kaiser (1974) declares measures in the 0.90's as marvellous, in the 0.80's as meritorious, in the 0.70's as middling, in the 0.60's as mediocre, in the 0.50's as miserable, and below 0.50 as unacceptable (Norušis 2008, p. 394).

[49] *Bartlett's Test of Sphericity (BTS)* is a statistical test for the presence of correlations among the variable. It provides the statistical significance that the correlation matrix has significant correlation among at least some of the variables (Norušis 2008, p. 396).

[50] The following numbers of negatively-keyed attitudinal items in the questionnaire were reverse scored using transform-recode option of SPSS 17: 1, 2, 3 4, 6, 9, 11, 12, 13, 15, 17, 18, 20, 21, 22, 24, 28, 29, 31, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52, 53, 55, 56, 57, and 58.

process mainly involved computation of a correlation matrix *(step 1)*, factor extraction *(step 2)*, factor rotation to make them easy to interpret *(step 3)*, and calculation of factor scores *(step 4)* (see Figure 18).

7.6.4.1 Principal Component Analysis with Quartimax rotation

As the first step, the correlation matrix was observed and inter-item correlations of between attitudinal items were found up to 0.51 *(step 1)*. For extracting factors from a correlation matrix, Principal Component Analysis was used *(Step 2)*. Principal Component analysis (PCA), also known as component analysis, is the simplest method in which linear combinations of the observed variables are formed (Norušis 2008, p. 398). The reasons for adopting PCA for factor extraction are (1) its ability to summarise most of the original information (variance) in a minimum number of factors for prediction purposes (Hair *et al.* 2006), and (2) it makes no assumptions concerning an underlying causal structure that is responsible for co-variation in the data (Hatcher 2003). Thus, as the underlying dimensions of attitudinal items were unknown in the present case, PCA was considered to be the best suited approach. During the analysis, 6 items[51] were discarded in the first few iterations as they either failed to significantly relate to any other attitudinal items or had low loadings (<.30), and were reducing reliability (Cronabach's α) of the potential factor structure.

Furthermore, a simple structure is expected to produce a factor solution where each variable has large loadings for only a few factors, preferably one. Therefore the third step in FA involved rotation; 'a procedure in which factor axes are rotated so that variables have large correlations with a small numbers of factors. It tries to make large loadings larger and small loadings smaller to make the factors easier to interpret (Norušis 2008, p. 410). Rotation can either be orthogonal or oblique. *Orthogonal rotations* assume that factors in the analysis are uncorrelated. In contrast, *oblique rotation* methods assume that factors are correlated. The rerunning of PCA, after discarding the 6 items, generated factors which had low inter-correlations among them especially the first four (< 0.30), and favoured orthogonal rotation *(Step 3)*. Thus, the analysis was re-run for different types of *orthogonal*

[51] Omitted variables item number in attitudinal questionnaire (Appendix D; part b): 7, 31, 34, 41, 47, and 48.

rotations (e.g. varimax, equamax, and quartimax). And the results produced from Quartimax rotation were retained as it achieved a simple and better factor structure.

7.6.4.2 Determining the number of factors to retain

PCA produces as many factors as variables. However, to decide how many factors to retain, three principal criteria are used in combination. Norušis (2008) identifies that the most applied rule is that each factor should have at least three variables that load highly on it. The other two objective conditions are of eigenvalue (>1)[52] and examination of the scree plot[53] (p. 400). For the attitudinal data, the running of PCA with Quartimax rotation generated seventeen factors with an eigenvalue greater than 1. By closely examining the scree graph of eigenvalues, a five-factor solution seemed appropriate. However, considering simplicity and interpretability, it was decided to keep a 6-factor solution structure because the solution was theoretically meaningful, accounted most of the variance, and was allowing to keep three more items of the AQ. Furthermore, it was decided to retain only those attitudinal items in the solution which *(a.)* met threshold value of loading on its principal factor (≥ .30) and; *(b.)* if a variable was loaded on more than one factor, the minimum difference between its loadings was set to be 0.50. Thus, based on these two criterions, 12 more attitudinal items[54] were discarded from the analysis.

7.6.4.3 Reliability analysis

As the purpose of each extracted factor was to exclusively quantify an underlying attitudinal dimension of the sample population, high internal consistency was imperative to confirm the reliability of results. Therefore, Cronabach's Alpha (α) was computed to determine the internal consistency of each of the six factors.

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[52] The default in most statistical software packages is to retain all factors with eigenvalues greater than 1.0. There is broad consensus in the literature that this is *among the least accurate methods* for selecting the number of factors to retain (Costello and Osborne 2005, p. 2).

[53] The scree test involves examining the graph of the eigenvalues (available via every software package) and looking for the natural bend or break point in the data where the curve flattens out. The number of data points *above* the "break" (i.e. not including the point at which the break occurs) is usually the number of factors to retain, although it can be unclear if there are data points clustered together near the bend (Costello and Osborne 2005, p. 3).

[54] Omitted variables item number in attitudinal questionnaire (Appendix D; part b): 1, 2, 5, 6, 8, 19, 27, 35, 39, 40, 56, and 57.

Alpha value could range from 0 to 1 with 0.7 or above considered to be an acceptable value (Norušis 2008, p. 432). However, when dealing with psychological constructs, values below 0.7 can, realistically, be expected because of the diversity of the constructs being measured (Field 2005). The analysis identified the two items which were not measuring the same construct and lowering the alpha value. Those items were deleted from the analysis[55]. Finally, all six attitudinal factors exhibited good reliabilities (α > 0.50). To complete the analysis, standardised regression scores for the factors were computed[56] and saved as variables to use in the subsequent cluster analysis *(Step 4).*

7.6.4.4 Interpretation and naming of the factors

In short, PCA with Quartimax rotation transformed the raw attitudinal data into six factors, leaving 38 out of 58 attitudinal items. Table 18 indicates that together these factors explained 31% of the total variance and showed good reliability. The first factor (A1) accounted for 8.43% of the variation (α=.81) and was labelled as *'attitudes toward rule-compliance'*. It emerged as a general factor with ten out of thirteen variables directly tapping attitudes towards rule-compliance. The highest loaded items on the factor were 'attention seeking risky driving on roads (51)', and 'breaking the rules under the influence of other drivers (44)'.

The second factor (A2) accounted for approximately 6.6% of the total variation (α=.74) and labelled as '*taking care in driving*'. All six items of the factor showed a strong association on it (>.40) with the highest loadings being 'ignoring traffic signals (17)' and 'driving on one-way road (18)'.

The third factor (A3) was composed of nine items and accounted for 6.5% of the total variance (α=.726). As the main focus of its collective items remained on

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[55] Omitted variables item number in attitudinal questionnaire (Appendix D, part b): 24 and 26. In total, twenty attitudinal variables were omitted in different stages of FA for the given reasons: (1) variable failed to load >.30 on factor, (2) variable loaded on more than one factor with a difference between the loadings <.50, and/or (3) variable reduced the internal reliability (α value) of the factor.

[56] The *Regression* type of factor scores was computed. Regression factor scores are standardized to a mean of zero (with standard deviation of 1 in case of PCA) and predict the location of each individual on the factor or component (DiStefano *et al.* 2009).

intensive traffic monitoring and law enforcement, it was labelled as '*value of enforcement*'. The highest loadings are noted for items related to 'stringent enforcement of vehicle safety standards (14)' and 'overtaking regulations (32)'. Items related to imposing fines and penalties (10 and 54) were loaded moderately on the factor (<.50). This may indicate a reluctance to pay heavy fines.

The fourth factor (A4) accounted for 3.4% of the total variation (α=.52) and was labelled as '*ability to override peer pressure*'. The factor not only taps the influence of peer pressure and traffic environment on drivers' rules-compliance attitudes (49 and 52), but also measures aggressive consequences (42).

The fifth factor (A5) explained 3.3% of the total variation after rotation (α=.52) and contained four items all related to '*regard for personal safety*'. The highly loaded items on the factor were tapping attitudes related to use of seatbelt/helmet (3 and 4). Interestingly, relatively lower loadings (<.40) were noted for 'driving with improper lights at night (12)' and 'taking illegal U-turn on roads (20)'.

The sixth and the last factor (A6) accounted for 3.2% of the variation (α= .524) and was labelled as '*regard for other road users*'. The highest loaded item on the factor tapped attitudes towards breaking of rules and regulations in absence of traffic police wardens (38). On the other hand, the lowest loaded item measured driver perceived behavioural control to drive safely after rule-breaking (46).

Table 18: Attitudinal dimensions of Pakistani drivers' towards road safety

	Mean (SD)	Factor loading	% Variance	α
Factor 1- Attitudes towards rule-compliance (A1: RULE-COMPLINC)			**8.4%**	**.81**
People stopped by traffic wardens for changing lane without using indicator are unlucky because lots of people do it (9)*	1.85 (.63)	.499		
Waiting time at signals is often too long so it is quite acceptable to drive through red lights if there is no other traffic lights (15)*	1.73 (.66)	.477		
Close following is not really a serious problem (28)*	1.89 (.63)	.308		
People stopped by police for close-following are unlucky because lots of people do it (29)*	1.93 (.63)	.331		
Traffic rules are often too complicated to be carried out in practice (33)*	1.86 (.62)	.582		
Traffic conditions on Pakistani roads are often so bad that it is acceptable to drive in an unsafe manner (36)*	1.86 (.58)	.544		
I would be happier to take revenge for an impolite driving behaviour (43)*	1.86 (.67)	.498		
When I see other people breaking the rules, I feel I should too (44)*	1.74 (.62)	.633		
I am confident that I can drive safely even I break the rules (45)*	1.86 (.64)	.417		
My friends and family would think I am not a good driver if I try to follow traffic rules and regulations (50)*	1.73 (.65)	.557		
To be able to get recognition as a competent driver, I think it is necessary to take a chance now and then (51)*	1.94 (.65)	.688		
I think it is ok to carry goods/articles in vehicle more than its capacity if vehicle condition allow you to do so (53)*	1.79 (.61)	.313		
For me to follow traffic rules and regulations each day is not enjoyable (58)*	1.90 (.67)	.524		

Extraction method: Principal Component Analysis;Rotation method: Quartimax with Kaiser Normalisation (rotation converged in 40 iterations).

Note: * indicates reverse scored items.

'High' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5).

Table 18 (cont...): Attitudinal dimensions of Pakistani drivers' towards road safety

	Mean (SD)	Factor loading	% Variance	α
Factor 2- Taking care in driving (A2: CARFUL DRIVING)			**6.6%**	**.74**
It is quite acceptable to drive a vehicle at night with poor lights (11)*	1.66 (.63)	.621		
It is quite acceptable to drive with worn-out tires (13)*	1.68 (.61)	.595		
It is okay to ignore traffic signals (17)*	1.59 (.61)	.747		
I think it is okay to drive the wrong way on one-way road (18)*	1.64 (.63)	.734		
I think it is okay to drive with a hand-held mobile (22)*	1.67 (.64)	.423		
I think it is okay to use high beam lights during driving at night time in built-up areas (55)*	1.84 (.62)	.516		
Factor 3- Value of enforcement (A3: ENFORCEMENT)			**6.5%**	**.73**
I think traffic wardens should fine as many people as possible who disregard stop lines at intersections (10)	3.62 (1.23)	.304		
I would welcome stringent checks and monitoring of a vehicle safety standards (14)	3.79 (1.15)	.644		
Even running a red light when there is no traffic makes you less safe as a driver (16)	3.45 (1.21)	.454		
I would be happier if regulations regarding use of mobile phones were more strictly applied (23)	3.77 (1.24)	.616		
The law should be changed so that drivers are not allowed to have LCD TVs in their vehicle (25)	3.71 (1.21)	.386		
Even driving slightly too close to the car in front makes you less safe as a driver (30)	3.56 (1.81)	.494		
Stricter enforcement of overtaking regulations on urban roads would be effective in reducing occurrence of road accidents (32)	3.69 (1.21)	.673		
If the condition of road traffic improves in Pakistan, I will follow rules and regulations more strictly than I do now (37)	3.97 (1.16)	.528		
I think traffic wardens should fine as many people as possible who carry goods/articles in vehicle more than its capacity (54)	3.56 (1.24)	.493		

Extraction method: Principal Component Analysis;Rotation method: Quartimax with Kaiser Normalisation (rotation converged in 40 iterations). Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety). Scale ranged from *strongly disagree* (1) to *strongly agree* (5).

Table 18 (cont...): Attitudinal dimensions of Pakistani drivers' towards road safety

	Mean (SD)	Factor loading	% Variance	α
Factor 4- Ability to override peer pressure (A4: PEER PRESSURE)			**3.4%**	**.52**
It is hard to remain calm and drive safely if everyone else is not respecting your right of way (42)*	1.81(.60)	.615		
It is too difficult to comply with traffic rules and regulations in low-income areas (49)*	1.89 (.64)	.705		
It is hard to follow the rules if everyone else is disobeying them (52)*	1.85 (.59)	.532		
Factor 5- Regard for personal safety (A5: PERSONAL SAFETY)			**3.3%**	**.52**
Driving without a seatbelt/helmet does not necessarily increase accident risk (3)*	1.84 (.65)	.609		
For me to wear seatbelt/helmet each day while driving on roads is unpleasant (4)*	1.88 (.63)	.667		
Some people can drive perfectly safe with improper lights (12)*	1.82 (.64)	.344		
It is ok to take U-turn from anywhere as turnings on roads are often allowed after long gaps (20)*	1.90 (.63)	.316		
Factor 6- Regard for other road users (A6: ROADUSERS REGARD)			**3.2%**	**.52**
For me to speed, blow horn or overtake to get ahead of female drivers is satisfying (21)*	1.83 (.64)	.426		
It would be easy for you to break traffic rules in absence of traffic police wardens (38)*	1.76 (.60)	.752		
I know exactly up to what extent I can ignore the rules and still drive safely (46)*	1.88 (.64)	.367		
Total variation explained (*after rotation*)			**31%**	

Extraction method: Principal Component Analysis; Rotation method: Quartimax with Kaiser Normalisation (rotation converged in 40 iterations).

Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5).

7.6.5 Summary

To summarise, PCA with Quartimax rotation successfully produced six composite variables out of the raw attitudinal data. It was intended to avoid ambiguous, meaningless results of a large number of items individually tapping attitudes. Thus, the analysis produced a reduced and robust attitudinal construct which could underpin good or bad driving behaviours. Figure 18 illustrates the stages of FA. The results implies that Pakistani drivers have six distinctive and indicative attitudinal dimensions, namely attitudes towards rule-breaking, careless driving, enforcement, influence of peer pressure, and regard for personal safety and other road users. All these factors exclusively measured a single underlying construct with high internal consistency (with α >.5), and could be treated as stand-alone results. In the following stage, the factors would be treated as a set of uncorrelated latent variables to perform cluster analysis.

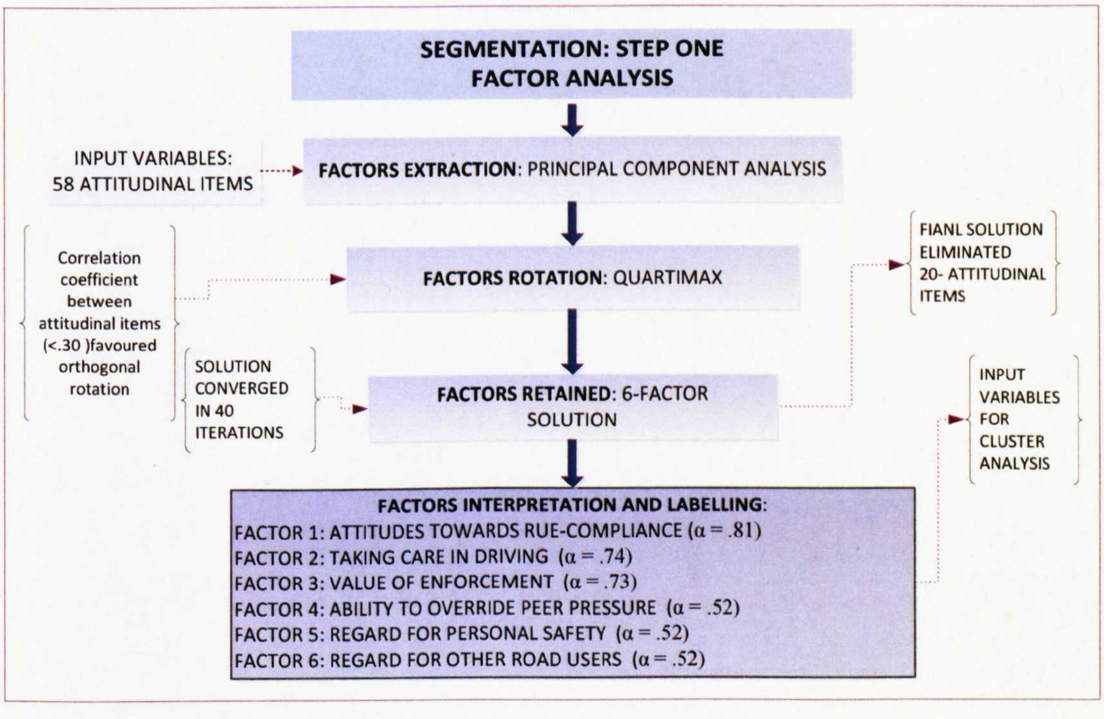

Figure 18: Segmentation step one: factor analysis

7.7 Cluster analysis

Step one of the segmentation identified six underlying socio-psychological, attitudinal constructs of the sample driving population of Pakistan. However the central aim of this thesis is to discover sub-groups of drivers who share similar attitudinal profiles and to determine to what extent these groups vary in terms of their driving behaviours and socio-demographic characteristics. Therefore, this section describes the process of finding homogenous groups of drivers with reference to their attitudes toward road safety. It segments the data using CA. It further assesses the impact and weight of each identified attitudinal dimension in the formulation of the sub-groups.

7.7.1 Introduction

The literature on multivariate statistics literature describes CA as a technique to reveal natural groupings within data that would otherwise not be apparent (Hair *et al.* 2006; Norušis 2008). According to Mitchell (1993), cluster analysis is synonymous with segmentation which mimics the goals of market segmentation by identifying groups of respondents in a way that minimises the distances within a group whilst simultaneously maximising the distance between groups. It is also referred as *Q* analysis, typology construction, classification analysis, and numerical taxonomy.

It is considered as one of the most useful techniques of data reduction and differs from FA in a sense that unlike variables, it groups objects (or cases/participants). The main objective of cluster analysis (CA) is to define the structure of the data by placing the most similar observations (i.e. objects) into groups (i.e. clusters) as suggested by the data, not defined *a-priori*, so that the cases in a given cluster tend to be similar to each other. It can be used to address research questions such as taxonomy description, data simplification, relationship identification, hypothesis generation or to examine previously stated hypothesis. To simplify, the primary purpose of conducting CA in the present research was to group objects (i.e. participants) based on the characteristics (i.e. attitudes towards road safety) they possess.

7.7.2 Objectives

The prime objective of the analysis was to inform the central hypotheses, formulated for the present research (including H1, H2, H4 and H5, for quick review, see Chapter 5, section 5.3). It was intended to use the exploratory nature of CA (1) to reveal natural grouping of drivers, if any within the sample population by using attitudinal factors, generated in PCA, as input variables, (2) to profile driving behaviours of prospective attitudinal segments and to investigate the potential correlation between attitudes and behaviours, and (3) to evaluate the socio-demographic compositions of the segments as possible correlates and mediators of drivers attitudes and behaviours.

7.7.3 Prerequisites

Before running the analysis, the sufficiency of attitudinal data to perform CA was assessed on two parameters.

a. Sample size: There is no fixed criterion about adequate sample size for cluster analysis. A trawl of cluster analysis based studies within the literature indicated a minimum sample size down to 10 and a maximum of 20,000 (Dolnicar 2002; Hair *et al.* 2006). Comfrey and Lee (1992) suggest that adequacy of sample size (n) might be evaluated very roughly on the following scale: 50 – very poor; 100 – poor; 200 – fair; 300 – good; 500 – very good; 1000 or more – excellent. The most conservative guidelines recommend 20 observations to every predictor variable (Anable 2002; Hair *et al.* 2006). Based on both the criteria, the data was considered sufficient n=428 (good) and 71.33 observations for each independent variable.

b. Suitability of input variables: It is also necessary to screen input variables for multi-colinaeraity as CA favours minimal correlations among variables in order to achieve good results[57]. As PCA has produced an uncorrelated set of variables due to orthogonal rotation (Quartimax), the data obviously met the second requirement. Thus, pre-testing concluded the data to be well-suited for cluster analysis.

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[57] Co-linearity can be simply defined as a high level of correlation between two variables. When more than two variables are involved, this would be called as multi-colinaeraity. Cluster analysis recommends avoiding it. The reason is when variables used in clustering are collinear; some variables get a higher weight than others. If two variables are perfectly correlated, they effectively represent the same concept. But that concept is now represented twice in the data and hence gets twice the weight of all the other variables. The final solution is likely to be skewed in the direction of that concept, which could be a problem if it's not anticipated (Sambandam 2011).

7.7.4 Analysis

Cluster analysis offers numerous ways to sort cases into groups including hierarchical cluster, *k*-mean clusters, and two-step cluster[58]. For this research, a two-stage cluster analysis approach, agglomerative *hierarchical clustering* and non-hierarchical *k-mean clustering analysis*, was adopted. There was no prior knowledge of how many groups are present or even whether there are any clusters in the data. Therefore, the hierarchical method was used first in an exploratory 'structure-seeking' phase. It was followed by the *k*-means iterative partitioning method to 'fine tune' the analysis (Hair *et al.* 2006, cited in Anable 2002). Although, this two stage clustering approach was more time-consuming, a number of researches have shown that it increases the validity of a solution (e.g. Mitchell 1993; Anable 2002; Kelly 2009). The following sections and Figure 23 illustrate the three stages of the analysis followed to identify clusters from the data.

7.7.4.1 Hierarchical cluster analysis (analysis 1)

The objective of doing hierarchical clustering in this phase was to reveal the number and structure of the clusters that represented the data most effectively, which could then be used as initial cluster seeds in *k*-means analysis (Anable 2002). It is one of the most straightforward methods which can either be agglomerative or divisive. The former begins with every case being a cluster unto itself, and ends with everybody in one large, but useless cluster. In contrary, divisive clustering starts with everybody in one cluster and end up with everyone in individual clusters. Obviously, neither the first step nor the last step is a worthwhile solution with either method, and a number of stopping rules are usually applied to select the appropriate number of clusters for the data (Nouršis 2008, p. 361).

The Average linkage (within groups) method of *hierarchical agglomerative cluster analysis* was used as the starting point to explore the structure and appropriate number of the clusters to retain from the data. The method combines clusters so that the average distance between all cases in the resulting cluster is as

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[58] In case of large data file or a mixture of continuous and categorical variables, use of SPSS two-step procedure is recommended. In case of a small dataset, where researcher wants to easily examine solutions with increasing numbers of clusters, hierarchical clustering should be used. However, in case of moderately size data with a prior knowledge of number of clusters needed, *k*-means clustering is recommended (Nouršis 2008, p. 361).

small as possible such that, the distance between two clusters is the average of the distances between all possible pairs of cases in the resulting cluster (Nouršis 2008, p. 371). The analysis at the start eliminated 153 cases from grouping iteratively and thus suggested 276 as the number of cluster solutions. A heuristic decision was needed to be made to select the appropriate number of clusters which could effectively divide the data into homogenous and well-balanced groups. Initially, a 3 to 6 cluster solution was considered reasonable for the data. Three criteria were further established to choose the best clustering solution.

Calculation of percentage difference in coefficients (check 1): According to this criterion, a substantial variation in the coefficients at any stage recommends the appropriate number of clusters for the data. Therefore, the agglomeration schedule, generated from the analysis, was inspected (Table 19), and the percentage differences in coefficients between the final stages of the schedule were calculated. Table 20 illustrates that a noticeable drop in the coefficient value between stages 272 and 273 (5.3%) and, then a sudden increase between stages 273 and 274 (7%) was observed. This variation suggested either a three or four-cluster solution as appropriate for the data.

Table 19: End segment of the average linkage (within groups) agglomeration schedule

Stage	Cluster combined		Coefficients	Stage cluster first appear		Next stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
268	33	139	8.621	263	239	272
269	3	121	8.650	266	237	271
270	12	71	8.910	264	251	273
271	3	15	9.463	269	0	274
272	6	33	10.041	265	268	274
273	12	21	10.570	270	267	275
274	3	6	11.309	271	272	275
275	3	12	12	274	273	0

Internal homogeneity of clusters (check 2): The check analytically examines the appropriate number of clusters to retain by calculating R-squared such that a sudden drop in the value of R-squared during cluster formation indicates a loss of homogeneity within clusters. Its value ranges between 0 (*perfectly heterogeneous* *clusters*) to 1 (*perfectly homogenous clusters*). A one-way analysis of variance (ANOVA) [59] using factor scores was performed to calculate homogeneity for each 3 to 6 cluster solution[60]. In agreement with the findings of check 1, a substantial drop in homogeneity was apparent for three and four-cluster solutions (7% and 5% respectively). However, it was considered manageable to retain the four-cluster solution in order to represent maximum variation in the sample population. Inspection of F-ratio (ANOVA) was applied as a last check to finalise the number of solutions (check 3).

Table 20: Percentage difference in coefficients between the final stages of the agglomeration schedule

Choosing the best clustering solution								
Check 1: The distance coefficients			No. of clusters	Check 2: Homogeneity of clusters				
				Pooled sum of squares across all clustering variables			Homogeneity of clusters	
Stage	Stage	% difference in coefficients		Within group	b/w group	Total	R^2	Change in R^2
269	270	3	7	1081.7	493.1	1574.8	0.31	-
270	271	6.2	6	1122.4	449.4	1571.8	0.28	-.02(2%)
271	272	6.1	5	1165.6	409.1	1574.8	0.26	-.03(3%)
272	273	5.3	4	1245.1	329.7	1574.2	0.21	-.05(5%)
273	274	7	3	1360.2	214.5	1574.2	0.14	-.07(7%)
274	275	6.1	2	1453.9	120.8	1574.2	0.1	-.04(4%)

Inspection of F-ration scores (check 3): The ANOVA examines the variability of the observations within each clusters as well as variability between group means by producing F-ratio. Based on these two estimates of variability, conclusions as to the significance of the differences in the means can be drawn

[59] Analysis of variance (ANOVA) is a general method of drawing conclusions regarding differences in population means when two or more comparison groups are involved (SPSS 2002).

[60] The analysis first summed up all within groups and between groups sum of squares. It then calculated the R-squared ratio by dividing between-groups sum of squares by total sum of squares.

(Anable 2002; Norušis 2008). The higher the F-ratio, the more there is variability between groups compared to within them and the more discrete and concentrated are the clusters (Banks 1998; Anable 2002). Table 21 shows the calculated F-ratio for each variable (attitudinal factor) for each of the possible cluster solutions. It indicates four-cluster solution as having the highest F-ratio[61]. Thus strengthened the preliminary decision of dividing driving population into four groups[62].

To summarise, the hierarchical clustering provided initial cluster seeds to be used in subsequent *k*-mean analysis which then attempted to extract more stable and homogenous groups from the sample population.

Table 21: F-Ratio scores for each of the cluster solution

Factors	3 clusters	4 clusters	5 clusters	6 clusters
A1-RULE-COMPLIANC	30.95	33.88	45.96	36.99
A2-CAREFUL DRIVING	27.55	94.19	77.77	66.24
A3-ENFORCEMENT	8.97	6.10	7.79	16.43
A4-PEER PRESSURE	14.67	10.48	14.97	12.56
A5-PERSONAL SAFETY	19.56	12.99	11.15	8.89
A6-ROAD USERS REGARD	30.24	23.65	18.67	15.18
	131.94	**181.31**	176.32	156.30

7.7.4.2 Non-hierarchical k-means cluster analysis (analysis 2)

After establishing the optimum number of clusters (i.e. four) for the sample population non-hierarchical clustering was subsequently performed to replicate the exploratory results with the intent to get more stable and homogenous sub-groups. There are number of methods available to conduct non-hierarchical clustering including centroid based *k*-means methods. The *k*-means analysis is a technique, also known as portioning technique, which attempts to construct a simple portioning of a data set into a set of *k* non-overlapping clusters such that the partitions optimise

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[61] As all six attitudinal factors were used to define segments. Therefore, while applying check 3, the analysis did not look for the highest number of large F-values. It instead looks for calculated sum of F-values to take into account combined effect of attitudinal factors. The higher the 'F' ratio, the more there is variability between groups compared to within them, and the more discrete and concentrated are the clusters (Anable 2002, p. 212).

[62] From now onwards, the clusters would interchangeably termed as 'groups' or 'segments'.

a given criterion. Each cluster must contain at least one data element, and each data element must belong to exactly one group. The method tries to assign data elements to clusters such that the mean square distance of data elements to the centroid of the assigned cluster is minimised (Anders 2003).

The technique differs from hierarchical clustering as it does not compute all possible clustering solutions. Instead, the number of clusters required (i.e. *k*) are specified as input and then the process iteratively assigns a case to the cluster for which its distance to the cluster mean is the smallest (Norušis 2008, p. 372). To simplify, the basic idea of this technique is to divide the objects into groups such that the between-group variation is large and the within-group variation is small (Bartholomew *et al.* 2008, p. 25).

To start running the process, the number of clusters (i.e. *k*=4) were specified as to perform a *k*-means analysis with 275[63] valid cases. Based on these cluster centres, the analysis placed each subject within the group with the closet centre. It iteratively re-computed the centres and subsequently reassigned the subjects in an attempt to achieve homogenous groups of drivers by maximising the distance between groups while minimising the distance within groups[64].

Finally, the analysis extracted four desired groups of unequal sizes with improved homogeneity in 15 iterations.

Table 22 shows the Euclidean distances[65] for the extracted groups and indicates that *k*-mean clustering successfully generated discrete groups such that

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[63] Sample size was reduced from 428 to 275 valid cases because in case of Cluster Analysis (and Factor Analysis), any missing data on any other variables excludes respondents from the analysis (for more details, see Anable 2002, p. 162).

[64] By using the cluster centres (i.e. four) generated by the prior hierarchical clustering, problems of the cluster results being biased by the order of observation are alleviated. As being iterative in nature, non-hierarchical clustering makes more than one pass through the data set. It places observations in the clustering groups by minimising the sum of the squared distances from cluster group means. The initial seeds are then replaced by the means of the clusters and the process is repeated until no more changes are made in the cluster (Anable 2003).

[65] A Euclidean distance is a measure of similarity and corresponds to the 'straight line' distance between two points (Bartholomew *et al.* 2008, p. 30).

even the two nearest clusters centres were at a distance of 1.71[66]. Based on the results it could be concluded that the *k*-mean clustering clearly produced distinguishable groups of drivers. However, to finally accept and interpret the findings, multiple discriminant analysis was conducted.

Table 22: Euclidean distance between final cluster centres

CLUSTERS	1	2	3
Cluster 1 (n=35; 12.73%)			
Cluster 2 (n=18; 6.54%)	3.020		
Cluster 3 (n=142; 51.64%)	2.106	2.541	
Cluster 4 (n=80; 29.09%)	2.344	2.660	1.715

7.7.4.3 Multiple Discriminant Analysis (analysis 3)

Before doing interpretation and profiling of the extracted clusters, multiple discriminant analysis was conducted as a penultimate stage of segmentation. The analysis was used to validate and assess how well clustering computed the most optimal solution. The technique is appropriate to adopt when the dependent variables are categorical (i.e. cluster groups) and the independent variables (i.e. attitudinal factor scores) are metric (Anable 2002, p. 51).

In the light of concepts derived from Norušis (2008, p. 275), the analysis was aimed (1) to examine whether the groups could be distinguished exclusively from each other based on linear combinations of values of predictor variables (i.e. attitudinal factors) used to create them, and (2) to determine if all the inclusive variables were appropriate to be used in clustering by assessing their individual contribution to separate the groups. The analysis involved '*derivation*' and '*validation*' stage, as discussed below.

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[66] The Differences between Final Cluster Centres table shows the Euclidean distances between the final cluster centres. Greater distances between clusters mean there are greater dissimilarities (UNT 2011, p.6). Its minimum value is 0, and it has no upper limit (IBM 2012).

a. Derivation stage: The analysis identified the influence of individual variables as well as the combined influence of variables (known as *discriminant function*) which were used to create the groups (in this case all six attitudinal factors extracted from PCA with Quartimax rotation) on dimension of discrimination (Norušis 2008). It determined whether statistically significant discriminant functions were derived to separate the groups (Anable 2002, p. 214).

Results of the analysis in Table 23 shows that all six factors, used in the formation of clusters, contributed well to explain their attitudinal characteristics by each loading significantly on at least one discriminant function (≥.30). For instance, attitudinal factor one, RULE-COMPLIANCE, contributed the most to Function 1, whereas CAREFUL-DRIVING and ENFORCEMENT contributed to Function 2, and PEER-PRESSURE, PERSONAL-SAFETY, ROADUSER-REGARD contributed significantly to Function 3.

Table 23: Multiple discriminant analysis

Factors	Discriminant function 1	Discriminant function 2	Discriminant function 3
A1- RULE-COMPLIANCE	.695*	-.357	-.387
A2- CAREFUL DRIVING	.289	.415*	.179
A3- ENFORCEMENT	-.151	-.382*	-.125
A4- PEER PRESSURE	-.110	-.329	.587*
A5- PERSONAL SAFETY	.209	.254	.432*
A6- ROADUSERS REGARD	-.261	.347	-.391*

*Largest absolute correlation between each variable and any discriminant function where loading >.30 considered significant.

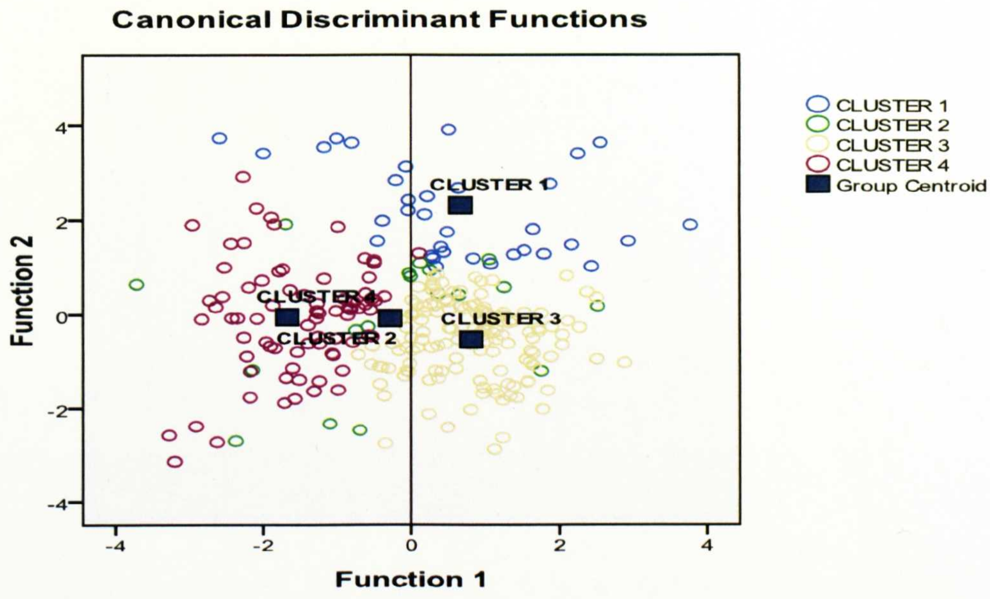

Figure 19: Clusters as determined by discriminant functions

Figure 19 further elaborates how four clusters generated in the study were distinct to each other on different attitudinal dimensions. For instance, discriminant function 1 (significantly representing attitudes towards rule-compliance) highlights the differences between clusters 3 and 4. Similarly, Function 2 (significantly representing attitudes towards careful driving and enforcement) could be seen clearly differentiating clusters 1 and 2. It would also be worth noting that cluster 2 and 4 seem to possess similar attitudinal dimensions as the groups' centres are close to each other. The subsequent analysis, therefore, also tried to explore whether the groups are generally comparable or not.

b. Validation stage: This assessed how good the discriminate functions were at putting cases into the right groups compared to what can be expected by chance alone (Anable 2002, p. 217). The results in Table 24 indicate that 96.7% of the cases (i.e. drivers) were correctly classified. The cross validation gave similar results by correctly classifying 94.4% of the grouped cases.

Table 24: Original and cross-validated classification results of sample population

Actual group	Actual no. of cases in each	Predicted group membership			
		Cluster 1	Cluster 2	Cluster 3	Cluster 4
Original: 96.7% of original grouped cases correctly classified					
Cluster 1	35	**35 (100%)**	0	0	0
Cluster 2	18	0	**171 (94.4%)**	0	1 (5.6%)
Cluster 3	142	0	11 (0.7%)	**138 (97.2%)**	3 (2.1%)
Cluster 4	80	3 (3.8%)	1 (1.3%)	0	**76 (95%)**
Cross Validated: 94.4% of cross-validated grouped cases correctly classified					
Cluster 1	35	**34 (97.1%)**	0	1 (2.9%)	0
Cluster 2	18	0	**17 (94.4%)**	0	1 (5.6%)
Cluster 3	142	1 (0.7%)	2 (1.4%)	**136 (95.8%)**	3 (2.1%)
Cluster 4	80	4 (5%)	1 (1.3%)	1 (1.3%)	**74 (92.5%)**

7.7.5 Summary

To summarise, cluster analysis concludes that the sample driving population of Pakistan is classifiable into four stable and homogenous attitudinal segments. Further, the results of discriminant analysis confirmed that the CA not only saliently used all latent variables in the attitudinal definition of the groups but classified more than 90% of subjects into their naturally occurring group. Therefore, the succeeding section interprets and label the segments in terms of their mean scores on all six attitudinal factors, and identify how distinct they are from each other.

7.8 Interpretation and profiling

The last stage of segmentation involved interpretation and profiling of the identified clusters in order to present the usefulness of the results for future research and intervention designs. The section not only aims to highlight the unique attitudinal characteristics of the clusters but to evaluate their behavioural dimensions and socio-demographic composition.

7.8.1 Attitudinal profiling of the segments

The clusters are labelled after their unique attitudinal profile, based on a combination of mean scores they had on each attitudinal variable. The mean factor score for each segment can be used to assess its degree of agreement or disagreement with a particular construct. The farthest away a particular score is from zero, the more strongly that cluster is related to that factor (Redmond 2000; Anable 2002, p. 228). The scores are also used to compare like-mindedness and differences of the groups on different road safety related aspects. Thus, the labelling has been done such as to facilitate immediate conceptualisation of attitudinal profile unique to each segment, and gaining quick understanding of the differences among the segments. Table 25 presents standardized means of clusters on all six attitudinal factors, generated during *k*-means clustering. ANOVAs with post-hoc multiple comparisons indicate that all four groups' responses differed significantly on each attitudinal dimension, described as follows.

It is important to note that while ANOVA is a general method of drawing conclusions regarding differences in population means when two or more comparison groups are involved, post-hoc multiple comparison tests see specifically which population groups differ. In this research, Hochberg and Games-Howell post-hoc multiple comparisons tests were used such that if the assumption of homogeneity of variance met for the factor, Hoch-berg results were used for multiple comparison of the groups. However, if the Levene test was significant ($p<0.05$) i.e. homogeneity of variance assumption wasn't true for the factor data than the F-value was rectified and inspected by using Brown-Forsythe and Welch test. Similarly, Games-Howell values were used for multiple comparisons of the groups on that particular factor (for further details, review SPSS 2002; Norušis 2008).

It is also important to note that the assumptions needed for the ANOVA are (1) random, independent sampling from the k populations; (2) normal population distributions; and (3) equal variances within the k populations. Assumption 1 is crucial for any inferential statistic. Assumptions 2 and 3 can be relaxed when large samples are used. As the present data specifically met the first assumption, and allowed to relaxed assumption 2, and 3 (due to its good sample size and its nominal composite scores of the segments produced in CA). Therefore performing parametric ANOVA was considered favourable in order to get more meaningful results (for more details, see Berger 2010). To further elaborate attitudinal characteristics of the segments, Appendix F provides their Mean scores (and standard deviation) on attitudinal items of each the extracted factor.

Cluster one (n = 35, 12.73%) emerged as a group of drivers who have the highest law-abiding attitudes (A1) and tend to appreciate careful driving (A2). Among the segments, the group has highest mean scores on 9 out of 13 attitudinal items of A1, and 2 out of 6 items of A2 such that it discourages to take a chance now and then on roads (item 51; A1), enjoy to follow traffic rules and regulations (item 58; A1), and appreciate if people are stopped by traffic wardens for changing lane without using indicator (item 9; A1). Similarly, the group's driver does not appreciate to ignore traffic signals (item 17; A2), or to drive a vehicle at night with poor lights (item 11; A2). However, at the same time, the group evolved as a group of 'independent drivers' who do not appreciate the influence of external factors such as 'enforcement' (A3), or 'peer pressure' (A4) which can control their driving. For example, amongst the segments, this group's driver is in least favour of applying stringent checks and monitoring of vehicle safety standards (item 14; A3). His attitude to comply with rules and regulations remain unaffected with changes in driving locations (item 49; A4) or disobeying behaviour of fellow drivers (item 52; A4). The group is therefore termed as '*autonomous*'. However, in order to ensure undisrupted, free movement, the group is least likely to regard other road users (A6) or their own personal safety (A5). The group's driver has reported the least favourable orientation to use seatbelt/helmet (items 3 and 4; A5), or respecting their fellow female drivers (item 21; A6).

Table 25: Mean scores and significant differences of clusters on attitudinal variables

	Autonomous (cluster 1)	Opportunists (cluster 2)	Regulators (cluster 3)	Risk-averse (cluster 4)	F-value
A1- RULE-COMPLIANC	**$.58^{23}$**	**$-.93^{134}$**	$-.29^{124}$	**$.46^{23}$**	24.55*
A2-CAREFUL DRIVING	**$.56^{34}$**	**$.96^{34}$**	$-.05^{124}$	**$-.43^{123}$**	19.39*
A3- ENFORCEMENT	$-.24^{234}$	**$-.95^{13}$**	**$.61^{124}$**	**$-.78^{13}$**	71.35*
A4-PEER PRESSURE	**$.98^{34}$**	$.33^{4}$	$-.02^{14}$	**$-.50^{123}$**	23.97*
A5-PERSONAL SAFETY	**$-.89^{34}$**	-.28	$.06^{1}$	$.25^{1}$	14.28*
A6-ROADUSERS REGARD	**$-.79^{234}$**	**1.52^{134}**	$-.01^{12}$	$.03^{12}$	27.23*
Total AQ score	136.28	129.89^{3}	137.70^{24}	133.35^{3}	4.26*

Note: A high score (centroid elements >0.40 in magnitude) on a factor either with positive (favourable) or negative (unfavourable) orientation, represents a strong association of the group on that particular construct. The Hochberg post-hoc multiple means comparison test was used for AF1, AF3, AF5, and AF6, and Games-Howell for AF2 and AF4 such that, the superscripts show which mean scores of clusters are significantly different (at *p<.01) from other groups.

The drivers in the smallest cluster, cluster two (n = 18; 6.54%) reported the strongest intentions to break the law (A1) in the sample, and indicated least favourable attitudes towards enforcement (A3). For example, in this group's driver opinion people should not be stopped for close-following (item 29; A1) or improper lane changing (item 9; A1), and favours to take revenge of an impolite behaviours (item 43; A1), or running a red light (item16; A3). Likewise, the group does not appreciate to receive fine for disregarding stop lines (item 10; A3), or strict enforcement of overtaking regulations on urban roads (item 32; A3). Therefore, the group is labelled as '*opportunists*' who always keep seeking a chance to moving ahead on the roads. Always looking for opportunities to get ahead, the group are very careful (A2) as any disruption could interfere with their ability to manoeuvre. Therefore, it does not appreciate to drive with worn-out tires (item 13; A2) or a hand-held mobile (item 22; A2). The group drivers are also appeared to be highly considerate towards other road users (A6) and reported the highest respect towards female drivers (item 21; A6), and traffic police wardens (item 38; A6).

Cluster three (*n* = 142, 51.64%) emerged as the largest group of the study, and is characterised by its highly favourable attitudes towards enforcement (A3). Among the segments, the group has highest mean scores on all nine attitudinal items of A1 such that the group strongly favours that traffic wardens should fine as many people as possible for disregarding stop lines (item 10; A3), for overloading (item 54; A3). The group has favourable orientation towards more stringent enforcement of rules and regulations related to overtaking (item 32; A3), use of LCD TVs in vehicle (item 25; A3), use of mobile phones (item 23; A3) as well as vehicle safety standards (item 14; A3). The group has reported the strongest attitudinal orientation on item 37 (M =4.45; SD=.83), and indicated to improve their intentional behaviour more if the condition of road traffic improves in Pakistan. Therefore, it is labelled as '*regulators*'. Although A1 does not have significant loading on the group (>.40), it is the only other noticeable dimension of this group, which indicates their low propensity to comply the rules (A1). The group thinks it is acceptable to drive in an unsafe manner in bad traffic condition (item 36; A1), or running red light if waiting time at signals is too long (item 15; A1).

Cluster four (n = 80, 29.09%) drivers are not in favour of stringent law enforcement (A3), tend to condone careful driving (A2), and are likely to be affected by peer pressure (A4). For example, the group does not appreciate to receive fine for carrying good/articles in vehicle more than its capacity (item 54; A3), thinks it is okay to ignore traffic signals (item 17; A2) or to drive with worn-out tires (item 13; A2), and are likely to get angry and drive unsafely if other drivers do not respect their right of way (item 42; A4). However, at the same time, the group significantly favours rule-compliance (A1), and tend to feel they should not break the rules if others do (item 44; A1). They think traffic rules are easy to be carried out in practice (item 33; A3), and appreciate to wait at traffic signals irrespective of long waiting times (item 15; A1). Therefore, the group emerged as '*risk-averse*' in nature.

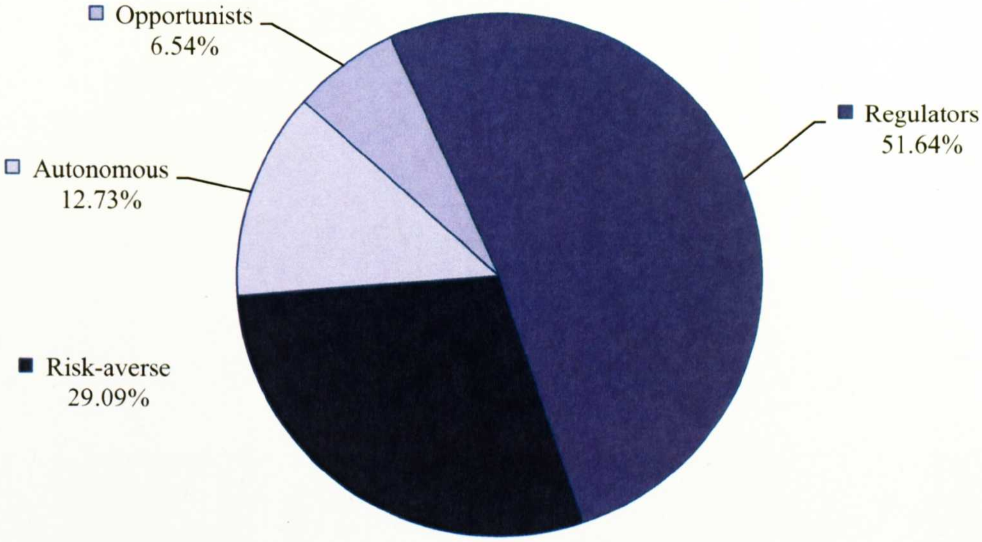

Figure 20: Names and size of each group

Figure 20 indicates name and size of each of the group. To further elaborate the attitudinal characteristics of the segments, Figure 21 draws average mean score of the clusters on each factor and shows how distinct (or similar) segments are from each other.

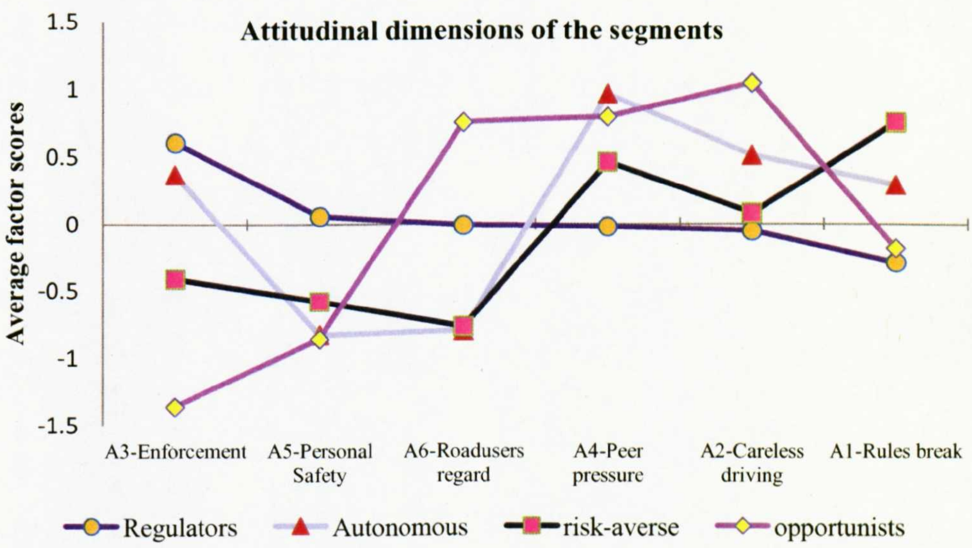

Figure 21: Attitudinal dimensions of the segments: average mean score of clusters on each behavioural factor

Figure 22 further observes total mean scores of the segments on AQ items. It shows that overall the *regulators* reported the most favourable attitudes towards road safety by scoring highest. Whilst, Hochberg post-hoc multiple comparisons indicates the group to be significantly different from the *opportunists* and the *risk-averse* (see Table 25). The *autonomous* and the *risk-averse* subsequently emerged as the second and third groups in terms of holding positive attitudes, and the *opportunists* as holding the most unfavourable attitudes towards road safety in the sample.

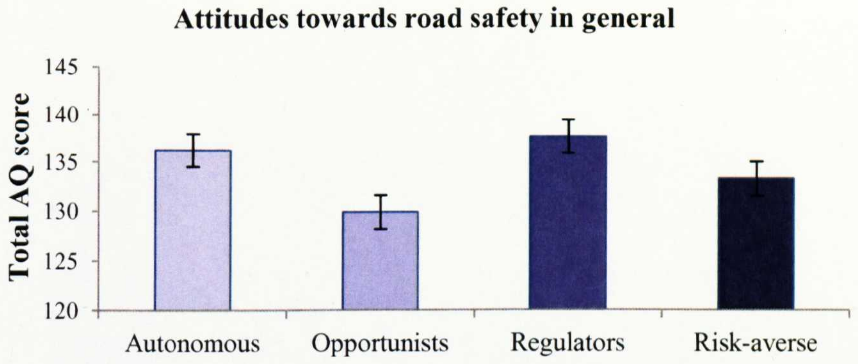

Figure 22: A relative comparison of self-reported total scores of groups on the Attitudinal Questionnaire (AQ)

To summarise, cluster analysis has classified the sample driving population of Pakistan into four attitudinal segments, namely the *autonomous*, *opportunists*, *regulators* and *risk-averse*. ANOVAs with post-hoc comparisons further confirmed that the groups are significantly different on each of the six attitudinal dimensions such that the *regulators* has the 'most' and the *opportunists* the 'least' favourable attitudes towards road safety. Figure 23 sums up the entire process involved in clustering and attitudinal profiling of the extracted groups.

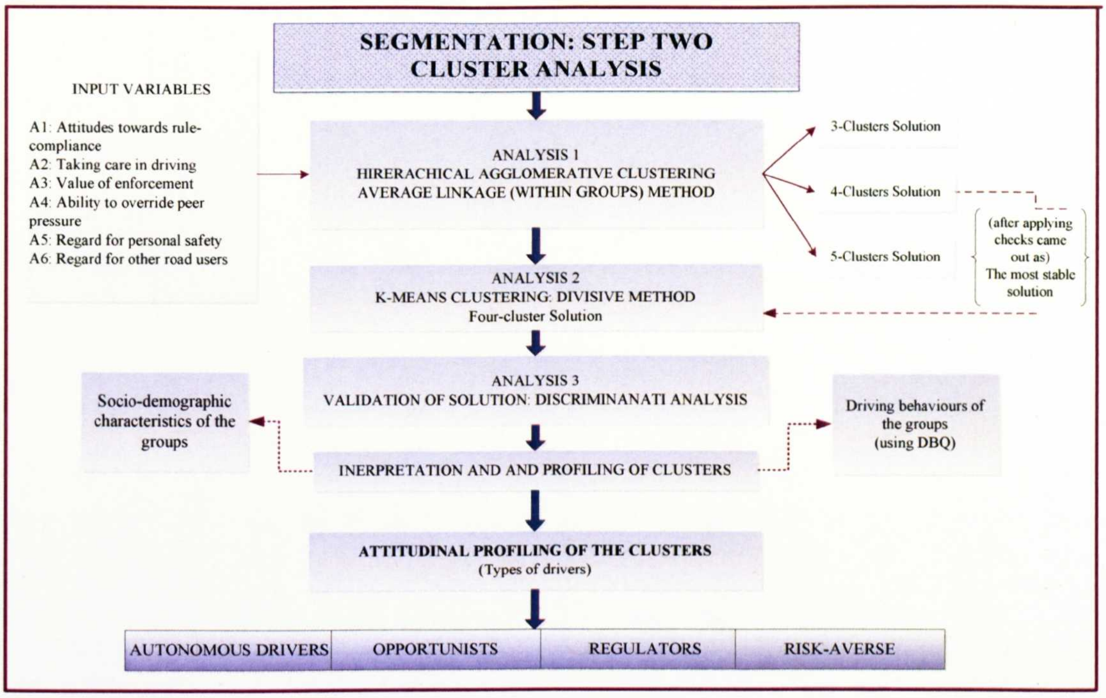

Figure 23: Segmentation step two: cluster analysis

7.8.2 Behavioural profiling of the segments

In this stage, attitudinal segments are profiled in terms of their driving behaviours, which were tapped using extended version of the DBQ. It also investigates influence of attitudes in shaping of segments behaviours.

7.8.2.1 Principal Component Analysis with Promax rotation

In order to (1) examine the behavioural dimensions of the sample population, and to (2) investigate whether the segments are distinct in terms of these dimensions; DBQ data was first factor analysed by following a similar procedure to that adopted for the attitudinal data (for details, refer back to section 7.6.4). The behavioural data was first screened and considered suitable for the analysis as it successfully met prerequisites of Kaiser-Meyer-Olkin measures of sampling adequacy (.928) and Bartlett's test of sphericity (2953.855, p <.000). The items were then subjected to Principal Component Analysis (PCA) as the underlying behavioural dimensions of Pakistani drivers were unknown.

The analysis generated five-factors with eigenvalue greater than 1 and noted a high inter-correlation between the first four factors (> 0.30). This favoured non-orthogonal (oblimin) rotation which was needed to simplify factors structure for interpretation. Thus, the analysis was re-run with promax rotation (a type of oblimin rotation). The scree plot suggested three-factor solution reasonable for the data set. However, based on the common rule of thumb of each factor having at least three variables that load highly on it (Norušis 2008), a four-factor solution was deemed appropriate to retain[67]. Collectively, these factors explained 51.28% of the total variance. Cronabach's alpha (α) reliability coefficients of the factors exhibited excellent internal consistency (>.70). Table 27 summarise the results of factor analysis.

The first behavioural factor accounted for 35.5% of the total variation (α=.853). It consists of a mix of items related to aggressive and Highway Code violations such that five out of eight items are directly tapping speeding and chasing behaviours of drivers. Therefore, this factor is labelled as measuring '*intimidating*' behaviour of the drivers. The second behavioural factor accounted for 6.55% of the variation (α=.78) with seven items, all tapping behaviours related to breaking rules and regulations. Therefore, it is labelled as '*being above the rules*'.

The third factor was composed of four '*risk-prone infringements*' and explained 4.76% of the variation (α=.76). It includes items such as drink driving and overloading. The last factor explained 4.46% of the total variation (α=.72) such that four out of its five items tap line/lane changing behaviours of drivers to compete for space on road. Therefore, it is labelled as '*assertion-this is my space*'.

The means (M) and standard deviations (SD) of the final set of DBQ items are also given in Table 26 in descending order. Univariate descriptives reveal that Pakistani drivers tend to sound the horn (item 9; M=2.35) and engage in risky overtaking (item 4; M=2.32) more than drunk driving (item 2; M=.81) or speeding (item 12; M= 1.37).

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[67] In total, five behavioural variables were omitted in different stages of FA for the given reasons: (1) the variable failed to load significantly on factor (>.30), (2) variable loaded on more than one factor with a difference between the loadings <.50, and/or (3) variable reduced the internal reliability (α value) of the factor (omitted variables item number in DBQ questionnaire are 14, 15, 16, 19, 20).

Table 26: Means and standard deviations for the DBQ violation items

Violation items (type, item number)	M	SD
How often do you sound your horn to indicate your annoyance to another driver? (AV,8)	2.35	1.56
How often do you overtake a slow driver on the inside? (HCV,4)	2.32	1.56
How often do you speed, blow horn or overtake to get ahead of female drivers? (AV,13)*	2.04	1.65
How often do you manage to drive a vehicle within poor maintenance conditions? (HCV,29)*	1.94	1.58
How often do you pull out of a junction so far that the driver with right of way has to stop and let you out? (AV,5)	1.93	1.54
How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane? (AV,3)	1.85	1.39
How often you do not stop at the stop line? (HCV,18)*	1.83	1.64
How often do you use a hand held mobile phone when you are driving? (HCV,28)*	1.78	1.48
How often do you drive so close to the car in front that it would be difficult to stop in an emergency? (HCV,7)	1.77	1.57
How often do you disregard the speed limit on a residential road? (HCV,11)	1.76	1.51
How often do you cross a junction knowing that the traffic lights have already turned against you? (HCV,6)	1.75	1.51
How often do you use high beam lights during driving at night time in built-up areas? (HCV,22)*	1.69	1.61
How often do you ignore continuous white lines while changing a lane on road? (HCV,17)*	1.69	1.38
How often do you use your status profile or personal connections to get rid of fines, penalties? (HCV,23)*	1.67	1.67
How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can? (AV,10)	1.64	1.42
How often you do not stop at the call of traffic police wardens? (HCV,24)*	1.63	1.73
How often do you park your vehicle in a no parking zone? (HCV,27)*	1.52	1.56
How often do you become angered by another driver and give chase with the intention of giving him/her a piece of your mind? (AV,1)	1.50	1.6
How often do you drive against one-way traffic? (HCV,26)*	1.46	1.46
How often do you race away from traffic lights with the intention of beating the driver next to you? (AV,9)	1.44	1.55
How often do you carry goods/articles in your vehicle more than its capacity? (HCV,21)*	1.38	1.41
How often do you disregard the speed limit on a motorway? (HCV,12)	1.37	1.51
How often do you drive with tinted windows glass? (HCV,25)*	1.36	1.57
How often do you drive when you suspect you might be over the legal blood alcohol limit? (HCV,2)	.81	1.28

Note: AV =aggressive violations; HCV=Highway Code violations; and * = newly included items related to Pakistan. Scale ranged from *never* (0) to *nearly all the times* (6).

Table 27: Dimensions of aberrant behaviours of Pakistani drivers

	Mean (SD)	Factor loading	% Var.	α
Factor 1- Intimidating other road users (B1-INTIMIDATING)			*35.5%*	*.85*
How often do become angered by another driver and give chase with the intention of giving him/her a piece of your mind? (AV, 1)	1.50 (1.60)	.517		
How often do you overtake a slow driver on the inside? (HCV, 4)	2.32 (1.56)	.728		
How often do you drive so close to the car in front that it would be difficult to stop in emergency? (HCV, 7)	1.77 (1.57)	.560		
How often do you race away from lights with the intention of beating the driver next to you? (AV, 9)	1.44 (1.55)	.580		
How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can (AV, 10)	1.64 (1.42)	.684		
How often do you disregard speed limit on residential road? (HCV, 11)	1.76 (1.51)	.772		
How often do you disregard speed limit on a motorway? (HCV, 12)	1.37 (1.51)	.467		
How often do you speed, blow horn or overtake to get ahead of female drivers? (AV, 13)*	2.04 (1.65)	.712		
Factor 2- Being above the rules (B2- ABOVE RULES)			*6.55%*	*.78*
How often do you cross a junction knowing that traffic lights have already turned against you? (HCV,6)	1.75 (1.51)	.367		
How often do you use high beam lights during driving at night time in built-up areas? (HCV, 22)*	1.69 (1.61)	.362		
How often do you use your status profile or personal connection to get rid of fines, penalties? (HCV, 23)*	1.67 (1.67)	.503		
How often do you drive against one-way traffic? (HCV, 26)*	1.46 (1.46)	.627		
How often do you park your vehicle in a no parking zone? (HCV, 27)*	1.52 (1.56)	.585		
How often do you use a hand held mobile phone when you are driving? (HCV, 28)*	1.78 (1.48)	.635		
How often do you manage to drive a vehicle with poor maintenance conditions? (HCV, 29)*	1.94 (1.58)	.779		

Note: Extraction method: Principal Component Analysis; Rotation method: Promax with Kaiser Normalisation (rotation converged in 11 iterations).

* indicates newly included items in the DBQ and 'high' loading on a factor denotes unfavourable driving behaviours.

Scale ranged from *never* (0) to *nearly all the times* (6) such that higher scores on any item indicates aberrant behaviour.

Table 27 (cont...): Dimensions of aberrant behaviours of Pakistani drivers

	Mean (SD)	Factor loading	% Var.	α
Factor 3- Risk prone infringements (B3- INFRINGMENTS)			*4.76%*	*.76*
How often do you drive with tinted window glass? (HCV, 25)*	1.36 (1.57)	.649		
How often do you drive when you suspect you might be over the legal blood alcohol limit? (HCV, 2)	.81 (1.28)	.757		
How often do you carry goods/articles in your vehicle more than its capacity? (HCV, 21)*	1.38 (1.41)	.471		
How often do you not stop at the call of traffic police wardens? (HCV, 24)*	1.63 (1.73)	.457		
FACTOR 4- Assertion; this is my space (B4- ASSERTION)			*4.46%*	*.72*
How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane? (AV, 3)	1.85 (1.39)	.472		
How often do you pull out of a junction so far that the driver with right of way has to stop and let you out? (AV, 5)	1.93 (1.54)	.455		
How often do you sound your horn to indicate your annoyance to another driver (AV, 8)	2.35 (1.56)	.424		
How often do you ignore continuous white lines while changing a lane on road? (HCV, 17)*	1.69 (1.38)	.637		
How often do you not stop at the stop line? (HCV, 18)*	1.83 (1.64)	.817		
Total variance explained (*before rotation*)			**51.27%**	

Note: Extraction method: Principal Component Analysis; Rotation method: Promax with Kaiser Normalisation (rotation converged in 11 iterations).

* indicates newly included items in the DBQ and 'high' loading on a factor denotes unfavourable driving behaviours.

Scale ranged from *never* (0) to *nearly all the times* (6) such that higher scores on any item indicates aberrant behaviour.

7.8.2.2 Behaviours of the segments

PCA with Promax rotation produced four factors, each measuring an exclusive and highly reliable behavioural construct related to Pakistani drivers. The study further explores the magnitude of these behaviours by attitudinal segments. For this, ANOVAs with post-hoc multiple comparisons were performed to study whether there were significant differences between the groups on mean scores of the extracted factors (Table 28). As for the attitudinal factors the mean score of a segment on any behavioural factor indicates its degree of agreement or disagreement on that particular construct. The behaviours of the groups are also assessed on some other driving indicators including total DBQ score, weekly mileage, near misses and accidents. Appendix G further elaborates behavioural characteristics of the segments by providing their mean scores on each of the behavioural item, the DBQ factors contained.

Table 28: Mean scores and significant differences of clusters on behavioural factors and other driving related variables

	Autonomous (cluster 1)	Opportunists (cluster 2)	Regulators (cluster 3)	Risk-averse (cluster 4)	F-value
B1.INTIMIDATING	-.08	**.41**	$-.23^{4}$	$.33^{3}$	5.65*
B2.ABOVE RULES	.22	**$.45^{3}$**	$-.24^{24}$	$.31^{3}$	5.90*
B3.INFRINGMENTS	.05	.29	$-.27^{4}$	$.28^{3}$	5.04*
B4.ASSERTION	.00	**$.49^{3}$**	$-.28^{24}$	$.35^{3}$	7.91*
Total DBQ score	57.43	65.22^{3}	47.43^{24}	63.44^{3}	10.06*
Weekly mileage (km)	240.20	240.06	445.85^{4}	255.19^{3}	3.63**
Near misses	1.77	2.61	2.66	2.38	.663
Accidents	1.11	1	1.64	1.27	.611

Note: A high score (centroid elements >0.40 in magnitude) on a factor either with positive (favourable) or negative (unfavourable) orientation, represents a strong association of the group on that particular construct. The Hochberg post-hoc multiple means comparison test was used for B1, B2 and B4, and Games-Howell for B3 such that, the superscripts show which mean scores of clusters are significantly different (at *p<.001 and ** p<.05) from other groups.

To be specific, the results indicate that *autonomous* drivers consider themselves above the rules (B1). This behavioural dimension of the group can be well-understood by recalling that this group of drivers hold strong rule-breaking attitudes (A1), and also do not favour stringent enforcement (A3) (refer to Table 25).

Interestingly, the group indicated indifferent behaviours on the other three dimensions. The post-hoc results indicate that, despite reporting significantly different attitudes towards road safety in comparison to rest of the sample population, the *autonomous* are not significantly different from it in terms of behaviours. The total DBQ score of the group suggests it to be the second safest group of the study. Amongst the segments, the notable behavioural characteristic of this group is its tendency to use its status profile or personal connection get rid of fines, penalties (item 23; B2), or to drive against one-way traffic (item 26; B2).

The *opportunists* emerged as the most dangerous group of drivers by loading consistently high (>.40) on all four behavioural factors. The results indicate that this group of drivers is more likely to engage in all types of aberrant behaviours on-roads. It is, therefore, not a surprise that despite being the smallest in size, the group has one of the highest rates of encountering near misses in the sample. The post-hoc multiple comparisons reveal that the group is significantly different than *regulators*. Among the segments, the groups has reported the most deviant behaviour while overtaking (item 4; B1), close-following (item 7; B1). The group has highest propensity to cross a junction against traffic lights (item 6; B2), to drunk drive (item 2; B3), and to pull out of a junction (item 5, B4). The group behavioural dimensions are clearly comparable to its opportunistic nature as overall it reported the least favourable attitudes towards road safety including a strong inclination towards breaking the rules (A1) and disfavouring enforcement (A3).

The *regulators* loaded consistently, although not significantly (<.40), on all the factors. Earlier, the group was characterised attitudinally by only loading significantly on one factor i.e. value of enforcement (A3). However, its moderate, although insignificant, loadings on behavioural factors helped gaining much more information about it. Overall, the group of drivers reported not to engage in deviant behaviours. A further close inspection of their mean scores on different behavioural items (see Appendix G) provides interesting information that the group has reported the least aberrant behaviours, in comparison to other three segments, on all of the items except item 23 (B2). Which indicates that the group driver tend to use personal connections to get rid of fines. The finding supports putting them in the safest category of the drivers in the sample with the lowest total DBQ score.

The *risk-averse* group somewhat mirrors the behavioural profile of the *opportunists* (e.g. see mean scores of both the groups on items 4, 10, 13, 22, 26 in Appendix G). Although not significantly (<.40), the group reported to engage in all types of aberrant behaviours with moderate loadings on the factors. With its total DBQ score, the group becomes the second most dangerous in the sample.

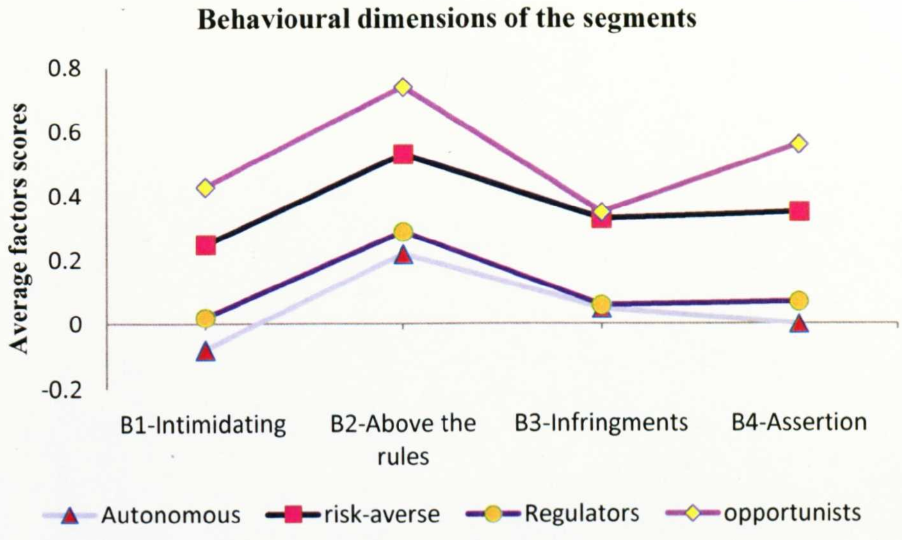

Figure 24: Behavioural dimensions of the segments

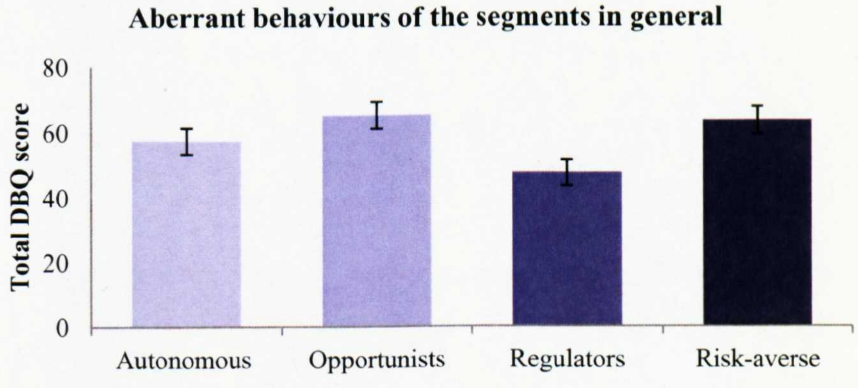

Figure 25: A relative comparison of self-reported total scores of groups on the Driver Behaviour Questionnaire (DBQ)

To further elaborate behavioural differences of the segments, Figure 24 indicates average mean score of the segments on each behavioural factor and shows that the attitudinal segments have relatively distinct behavioural dimensions (see Figure 21). However, by plotting their total DBQ scores, Figure 25 reveals that although the groups reported different behaviours from each other, the differences are only slightly noticeable to the naked eye unlike their overall attitudinal differences (see Figure 22).

7.8.2.3 Correlations between attitudinal and behavioural factors

This research hypothesised that the reason why drivers engage in risky behaviours is predominantly linked to their attitudes towards road safety. Therefore, along with profiling of behavioural characteristics of the segments, this study also measured Pearson's bi-variate correlation coefficients (r)[68] for attitudinal[69] and behavioural factors. Table 29 indicates that favourable attitudes towards road safety significantly reduce aberrant behaviours of drivers (total DAQ score versus DBQ score).

Specifically, the results suggest that attitudes towards enforcement (A3) are the strongest predictor of drivers' behaviours such that favourable attitudes significantly reduce commissioning of all types of aberrant behaviours. The factor is also inversely correlated to accidents. Attitudes towards careful driving (A2) have small but significant contribution to engaging in aberrant behaviours (B1, B2, and B3). Ability to override peer pressure (A4) emerged as the third significant attitudinal dimension shaping drivers' behaviours such that drivers who are not affected by peer pressure or their surroundings, are less likely to break the rules (B1). The results also indicate that all behavioural factors are strongly correlated to each other such that committing one leads to another, and results into near-misses and accidents.

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[68] The Pearson correlation coefficient is a measure, in absolute value, of the strength of the linear relationship between two variables. Its value ranges from -1 to +1 (Norušis 2008; p. 203) such that strength of association can be small (.1 to .3), medium (.3 to .5), and large (.5 to 1) (Lund Research 2010).

[69] As the attitudinal factors are un-correlated (PCA; orthogonal rotation yielded un-correlated attitudinal factors, therefore, Table 29 does not report the association of all six attitudinal factors with each other.

Table 29: Correlations between attitudinal and behavioural factors

Variables	B1	B2	B3	B4	DBQ	NM	AC
A1. RULE-COMPLIANC	-.04	.02	-.00	.03	.02	-.07	-.01
A2. CAREFUL DRIVING	.17**	.18**	.21**	.09	.21*	.07	.01
A3. ENFORCEMENT	-.33**	-.30**	-.27**	-.26**	-.33*	.00	-.23**
A4. PEER PRESSURE	-.13*	-.07	-.08	-.10	-.12	-.06	-.01
A5. PERSONAL SAFETY	-.01	-.01	-.04	-.1	-.07	.18**	.00
A6. ROADUSERS REGARD	-.01	.01	.09	.07	.07	.05	.00
Total AQ score	-.17**	-.13*	-.07	-.12*	-.29**	-.10*	-.03
B1. INTIMIDATING	-	.55**	.50**	.53**	.85*	.24**	.16**
B2. ABOVE RULES		-	.44**	.38**	.76*	.17**	.13
B3. IINFRINGEMENTS			-	.35**	.71*	.08	.08
B4. ASSERTION				-	.69*	.12	.00
Total DBQ score					-	.23*	.15*
NM. Near misses						-	.14**
AC. Accidents							-

Note: Correlation is significant at the * 0.05 level (2-tailed) and at the **0.01 level (2-tailed).

To summarise, PCA with Promax rotation produced four behavioural factors. However, the correlations with the attitudinal segments were generally low (except the *opportunists* which loaded >.40 on all the factors except B3). ANOVAs with post-hoc comparisons indicate that the behaviours of the *regulators* are significantly different from the *opportunists* and *risk-averse*. It is also worth noting that despite holding different attitudes towards road safety, the *opportunists* and the *risk-averse* are somewhat similar in terms of their driving behaviours, and can be treated as relatively more dangerous groups of the drivers in the sample. The results are concluded with different attitudinal and behavioural factors are low to moderately correlated to each other.

7.8.3 Socio-demographic characteristics of the segments

In order to assess the influence of personal characteristics on the attitudes and behaviours of drivers in Pakistan, the final stage of the profiling identified demographic and socio-economic composition of the segments. Table 30 provides socio-demographic composition of the groups in percentages[70]. To add, due to unequal group sizes, relative percentages of the groups have been compared not only with each other but with the overall sample to get a broader idea. Table 31 examines significant differences between the groups on the personal variables using chi-square[71].

The results indicate that the *autonomous* group is mainly composed of drivers from young age group and lower-income background. Being less successful in socio-economic terms, the group has the highest percentage of motorcyclists in it. Nearly two-third of its drivers have only attained basic education (up to intermediate), and are mainly in full/part-time employment in government sector. However, interestingly, the group has a reasonable percentage of degree holders in it (37.2%) in comparison to other affluent groups and overall composition of the sample. One possible reason of this contradiction is that a trend of distant learning in lower-income groups of the society is developing. Due to this trend, the increasing number of open universities is also being established in the country (e.g. Virtual Univeristy of Pakistan, Allama Iqbal Open Univeristy).

The *opportunists* are the drivers from higher-income group who mainly drive cars. As the overall sample population consisted of 86.2% of males, it is obvious that the groups are predominantly male. However, nearly one-third of drivers in the group are female, which is the largest proportion of all. Furthermore, half of the group population is single, with also a considerable percentage of separated/divorced individuals in comparison to other groups. As the group is affluent, it therefore should not be surprising that it has students and degree holders in higher percentages than the sample as a whole.

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[70] The table provides within group, not between group socio-demographic compositions of each group in order to indicate their unique characteristics. It is also important to note that when respondents did not provide their personal information, cumulative percentage is less than 100.

[71] Due to variables being categorical in nature, chi-square test was used.

Table 30: Socio-demographic characteristics of the segments

Variable	Autonomous (cluster 1)	Opportunists (cluster 2)	Regulators (cluster 3)	Risk-averse (cluster 4)	In sample
1. Age (%)					
≤19	14.3	16.7	7.70	17.5	*12.0*
19-34	60.0	61.1	66.9	63.8	*64.7*
≥35	20.0	22.3	23.2	13.8	*20.0*
2. Income group (%)					
Lower-income	48.6	27.8	45.8	22.5	*38.2*
Middle-income	17.1	16.7	24.6	21.3	*22.2*
Higher-income	17.1	38.9	13.4	31.3	*20.7*
3. Gender (%)					
Male (%)	85.7	72.2	91.5	75.0	*84.7*
Female (%)	14.3	27.8	7.70	25.0	*14.9*
4. Marital status (%)					
Single	51.4	50.0	48.6	66.3	*54.2*
Married	40.0	38.9	49.3	28.8	*41.5*
Separated/divorced	2.90	5.60	0.70	2.60	*1.8*
5. Housing tenure type (%)					
Own/buying	51.4	55.6	41.5	58.8	*48.7*
Rent	22.8	27.8	27.4	22.5	*25.4*
Living in joint family	20.0	11.1	24.6	15.0	*20.4*
6. Education (%)					
Up to intermediate	57.2	40.7	65.5	51.4	*59.6*
Graduates	22.9	27.8	18.3	26.3	*21.8*
Postgraduates	14.3	16.7	10.5	11.3	*11.7*
7. Children at home (%)	25.7	38.9	43.7	30.0	*37.1*
8. Type of vehicle (%)					
Motorcyclists	48.57	33.33	41.55	40.0	*41.45*
Car	34.28	55.56	35.21	50.0	*40.73*
Professional drivers	17.14	11.11	22.53	10.0	*17.45*
9. Occupation type (%)					
Self-employed	8.60	16.7	24.6	17.5	*20.0*
Part/full-time employed	37.1	27.8	41.5	22.5	*34.5*
Unemployed/retired/ Looking after family	20.0	11.2	4.20	12.6	*12.6*
Student	31.4	44.4	22.5	43.8	*31.3*
10. Occupation category (%)					
Government	37.1	22.2	24.6	15.0	*23.2*
Private	17.1	22.2	50.0	30.0	*38.2*

The *regulators* mainly belong to lower and middle-income backgrounds. The group has younger drivers in the least and mature drivers in the highest percentage in comparison to the sample, equally for married individuals with children at home. Coming from humble backgrounds, the group contains degree-holders and individuals with their own houses in the lowest percentages. It also has the highest percentage of professional drivers along with full/part-time employed individuals who mainly work in the private sector.

Table 31: Statistical significance of the differences in demographic characteristics among clusters

	Between the groups X^2 (df, N), p-value
1. Age	NS
2. Income	$X^2(9, N = 257) = 23.145, p = .006$
3. Gender	$X^2(6, N = 257) = 15.305, p = .017$
4. Marital status	NS
5. Kids at home	NS
6. Housing tenure type	NS
7. Education	NS
8. Vehicle type	NS
9. Occupation type	$X^2(27, N = 257) = 52.714, p = .002$
10. Occupation category	$X^2(12, N = 275) = 34.539, p = .001$

Lastly, the personal profile of risk-averse indicates them to be mainly single, student and affluent, people who drive cars. The group has the highest percentage of home-owning in the sample. It also has second highest percentage of degree-holders and females in the sample after the opportunists.

Although, the segments have varying socio-demographic characteristics, the results in Table 31 note that the groups have only a few statistically significant differences; among which income-level, gender and occupation types are prominent attributes.

To summarise, the attitudinal segments have varying compositions of socio-demographic characteristics. For instance, the results suggest that the *regulators*, who hold most favourable attitudes towards road safety, are mainly from lower to middle-income backgrounds. In contrast, the *opportunists* who hold most unfavourable attitudes are mainly from high-income background. The results also suggest that the *opportunists* and the *risk-averse* share a comparable socio-demographic profile.

7.9 Summary

The segmentation has classified the sample driving population of urban Pakistan into four different attitudinal groups in association with their behavioural inclinations and socio-demographic composition. Table 32 summarises the results of the analysis.

Table 32: Overall description of the segments based on their attitudes, behaviours and socio-demographic composition

CLUSTER DESCRIPTION
Autonomous (n= 35; 12.73%)
This group driver is autonomous in nature. By having relatively favourable attitudes towards road safety, the group overall can be treated as second safest group of the study. The group appreciates rules-compliance, careful driving and has ability to override peer pressure. The self-reported low commission of aberrant behaviours makes it the second most compliant among all. The only noticeable behavioural dimension of the group is its propensity to consider itself above the rules. For example, the group has reported to use its personal connection to get rid of fines, penalties (item 23; B2). This could be linked to their working status. As the group of drivers are mostly government employees, it is quite possible for them to get away with fines and penalties by taking advantage of their status (the issue of using bribes, personal connections is highlighted earlier in Study 1). The other socio-demographic indicators indicate that the group of drivers have lower-income levels, drive motorcycles (which collectively highlight a youthful component of the group), and more than one-third of them are degree holders. It also has highest percentage of unemployed/retired individuals or those looking after family members.
Opportunists (n=18, 6.54%)
This group of drivers are opportunistic in nature. The smallest in size, the group has the most unfavourable attitudes twoards road safety particulalry those related to rule-compliance and enforcment. It is the only group which consistently reported committing all types of aberrant behaviours. Specifically, this group driver is highly likely to intimidate other road users and to compete with them for road space. The group's drivers considered themselves highly above the rules which make them appear a supermacist in nature. This could be linked to being affluent and/or students (Study 1 highlighted the issues of bribes and influence peddling by the affluent, as well as a lenient penalty system for student drivers). The other notable scoio-demographic characteristic of the group is its good education level with the highest percentage of degree holders in the sample. It also has the young, females, singles as well as separated/divorced individuals in high percentages who mainly drive cars.

Table 32 (cont...): Overall description of the segments based on their attitudes, behaviours and socio-demographic composition

CLUSTERS DESCRIPTION
Regulators (n=142, 51.64%)
This group driver is regulatory in nature. The group is the largest in size and also emerged as the safest by having the most favourable attitudes towards road safety. The group strongly value enforcemnt of rules and regulations. With reference to its driving behaviours, the group of drivers reported to refrain from all types of aberrant behaviours, have the lowest DBQ scores and are significantly different from the *opportunists* and *risk-averse*. The possible explainations of their safe attitudes and behaviours can partciulalry be linked with their income levels, age distribution, employment as well as marital status and household structure. Although, in accord with the sample overall composition, the group is predominantly composed of lower-income group drivers. It also has the highest percenatge of drivers from middle-income household as compared to the other groups. The group of drivers is relatively mature, and either full/part-time employed in the private sector or running their own bussinesses. They are mostly married with children at home, have the lowest percentage of seperated/divorced individuals and the highest percentage of living in a joint family system. The group also has highest percentage of professional drivers and, lowest percentage of individuals who are unemployed/retired/looking after family in it.
Risk-averse (n=80; 29.09%)
This group of drivers is risk-averse in nature. It is the second largest in the sample and also has the second most unfavourable attitudes towards road safety. It does not appreciate careful driving, does not value enforcement, and reported to be affected by peer pressure. Interestingly, the group mirrors the *opportunists* in terms of its behavioural characteristics and socio-demographic composition. For instance, although not significantly, the group driver tends to intimidate other road users, compete with them for road space, commit risk-prone infringements and consider themselves above the rules. The group has the highest percentage of young drivers, single persons and home-owning individuals in it. It also has the highest percentages of students, females, degree-holders who mainly drive cars and come from affluent backgrounds after the *opportunists*.

7.10 Discussion

The purpose of the present study was to empirically investigate the attitudinal and behavioural dimensions of the driving population of Lahore. It has also assessed the hypothesized link between attitudes and behaviours, and the influence of socio-demographic characteristics on these, as documented in the Chapters 3 and 5. Study 1 already suggests that Pakistani divers have diversified unsafe attitudes and behaviours which are attributed to their socio-demographic characteristics. The following sections expand the results of Study 1 and initially discuss the variation of the sample population on a range of attitudinal and behavioural factors. Subsequently, the key attitudinal determinants of risky behaviours have also been discussed as well as the role of socio-economic characteristics in distinguishing safe and unsafe drivers.

7.10.1 Attitudinal segmentation of Pakistani drivers

This study was inspired by the TPB to tap drivers' attitudes towards road safety in Pakistan. The theoretically-driven attitudinal data was first factor analysed which resulted in six meaningful and empirically significant attitudinal constructs, named attitudinal factors. The factors assessed Pakistani drivers' attitudes towards rule-compliance, careful driving, enforcement, peer-pressure, personal safety and regard for road users. The factors were then used as independent variables to perform cluster analysis in an attempt to investigate how different Pakistani drivers were from each other are in terms of the degree of association they revealed on each factor. The analysis suggested that the sample driving population was classifiable into four stable and homogenous groups. This was reassessed by discriminant analysis. The analysis also confirmed all six attitudinal factors to be highly relevant to the Pakistani population and to play a pivotal role in segregating different attitude-holding groups in the population. This finding along with high internal consistency of the factors themselves (>.50) provided a support for using the AQ to measure the attitudes of drivers in Pakistan. Finally, the groups were named after their salient attitudinal characteristics as *autonomous*; *opportunists*, *regulators* and *risk-averse*.

Each group is found to have a unique and meaningful combination of attitudinal characteristics (for a quick review, refer to Table 25 and Figure 21). For instance, an *autonomous* driver (12.73%) has significantly favourable attitudes towards rule-compliance, careful driving and a strong ability to override peer pressure. However, at the same time, this group of drivers does not value enforcement. They are also less likely to regard their own personal safety as well as that of other road users. The phenomenon can be linked to their self-governing nature; which might has made them over-confident about their driving skills and less concerned about others or personal safety. The total attitudinal score of the group makes it the second safest in the sample.

The second and smallest group of the study, the *opportunists* (6.54%), are different from others due to their highly unfavourable attitudes towards rule-compliance and enforcement. The group is likely to be affected by peer pressure. However, interestingly, this group of drivers has the highest degree of regard towards other road users in the sample. Probably, it is due to guilt or realisation of their risk-taking nature which makes other road users vulnerable to get into dangerous situation in their presence. Consequently, an opportunistic driver also realises the importance of careful driving and therefore, encourage safety measures such as good vehicle fitness, and avoid using hand-held mobiles while driving; which can not only reduce chances of conflict with the traffic but can potentially disrupt him taking a chance now and then to keep moving ahead. Overall, the lowest attitudinal score of the group on the AQ makes them the most unsafe in the sample.

The third and the largest group in the study are the *regulators* (51.64%). Unlike others, this group of drivers did not report strong associations on any of the construct, with the exception of showing highly favourable attitudes towards enforcement. The only other noticeable dimension of the group, although not significant, is its tendency to break the rules. The explanation of these two contradicting attitudinal facets of the group can be found within. It can be judged that a *regulator* driver does not appreciate his tendency to break the rules and might think to overcome it if stringent enforcement is applied on the roads. Thus the contradiction is perhaps not as inconsistent as rules are only fair if enforced. The highest score of the group on the AQ makes it the safest, closely followed by the *autonomous*. The post-hoc multiple comparisons also revealed it to have significantly different attitudes from the *opportunists* and *risk-averse*.

The fourth and second largest group of the study, the *risk-averse* (29.09%), shows no concern about careful driving; does not value enforcement and is highly likely to be affected by peer-pressure. What makes this group of drivers risk-averse in nature is as favourable attitudes towards rule-compliance and regard for personal safety such as use of seatbelts/helmets or proper lights. It seems that the group has a realisation of the risks they are exposed to due to their careless nature and propensity to be influenced by the surrounding environment. Therefore, they tend to abide by the law to avoid any risky encounter. These are the measures which can effectively counterbalance his potential encounter with the traffic under peer-pressure or careless driving. The total AQ score of the group makes it the second most unsafe attitudes holding group in the sample.

The results of this study suggest that 'attitude towards enforcement' is the most powerful construct to define and differentiate sub-groups of Pakistani drivers. The ANOVA post-hoc results with the highest F-value among all the factors[72] indicate that not only have all the groups consistently loaded on the factor (at least three loadings >.50) but also that they are significantly different from each other on the dimension. Interestingly, the groups' inclination towards the construct (either positive or negative) is also reflected in their total AQ score such that the favourable attitudes towards enforcement result in overall positive attitudes towards road safety and vice versa.

For example take the *opportunists,* who have the most unfavourable attitudes towards enforcement so as score lowest on the AQ. Similarly, the *regulators*, with the most favourable attitudes towards it, scored highest on the AQ. The finding is in accord with previous research which has emphasised the need to promote positive attitudes towards enforcement in order to improve road safety (e.g. Cauzard and Quimby 2000; Nabi *et al.* 2007). The results in Table 29 also indicate that favourable attitudes towards road safety, although weakly, but inversely correlated to near misses (.10) and accidents (-.03). The relationship is particularly significant

[72] A high F-value can be found when the means for all of the groups differ at least moderately from each other (SABLE 2011).

between the AQ and near misses. Thus implies that the groups holding favourable attitudes towards road safety are less likely to encounter near misses and vice versa.

To summarise, the findings of the study confirm that the segmentation placed 'like-minded' individuals who have similar attitudes towards road safety, into a single group. The grouping not only helped assessing the attitudinal similarities and differences which can later be used to develop target interventions but confirmed one of the central hypotheses of the present research (H1). By producing six statistically meaningful attitudinal constructs, this study also expands the previous findings of validity and appropriateness of the theory of planned behaviour to explore the various facets of drivers' attitudes (e.g. Forward 1997; Elliott 2002).

Hypothesis 1: The driving population of Pakistan has unfavourable attitudes towards road safety and is likely to fall into distinct segments or subgroups in accord with their attitudes (Status: confirmed).

7.10.2 Behavioural dimensions of Pakistani drivers

7.10.2.1 Applicability and utility of the DBQ

Having established the attitudinal characteristics of the groups, the study next assessed their driving behaviours. At first, the behavioural data, collected using the DBQ, was factor analysed. The analysis identified four distinct driving dimensions of the sample population including intimidating behaviours (B1), being above the rules (B2), commission of risk-prone infringements (B3), and assertiveness for the space on-roads (B4) (for a quick review, refer to Table 27). The high percentages of variation explained by the extracted factors including internal consistency (>.50) supported the use of the DBQ as a reliable measure of behaviours, in agreement with previous research work (e.g. Eugenia *et al.* 2006; Wåhlberg *et al.* 2011).

The factor structure also confirms the theoretical distinction between AVs and HCVs in agreement with previous research work by Lawton, Parker *et al.* (1997). Thus B2 and B3 are solely comprised of HCVs, whereas, B4 is predominantly composed of AV items. However, B1 contains a mix of HCVs and AVs and to an extent has replicated the Lawton *et al.* (1997) first factor. It is also important to note that HCVs have high loadings on the factors with respect to AVs. Further, examination of the correlation matrix (see Table 29) reveals a strong positive association among the factors, implicating that the commission of one is most likely to lead to the other. Thus B1, tapping intimidating behaviours of drivers, is the strongest aberrant dimension which significantly results in near misses and accidents.

With respect to the inclusion of the new seventeen violation items specifically for Pakistan, twelve successfully came together and mainly constituted factors two and three (with α >.75). As the items successfully indicate two distinct behavioural dimensions of the drivers, the initial idea of testing and empirically quantifying different types of aberrant behaviours mentioned in Study 1 is reinforced. Thus the mean scores of all twelve items are high with two of the items making it into the list of top five the most committed aberrant behaviours (items 13, 29). Therefore, this study justifies the inclusion of this set of new items in the DBQ and promotes its utilisation in the future research related to the DBQ in Pakistan.

7.10.2.2 Comparison with the UK drivers

This study has also attempted to generically compare the driving population of the UK using the DBQ from Lawton *et al.* (1997), with Pakistani drivers (Appendix E). It is important to note that the comparison has been made to determine if the two populations are different or not, as hypothesised in Chapter 5, and not aimed to identify which one of them is safe (or unsafe). As the versions of the DBQ used for both of the populations were different so as the practicalities of the studies. Therefore, one-to-one comparison of mean scores of the UK and Pakistani drivers on different behavioural items is not practical, and a general comparison has been made on the basis of rankings various intentional violations have received in both of the populations.

The differences have been noted among the populations such that the UK drivers tend to engage more in speeding (on motorways, residential zone). By contrast, Pakistani drivers most likely to sound horn, do risky overtaking, intimidate female drivers and drive a vehicle with poor maintenance (see Table 26). The finding suggests that, unlike UK drivers, Pakistani drivers tend to exhibit aggressive behaviours more. However, both the groups are broadly comparable in terms of their least reported aberrant behaviours including drink driving and chasing with anger.

In terms of the factor structure, only factor one of this study -intimidating other road users- replicated the Lawton *et al.* (1997) first factor to an extent by loading four of its items in it (4, 9, 11, 12). However, at the same time, the factor contains items which were loaded on her factors two and three (1, 7, and 10). The rest of the original items of the modified DBQ also failed to come together in a similar order to that of in Lawton *et al.* (1997) and were split in this study. Therefore, it can be concluded that the driving behaviours in Pakistan a developing country) are not very similar to the UK (a developed country). This reaffirms the need to do country-specific research highlighted in Chapter 1 in order to develop a better understanding of local behaviours.

7.10.2.3 Differences in driving behaviours of the segments

After the factor analysis, the groups' behaviours were evaluated with the post-hoc ANOVAs. The results showed that drivers' attitudes towards road safety were reflected in their overall DBQ score such that the *opportunists* emerged as the most dangerous group and the *regulators* as the safest (Table 28 and Figure 25). However, it is also worth noting that, although the segments have shown strong associations on attitudinal constructs (irrespective of favourable or unfavourable orientation), the associations with reported driving behaviours were weak. Particularly, for the *autonomous* drivers who hold strong attitudinal profile, slight behavioural associations were noted. Only the *opportunists* loaded significantly on all behavioural dimensions ($\geq$.40).

The possible explanation of this phenomenon can be linked to social desirability bias which causes respondents to understate their negative behaviours (West *et al.* 1993; Hatfield *et al.* 2008). The other explanation can be taken from Study 1 which suggests a lack of accurate self-assessment among drivers about their own driving behaviours and their tendency to consider themselves safer particularly in comparison to other drivers (refer to section 6.6.4.1). Thus, it seems that the phenomenon of optimism bias is applicable to Pakistani drivers. However, further empirical evidence is required to falsify or prove this. This emphasises the need to utilise observational measures to study drivers' behaviours, as established earlier in the review. It is anticipated that real life exploration of behaviours can eliminate potential biases and would help to provide an understanding of the extent of behavioural tendencies of the groups. Interestingly, further inspections of post-hoc multiple comparisons suggest that driving behaviours of the *risk-averse* are closely comparable to those of the *opportunists,* despite both of them having salient attitudinal characteristics. Both the groups reported high aberrant behaviours and loaded consistently on all the factors.

The discussion concludes with the *opportunists* and the *risk-averse* having somewhat similar behavioural characteristics and being relatively dangerous in comparison to the *regulators* and the *autonomous*. The modified DBQ inclusive of Pakistan's related violations items proved to be a reliable measure as all of its factors showed high internal consistency and significantly differentiated the groups. However, low reporting of negative driving behaviours by the participants suggests a potential biasness in the data and recommends the need for further exploration of the groups' behaviours. The discussion also confirms the second hypothesis of this research.

Hypothesis 2: A substantial proportion of the driving population of Pakistan (a developing country) has unsafe driving behaviours; and Pakistani drivers are likely to be significantly different from drivers in the UK (a developed country) in terms of behavioural characteristics (Status: confirmed).

7.10.3 Key attitudinal determinants of risky driving behaviours

This study further inspects and elaborates the relationships between attitudinal and behavioural factors. In general, as discussed earlier, drivers' behaviours are found in agreement with their total attitudinal scores making the *regulators* the safest and the *opportunists* the most dangerous. A further bi-variate inspection of correlations provides support that favourable attitudes and aberrant behaviours are significantly and inversely correlated (see Table 29). However, the results have noted a weak strength of association between attitudinal and behavioural factors ($\leq$ .30) which is possibly attributable to low self-reporting of drivers' negative behaviours. This study, therefore, encourages further exploration of the relationships before coming to final conclusions.

To be specific, drivers' attitudes towards enforcement (A3) emerged as a key attitudinal determinant of risky behaviours. The results indicate that drivers with a favourable orientation towards enforcement are less likely to intimidate other road users (r=-.33), consider themselves above the rules (r= -.30), commit risk-prone infringements (r= -.27), and compete for road space (r= -.26). It also emerged as the only attitudinal dimension significantly reducing crash involvement (r= -.23). These findings coincide with those from an earlier study carried out by Shaheed Zulfiqar Ali Bhutto Institute of Science & Technology (SZABIST) in Pakistan. The study reported that half of its respondents believed police presence on the roads forced them to respect traffic laws and more than half said that speed cameras would improve traffic flow and reduce the number of traffic accidents (SZABIST 2009).

Study 1 has also noted similar trend where 56% of the driver participants supported stricter enforcement of traffic rules and regulations. In the road safety literature, a number of studies have also documented the significant impact of 'stringent enforcement to shape and change drivers' behaviours (e.g. Hakkert *et al.* 2001; Avineri and Goodwin 2009; Jovanović *et al.* 2010). For example, a meta-analysis that provided important insight into the key elements of successful road safety communication campaigns found that when combined with enforcement, campaigns had statistically significant accident reductions during the campaign, lowering the number of accidents by 6.9% (see Delhomme *et al.* 2009a). It is important to note that the effect of enforcement is related to drivers' perception of being caught (for details, refer to section 9.4.2).

Attitudes towards careful driving (A2) are also noted to be influential on drivers' behaviours. The results suggest that drivers who have shown concern about careless driving also have a propensity, although weak, to engage in deviant behaviours. This is an interesting finding as the construct taps attitudes which can distract driver from operating safely and uninterruptedly; for example driving with worn-out tires, improper lights or with hand-held mobile. This relationship, thus, indicates that drivers' who take such measures into account are also likely to take advantage out of it. With good condition driving vehicle in hand and basic measures, they are more likely to intimidate fellow drivers, consider themselves above the rules and commit risk-prone infringements. Currently, as the correlations are weak, observational study of behaviours can prove useful to validate the strength of this finding.

The results also noted weak but significant effect of ability to override peer-pressure (A4) on behaviours of drivers and indicate that drivers who do not get affected by their surroundings are less likely to intimidate other road users (r= -.13). However, no significant association of the factor with other behavioural dimensions has been found. Further research should be conducted to collect more information about its role in drivers' behaviour.

Lastly, attitudes towards rule-compliance (A1), regard for personal safety (A5), and regard for road users (A6) were noted to have insignificant relationships with behaviours. It is important to recall that the factors especially A1 and A6 have played an important role in segmenting the drivers (see Table 25). It is therefore worth confirming whether these constructs actually do not influence drivers' behaviours or whether these results are generated due to under-reporting of behaviours. On the other hand, the ineffectiveness of A5 can be relatively understood and linked with its role in the segmentation. The factor emerged as the weakest construct with the lowest F-value among all (F=14.28) and, except for the *autonomous* none of the groups indicated a strong favourable (or unfavourable) orientation towards it.

To sum up, this study concludes that drivers' attitudes towards road safety have a significant role in the shaping of their driving behaviours. And in case of Pakistani drivers, their attitudes towards enforcement and careless driving especially key determinants. By concluding this, the study also confirms the fourth hypothesis of this research.

Hypothesis 4: Aberrant driving behaviours are a function of unfavourable attitudes and those who have more unfavourable attitudes are likely to commit more road traffic violations. (Status: confirmed)

7.10.4 Socio-demographic differences of the segments

The literature review and Study 1 suggest that the socio-demographic characteristics of drivers significantly influence their attitudes and behaviours. Therefore, the current study also investigated the socio-demographic composition of the segments and assessed whether the variation in drivers' attitudes was attributable to their socio-demographic characteristics. Although, the segments are found to have considerably varying socio-demographic characteristics, only a few statistically significant differences are noted on variables such as gender, income, occupation type and occupation category (see Table 31).

This suggests that the attitudinal dimensions of drivers, not socio-demographic characteristics, split them into different segments. This supports and strengthens the premise of this research of avoiding *a-priori* classification which has the potential to stereotype individuals. Therefore, this thesis will now employ a driver classification based on their attitudes which can be influenced and improved in contrast to their socio-demographic characteristics. The discussion in the above section established that the *opportunists* and *risk-averse* share a similar behavioural profile. Interestingly, the results in Table 30 indicate that the *risk-averse* also mirror the *opportunists* with reference to socio-demographic characteristics. For instance, both the groups have a more or less similar composition on the two pertinent socio-demographic variables of this study -gender and income. These groups of drivers are mostly affluent.

In addition, despite being a smaller proportion of the sample (13.6%), female drivers constitute one-third of both the groups. The finding rejects the self-claims of females in Study 1 of holding a favourable orientation towards roads safety and implies that the possibility of them being dangerous on-roads cannot be ruled out. The support for this argument can also be found in literature (Bone and Mowen 2006; Gulliver and Begg 2007; Tannert 2009). For instance, Tannert (2009) reports "it's true that men do take more risks than women...however; [women] are partaking in more risky behaviours than ever before. The gap is closing quickly". The possible explanation for this can also be derived from Study 1 which highlights that woman drivers in Pakistan are subject to unfair treatment by their fellow men, and therefore, tend to behave aberrantly under peer-pressure (for details, refers to Study 1; section 6.7.4). The other notable features of the groups are the presence of young drivers, students, and degree-holders as well as single or separated/divorced individuals in higher percentages than the other groups. The groups also have the highest percentages of owning a house and driving a car. Thus emphasising their relative affluence.

The *autonomous* and *regulators*, who emerged as relatively safer groups, can also be compared to an extent on certain parameters such as income. Both the groups are predominantly composed of drivers from lower-income backgrounds. However, the *regulators* also have the highest percentage of middle-income group drivers. The finding thus suggests that drivers with lower and/or middle-income levels are safer than those with higher-incomes i.e. the *opportunists* and *risk-averse*. It also strengthens the argument propounded by Study 1 participants who stated that different income groups hold different attitudes towards road safety in Pakistan where affluent drivers are more likely to abuse the system.

The support for the finding can also be found within the domain of driver attitudinal and behavioural research which link higher income levels with aberrant behaviours such as speeding (e.g. Cauzard and Quimby 2000; Shinar *et al.* 2001; Kweon and Kockelman 2006). However, care should be taken before generalising the finding and more empirical research would definitely help to in applying it across the board. Apart from income, it is also noted that both the groups have a slightly higher percentage of mature drivers and a lower percentage of young drivers in the sample. It is therefore obvious for them to have full/part time employees and married individuals in higher percentages. The groups also have considerable representation of individuals living in a joint family system as well as motorcyclists and professional drivers. The *autonomous* specific characteristics are the highest percentage of drivers who are unemployed/retired/looking after family and those who work in the government sector. The group also have a good proportion of degree-holders. By contrast the *regulators,* specifically has the lowest percentages of home-owning, female drivers, separated/divorcees and degree holders in the sample. It also has highest percentage of drivers working in private sector and with kids at home.

Figure 26 summarises the exclusive influence of the socio-demographic variables on drivers' attitudes. The effects of age, education, marital status and income are already well-documented on drivers' attitudes and behaviours (e.g. see David 1990; Laapotti *et al.* 2001; Shinar *et al.* 2001). This study has further elaborted them by starting from *age*. It concludes that young drivers are more prone to risky taking attitudes than the older drivers. Some other relevant, although not statistically significant, variables include marital status, housing tenure type and level of education. The results suggest that single as well as separated/divorced individuals hold more risky attitudes than married drivers with kids at home. Living in joint families also improves driver's attitudes. Interestingly, with higher level of education, drivers tend to get more risky. The finding strengthens the Study 1 argument according to which drivers' behaviours in Pakistan remain unaffected by their education level. It also complements the general literature of road safety which usually associates higher education and income levels with speeding. One may argue that this is in many cases due to higher values of travel time and driving newer vehicles with better safety features (Kweon and Kockelman 2006).

The other two statistically significantly variables as noted in Figure 26 are concerned with occupation type and its category. While working in part/full-time employment is likely to improve drivers' attitudes, unemployment or studentship is more likely to worsen it. Working in the private sector is also positively influential than being in the government sector. This is possibly due to the advantage particularly students and government employees take of leniency in the licensing and penalties system, an issue raised earlier in Study 1. For instance, the government allows underage students to drive to schools/collages in order to offset inadequacies in public transport.

The discussion concludes that drivers' attitudes are influenced by their socio-demographic characteristics. The overall characteristics of the two most unsafe groups -the *opportunists* and *risk-averse* - lead to the inference that being young, affluent, student and separated/divorced negatively affect attitudes and make drivers more dangerous on roads. It can also be concluded that higher education levels do not guarantee low risk driving behaviours, and neither does being female. The finding is not in agreement to a number of road safety studies (e.g. Yılmaz and Çelik 2006). However, there are also studies which found that level of education, (or being male or female) does not affect drivers involvement in violations or accident involvement (e.g. see Lourens *et al.* 1999). As a Pakistani driver is poorly educated about traffic rules and regulations, so as lacks understanding and awareness about road safety (e.g. refer to section 7.5.2), therefore it can be inferred that his/her attitudes are therefore not significantly improved with improved level of e.g. academic education.

Influences of socio-demographic factors on drivers' attitudes

Variables	Opportunists The most unsafe group	Risk-averse	Autonomous	Regulators The most safe group	The findings Imply...
1. age	HIGHER % of youngsters	HIGHEST % of youngsters, LOWEST % of matured drivers	HIGH % of youngsters	LOWEST % of Youngsters HIGHEST % of mature drivers	Young drivers have most risky attitudes whereas mature drivers are relatively safer.
2. Income	MOST affluent	MORE affluent	POOREST	POORER to HIGHEST % of middle-income drivers	Affluent drivers are the most dangerous whereas drivers from poor to middle-income backgrounds are the safest.
3. Gender	HIGHEST % of females	HIGHER % of females	HIGH % of females	LOWEST % of females	Female drivers can be equally dangerous as males.
4. Marital status	HIGH % of singles HIGEST % of divorcees	HIGHEST % of singles HIGH % of divorcees	HIGHER % of singles and divorcees	HIGHEST % of married drivers with kids LOWEST % of divorcees	Single and separated/divorcee drivers are dangerous whereas married with kids at home are safest.
5. Type of household	HIGHER % of house ownership LOWST % of living in joint family	HIGHEST % of house ownership LOWEST % of renting houses	HIGH % of houses ownership HIGHER % of living in joint family	LOWEST % of house ownership HIGHEST % of living in joint family	Drivers living in joint family systems or rented houses are more safe than those living in their own houses.
6. Education	HIGHEST % of degree holders	HIGHER % of degree holders	HIGH % of degree holders	LOWEST % of degree holders	Drivers with high-education levels are less safe.
7. Type & category of occupation	HIGHEST % of students LOW % of unemployed and self-employed drivers	HIGHER % of students HIGHER % of drivers working in private sector	HIGHER % of employees; HIGHEST % of non-working HIGHEST % of drivers working in government sector	HIGHEST % of working drivers; LOWEST % of non-working and students HIGHEST % of drivers working in private sector	Students, non-working drivers as well as those working in government sector are more dangerous. Whereas, working drivers, especially from private sector have safer attitudes.
8.Ttype vehicle	HIGHEST % of car drivers	HIGHER % of car drivers LOWEST % of professional drivers	HIGHEST % of motorcyclists HIGHER % of professional drivers	HIGHER % of motorcyclists HIGHER % of car drivers HIGHEST % of professional drivers	Motorcyclists, car drivers as well as professional drivers; all can have safe attitudes.
9. Children	HIGHER % of kids at home	HIGH % of kids at home	LOWEST % of kids at home	HIGHEST % of kids at home	Drivers with kids have safe attitudes.

Figure 26: One-to-one influence of socio-demographic variables on drivers' attitudes towards road safety

In contrast, factors such as being less prosperous, older, married with children at home, working and living in joint families are the factors which positively influence drivers' attitudes and make them safer on the roads. The discussion also noted that unlike attitudinal and behavioural factors, only a few socio-demographic characteristics such as income statistically differentiated the groups. Therefore, it can be concluded that the attitudinal segmentation successfully classified the sample population and is mainly responsible for differences across the groups and the shaping of their behaviours; although socio-demographic characteristics contribute. Nevertheless, the varying socio-demographic characteristics make the groups easily identifiable and targetable to implement specific road safety interventions. This has also partially confirmed fifth hypothesis of this research.

Hypothesis 5: Differences in attitudes of drivers (segments of drivers) towards road safety are attributable to their personal characteristics (Status: partially confirmed).

7.11 Conclusions

This study has provided a multitude of results. It suggests that the urban population of Pakistan has discrete attitudinal dimensions and can broadly be grouped into four clusters namely, the *autonomous*, *opportunists*, *regulators*, and *risk-averse*. The driving behaviours of these groups are found attributable to their attitudes particularly those related to enforcement and careless driving. It has also noted significant relationships between aberrant behaviours and crash involvement and identifies intimidating behaviours of Pakistani drivers and their propensity of taking themselves above the rules as the most risky behaviours. Based on the overall attitudinal and behavioural profiles of the segments, it can be concluded that the *regulators* and *autonomous* constitute a relatively safer category of the drivers in comparison to the *opportunists* and *risk-averse*. The *risk-averse* are also noted to be similar to the *opportunists* in terms of behaviour and socio-demographic characteristics. The study further adds that being young, student, single/divorce/separated, and/or affluent negatively influence drivers' attitudes. It also suggests that stereotyping men with bad behaviours is not true in Pakistan's case as female drivers are found to constitute one-quarter of the groups holding the most unfavourable attitudes (i.e. the *opportunists* and *risk-averse*).

This study also has analytical implications. For instance, the generation of discrete and statistically robust attitudinal and behavioural factors from the AQ and DBQ provides support for using the measures for future research in Pakistan. Another implication is the success of the attitudinal grouping of the drivers. This study advocates that rather than simply aggregating drivers' responses or classifying them on *a-priori* judgment, using a segmentation technique is more useful to get collective and richer information about them in terms of multidimensional constructs. It has also noted that, unlike attitudinal profiles, the multiple comparisons of the groups on the behavioural factors contributes only a limited understanding of their behaviours as they either do not load significantly and/or very low. This suggests that self-reported behavioural data were potentially subject to bias and emphasises the need to assess actual behaviour of drivers.

7.12 Limitations of the study

There are a few limitations which may affect to generalise study's findings. For instance, although, the AQ and the DBQ generated distinct and reliable factors, the measures were adopted for the first time in Pakistan. Therefore, more research work is encouraged to refine and validate them for the country. The data may also be subject to sampling bias due to the limited number of participants in comparison to the overall population of Lahore. However, confidence for the data can be drawn, knowing the fact that on some indicators, e.g. age, marital status, the data is comparable to the general statistics of the urban population (see section 7.5.2). It is also worth noting that, by asking drivers their contact details for a follow-up study, the response rate dropped slightly. Further, the study tried measuring all the relevant issues, identified in Study 1 and in the literature review, which can influence drivers' behaviours particularly specific to Pakistan. However, due to self-reporting, influences of some of the external factors e.g. traffic conditions, driving environment remained partially untapped. Finally, the behavioural scores of the groups suggest that the data may have suffered from self-report bias. These limitations, therefore, support to observe on road behaviours of the groups.

CHAPTER EIGHT

STUDY 3: OBSERVING BEHAVIOUR OF DRIVERS ON THE ROADS

8.1 Overview

This chapter is a continuation of the previous discussion made in regard to Study 2 related to different attitudinal segments of drivers in Pakistan and their behaviours. The chapter first considers the shortcoming in subjectively assessing and interpreting drivers' behaviours and it then examines the advantages of incorporating observational techniques in behavioural research and how these could prove beneficial in bridging the attitudes behaviours research gap. Subsequently, the discussion moves to the on-road study that had been carried out to observe the dimensions of aberrant behaviours which could be possessed by the driver groups, derived from Study 2. The study, in particular, attempts to observe changes in drivers' behaviours under different road environments. The chapter is concluded with a discussion of the benefits from deploying both self-reports and observational behavioural techniques in the present research.

8.2 Introduction

8.2.1 Subjective and observed measures of drivers' behaviours

A broader aim of this research programme was to examine the attitudes and behaviours of Pakistani drivers towards road safety. Study 2 segmented the driving population of Pakistan into four groups based on their attitudes towards road safety. Later in the study, these segments were interpreted and profiled for their behavioural and socio-demographics characteristics. The results noted that the behavioural factors provided only insignificant results in clearly identifying the differences among the groups. Although post-hoc multiple comparison ANOVAs indicated significant mean differences among the groups' behaviours, it failed to clearly separate any single driving population from the rest. This implied that the groups which were significantly different in terms of their attitudes, reported somewhat similar or potentially safe driving behaviours. The findings thus raised intriguing questions about the reliability of self-reported behavioural data.

The methodology review already established that subjective data is vulnerable to a number of biases that can lead to both under-reporting and over-reporting particularly in relation to 'deviant' forms of behaviour (e.g. Iversen and Rundmo 2004; Elliott *et al.* 2007). Furthermore a number of studies favour the utilisation of the observation measures to overcome these potential caveats of self-reports (e.g. West *et al.* 1993; Hatfield *et al.* 2008; Merat *et al.* 2011). Another related concern was the inability of self-reports to interactively assess the impact of continuously varying external factors such as effect of the traffic environment on drivers - an important aspect highlighted earlier in the review and Study 1. Thus, for the present research, it was concluded that the sole dependence on self-reports to explore Pakistani drivers' behaviours seemed inappropriate. It was decided to observe the actual behaviour of each group on-road in order to enhance confidence in the results of the present research.

However, it is important to note that there are also concerns about in-car observations e.g. if driver drove in a normal way in presence of observers or whether observers, record behaviours in a correct and coherent way. A few studies have dealt with the issue of observer effect, and there are some differences in the results. Höfner (1967, cited in Hjälmdahl and Várhelyi 2004) found that the behaviour of moped riders did not change when they knew that they were being observed. On the other hand, Rathmayer *et al.* (1999) found that subjects, driving an instrumented car with an experiment leader, had a 1–2 kph lower mean speed when the experiment leader was present. They further found that acceleration and deceleration were smoothed down and lateral acceleration was reduced. Hjälmdahl and Várhelyi (2004) also carried out comparisons of 238 spot-speed measurements to establish whether the test drivers drove in a normal way during the in-car observations. The researchers compared driver's speeds when driving their own private cars to their speeds during the in-car observations, and concluded that the drivers drove in the same way when being observed as they did normally. Hence, overall, in-car observations are shown to be a reliable and valid method to observe driver behaviour.

8.3 Aims

To be specific, this study set out to (1) explore the types of erroneous behaviours performed by the groups holding different attitudes; by supplementing the findings of self-reported aberrant behaviours from Study 2 with actual observations, (2) to compare the compatibility and advantages of using subjective and observed data, and (3) to analyse the impact of external factors such as the driving environment on drivers' behaviours; which left unanswered in Study 2.

8.4 Method

8.4.1 Study procedure

This study was the extension of work carried out in Study 2 for performing behavioural interpretation of its attitudinal segments namely the *autonomous*, *opportunists*, *regulators* and *risk-averse*. A sample of drivers from each segment was recruited and calls were made to fix appointments with them. The WF technique was then used to observe the drivers' behaviours. At the start of the study, participants were briefed about the test route and purpose of the research. Following that, participants were asked to drive through five different sections of roads in Lahore with two observers. The observers recorded different variables related to road traffic violations and errors on WF sheets[73] (see section 4.2.3).

In order to ensure that observers record data in a correct and reliable way, numbers of things had been taken into account. For example, observers were briefed about the definition and types of behaviours under study. It was attempted to give them standardised instructions, where possible, about how to differentiate between right and wrong behaviour with the help of the guidelines provided by Chaloupka and Risser (1995). A pre-test exercise had been carried out with the observers in order to accustom them with the technique. The observers were also not told about which group, driver under study belonged to in order to ensure that data collection was done without any pre-conceived notions. It is important to note that in total four observers had been recruited to conduct the study. All of the observers had a good level of understanding about traffic engineering and road safety as they were final

[73] On completion of the drive, participants received £5.

year students (except one) of undergraduate transportation engineering programme of UET, Lahore.

Furthermore, to deal with the issue of observers' effect, drivers were asked to drive in the same way they normally did. They were kept uninformed about the types of behaviours under observation. It is important to note while debriefing drivers about the intent of research, they were also told about the confidentiality and anonymity of the data in order to increase their confidence about the study. To make drivers familiar and accustomed with the study and drive, a trial section of 5 minutes drive was included at the beginning of the actual test-route.

8.4.2 Participants

In total, twenty-two participants took part in the study - six participants from each segment (except *opportunist* which had four drivers) based on its socio-demographic composition.

Table 33: Socio-demographic composition of each group participants

Factors	Autonomous (n=6)	Opportunists (n=6)	Regulators (n=6)	Risk-averse (n=6)
Age	≤ 19 (1) 19-34 (4) ≥ 35-55 (1)	≤ 19 (1) 19-34 (2) ≥ 35-55 (1)	≤ 19 (1) 19-34 (1) ≥ 35-55 (4)	≤ 19 (2) 19-34 (3) ≥ 35-55 (1)
Gender	M (5) & F (1)	M (4)	M (5) & F (1)	M (5) & F (1)
Education	Intermediate (4) Graduates (1) Postgraduates (1)	Intermediate (1) Graduates (2) Postgraduates (1)	Intermediate (4) Graduates (1) Postgraduates (1)	Intermediate (3) Graduate (2) Postgraduates (1)
Income group*	LIG (5) MIG (1)	MIG (1) HIG (3)	LIG (4) MIG (1) HIG (1)	LIG (2) MIG (1) HIG (3)
License holder	Yes (3)	Yes (2)	Yes (4)	Yes (5)
Drivers' type	Car drivers (5) Professional drivers (1)	Car drivers (4)	Car drivers (5) Professional drivers (1)	Car drivers (5) Professional drivers (1)

Note: * LIG indicates lower-income group, MIG indicates middle-income group, and HIG indicates higher-income group.

It was intended to balance the groups particularly according to their age, income, educational and occupational composition (for reference, see section 7.8.3). Concurrently, participants from each group who met the criteria were shortlisted. To contact selected participants, their personal information was retrieved and telephone calls were made[74]. However, some of the participants had either provided fake details or no contact information at all. The situation was worst for the *opportunists*, which was only composed of 18 drivers. Due to the group's smaller size, only four of its drivers could be reached to take part in the study. Table 33 shows the composition patterns derived for each group to equally represent its population in the study.

8.4.3 The 'Wiener Fahrprobe' technique

In this study, the Wiener Fahrprobe technique was used as an observational tool to assess drivers' behaviours with the help of *free* and *coding* observers. Information was collected on erroneous driver behaviour[75], their communication with other road users and number of traffic conflicts they were involved in. As discussed in section 4.2.3, the reason for selecting the WF as an observational technique was its relatively easy applicability, proven reliability (e.g. see Comte 199; Hjälmdahl and Várhelyi 2004), and appropriateness due to limited resources in the context of present research.

8.4.3.1 Behavioural observations

During the study, the observers recorded four sets of variables including standardised variables, errors, interaction/communication processes and traffic conflicts (Table 34). For this study, an updated version of the WF recording sheets (standardised coding sheet and free observer coding sheet) used in an earlier on-road study was adopted (Comte 1999). The coding sheet was slightly modified to tailor it

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[74] In Study 2, participants were asked to provide their contact details if they wished to take part in the next stage (i.e. Study 3).

[75] The term erroneous behaviour is used for the WF observed variables because the technique not only collects information about violations (e.g. driving above the speed limit) but errors (e.g. overtaking or lane changing without sufficient vision). Therefore, for the sake of clarity, drivers' aberrant behaviour is labelled as erroneous.

to the needs of the present research, whilst one additional factor, named 'careless behaviours', specifically relevant to Pakistan was added.

This factor included the most frequent types of violation items reported in Studies 1 and 2 and was composed of items including the use of handheld mobile phone, driving a poorly maintained vehicle, driving with tinted window glass, overloading of articles/passengers, and no stopping at the stop line. According to statistics provided by the Lahore traffic police authority in Study 1, these violations were extremely prevalent locally. The addition of this factor was also believed to facilitate an overall comparison subsequently between the DBQ and WF data on nearly parallel dimensions (for a complete list of behaviours tapped by the WF, see Appendix H).

Table 34: Wiener Fahrprobe observation variables

Standardised Variables recorded by *Coding Observer*	Non-standardised Variables recorded by *Free Observer*
Speed behaviour, distance keeping, use of indicator; lane keeping behaviour ;behaviour at traffic lights; behaviour when merging	Errors, Interaction/communication with traffic, traffic conflicts

8.4.3.2 Test route

The test route was in Lahore and was divided into five main sections with varying traffic conditions and driving environment; as elaborated in Table 35 and Figure 27. The length of the route was approximately 14km with varying speed limits (from 30 to 50kmh) and road layouts (single and dual carriageway). On average, it took 40 minutes to complete the drive. The route started from 'Wahdat road' which connects two primary roads of the city: Multan road and Ferozpur road. The road was divided into section 1 and section 2 for the study.

Section 1 of the road (Multan Chungi to Bhaikawal Morr) was mainly in a planned residential town with a few educational establishments and shops at the roadside. There was also a large cultivated area at the end of the section.

Section 2 (Bhaikawal Morr to Muslim Town Morr), the second half of Wahdat Road, was mainly surrounded by restaurants, takeaways and retail stores. Both section 1 and section 2 were situated in a relatively high-income area of Lahore (Iqbal Town and Muslim Town) with well-maintained roads and in which most of the residents belong to middle and high-income groups.

Section 3 (Muslim Town Morr to Mozang Chungi) covered a 3.6 km long stretch of 'Ferozpur Road'. The road connects old and new Lahore and is used by both inter-city and intra-city traffic. The section was heavily surrounded by commercial and business activities.

Section 4 (Mozang Chungi to MAO College) was chosen so that the drivers had to make an adjustment to drive from well-maintained wide roads to poorly maintained roads in less privileged areas of the city. The section was located in a densely populated zone of old Lahore with a many activities carried out at the side of the road.

Section 5 (MAO College to Chowk Noori Building) completed the test route by taking drivers to another densely populated zone of Lahore with a mix of residential and commercial activities. The stretch was composed of single carriageway without any traffic calming measures.

To summarise, the driving conditions of the route were heterogeneous such that it started from a well-planned residential neighbourhood with relatively light traffic and better road conditions. Then, the traffic conditions and driving environment gradually kept becoming more complex such that the last section of the drive ended up in the old, ill-planned part of the city with poor road conditions and little law enforcement.

Table 35: Description of different route sections included in the study

Test Route Description					
Features	Section 1	Section 2	Section 3	Section 4	Section 5
General Description	Dual carriageway; 2 lane each side; mix traffic; well-carpeted road laid in residential zone	Dual carriageway; 2 lane each side; mix traffic; well-carpeted road laid in business zone	Dual carriage way; 3 lane each side; good condition road laid in busy commercial zone; carrying local and through traffic;	Dual carriageway; no lane marking; mix traffic; poor condition road laid in commercial zone	Single carriage way; no lane marking; mix traffic; poor condition road laid in residential and commercial zone
Section Length/speed limit/Lane marking	4km/not posted/yes	2.7km/not posted/yes	3.6km/50kmh/yes but only half of the section was painted	2.1km/30kmh/no	1.2km/not posted/no
Time length (average)	7 minutes	7 minutes	14 minutes	8 minutes	6 minutes
Side Roads	Yes	No	Yes	No	No
Access to road side development	Frontage road to access residential properties	Unlimited access to houses, shops, businesses	Frontage road to access shopping markets and businesses	Unlimited access to houses, shops, businesses	Unlimited access to houses, shops, businesses
Parking and loading	None	Unrestricted; on-street parking	Restricted; on-street parking	Restricted; on-street parking	Unrestricted; on-street parking
Pedestrian crossings	None	None	Both at grade and grade separated	At-grade	None
Bus stops	In lay-bys	At kerb side	In lay-bys and kerb side	Kerb side	Kerb side

Figure 27: Different sections of the route included in the study

8.5 Analysis

The analysis was performed not only to meet the aims of this study but also to empirically test the hypotheses proposed in the research (H2 to H6). Following the standardised approach of analysing the WF, all types of behavioural variables collected, i.e. erroneous behaviours, errors, negative interactions and communication with other road users as well as traffic conflicts encountered by the participants, were summed up. A one-way ANOVA along with post-hoc tests was then performed to look at the significant differences among the groups for different behavioural dimensions. The comparison helped to re-assess the behaviours reported earlier by the groups.

Further, inter-correlations between standardised and non-standardised variables as well as attitudinal scores of the drivers (retrieved from Study 2) were explored. The analysis helped to find out if erroneous behaviours could lead to traffic conflicts and ultimately increase the probability of accidents. It also aimed to contribute more to the understanding developed in Study 2 about the role of drivers' attitudes in determining their behaviours. Further, an overall comparison between the DBQ and the WF scores of the groups was made. The comparison was performed to assess the advantages of utilising both self-report and observational behavioural measures together.

8.6 Results

In the following section the standardised and non-standardised aberrant behaviours exhibited by the groups are reported in sequence. The groups' behaviours across different route sections are compared in section 8.6.3 and the correlations between the variables are covered in section 8.6.4.

8.6.1 Standardised behaviours

The standardised aberrant behaviours exhibited by the groups were analysed by collating all related variables in sets and developing indices. The indices reduced excessive and unnecessary information and helped in producing concise results for the study (Table 36 and Figure 28).

For instance, the first index measuring *'overtaking/lane changing behaviour* 'of drivers was built by adding all negative variables such as overtaking or lane change was performed 'not correctly', 'in spite of oncoming traffic', 'without sufficient vision', 'while forbidden', and 'use of right lane mainly'. An ANOVA compared the groups mean scores on the index and noted significant differences between them. Games-Howell post-hoc multiple comparisons of the groups further indicated that the *opportunists* performed significantly more aberrantly on the dimension than the others such that it committed 4.53 violations per section of the test route.

The second index explored *'indicator using behaviour'* of the participants by noting if they 'did not use it', 'did not use it on time' or 'used it ambiguously'. ANOVA results demonstrated no significant differences among the groups for the index.

The third index regarding *'lane use behaviour'* of the participants was developed by adding two sets of negative variables from the coding sheet, (1) lane use variables ('inaccurate, weaving', 'extremely on the right side of the lane', 'extremely on the left side of the lane'), and (2) lane choice for proceeding variables ('at the last moment' and 'incorrect'). The post-hoc ANOVA shows significant differences among the groups' lane use behaviour with the *opportunists* making the most incorrect use of it in comparison to the *autonomous* and *regulators* but similar to the *risk-averse*.

The fourth index characterised the *'merging behaviour'* of the groups by calculating if it was carried out 'unsafely', 'without traffic' and at 'inappropriate speed'. ANOVA for the index shows similar results to third index with *opportunists* being the riskiest.

The fifth index of *'speed behaviour'* was calculated by adding eight variables related to speed in Coding Sheet: 'inappropriate', 'inappropriate for road geometry', 'too fast near vulnerable road users', 'without platoon', 'above the speed limit', 'considerably slower than limit', 'brakes applied abruptly' and 'unsteady speed'. The post-hoc ANOVA statistically confirms the differences among the groups' speeding behaviour with the *opportunists* being found to be involved in speeding most frequently and *regulators* the least.

The sixth index analysed *'distance keeping behaviour'* with the groups score on a variable 'too short distance to the road user ahead'. The results indicate no significant differences between the groups on the dimension.

The seventh index defined the participants in each groups' *'behaviour at traffic lights'* in terms of 'driving against red', 'driving against amber', 'doesn't start when it is green' and 'starts when it is too early'. With the lowest F-value, the post-hoc ANOVA for the index indicates no significant differences between the groups. This suggests that all four groups behave more or less similarly at traffic lights.

The eighth and last index assessed 'careless behaviours' of the groups. The index was generated by adding the variables 'use of hand held mobile phones', 'driving vehicle with poor maintenance', 'driving vehicle with tinted window glasses', 'overloading of articles/passengers' and 'do not stop at the stop line'. Although the ANOVA result indicates significant F-value, post-hoc comparisons observed no mean differences between the groups.

Taken together, the total DBQ score and mean scores of the groups on four out of eight indices suggest the *opportunists* to be the riskiest. The study also found incorrect overtaking, lane use, speeding, merging and careless driving as the most frequently committed violations by Pakistani drivers. All the groups were noted to be more or less similar to each other in terms of use of indicators, distance keeping, behaviours at traffic lights and careless driving.

Table 36: Mean scores and significant differences of groups on standardised behavioural indices

Behavioural Indices	Autonomous (cluster 1)	Opportunists (cluster 2)	Regulators (cluster 3)	Risk-averse (cluster 4)	F-value	Sample avg.
1. Overtaking behaviour	2.63^{2}	4.85^{134}	2.03^{2}	3.03^{2}	6.67^{*}	2.98
2. Indicator using behaviour	.73	1	.57	.73	4.72^{**}	.74
3. Lane use behaviour	1.77	3.05^{3}	1.43^{2}	2.20	4.12^{**}	2.03
4. Merging behaviour	1.03^{2}	2.85^{134}	$.73^{2}$	1.30^{2}	5.90^{*}	1.35
5. Speed behaviour	1.67^{2}	3.47^{13}	1.33^{2}	1.98	4.95^{*}	1.99
6. Distance keeping behaviour	.53	.95	.53	.70	NS	.65
7. Behaviour at traffic lights	.67	1.05	.57	.90	3.17^{**}	.77
8. Careless behaviours	.63	1.30	.63	.73	NS	.78
9. Total WF score	102.50^{2}	164.75^{134}	82^{2}	112.17^{2}	4.67^{*}	110.86

Note: A high score on behavioural index represents aberrant behaviour of the group. The Tukey HSD post-hoc multiple means comparison test was used for indices 3, 4, 5, 6, 7 and 8, and Games-Howell for index 1, 2, 9 such that, the superscripts show which mean scores of clusters are significantly different at *p<.01 and ** p<.05, from other groups.

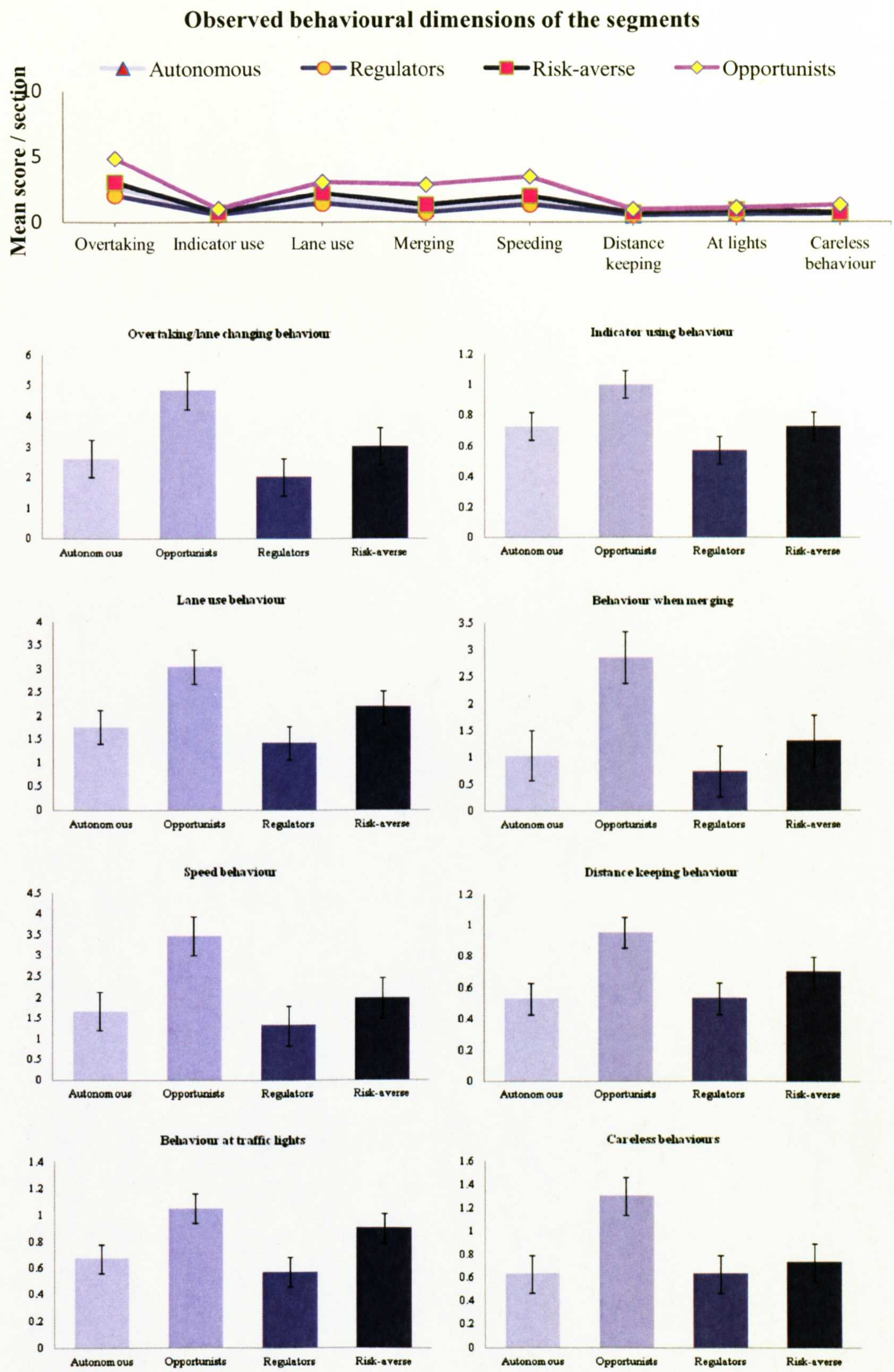

Figure 28: Observed behavioural dimensions of the groups [76]

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[76] Label for Y-axis is the same for all the graphs i.e. Mean score on a behavioural index/section.

8.6.2 Non- standardised behaviours

The free observer coding sheet recorded negative interactions and critical events/traffic conflicts encountered by the driver with other road users. A count was made of the total negative interactions each group had with other road users which includes 'insists on right of way' (ROW), 'doesn't allow continue/merging', 'doesn't reduce speed', 'presses other cars', and 'obstruct others'. Similarly, a count was made for traffic conflicts encountered by each group. Figure 29 shows that the most negative interactions and traffic conflicts were observed for the *opportunists*. The maximum negative interactions were observed in Section 5 of the route which was in a least-privileged area and therefore had poor quality roads (refer to section 8.4.3.2).

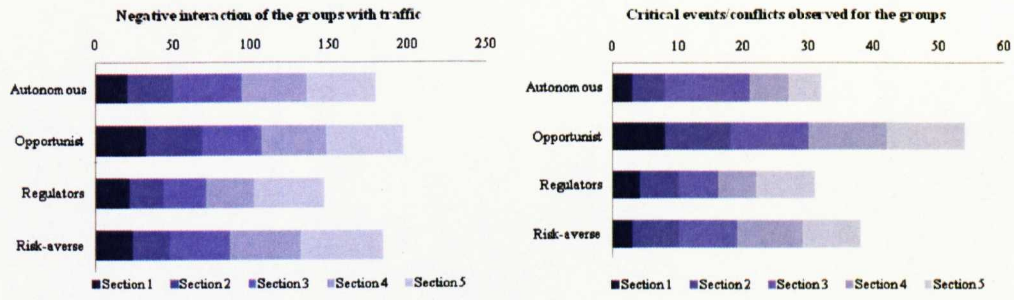


Figure 29: Total number of negative interactions and critical events/traffic conflicts observed for each group

8.6.3 Groups performances in different sections of test-route

The WF also allowed aggregating the influence of driving environment on drivers' behaviours. Total WF mean scores of each group across five sections of test-route were calculated. The variation in scores helped to assess the influence of the road environment on drivers' behaviours. The results indicate that all four groups exhibited the least aberrant behaviours in Section 1 of the route. As the drive continued towards the areas with heavy traffic and poor driving conditions, the WF scores for each group also increased, i.e. worse driving standards were exhibited. Figure 30 shows each group's performance on each section of the route.

Interestingly, for the *autonomous* and the *risk-averse* groups, similar behaving patterns were observed. The WF scores of both the groups gradually increased from Section 1 and were to the highest in Section 4. After that a drop was observed and the groups exhibited relatively less negative behaviours in Section 5 in comparison to Sections 3 and 4. The *opportunists* and *regulators* also exhibited a similar behavioural pattern. The driving behaviours of both the groups remain consistent throughout the drive and little variation was observed except in Section 2 (for the *opportunists*) and Section 3 (for the *regulators*).

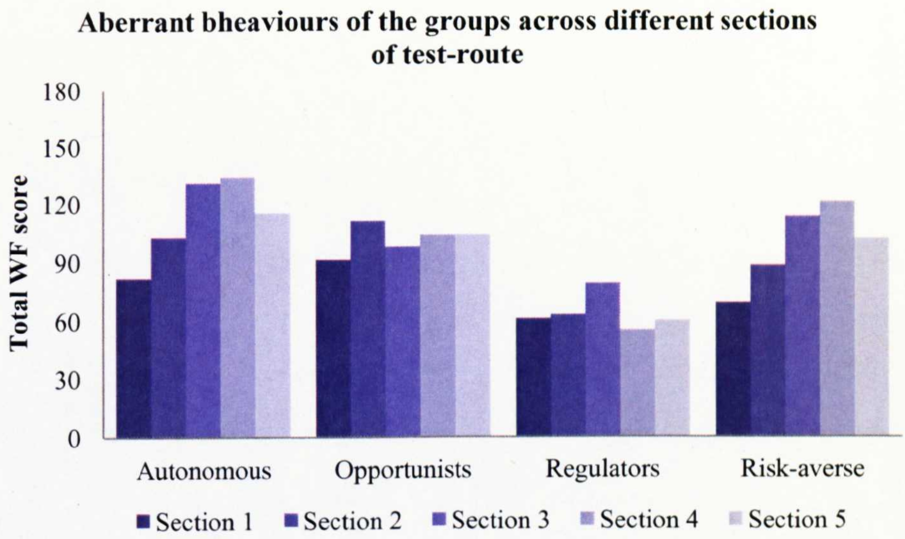


Figure 30: Comparison of groups' behaviour across different sections of test-route

In summary, the WF results significantly differentiated the groups across different behavioural dimensions using eight indices. Significant differences among the groups were noted for at least five out of eight indices. The technique also assessed the groups' tendency to get involved in negative interactions with other road users and their probability of being involved in traffic conflicts. The results clearly demonstrated the *opportunists* as the most unsafe and the *regulators* as the safest group of drivers. The technique also assessed the effect of traffic conditions and road environment on drivers' behaviours and concluded that groups tend to behave more aberrantly in impoverished areas with poor driving conditions.

8.6.4 Correlations between standardised, non-standardised behaviours and attitudinal factors

Finally, the relationship between standardised and non-standardised variables was determined. Results in Table 37 indicates that a significant, positive relationship exists among all the variables at $p<.01$. It suggests that all unwanted behaviours are significantly linked with each other and the commission of one would lead to the commission of another. It is also observed that out of the eight indices, exhibition of any on-road significantly increases the negative interaction with other road users and consequently the chances of being involved in traffic conflicts which could lead to an accident.

The analysis also explored the correlation between attitudes and behaviours of the groups of drivers. Unlike Study 2, which could only explain the role of attitudes towards enforcement and careless driving, the WF has observed a significant contribution of all six attitudinal constructs on drivers' performance.

Table 37: Correlations between attitudinal factors and standardised and non-standardised behavioural variables

Variables	1	2	3	4	5	6	7	8	9	WF	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ
1. Overtaking/lane change index	-	.85**	.89**	.90**	.89*	.75*	.85**	.69**	.89**	.96**	-.36	.49*	-.36	.15	.29	.45*	-.17
2. Indicator using behaviour		-	.79**	.79*	.82**	.83*	.79**	.63*	.85**	.90**	-.24	.49*	-.32	.19	.16	.28	-.27
3. Lane use behaviour			-	.88**	.91**	.69**	.81**	.57**	.80**	.94**	-.22	.55**	-.38	.04	.21	.29	-.07
4. Merging behaviour				-	.97**	.81**	.74**	.63**	.94**	.94**	-.40	.44*	-.35	.17	.23	.35	-.18
5. Speed behaviour					-	.80**	.79*	.61*	.90**	.95**	-.38	.49*	-.33	.12	.31	.38	-.16
6.Distance keeping behaviour						-	.64**	.60**	.85**	.78**	-.30	.31	-.17	.20	.28	.38	-.06
7. Behaviour at traffic lights							-	.58**	.75**	.85**	-.26	.37	-.40	.08	.16	.55**	-.10
8. Careless behaviours								-	.67**	.67**	-.21	.08	-.15	-.06	.35	.42*	-.13
9. Negative interactions & conflicts									-	.92**	-.34	.32	-.37	.27	.23	.38	-.19
Total WF score										-	-.31	.51*	-.38	.16	.21	.36	-.16

Note. Correlations are significant at **$p<.01$ (2-tailed) and *$p<.05$ level (2-tailed).

8.7 Discussion

The findings reported in Study 2 suggest that the driving population of Pakistan has a significantly different attitude towards road safety and based on those attitudes, it could be classified into four groups. The study also demonstrated that the groups differed on all behavioural dimensions, and only opportunists loaded significantly on the DBQ constructs. However, post-hoc multiple comparisons suggested that the groups are similar to at least one other group in the study and failed to characterise them exclusively due to low reporting of behaviours. The study also identifies the *regulators* to be the safest group and significantly different from the *opportunists* and the *risk-averse* groups while at the same time noted that the behaviours of the *risk-averse* drivers were comparable to the *opportunists*. The contributions of drivers' attitudinal orientations on its behaviours were also not evident in Study 2. Therefore, the purpose of Study 3 was to address these deficiencies and to investigate if any group behaved differently from the rest of the population. It also aimed to validate the self-claims of the groups about their driving styles and whether significant differences among the groups actually exist on different behavioural dimensions.

8.7.1 Behavioural dimensions of Pakistani drivers

The WF technique helped to characterise the drivers by observing them on different behavioural dimensions including overtaking/lane change, indicator and lane use, merging and distance keeping with traffic, speeding, as well as carelessness during the drive. The inspection of the mean scores on the indices provides interesting results (Table 36). For instance, the most frequent mistakes committed by the drivers were related to overtaking or lane change (2.98 mistakes/section). The second most frequent mistake observed for the drivers was poor use of lanes (2.03 mistakes/section). The third most frequent mistake was speeding (1.99 mistakes/section), followed by poor merging behaviour (1.35 mistakes/section). The results are generally in agreement with the findings of Studies 1 and 2 as well as with on-going discussions made on different public and government platforms in Pakistan where the issue of improper overtaking and lane usage has been treated as more serious than speeding.

For instance, official statistics provided by the Chief Traffic Police Lahore (CTP) indicates that in only a single month of 2010, 7.60% drivers were fined for speeding while 92.4% for not following the line and lane rules (The Nation 2010). It has been reported consistently that the fast lanes always remain clogged, and that the only reliable way to escape a 'fast lane blockade' is to drive fast in the slow lane (Shirazi 2006). The reasons why drivers overtake while it is forbidden, do not obey speed limits or weave freely in and out of lanes could be linked to the findings of Study 1. The study reported that most of the drivers in Pakistan are unfamiliar with basic traffic rules and regulations since the procedure for obtaining a license and passing the driving test is very lenient (for details, refer to Study 1; section 6.6.3.6). The quantitative findings of Study 2 revealed that only 53% of the participants had a license, out of which only 51% had passed the test. Another survey of 4034 drivers in Lahore found a similar trend with only 34% of drivers having a license; out of which 32% reported getting it without passing the test (Rescue 1122 2006).

The analysis also examined simple correlations across behavioural indices, negative interactions and traffic conflicts (Table 37). The results reveal some statistically significant, positive correlations with a large strength of association between variables (>.5). This confirms previous findings in the literature. For example, Chaloupka and Risser (1995) conclude that errors in behaviour and interaction can hypothetically be seen as 'predecessors' of traffic conflicts in the same way as traffic conflicts are predecessors of accidents.

8.7.2 Differences in driving behaviours of the segments

The study observed the *opportunists* committing the most erroneous behaviours on the roads. An overall comparison of the WF scores for the groups reveals that the *opportunists* (Total WF score=164.75) are the riskiest and statistically different from the other three groups. It is worth recalling that the group also has the most unfavourable attitudes towards road safety particularly those that are related to rule compliance and enforcement (for details, see section 7.8.1). Interestingly, the results of post-hoc multiple comparison found no differences among total WF scores of the *autonomous* (Total WF score =102.50), *regulators* (Total WF score =82) and the *risk-averse* (Total WF score =112.17) which implies that the groups behavioural profiles are similar.

Furthermore, the *autonomous* and the *regulators* have similar mean values on the 'distance keeping' and 'careless behaviour' indices (M= .53 and .63 respectively). Both the groups were also equally engaged in traffic conflicts (1.06 times/section). Collectively, these findings also lead to better understanding of the behavioural characteristics of the *regulators*. It is important to note that although, the *regulators* scored the least aberrant behaviours, the group is not statistically different from the *autonomous* and the *risk-averse*. Therefore, it does not clearly stand out as the safest group overall. This study thus falsifies its previous claim of having the safest behavioural practices in Study 2 (with the lowest total for the DBQ) and attributes it to self-report bias. Furthermore, it also rejects low behavioural tendencies of the *autonomous* as they reported in Study 2. This group of drivers were continuously observed engaging in different deviant behaviours although less frequently.

The differences in behaviours on specific indices were also systematically assessed. The result for the first index, overtaking behaviour, indicates the *opportunists* to be the most aberrant and significantly different from rest of the population as regards its merging behaviours. In parallel, the *risk-averse* are noted to be similar to the *opportunists* in terms of using lanes and speeding. This finding provides partial strength to results from Study 2 and asserts its argument that both the groups share a somewhat similar behavioural profiles; despite having significant differences on various attitudinal dimensions. This similarity can further be imputed to similarity in socio-demographic characteristics of the groups especially their income, occupation and educational level.

However, at the same time, the various groups are found to be not so different from each other in terms of the indicators; 'keeping distance with traffic', 'staying at traffic lights', and 'being careless while driving', although, the *opportunists* scored higher than the others. This alikeness implies that the driving population of Pakistan is targetable as a unit on some behavioural dimensions irrespective of their attitudinal differences towards road safety.

With the help of the WF, other important indicators of risky behaviours of drivers including interaction with road users and traffic conflicts were also observed. The character of interaction and communication in traffic is an important factor for traffic safety, as they represent the social climate, and as they can be looked upon as precondition for the degree and the quality of cooperation between road users (Risser 1988, cited in Chaloupka and Wien 1990).

Post-hoc multiple comparisons reveal that the tendency of the *autonomous*, *regulators* and the *risk-averse* to engage in negative communication with other road users is the same (avg. 5.85 times/section of the route). However, as expected, for the *opportunists* it is considerably higher (9.85 times/section), so that the risk of being involved in traffic conflicts is two times more than for the others (2.7/section).

8.7.2.1 A relative comparison between self-reported and observed behaviours of the segments

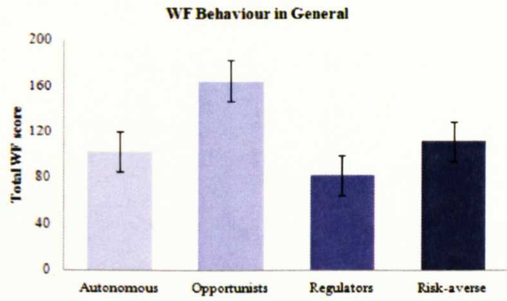
So far, the discussion has established the differences and similarities between the groups. In order to further examine the advantages of utilising observational measures, a relative comparison of the total DBQ scores and WF scores for the groups has been made. Table 38 and Figure 31 demonstrate notable differences between the behaviours. For instance, the *regulators'* actual behaviours contradict their self-reported behaviour, as discussed earlier. Further, it can be seen that the DBQ failed to show any prominent differences among the groups with minimal variation in the columns' height.

By contrast, the WF evidently helped in differentiating the groups such that the *opportunists* stand out clearly from the rest. Though, these are indicative differences, the ranking of the groups (from most dangerous to least dangerous) in both the studies remains the same.

Table 38: Observed and behavioural differences across the groups

	Autonomous	Opportunists	Regulators	Risk-averse	F-value
T. WF score	102.50^{2}	164.75^{134}	82.00^{2}	112.17^{2}	4.67^{**}
T. DBQ score	57.43	65.22^{3}	47.43^{24}	63.44^{3}	10.06^{*}

Note: Mean difference is significant at *p<.001



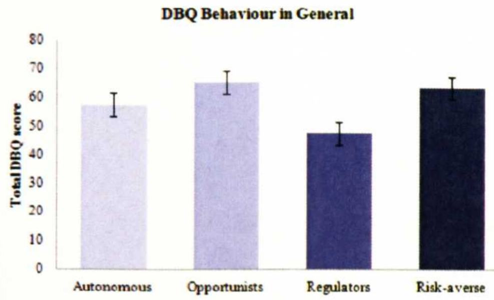


Figure 31: Relative comparison of aberrant behaviours of the groups using total WF and DBQ scores

In summary, the data collected from WF helped to demonstrate similarities and differences between the groups on different behavioural indices. The evidence points conclusively towards the *opportunists* being the most dangerous group. The study concludes that the *autonomous*, *regulators* and the *risk-averse* can be treated together, if it is needed to develop cost effective interventions, a no significant differences are found between the groups at any of the behavioural dimension tapped by the WF. However, the *risk-averse* are also comparable to *opportunists* on some indices. Therefore, alternatively, these two can be treated in combination. Nevertheless, the *opportunists* are the riskiest and more attention should be given to targeting this group. This discussion is closed with confirmation of H3 of this research.

Hypothesis 3: Direct observation of behaviours is a more reliable approach to tap aberrant behaviours of drivers than subjective reporting (Status: confirmed).

8.7.3 The effect of driving environment on drivers' behaviours

One important element of the analysis reported in this chapter is the influence of driving environment on drivers' behaviours. This study supports and extends previous research suggesting that road and/or environment influence drivers' behaviour (e.g. Sato and Akamatsu 2007; WHO 2009b; Török 2011). As discussed earlier in section 8.4.3.2, the route in the present study was laid out in five different sections having varying driving conditions and physical characteristics to take into account differences in drivers' manoeuvres.

In general, the results demonstrate that drivers tend to behave more erroneously in heavy traffic, and where there is poor law enforcement or poor road layout. The least erroneous behaviour for the sample population was observed in Section 1 (Total WF score=13.77, SD=9.39) and the most in Section 3 (Total WF score =19.14, SD=8.23). The finding is in agreement with discussion held earlier in section 3.3.3 that greater environmental diversity is likely to produce greater variability and intentional violations such as lane use, speeding are affected by the factors such as road layout.

Two groups within the study, the *autonomous* and the *risk-averse*, have noticeably confirmed the influence of the driving environment on their behaviours These groups exhibited a similar pattern of changes in their behaviour along with change in the environment such that the drivers exhibited risky behaviours under complex driving conditions (Figure 30). However, it is interesting to note that the driving style of the *opportunists* and the *regulators* appeared to be free from the impact of their surroundings. The groups' behaviours mostly remained consistent on each section of the route. This was especially true for the *opportunists*, no variation in the WF scores was observed in the last two sections (Total WF score=104). This implies that the group remains unresponsive to better or poorer driving conditions and would not refrain from behaving erroneously[77] on all types of the roads and in all environments.

Similarly, the *regulators* also remained unaffected by changes in the driving environment. However, a slight variation in their behaviours was observed on Section 3. The group has the highest WF scores for that section. It should be noted that the *regulators* are the group of drivers who strongly favour stringent law enforcement (see Table 25). The main reason for their aberrant behaviour in Section 3 could be linked to the absence of traffic wardens and a poor monitoring system. There is a possibility that the group might have been affected by the large number of vehicles around them that were breaking the rules. However, as the traffic load reduced in Section 4, the group came back to its standard behavioural pattern irrespective of the fact that driving conditions were poorer.

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[77] It is important to note that the WF technique has observed both intentional and erroneous driving behaviour, and the treatment of road safety problem resulted due to driver's errors is different from the intentional violations. However, as this research is focused on RTVs, therefore only the approaches to improve intentional violation behaviour are brought into discussion.

To sum up this discussion, the results highlight that complex driving conditions can increase aberrant behaviour. This study also suggests that a further in-depth investigation is needed to understand the kind of improvement required in the road environment to change drivers' behaviours. As for the *opportunists* and the *regulators*, the two strongest behaviours holding groups of this research are found not to be very dependent on the physical characteristics of roads and traffic. Thus, it can be concluded, as mentioned in SmartMotorist (2011), that roadway maintenance contributes to some motor vehicle accidents, but not to the extent that drivers use it as an excuse. Hence, H6 of the research remains partially confirmed.

Hypothesis 6: Changes in driving environment (e.g. physical characteristics, traffic conditions) substantially influence behaviours of drivers in Pakistan (Status: partially confirmed).

8.7.4 Key attitudinal determinants of driving behaviours

An added benefit of conducting this study was to reassess the relationship between drivers' attitudes and behaviours as in Study 2. The present study, in line with the findings of Study 2, reaffirms the role of driver attitudes as predictors of driver behaviour in Pakistan. For example, the *opportunists* who reported the most unfavourable attitudes towards road safety in Study 2 by scoring lowest on the AQ were observed to behave most erroneously on roads by scoring the highest on the WF. Similarly, the attitudes of the *risk-averse* and the *autonomous* are also reflected in their WF scores such that the groups appeared to be the second and third most aberrant. By contrast the *regulators*, the most favourable attitudes holding group towards road safety, were observed to be behaving the least aberrantly on the route.

An examination of the six attitudinal dimensions, extracted in Study 2, show that they play pivotal role in defining drivers' behaviours on roads. The dimensions are *attitudes towards rule-compliance* (A1*), careful driving* (A2), *value of enforcement* (A3), *ability to override peer-pressure* (A4), *regard for personal safety* (A5), and *regard for other road users* (A6). Table 37 examines the correlations between attitudinal and behavioural factors. It is important to note that Study 2 failed to characterise the influence of all attitudinal constructs on drivers' behaviours and reported a weak strength of association between them. This was attributed to low or insignificant reporting of behaviours on the DBQ (refer to sections 7.8.1 and

7.8.2). The results of this study indicate a strong association between the WF indices with attitudinal factors in comparison to Study 2.

Unarguably, in case of Pakistani drivers, their attitudes towards 'enforcement' (A3) strongly influence their driving behaviours. Although, significant relationships are not observed, this study suggests that favourable orientation towards enforcement makes drivers behave less aberrantly. The same is true for holding favourable attitudes towards rule-compliance (A1). The finding is not only in accord with Study 2 but also with the general literature of road safety (e.g. Crozet and Guillaume 2004; Jovanović *et al.* 2010). Traffic enforcement is an essential element of the traffic safety approach labelled as '*3 Es*' (the other E's being engineering and education). It affects safer drivers' behaviour and the proper shaping of attitudes towards traffic safety (Jovanović *et al.* 2010).

This study has observed the weakest and insignificant correlations between peer-pressure and behavioural indices. This is in accord with the results of Study 2, which suggests that peer-pressure is not a key attitudinal determinant. The finding can be linked with earlier discussion made about the influence of changing environment on drivers' behaviours. It has been noted that the behaviours of two of the strongest groups of this research, the *opportunists* and *regulators*, remain unaltered with changing traffic condition. Collectively, these findings imply that the influence of external factors is very low in defining behaviours of Pakistani drivers. Thus most of the drivers' are less likely to alter their (good or bad) behaviours under the influence of peer-pressure and/or the driving environment.

The other two attitudinal constructs which are noted to influence drivers' behaviours are 'careful driving' (A2) and 'regard for personal safety' (A5). This study has observed positive correlations between the factors and all behavioural indices. This implies that the drivers who are careful about properly maintaining their vehicle or who avoid distraction during driving e.g. mobile phones (A2) are more likely to engage in aberrant behaviours as are the drivers who have regard for their personal safety e.g. use seatbelt/helmet (A5). The findings are interesting and imply that Pakistani drivers either become fearless and/or tend to take advantage of their safe positions with good control of car and basic measures and therefore, behave more aberrantly. However, this research encourages further in-depth investigation in future before generalising the findings.

Lastly, a medium strength of positive association has been noted between A6 that tapped drivers' attitudes towards other road users and behavioural indices. The positive and significant correlations on most of the indices imply that even if drivers are concerned about the safety of other road users, practically when these drivers come on the roads they cannot prevent themselves from behaving aberrantly. This finding has once again highlighted the issue of an inadequate civic sense amongst the driving population of Pakistan, raised earlier in Study 1.

To summarise, the WF results, in corroboration with Study 2, reaffirm the influence of drivers' attitudes in shaping of their behaviours. The technique is found to be much more helpful to assess the influences of all attitudinal constructs and concludes that behavioural observations provide richer information about the correlations between attitudes-behaviours than self-reports. It has also reconfirmed H4 of this research.

Hypothesis 4: Aberrant driving behaviours are a function of unfavourable attitudes such that the drivers who have unfavourable attitudes are likely to commit more road traffic violations (Status: re-confirmed).

8.7.5 Advantages of utilising subjective and observed behavioural measures

Study 3 was initially intended to extend the previous work carried out in Study 2 to understand behaviours of different attitudinal segmentation of sample population of Lahore. However, it also went on to address issues raised from the DBQ data. This study demonstrates that the WF successfully takes into account the deficits resulting from self-reports and extends support to previous research on observed measures of driving behaviour (e.g. Chaloupka and Risser 1995; Lai *et al.* 2005; Carsten *et al.* 2008; Merat *et al.* 2011). First of all, the results suggest that observational techniques such as the WF have the ability to assess influences of constructs such as the driving environment which in the case of self-reports usually remains untapped. Furthermore, the technique proved very successful in exploring the causal link between attitudes and behaviours.

It is also concluded that self-reported behavioural responses suffer from biases and inaccuracies in recalling behaviours. For instance, the behavioural characteristics of the *autonomous* are found to be much different than what they have reported initially in the DBQ so that the groups are not as distinct as they reported in Study 2. In fact, they are found comparable on many behavioural aspects (see Figure 24 and Figure 28 for a quick comparison). However, the results also lend some support to the utilisation of self-reports techniques. For instance, the ranking of the groups (from most to least dangerous) in both the studies remain the same such that the *opportunists* were the most dangerous and the *regulators* the safest. Thus, the results given by the DBQ are not only validated but the replication suggests that self-reports are somewhat reliable technique and; can be used as surrogate method if direct behavioural observations are not possible.

To conclude, the observed measurement of drivers' behaviours compensated for the deficits incurred in self-reports. The technique determines that actual behaviours of the groups are not as distinct as they had reported initially, and direct observations can lead to more meaningful, precise results. Therefore, utilisation of both subjective and observed techniques can help to develop a better understanding of drivers' behaviour.

8.8 Conclusions

This study found support for assessing actual behaviours of drivers. Findings revealed that Pakistani drivers are most likely to engage in incorrect overtaking, lane use as well as speeding. Further, all the drivers irrespective of their attitudinal or socio-demographic backgrounds, are found similar in terms of indicator use, distance keeping, merging with traffic and carelessness. The study has also provided more details about relationships between attitudes and behaviours in comparison to Study 2 and particularly reaffirms the role of 'enforcement' and 'careless driving'. The results further indicate that external factors such as the driving environment and peer pressure do not have a powerful influence on drivers' behaviours especially in the case of the *opportunists* and *regulators*.

However, in general, lack of enforcement, poor physical characteristics and heavy traffic loads on roads are found to increase aberrant behaviours. On the whole, the results of the WF are in agreement with the results of the DBQ and demonstrate that both techniques are reliable measures of drivers' behaviours. However, the WF data produced more comprehensive results and acknowledged the deficits of self-reports. For instance, it suggests that the groups are not as distinct as they had claimed subjectively; although the *opportunist* drivers clearly come out worse than they have claimed as do the *regulators*. The study concludes that the use of subjective and observed measures in combination, validate the results and consequently help in achieving the ultimate aim of exploring aberrant behaviours of drivers in-depth.

8.9 Limitations of the study

There are a few limitations also attached to Study 3. For instance, factors like limited time and inadequate contact information of the potential participants prevented achieving a more ideal sample size for the study. Furthermore, in WF, the data collection is dependent on the surveyors. The data reliability can also be opened to criticism in this study as inter-observer reliability checks are not applied rigidly. Therefore, the chances of incurring human error or collection of information in less coherent way whilst recording the behaviours always exist and this may leave data open to potential criticism. However, confidence in the data remains as the surveyors were adequately briefed and trained beforehand. Lastly, participants in the study experienced continuously varying traffic scenarios irrespective of driving on the same route. This is regarded as another methodological caveat. Although, direct observations tap actual behaviours in contrast to other observational techniques such as simulation based studies, the technique cannot expose all participants to identical driving scenarios as under a controlled environment. However, this was compensated by conducting experiments during weekdays in more or less similar time slots.

SECTION IV

CONCLUSIONS AND RESEARCH IMPLICATIONS

CHAPTER NINE

CONCLUSIONS AND RESEARCH IMPLICATIONS

9.1 Introduction

Given the lack of theory driven road safety research, the principal aim of this thesis was to assess the human side of accidents in Pakistan by focusing on attitudes and behaviour of drivers in the context of road traffic violations. The principal approach adopted to assess the pre-crash phenomenon was the statistical segmentation, which classified sampled driving population into relatively homogenous and distinct groups based on theory-driven attitudinal constructs. It was postulated that the attitudinal segmentation would provide underlying explanation of aberrant behaviours and aid to understanding the differences between safe and un-safe drivers. In order to achieve this, following aims of this research were set:

1. To contribute to an understanding of the attitudinal and behavioural dimensions of Pakistani drivers' towards road safety in the context of road traffic violations along with the assessment of a causal link between attitudes and behaviours together with the underlying influence of socio-demographic factors and the driving environment.
2. To discuss possible theoretical, methodological and policy implications of research findings useful not only with reference to Pakistan but overall attitude behaviour research in road safety.

The purpose of this last chapter is to summarise and integrate the numerous findings obtained across all three studies conducted during this research. To begin with, a brief review of the hypotheses - which were constructed to meet the research aims – is carried out in section 9.2. Section 9.3 mainly suggests empirically driven person-based road safety interventions, specific to the identified segments. Section 9.4 then broadly addresses the possible system-based interventions for Pakistan. Following this, section 9.5 discusses unresolved issues and recommends potential avenue for research in future. Before finalising the discussion, the chapter also assesses the extent to which the research findings can be generalised in section 9.6.

Lastly, based on the findings and limitations of the work carried out in this research, the final conclusions are presented in section 9.7.

9.2 Review of the research hypotheses

In order to meet aims of the research, a number of hypotheses were constructed. This section revisits each of the hypotheses, assesses the extent to which each of these are confirmed, and draws final theoretical and methodological conclusions to take forward into the discussion held in consecutive sections 9.3 and 9.4.

9.2.1 Hypothesis 1

> The driving population of Pakistan has unfavourable attitudes towards road safety and is likely to fall into distinct segments or subgroups in accord with their attitudes.

The rationale for this hypothesis came from the neglect of attitudinal and behavioural research in Pakistan, and an excessive reliance on *a-priori* drivers' classification schemes with aggregated responses to design road safety interventions (refer to sections 5.1.1 and 5.1.4). In order to assess whether the driving population in the country had unfavourable attitudes towards road safety, firstly a qualitative study was carried out (Study 1). As the literature review identified RTVs to be motivation-based, it was important to know which local factors motivate drivers to commit them. Thus, the study identified socio-cultural and psychological factors to be studied in the AQ.

The questionnaire was inspired by the conceptual framework of the TPB (Study 2). Factor analysis was performed on the questionnaire data which extracted six attitudinal constructs relevant to the study's population. Finally, cluster analysis was performed to assess whether the population was falling into distinct groups. The extracted attitudinal constructs were used to define and describe the groups. The analysis revealed that the population was classifiable into four stable groups and each of the attitudinal dimensions weighted differently on each of the group. Consequently, the groups were named after their most salient characteristics as the *autonomous*, *opportunists*, *regulators*, and *risk-averse*. Discriminant analysis further revealed that the groups were *statistically* distinct and all six attitudinal constructs played significant roles to define their attitudinal profiles.

Thus, the elucidation of the four coherent, attitudinally distinct and meaningful segments confirmed hypothesis 1. The methodological and policy conclusions drawn from the finding are two-fold. *First*, it discourages the adoption of conventional univariate segmentation, and indicates that in a driving population a number of groups holding disparate attitudes can exist; which are *naturally* identifiable with the help of Cluster Analysis, and without making any prior assumptions, stereotyping individuals, and/or averaging out responses. *Second*, the technique has identified multifarious aspects associated with people's driving (including attitudinal, behavioural, and socio-demographic characteristics), and thus has proved to have a high explanatory utility to provide various policy implications (see section 9.3).

9.2.2 Hypothesis 2

> A substantial proportion of the driving population of Pakistan (a developing country) has unsafe driving behaviours; and Pakistani drivers are likely to be significantly different from drivers in the UK (a developed country) in terms of behavioural characteristics.

The rationale for this hypothesis came from the ever declining road safety performance of Pakistan (refer to sections 1.3, 2.3 and 5.3.2). To assess the hypothesis, the qualitative results presented in Chapter 6 acted as the starting point. The findings highlighted that all drivers in Pakistan more or less behave aberrantly irrespective of their socio-demographic characteristics. They appeared to be aggressive, competitive and lacking in self-assessment with no recognition of some of the inappropriate driving behaviours as offences e.g. horn blowing, tailgating (Study 1). To quantify the frequency of aberrant behaviours, a modified Driver Behaviour Questionnaire was deployed in this research (Study 2). Chapter 7 presented the results of the questionnaire using principal component analysis and highlighted *intimidating other road users* as the strongest aberrant dimension of study's drivers. The drivers were also noted to consider themselves above the rules, most likely commit risk prone infringements and could be assertive to compete for space on roads.

In relative comparison to the drivers in the UK, the results identified that drivers in Pakistan were more undisciplined and aggressive. They tend to sound the horn; engage in improper overtaking; intimidate female drivers; force their way out as well as disregard stop lines and continuous lines. However, the drivers were found least likely to engage in speeding unlike drivers in the UK. The DBQ data also did not replicate the factor structure applicable to the UK drivers. The results of the Wiener Fahrprobe based observational study presented in Chapter 8 reaffirmed the prevalence of inappropriate lane use and lane changing behaviours among drivers.

Together, these results confirmed hypothesis 2 and suggest two policy recommendations. *First*, the finding encourages conducting more country-specific research. The differences between the driving populations of developed and developing countries coupled with Pakistan's extremely poor road safety statistics in comparison to the UK – a country that is six times more motorised with lower current and projected fatality rates - lead to believe that drivers in Pakistan behave aberrantly as compared with countries which have good safety practices. And in this case, road safety solutions which are usually *adopted* from the developed world into Pakistan are not likely to succeed unless they are *adapted* to take into account local behaviours. *Second*, it empirically provides the basis to develop countermeasures specific to the most frequently committed aberrant behaviours on roads (see section 9.4.1).

9.2.3 Hypothesis 3

> Direct observation of behaviours is a more reliable approach to tap aberrant behaviours of drivers than subjective reporting.

The rationale for this hypothesis came from the dominance of self-reports to assess driving behaviours in road safety (see sections 4.2.3 and 5.1.2). To assess the hypothesis; self-reported and observed driving behaviours of the extracted segments (with the help of the DBQ and WF respectively) were broadly evaluated. The overall results of the two data sets were found to be in agreement such that the *opportunists* emerged as the most dangerous group and the *regulators* as the safest (see section 8.7.2). However, one-to-one comparisons of the results indicated that all the groups reported low aberrant behaviours on the DBQ.

Furthermore, the results indicated that the *regulators* did not behave as safely as they claimed in comparison to their fellow drivers. Likewise, the *opportunists* clearly came out worse than what they had claimed. The observed data was also successful in explaining the relationships between attitudinal and behaviours dimensions in much more detail than the subjective data[78]. The WF technique also helped to assess the influence of road environment on the behaviour of drivers.

Together, these results confirmed hypothesis 3. The two salient conclusions drawn from the finding are as follow. *First*, the utilisation of observed measures can provide richer and more reliable information about deviant driving behaviours. Hence, this research suggests that observed measures should receive preference over subjective methods when possible. *Second*, in agreement with the road safety literature, this research acknowledges that bias can affect subjective reporting of deviant behaviours, and in the case of Pakistani drivers the sources of bias are possibly social desirability in responding and optimism bias which can be aggravated due to face-to-face interviewing (see section 9.5).

9.2.4 Hypothesis 4

> Driving behaviours are a function of attitudes such that the drivers who have unfavourable attitudes are likely to commit more road traffic violations.

The rationale for this hypothesis came from the relationship between attitudes and behaviours of drivers established earlier in Chapter 3 (refer to sections 3.3.2 and 5.1.1). Profiling the segments based on their attitudinal characteristics in Study 2 was of little use, unless it could help understanding the influences of these characteristics on the behaviour of drivers. To confirm the hypothesis, influences of attitudes on both reported and observed behaviour of drivers were assessed in Studies 2 and 3 (see sections 7.10.3 and 8.7.4). Collectively, the behavioural

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[78] Bi-variate inspection of correlations in Study 2 noted a weak strength of association between attitudinal and behavioural factors ($\leq .30$) which was attributed to biases of subjective data. Conversely, Study 3 successfully characterised the influence of all attitudinal constructs on observed behaviours of drivers and also reported good strength of association between them ($\leq .57$) (see sections 7.8.2 and 8.6.4).

profiling of the segments across the studies demonstrated that the cognitive understanding of drivers successfully translates into their driving behaviour.

The results indicated that the drivers who reported the least favourable attitudes towards road safety reported the most aberrant driving behaviours and vice versa. As a result the *regulators* emerged as the safest and the *opportunists* as the riskiest groups of drivers. More specifically, attitudes towards enforcement appeared to be the strongest determinant of behaviours of drivers in Pakistan, followed by attitudes towards rule-compliance. The results also highlighted some concerns which needed to be addressed before interpreting the roles of attitudes completely for drivers in the country. For example, it was noted that holding favourable attitudes towards careful driving and regard for personal safety is likely to result into exercising more deviant behaviours. For example, the *opportunists* strongly discourage to drive with hand-held mobile or worn-out tires (refer to section 7.8.1 and Appendix F), and at the same time observed to be consistently engaged in acts such as speeding (see Table 36).

In brief, the empirical results of this research confirmed hypothesis 4, and also highlighted two key theoretical implications. *First*, this research acknowledges that driving behaviours are a function of attitudes, and therefore, implicate that behaviour-changing interventions developed on good understanding of socio-cognitive mechanism of drivers can prove highly successful. *Second*, it indicates that drivers tend to misuse some of their positive attitudinal orientations (e.g. careful driving, personal safety) to their own advantage. The finding is interesting and indicates that treatment is needed to alter this mind-set for the good of road safety (see section 9.3.2).

9.2.5 Hypothesis 5

> Differences in attitudes of drivers (segments of drivers) towards road safety are attributable to their socio-demographic characteristics.

The initial rationale to construct this hypothesis came from one of the aims of this research: to explore which socio-demographic variables exacerbate risky attitudes and behaviours in order to design more effective target interventions (refer to 3.3.5). The second rationale came from the concern this research raises on *a-*

priori classification schemes in road safety. The methodology review conducted in Chapter 4 challenged the usual practice of pre-classifying drivers into groups based on key socio-demographic variables (e.g. gender, age, income) with the assumption of homogeneity within the groups to design targeted road safety policies (refer to sections 4.3 and 5.1.4).

To confirm the hypothesis, the results of Study 1 presented in Chapter 6 acted as a starting point (refer to section 6.6.4). The results of the interviews informed that various negative driving behaviours in the country were practised by individuals coming from various backgrounds. Specifically the combination of affluent, young, and male was particularly adverse. In order to confirm the hypothesis empirically, Study 2 investigated the socio-demographic composition of each of the segments (see section 7.8.3), and assessed whether the variation in drivers' attitudes was attributable to their socio-demographic characteristics (see section 7.10.4). The results revealed all four segments had varying socio-demographic characteristics but noted only a few *statistically* significant differences between them on variables such as gender, income, and occupation type and category.

The results thus partly confirm the hypothesis that differences in attitudes of the segments towards road safety are attributable to their socio-demographic characteristics. At the same time, it strengthens the premise of avoiding an *a-priori* socio-demographic classification and adoption of an attitudinal segmentation in this research. It suggests that the assumption of homogeneity cannot always be true as no *statistically* significant differences between the groups were found on various descriptive variables including age, education. Thus the two key conclusions extracted from the finding are as follows: *first*, this research acknowledges that socio-demographic characteristics influence driving behaviours but disprove the assumption of homogeneity and states that the technique cannot classify groups of drivers systematically and uniformly; *second*, this research recommends that combining groups of drivers sharing similar attitudinal profiles is much more valuable as attitudes can be persuaded to change, whereas, socio-demographic characteristics do not.

9.2.6 Hypothesis 6

Changes in the driving environment (e.g. physical characteristics, traffic conditions) substantially influence behaviours of drivers in Pakistan.

The rationale for this last hypothesis came from the importance of the driving environment as gauged from the literature review (refer to section 3.3.4). To inform the hypothesis, Study 3 observed changes in the behaviour of drivers with changes in the driving environment (refer to sections 8.4.3 and8.7.3). Broadly, the study noted that complex driving conditions (e.g. heavy traffic, poor law enforcement and badly maintained roads) increase aberrant behaviour as expected.

However, the detailed analysis observed that behaviours of two of the groups holding the strongest attitudes, the *regulators* and *opportunists* (containing 58% of the sample population in total), remained almost unaffected or unaltered with changing traffic condition. Thus, hypothesis 6 remains partially true for drivers in Pakistan. The two key conclusions which can be drawn from the finding are as follow. *first*, influences of exogenous factors on behaviour of drivers holding strong attitudes remain minimal; and *second*, person-based interventions are likely to have an advantage over system-based interventions for the majority of drivers in Pakistan.

In brief, apart from providing a wide-range of information about the driving population of the Lahore, the results have demonstrated the methodological utility of adopting a market segmentation approach and measurement of actual behaviours on the roads, and also provided an empirical base for developing road safety policies with a focus on the diverse characteristics of the sub-groups of drivers. The discussion in the subsequent two sections recommends interventions to improve road safety in Pakistan starting from a person-based focus.

9.3 Person-based road safety implications for the segments

The real value of segmentation analysis lies in its ability to be translated into achievable strategies (Anable 2002, p. 315). It needs to inform policy decisions which are primarily concerned with behaviour change in the population (Thornton *et al.* 2011, p. 25). Considering how little was known, the main objective of this research was to reach to a common understanding of the dimensions of risky driving behaviour in Pakistan and their underlying socio-psychological mechanisms.

Therefore, the ultimate contributions of this research could be the identification of useful targets for developing road safety interventions for the country in the light of the evidence collected. The literature review has indicated that effective road safety campaigns can be designed following person-based and/or system-based approaches (see section 3.4).

Considering the limitation of resources in the country, it is sensible to focus more on person-based cost effective solutions, where possible, which can be incorporated readily into existing decision-making structures. Secondly, it is difficult to entirely rebuild a different transport system to meet the needs of the different segments identified – any such improvement is particularly likely to remain ineffective for the *regulators* nor *opportunists* (refer to section 9.2.6). Davies *et al.* (1998, cited in Anable 2002) say that the understanding of different demands and decision making process of the segments can be used to design different messages for different groups to be channelled through different media at different times as part of a coordinated and systematic campaign (p. 316). The following sections highlight the potential areas of improvement in each of the identified segment. Discussion is carried out in a way to provide a framework that can be used to develop a large scale road safety campaigns at later stages.

9.3.1 Targeting multifarious cognitive antecedents of the segments

The commercial marketing literature indicates that targeting is essential for any realistic marketing campaign (Roberts 1996; Anable 2002). The socio-cognitive characteristics of each of the segments had provided their propensity to act safely or unsafely on the roads. This diagnostic insight is valuable so as to refrain from *average* mass marketing, and to develop *targeted* campaigns with an emphasis on the *individuality* of each segment which can attract and influence diverse audiences. It is considered much more productive to first concentrate efforts on the segments which emerged as safer. The reason is that stimulating safe driving practices would be achieved much more easily in the groups already holding favourable attitudes and behaving less aberrantly. By applying this principle, the *regulators* and *autonomous* should be the focus. Collectively, these groups contain nearly two-thirds of the sample population.

Moreover, contrary to the common belief that cognitive flexibility and readiness to change one's attitudes decline with age, the results of several studies have demonstrated that susceptibility to attitude change declines from early to middle adulthood and then increases again in late adulthood (Ajzen 2001, p. 37). Thus the idea of keeping a prime focus on the *regulators* and *risk-averse* is further reinforced as both the groups contain a relatively mature population. The discussion carried out is such that it first identifies favourable attitudes which need to be reinforced and likewise highlights unfavourable attitudes which should be changed. As the attitudes can be changed through persuasion (see section 3.3.2.1), therefore in order to help drivers learning favourable attitudes, recommendations are generally made by following the basic psychological tactics including observational learning and operant conditioning.

9.3.1.1 The regulators

The *regulator* group have the strongest potential to act as a *safeguard* against aberrant practices because it contains (i) more than half of the sample's population, (ii) holds the most positive attitudes and safest behaviour, and (iii) is most likely to exercise safe behaviour consistently irrespective of the driving environment. These traits make the group the most attractive to target first. This group of drivers strongly supports stringent enforcement. Therefore, it is recommended that campaigns should capitalise on this aspect and should assign to the group a social role of literally acting as *'regulators'* on the roads. However, at the same time it is important to note that these drivers have a motivation to break traffic rules, although weak, in case they are not enforced properly. Additionally, Study 3 observed that the group's drivers perform inappropriate overtaking and make inappropriate use of the lane.

As these behaviours are found to be weak in terms of empirical strengths and considered to be the result of unawareness of traffic rules and/or adverse consequences of committing violations. They can be easily uprooted by educating the group about basic traffic rules and regulations and consequences of engaging in intentional violations with an overriding aim to improve their self-awareness (e.g. through training courses, media campaigns or by simply distributing pamphlets). Delhomme et al. (2009a) say that education can be used to communicate information and raise awareness of a specific issue. It helps people develop knowledge, skills, and changes in attitude (e.g., educational programmes, driver's training, etc.) and promotes the development of internal and informal social controls. They further say that awareness about adverse consequences of intentional violations can be promoted among drivers by educating them that "this could happen to them" through the use of emotional, realistic portrayals of road crashes and their consequences.

The utility of such education campaigns to change attitudes and intentions of drivers e.g. to speed are now been demonstrated several times. For example, the speed awareness workshop, organised by McKenna (2007) was shown to produce small to medium differences in drivers' attitudes to speeding, their perceived social pressure against speeding and their perceptions that they could control their speeding in the future. The workshop diminished the belief that speeding is enjoyable and increased the perceived legitimacy of speed control. At the end of the workshop, drivers were more than four times more likely to disagree that driving at 35 mph in a 30 mph limit is safe. There were also clear differences in speeding intentions. For example, drivers at the end of the workshop were more than five times more likely to intend to keep to the 30 mph limit (for details, see McKenna 2007).

With little training and persuasion of the group, policy makers can not only rectify its behaviour but can later empower them to create a *critical mass* of safe and traffic regulatory drivers – a concept which is known to bring a social change. Oliver *et al.* (1985) explains that collective action usually depends on a "critical mass" that behaves differently from typical group members. Sometimes the critical mass provides some level of the good for others who do nothing, while at other times the critical mass pays the start-up costs and induces widespread collective action. In simple terms when a certain 'critical mass' of people believes in something, suddenly the idea becomes true for everyone (O'Hara 1985) such that the change spreads rapidly and crystallizes to become self-sustaining in society (Shapiro 2005). This is so because in public behaviour, a person is more likely to go along with the crowd when seeking approval among peers (wiseGeek 2012). O'Hara (1985) says the means, by which critical mass is achieved, is not in any way mysterious. It is a matter of telecommunication, not telepathy.

The literature indicates that critical mass can reasonably be achieved with 10 to 20% of people in the population. For example Valente (1995, cited in Morris and Ogan 1996) notes that usefulness of the telephone or an e-mail system in the early years of their development was established when about 10 to 20% of the population had adopted the innovation. Thus the inclusion of the concept through the *regulators* seems easily achievable in driving population of Pakistan as the group emerges as around half of the total and is already inclined towards stepping up the level of enforcement measures. Considering this strength along with a dire need for an immediate plan of action, policy-makers can go a step further and can more specifically approach professional drivers out of this group in order to achieve the mass relatively quickly. The following discussion presents the rationale for this idea.

Despite emerging as the most dangerous in Study 1, the segmentation has identified that professional drivers constitute nearly one-fourth of the *regulators*. The finding suggests that professional drivers have great amenability to improve behaviour as they have highly favourable orientation towards road safety. The revelation is interesting and can be exploited by the policy-makers; especially considering the fact that these drivers are easily identifiable, accessible, and can be hand-picked for training purposes in order to induce the phenomena in mainstream traffic. The only need is to drill down and address the issues which prohibit them from translating their favourable attitudes comfortably into safe behaviour on the roads. Study 1 has also provided a possible explanation of their inappropriate discourse and linked it to competition; poor-working facilities, low-wages and unawareness of rules and regulations etc. (refer to section 6.6.4). The corrective measures which government can immediately take are enforcement of basic working regulations for the drivers, and requiring the operators to adhere to them with heavy penalties and fines. Chapter 2 indicates that district governments are responsible for jurisdiction and budget preparation for public transport. At this local level, decision-makers can set these requisites easily in terms of time, cost as well as institutional formalities.

Another issue to address is the unawareness of basic rules and regulations. To rectify this, city district governments can design intensive road safety courses for the drivers with a compulsion to attend. It is important to recall that not only mass- but para-transit services are extensively operational in the urban cities of Pakistan including Lahore. These services such as rickshaw, qinqi are pervasive. Therefore, this research strongly recommends making this group a focal point of training and awareness. At this micro level just by stopping this group from committing its three most frequent violations - wrong overtaking, inappropriate use of lane and speeding - can have a substantial impact in regulating the overall traffic of the cities.

It is also recommended that not only educating the group is important but making it aware of its 'true' potential and role in bringing positive and lasting change on the roads. Nevertheless, as this group of drivers have low incomes, making them aware of the economic benefits of disciplined regulatory driving e.g. driving smoothly or less haphazardly is more fuel efficient, can prove very attractive. Once the message of safe driving practices has convinced up to half of this driving population, it can be hoped to have a trickledown effect and that other drivers will imitate their good behaviour.

In brief, the content of any road safety campaign, training course or workshop developed for the group should focus not only educating the group particularly in basic line, lane, and overtaking rules but raising their awareness about adverse consequences of aberrant behaviours. The group would then realise its potential of *regulating* and improving traffic flow, persuading them not to break the rules even out of necessity in areas where these are not enforced by promoting a significance of professional and disciplined attitude. Lastly the key messages should involve creating narratives/messages that give the group a moral duty to act as an enabler-governor of safety on the roads. The low cost means by which these ideas can be communicated to wider audience of this group aside from professional drivers are discussed in section 9.3.5.

9.3.1.2 The autonomous

Having defined the prospective role of the *regulators*, tapping attitudinal and behavioural characteristics of the second safest group in the population can also bring important changes. Taking into account the profiling of the segment, it is conceivable that the *autonomous* have the potential to be the accomplices of the *regulators*. The group not only has the second most favourable set of attitudes towards road safety (significantly favourable orientations towards rule-compliance, careful driving, and unconcerned from peer pressure), but in both Studies 2 and 3 its driving behaviour was found not to be *statistically* different from the *regulators*.

However, unlike the *regulators*, the *autonomous* considered themselves above the rules and were observed to be affected by external factors (refer to sections 7.8.2 and 8.6.3). These behavioural tendencies of the group were attributed to its independent, self-regulatory nature with a temptation for undisrupted, free movement. Other than that this group of drivers were reported found to have unfavourable attitudes towards enforcement, although weak, and disregard for other road users. Therefore, in order to improve its performance, policy makers should address these cognitive issues.[79]

First of all, it is recommended that the content of any road safety campaign developed for the group should continually impress the connection between enforcement and accidents. Further success may be gained by altering the group's propensity to consider itself above the rules. This group of drivers are mostly motorcyclists, working in the government sector. Therefore, they appear relatively comfortable in breaking the rules by taking advantage of their physical and social positions. This rationale is strongly linked to the findings of Study 1. The study identified the rampant issue of influence peddling in Pakistan. It is recommended that the safety profile of the group can be improved by instilling in it the values of respecting the law and their fellow road drivers. This can be achieved by linking it up with the moral and social responsibility of the group's drivers as citizens towards the society as a public servant.

It is recommended that, similar to the targeting of professional drivers in the *regulators*, road safety agencies should liaise with all the government departments to run safety courses as an immediate plan of action. The content of such programs should not only provide road safety education but should be designed with the aim to encourage the above mentioned values. To further combat the behaviour, the adverse impacts of abusing the power should be conceptualised to the group by

[79] There is also a youthful component attached to the group (with high percentages of motorcyclists and young drivers) which is addressed as an overall policy measures for urban areas of Pakistan in sections 9.3.4.1 and 9.3.6.1.

making it aware of the greater issue of social inequity and feelings of deprivation they are likely to create in other road users. Furthermore, the group of drivers should be trained and taught not to be affected by changes in driving environment and to maintain safety while driving in ill-enforced areas.

It is important to note that vehicles in Pakistan with government number plates are increasingly in use. It is reported that such vehicles not only bypass the attention of law-enforcement agencies but bring many other advantages e.g. easy access to parking lot (Qureshi 2011). Another immediate policy action decision-makers can take is to end the issue of such number plates. In the long-term it is advised that the trend can be reversed by imposing a ban on such vehicles in the country. If it cannot be imposed completely due to security or other reasons then may be a law can be made which can restrain the use of such vehicles e.g. in congested urban areas. For the time being, such people should be made aware that their behaviour can make them held responsible of the social distress particularly due to their easy identification, while at the same time their moral role to carry out the law as a public servant should be glorified. One the other hand, authority and confidence should be given to traffic wardens to treat offenders without any discrimination.

In short this first half of the discussion concludes that policy-makers can distribute the responsibility of ensuring and encouraging safe practices through the *regulators* and *autonomous* more immediately by targeting professional drivers and government employees, and introducing them with the power of their moral and social reflections on roads. These sections of the groups can, after receiving education and training, also be used to collectively achieve critical mass. The second half will now address the issues of the other two relatively unsafe segments of the population.

9.3.1.3 The opportunists

Keeping in mind the evidences of Studies 2 and 3, it would not be wrong to assume that the *opportunists* have a strong propensity to act as '*spoilers*' in interactions with others, closely followed by the risk-averse (see Figure 22). It is the smallest group in size (6.54%) with the most unfavourable attitudinal orientations (significantly unfavourable attitudes towards rule-compliance and enforcement). It is advised that the harm that the group is likely to cause due to its actions in traffic should not be underestimated on account of its smaller size (see Figure 28).

Therefore, firm actions are needed to control the large-scale problems likely to occur when the numbers of this group increase. The significant impact of this group is reinforced by the fact that the group was observed to behave consistently in an aberrant manner on all types of roads in Study 3 (see Figure 30). Thus discussion in below focuses on aspects which are the main motivators for the group's drivers in promoting unsafe driving and how the group can be persuaded to change by promotional campaigns. Based on these results, it is indicative that socio-psychological person-based interventions can be effective to influence the group's behaviour. Endogenous cognitive mechanisms affect the *opportunists* more strongly than is the case with the other the segments, and are much more active in shaping the group's behaviour particularly in reference to exogenous factors such as driving environment as discussed above. However, the attitude-change literature tells that the stronger the attitudes, the harder it is to effect change (refer to section 3.3.2). Therefore, a stronger emphasis on reinforcing and facilitating positive attitudes already held by the group may prove much more beneficial and realistic in promotional campaigns than making attempts to uproot negative attitudes which are robust and more likely to be difficult to change.

Based on this principal, it seems much more appealing to capitalise on the group's regard for other road users. The results inform that they uphold the highest regard for other road users amongst the segments and also disapprove careless driving. However, interestingly, correlation analyses indicated that favourable orientations on these constructs are inversely related to safe behaviours. As a result drivers holding these attitudes are likely to exercise aberrant behaviours which could be due to various reasons (for details, refer to section 8.7.4). This research recommends that attitudes and behaviour of the group may be improved by impressing a link between road users regard and civic sense while considering the fact that the group's cognitive mechanism strongly recognise/understand road courtesy. Study 1 has indicated that drivers in Pakistan are concerned about a lack of civic sense in the country. Given that this group of drivers are highly educated and affluent, inducing the concept in the group may prove convenient and practical.

The other attitudinal orientations of the group which should be changed are its strong intentions to break the rules and dislike for stepping-up the level of enforcement. There is sufficient evidence that both of the dimensions are key determinants of behaviour of drivers. Therefore, the group should be encouraged to change this orientation by conceptualising the strong association between enforcement, rule-compliance and road traffic accidents. However, as the group holds strong beliefs, associating additional benefits with rule-compliance or enforcement can gain a much more productive outcome. For instance, promoting health benefits along with social benefits of practicing civic sense can be an effective option in this regard. It is so because the group of drivers come from affluent backgrounds and also contains one-quarter female drivers in it. Literature in psychology informs that historically affluent people and females are the health conscious people (e.g. see BBC 1999; Khor 2008). Therefore, these drivers should be informed about the health and life-time risks associated with aberrant driving, which are supported by the literature references of high credibility. Furthermore, as an immediate plan of action, concerned authorities can deliver a safety message by approaching one stratum of this group i.e. students who are studying in expensive private universities.

9.3.1.4 The risk-averse

While the *regulators* and the *autonomous* can act as law enforcement conduits, road safety can also substantially benefit by improving the behaviour of the *risk-averse*. The group is the second largest in the sample and contains one-quarter of its population. Therefore, even a small improvement in its behaviours is likely to make a significant contribution to improving overall standards of road safety on urban roads, and may also help to sustain a positive change induced in traffic culture through other drivers. This group of drivers strongly disapproves of stringent enforcement, similar to the *opportunists*. Moreover, the group also mirrors the *opportunists* in terms of its behavioural characteristics and socio-demographic composition. Therefore, policy guidelines developed for the *opportunists* might also be applicable for the *risk-averse* and vice versa. For instance, the promotion of health benefits associated with safe driving should be promoted in the group and it should be targeted with messages that continually establish the connection between enforcement and accidents.

As this group driver is risk-aversive in nature, it is expected that such messages would appeal them more by telling the amount of risk, different types of aberrant behaviours invite with them when practiced. For example, when speed goes down, the number of accidents or injured road users also goes down in 95% of the cases (Elvik *et al.* 2004). The only favourable attitudinal orientation of the group is its law-abiding nature. It is recommended to emphasise the importance of reinforcing and practicing law-abiding behaviours more than condemning the disadvantages of disapproving enforcement. Davies *et al.* (1997) point out that the prevalent view in health promotion campaigns is to avoid 'condemning' behaviour, but to focus on the benefits of behavioural adaptation. For instance, a more acceptable and effective message than 'do not eat chips', would be 'keep chips to once a week'. Thus messages focusing on the positive aspects of safe driving or rule-compliance are expected to encourage the group to change its behaviour.

At the same time, it is also important to consider that promoting intrinsic benefits may not always be effective in promoting enduring changes. For instance, investigators of pro-environmental behaviours have concluded that intrinsic rewards are not sufficient to influence behaviour and that people must be provided with extrinsic rewards of tangible value (Roberts 1996; Anable 2002). Considering the fact that (i) the group's law-abiding nature is its only positive dimension, and (ii) it mainly has single status, e.g. student drivers from affluent backgrounds; policy-makers should focus on providing some innovative and interesting rewards and penalties for the group for complying with the law rather than just imposing heavy fines (section 9.3.6 looks into the possible options). Lastly, the *risk-averse* is the only group which reported being affected by peer pressure and was also observed to be influenced by the driving environment. Therefore along with persuasive campaigns, system-based measures are likely to prove much more beneficial in improving its behaviour (for details, see section 9.4).

To summarise, this thesis suggests that policy measures must be refined and fleshed out by the characteristics salient to each segment rather than adopting a '*one size fits all*' approach. Table 39 consolidates the discussion held in this section and defines each segment most positive aspect to promote safety culture. Other than suggesting segment-specific interventions, the collective results of the three studies conducted during this research are identified to have implications for road safety in three different ways by individually targeting overall cognitive antecedents of the population, vulnerable groups and its cultural dimensions, as discussed below.

Table 39: Guidance on potential persuasive interventions to influence and promote safe driving behaviours in each of the segment

	Road safety positives to capitalise	**Road safety negatives to uproot**	**Potential policy options**
The regulators	Appreciate stringent enforcement	Weak potential to break rules	***Persuasive Content***: should educate about basic traffic line and lane rules; should promote professional and disciplined attitudes; should make drivers realise about their potential to regulate traffic flow; should promote economic benefits of safe driving ***Immediate target***: professional drivers
The autonomous	Appreciate traffic rules, careful driving,	Mildly disapprove enforcement	***Persuasive Content***: should educate drivers about their moral and social obligations; should give them training to behave consistently safe; should conceptualise on social-inequity issue ***Immediate target***: government employee drivers
The opportunists	Highly regard other road users	Strongly disapprove enforcement, rule-compliance	***Persuasive Content***: should impress the link between enforcement, rule-compliance and accidents; should promote association between road safety and civic sense; should promote health and social benefits of safe driving ***Immediate target***: affluent students
The risk-averse	Appreciate rule-compliance	Strongly disapprove enforcement	***Persuasive Content***: should reinforce rule-compliance attitudes; should promote health benefits of safe driving; should train drivers to achieve equilibrium in driving ***Immediate target***: affluent students

9.3.2 Targeting overall attitudinal dimensions of population

There is a need for a fundamental understanding of which attitudinal dimensions correlate with risk behaviour in traffic so as to discover which attitudes should be targeted when trying to change behaviour (Iversen and Rundmo 2004, p. 558). The attitudes towards road safety emerged as consistent and significant determinant of driving behaviour in this research. Therefore, interventions developed to influence the general cognitive underpinnings of drivers will prove effective in reducing unwanted incidents on Pakistani roads. Interventions suggested in this section are based on the results of the correlation analyses performed across attitudinal and behavioural variables in Studies 2 and 3 (see sections 7.7.2.3 and 8.6.4). The analyses highlighted some overall attitudinal orientations which should be considered in designing road safety campaigns.

To begin with the positives, correlational analyses confirmed that regard for rules and regulations, and enforcement lead to safe driving behaviours. Thus campaigns strengthening positive beliefs and confirming the stringent legal implications of violations as well as increasing the level of monitoring of drivers' behaviour can provide useful and stable bases for interventions (for details, see section 9.4.2).

Talking about favourable orientation towards careful driving and personal safety, the results informed that these dimensions have rather more utility for Pakistani drivers than simply adhering to the basic needs of road safety. In the country, drivers are more likely to adopt safety measures (e.g. avoid mobile phone distraction, keep a well-maintained car) to satisfy their personal motives e.g. driving faster or uninterrupted. The finding is interesting and probably indicates an appetite for adventure and sensation-seeking in drivers, which they try to satisfy by adhering to good driving standards. Greater weight can be given to this proposition by considering the presence of risk-taking, adventure seeking traits in the population as identified in Study 1. Nevertheless, it also raises questions about the traffic and transport system of the country which facilitate such drivers taking advantage of their safe positions. Addressing this phenomenon in future research is strongly recommended.

One possible measure to counter these aspirations can be operant conditioning. According to 'operant conditioning theory', penalties can influence human behaviour, and the certainty, speed and severity of the penalty can determine the effectiveness of that penalty in mutual interaction. The combination of enforcement and penalty is generally preventative when road users avoid traffic violations on the basis of the expected negative consequences. We speak of specific prevention when road users avoid committing traffic violations on the basis of fines or penalties they had to pay as a consequence of earlier violations. Specific prevention therefore involves a change in behaviour resulting from the penalty itself (SWOV fact sheet 2009). Apart from that, road safety messages should also highlight this ambivalent relationship. The public should be informed how careful driving and personal safety measures are related to road safety. It should also be propagated that the power of safety measures for reducing road traffic accidents and injuries should not be devalued over personal advantages.

Furthermore, a medium strength positive association has been observed between attitudes holding regards towards other road users and aberrant driving behaviour. The association implicate that irrespective of valuing the presence of other road users, practically when drivers come on the roads they cannot refrain from behaving aberrantly. This finding as mentioned earlier has highlighted the issue of inadequate civic sense. It is recommended that standard persuasive techniques can help them translating the belief into positive behaviour to others, e.g. sensitising the drivers about the losses, grief and trouble they can cause to other road users.

Talking about the role of normative influences on behaviour of drivers, the collective results of Studies 2 and 3 suggest that peer pressure is not a key attitudinal determinant. However, the results of Study 1 make it difficult to assume that peer pressure does not influence driving behaviours. The study highlighted that drivers are prone to join a bandwagon under normative influences, just to keep up with the flow of traffic. Thus for future research, it is highly recommended to evaluate its role more comprehensively.

9.3.3 Road safety implications of targeting vulnerable groups of drivers

The qualitative findings of Study 1 as well as profiling of the segments in Study 2 have highlighted the drivers who are prone to risky behaviours because of their socio-demographic characteristics (refer to sections 6.6.4.1, 7.8.3 and 7.10.4). Working with limited resources at hand, policy makers can target these groups individually and develop campaigns, training courses, enlightenment programmes specific to them at a local level to initiate positive attitudes change. Discussion in section 9.3.1 has already covered some of these groups in relevance to the segments. This section briefly provides more ideas for concept-based reforms for some of the vulnerable groups.

9.3.4.1 Targeting the power of youth

The effect of an *age* on attitudes of drivers was found not to be significant in the segmentation. However, findings of both Studies 1 and 2 collectively indicate that young drivers hold more risk-taking attitudes and behaviours than older drivers (refer to sections 6.6.4.1 and 7.10.4). It is also important to note that more than 70% of study population was young (see Table 16). Therefore, this thesis initate the idea of empowering youth in its early ages in order to introduce road safety as a normal, mainstream concept to them for *positive attitudes formation*. Considering the exciting demogrpahic composition of population of Pakistan[80], this thesis strongly emphasises that the potential role of youth in inculcating road safety values rapidly in the society should not be overlooked or under-utilised. In recent years youth around the world has showcased its power to fight for social change starting from powerful protest against fee rises in the UK to agitate political change through Arab spring.

This research therefore strongly advocates that policy-makers should realise the strength and potential of this human capital in the country, and should work on making the hundreds of young drivers coming on the roads every day a part of the solution not the problem. Any road safety campaign which engages youth should make it realise the power of its strength, and should educate it to transfer their *street power* into *road safety power*. An intelligent message can tap their enthusiasm into

[80] An estimated 63% of the population of Pakistan fall under the age of 25 years (UNDP 2012).

action by giving them a purpose to lead on the roads and to set a moral example to their fellow road users.

Furthermore, introduction of reform-oriented road safety pedagogy with credits is highly recommended to not only impart knowledge but skill to future teen novice drivers. The research findings suggest that higher education levels do not guarantee low-risk driving behaviours (e.g. see 7.10.4). Therefore, it is recommended to make these courses mandatory to attend for students at all grade levels starting from kindergarten to universities. The research-based findings such as generated in this thesis should be used to develop an up-to-date content of safety courses in order to not only increase the road safety literacy of the students but to educate them about prospective groups of drivers they are likely to meet on roads.

9.3.4.2 Targeting the low will power of females

Contrary to the general beliefs, the research findings suggest that female drivers in Pakistan tend to be highly risky on the roads. A potential explanation of their aberrant behaviour is identified from Study 1 which highlights that woman drivers are subject to unfair treatment by their fellow men. It can be assumed that as a result they tend to behave aberrantly under peer-pressure. The only possible solution, as recommended by Mahmood and Sandhu (2011) is a social change that could reweave the basic fabric of the society to bring a better hope for a gender egalitarian society. It is conceivable that changing the mind-set will take time. However for the time being, this thesis recommends that women should be made aware of their vulnerability and that their susceptibility to behave aberrantly under pressure is likely to expose them to more dangerous situation. Furthermore, to discourage the poor behaviour of male drivers at a societal level, policy-makers can expose which poor driving behaviours to ridicule so as to make such actions publicly despised.

9.3.4.3 Targeting the emotional distress of divorced/separated drivers

The results suggest that in Pakistan single as well as separated/divorced individuals hold more risky attitudes than married drivers with children at home. According to the psychology literature, the risk of being involved in a road accident increases people who have been affected by adverse life events such as recent separation or divorce (McMurray 1970, cited in Gordon 2004). Studies have shown that women feel more helpless, vulnerable and low self-esteem, while men tend to work harder, sleep less, and function ineffectively (WD 2012). In Pakistan, family courts grant divorce. To address the issue, road safety experts can either liaise with these courts to arrange awareness courses, rehabilitation programs and/or to counselling services working in the country to target this group.

9.3.4.4 Targeting non-working, inactive drivers

Lastly, this thesis recommends that targeting drivers, who are unemployed, retired or looking after family members also has potential to improve road safety standards in the country. Results of the segmentation indicate that the *regulators* have the lowest percentage of non-working population. The finding implies that working drivers tend to be safer than non-working. The finding is interesting and indicates another potential area for improvement. It is important to note that Pakistani society is a hierarchical society which has a very strong family structure. By educating an older driver, spending a retired life - which in the society is treated as the most respected and influential entity - or a mother looking after family[81] - who is in charge of the everyday affairs of every member of her household – the message of road safety could be widespread. For this section of the society, courses, events, workshops can be organised at a community level.

9.3.4 Road safety implications of targeting cultural dimensions

The rate at which a once-attained level of attitude deteriorates depends on the type of social support the person receives over time (Ofshe 1992, p. 5). The persuasive measures suggested in the above discussion will prove futile and fruitless unless Pakistani society does not harness these positive changes. The promotion of safety culture in the country is especially pertinent considering the findings of Study 1. The study has highlighted that drivers holding good attitudes and behaviours are usually not facilitated by the society they belong to and are often discouraged.

It is important that the public understand the thinking behind the strategies and the need for individual nations, as said by Jhonston (2010), to develop tailored approaches to culture change to reflect their unique patterns is crucial. Having an appropriate strategy and action plan is one thing, achieving implementation is quite

[81] It is important to note that women constitute nearly half of the population of Pakistan. Therefore, it is highly significant to increase road safety literacy of this section of the society in order to promote safety culture.

another. As there are several excellent road safety management systems in the literature but they cannot be implemented effectively without a political and community willingness to tread down a safe (or even a safer) system path. For example, a population-wide speed behaviour change (a general slowing down) in the interest of the common good is hardly likely without significant cultural change. Individuals perceive a personal benefit from setting their own travel speed, do not regard low level speeding as dangerous and seem not to accept that if everyone moderated their speed by a small margin there would be significant safety gains for the community.

In developing a culture change, the Dutch have started examining the theoretical principles underpinning what they call 'social forgivingness" to begin to understand how to formulate a strategy for changing the prevailing cultural more of personal gain to one of community gain in dictating road user behaviour (Houtenbos 2009). Howard and Sweatman (2007, cited in Jhonston 2010) use the term ''social contract" to describe the bringing together of prevailing community views and strategic thinking around road safety. We must systematically address several critical socio-cultural issues around car use and road safety and explore ways of moving towards community acceptance of a duty of care. It may well be that a duty of care in road use can best be developed through public engagement in sustainability. This will require political leadership, duty of care role-modelling by governments and large companies, and the creation of partnerships with others concerned with the sustainability of urban society. A community constituency needs to be created and the beginning likely lies in vigorous and well-informed public debate (Howard and Sweatman, 2007). The ethic of care (conservation) created in nations like Australia around water and waste needs extending to road transport. This section briefly elucidates what can be done in order to develop and inculcate a road safety culture in the Pakistani society.

9.3.4.1 Utilising the moral and social authority of mosques

The challenge of sensitising the community and building its road safety consciousness can be addressed by empowering it into the process. This thesis recommends that, other than educating influential people in Pakistani families (mothers, older people), road safety awareness can benefit from extending involving local mosques. In the Muslim world, a mosque serves as a centre for information, education and dispute settlement apart from a place where Muslims can come together for five daily obligatory prayers (Arab News 2012). In developing countries public health campaigns are receiving success with the engagement of people through religious institutions. For instance in the Indian city of Moradabad, described as nondescript and shabby with one of the most stubborn concentrations of polio in India, an astonishing victory in the war against polio has been achieved with the help of religious leaders who convinced people to attended immunisation clinics (for details, see Burke 2012).

Working along similar grounds, weekly consciousness-raising activities, workshops or sermons on road safety could be held in the mosques in Pakistan, particularly after Friday prayers[82]. It can be expected that these kinds of initiatives will help to raise massive public awareness, and may also succeed to gain support for stronger legislation by shifting public opinion e.g. towards stringent enforcement through consensus. This level of encouragement of safe behaviours at a local level might also help to bolster the morale of drivers already holding favourable orientations towards safety but receiving less encouragement from society. Establishing and fostering links between road safety and moral and civic senses may also help to focus on the issue of influence-peddling. The approach can also prove cost effective as residential areas in the country usually have a number of mosques and religious centres.

9.3.4.2 The role of mass media campaigns

This section briefly looks into the role of media to deliver and promote ideas projected in this thesis to prompt more rapid cultural change.

The potential of involving role models, celebrities: To attract mass attention to the road safety cause, celebrities and respected national heroes can front the road safety campaigns. In many public health campaigns around the world, the involvement of celebrities is considered to have had a substantial impact in altering the public's behaviour e.g. reducing high-risk drinking among college students (DeJong 2002), programs focusing on HIV prevention (Casais and Proença 2010),

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[82] The Friday prayer holds importance for Muslims and attracts more attendees than week days. People gathered in mosques to listen to Friday sermon (khutba) which usually cover several topics of religious and social importance.

and those promoting global green cars (see Courtenay 2005). In order to influence people more with the content, psychological tactics of emotional narratives and fear appeal (for details, see Delaney *et al.* 2004) can be used. People can, for example, be reminded of those tragic incidents in which the country has lost its rennowned artists. Lapinski and Witte (1998) defined fear appeals as "persuasive messages that frighten an audience into adopting a recommended response". The approach has been shown to be very effective in the area of road safety. For example research on fear appeals regarding seat belt use has shown that a moderate level of fear arousal resulted in more frequent seat belt use (Loo 1984, cited in Delaney *et al.* 2004).

The potential of internet-social media marketing: To reach the masses with limited resources at hand, this thesis recommends that policy makers in the country can also benefit from social networking sites. The incorporation of such strategies in awareness campaigns can help achieving many of the concepts introduced in this thesis including creating a critical mass and empowering youth. It is recommended that policy-makers should not overlook the emerging Information technology (IT) and telecommunication (Telecom) boom in Pakistan, and its potential as a cost-effective medium of social marketing. The industry is showing tremendous growth in terms of its users and according to official statistics, Pakistan ranks among the ten countries charging the lowest call rates in the world with 100 million cellular users (and growing), more than 19 million internet users, and over 688,000 broadband subscribers (Government of Pakistan 2012).

Youth interaction via social media in Pakistan has also grown unexpectedly in both urban and rural areas. For example, mobile internet use shot up to 161% in 2010 alone and 15% of Facebook users are from Pakistan (Inam 2011). Short message service (SMS) is also quite popular and recently the Election Commission of Pakistan has launched the World's biggest voters' SMS information service for 85 million voters (for details, see ECP 2012). Utilising the potential of e-marketing, experts can build nation-wide media-literacy programs, road safety knowledge disseminating pages on social networking sites, road safety educational apps for smartphones and interactive road safety games.

9.3.5 Summary

To help teaching the segments favourable attitudes towards road safety, it is recommended that their *observational learning* can be enhanced by introducing well-educated, trained drivers on roads who exercise safe behaviours consistently. It is considered that professional drivers, government employees, students in privileged institutes might form useful targets for applying these ideas immediately. It is also recommended that road safety messages should highlight the direct connection between enforcement and law compliance and accident prevention. It is suggested that negative beliefs, particularly those held by the risky drivers, can be weakened by linking road safety with civic sense, moral obligation, economic and health benefits. These motivations and reasons to behave safely can be inculcated through emotive advertisements (*classical conditioning*), and can be further strengthened through *operant conditioning* (e.g. heavy fines, community services).

9.4 System-based road safety measures

The person-specific aspects targeted in the above discussion need to be linked to many other system-based policy reforms in order to achieve sustainable safety outcomes. Almqvist and Hydén (1994) say that a successful safety programme is not one-dimensional. Actions in all the areas of education, information, legal measures, enforcement, and engineering and planning measures must support each other. The overall goal is greater traffic awareness through better understanding, competence, willingness, care for other road users and skill in traffic (p. 6). The following discussion extends the recommendations presented in Study 1 (refer to section 6.7), and briefly suggests some more system measures based on the lessons learned about the country's drivers and traffic environment across all three studies. The studies have demonstrated that loopholes in the traffic and transport system (e.g. poor road environment, ill-enforced areas, a mix of traffic) prohibit drivers from exercising safe driving practices on roads. Therefore, it would be highly significant that system-oriented reforms at different organisational levels complement aforementioned person-based reforms with the objective of (1) guiding and controlling the behaviour of risky drivers, and (2) fostering positive beliefs in safe drivers without imposing on them the sole responsibility to improve safety standards.

9.4.1 Road calming techniques to target indiscipline driving behaviours

Unarguably, an excessive lack of line and lane discipline in Pakistani drivers (including violations of stop lines, overtaking/lane change, lane use, and distance keeping rules) recurrently emerged as a serious cause of concern across all three studies. Unfortunately there is no data available to quantify economic losses due to these behaviours. However in the UK, drivers hogging the middle and outside lanes effectively "steal" up to 700 miles of motorway during peak periods (The Telegraph 2004). This means that the costs for Pakistan can be presumed to be strikingly high especially considering the fact that road traffic operation of the country are notably low and haphazard in comparison to the UK (refer to 7.10.2). To add, Study 1 indicated that behaving aberrantly is seen as indispensable by the drivers in the country. The population admitted to joining the bandwagon in order to keep up with traffic flow and to sustain a space on roads as discussed earlier. Anable (2002, p. 319) points out that it is especially difficult to encourage a change in a behaviour that is perceived as essential. Hence, physical measures would prove more effective to control these practices than would persuasive measures.

It is recommended that the government should address the issue as a top priority. They can benefit from experiences of the countries around the world working on the same lines to control poor road use behaviour. For instance, in the Indian capital Delhi, traffic regulatory authorities have recently addressed the issue of compliance through the installation of 1,700 cameras covering different intersections of the city, imposing fines with constant patrolling and through the introduction of effective bus management in 15 corridors (IANS 2011). Section 9.4.2 below looks in more detail into the role of enforcement to improve behaviours. It is worth noting that one of the most burning issues in Pakistan today is an energy crisis. The high fuel charges and shortages are causing enormous problems and sparking protests throughout the country. Policy-makers may benefit from linking the energy crisis issue with disciplined road use behaviour. Drivers can also be introduced to the spirit of road sharing in a promotional message and associating its effectiveness in avoiding a bout of road rage, improving travel times and improving fuel economy and ultimately road safety.

Furthermore, roads in less-privileged areas are in poor condition and inadequately sign-posted with no lane markings and therefore provoke more disorderly behaviours. This thesis recommends that an instant action to improve the situation can be the introduction of simple and cost effective road calming measures. Recently, in India the effectiveness of various low-cost measures has been tested and validated by traffic engineers e.g. lane adherence through plastic bollards (increased traffic throughout at least 15%); marking of bus lane on the wider part of the road (increased throughput of buses in peak hour by 30%); and use of bright, durable and luminous paint for marking lanes. They stated that, with a rapid rise in car ownership, this is the least that various government agencies can do (for details, see TrafficInfraTech 2011). These kinds of measures can also prove useful in Pakistan to encourage lane discipline without any big investment.

9.4.2 The role of enforcement

It is clear that the role of enforcement outperformed all other socio-cognitive influences in defining the behaviour of drivers in Pakistan. There is a consensus in the results of all three studies that strict and fair law enforcement can substantially improve road safety. Attitude towards enforcement also comes up as the most powerful construct to differentiate sub-groups of drivers in segmentation such that unfavourable attitudes towards enforcement acted as a '*barrier*' while favourable attitudes towards enforcement acted as an '*enabler*' to exercise safe behaviours on road. This means persuasion is only likely to work when coupled with enforcement. Therefore, a concentrated enforcement effort is required to see persuasive reforms through to implementation.

Mäkinen *et al.* (2003) also verifies the psychological assumptions linking intensity of enforcement to compliance through perceived likelihood of detection in the Europe Union. They state that there is considerable evidence that substantial changes in the extent of police enforcement are correlated to changes in the number or severity of traffic accidents; more enforcement is associated with fewer accidents. Joint re-analysis of scores of separate evaluation studies of changes in enforcement levels suggest that increased enforcement may have reduced injury accidents by an average of 6% to 17% (p. 16). According to Delaney *et al.* (2004) the success of road safety campaign reforms is linked with enforcement, legislation, and institutional management (for more details, refer to section 3.4.3).

It is important to note that the effect of enforcement is related to drivers' perception of being caught. This phenomenon is explained with the Deterrence Theory. The theory states that a person will avoid a criminal act if he/she believes and fears that it will result in sanctions. More specifically, this theory (for a review, see Myers 2005) suggests that law-breaking is inversely related to the certainty, severity, and swiftness of punishment, although recent work indicates that certainty of punishment has a greater impact than severity or speed. Notwithstanding these recent findings, it is commonly regarded as a mistake to emphasise one element of deterrence at the expense of the others. There are also two main types of deterrence: specific deterrence, which is when punishment acts to reduce recidivism, and general deterrence, which is when the fact of punishing offenders discourages others from offending (e.g. the general public or people who know of the punishment vicariously). That is, both general and specific deterrence are part of the deterrence process, but the former is concerned with one's indirect experience with punishment whereas the latter is concerned with one's direct experience of punishment. In this framework, law enforcement can be seen as preventing violations through general deterrence, and if a violation occurs, as preventing further violations through specific deterrence (Delhomme *et al.* 2009a, p. 59).

This combination of enforcement and road safety campaigns has been consistently proved successful in the literature. For example, For example, meta-analyses of road safety communication campaigns, conducted by Elliot (1993) found that campaigns that include publicity and/or enforcement are more effective than campaigns without these combined measures (p. 90). According to Delhomme *et al.* (2009a), enforcement can be used to support the campaign message. Law enforcement, particularly high-visibility enforcement, can raise audience awareness about the campaign theme. Enforcement upholds society's expectations and standards, and imposes sanctions when laws are broken. The threat of these sanctions is what persuades most road users to comply with the rules (e.g., fines, point systems, etc.).Enforcement discourages people from repeating behaviour that has already earned them a sanction, and thus helps in (p. 75). Thus, in brief, this thesis recommends that stepping-up the level of enforcement prove unequivocally successful to promote safe driving behaviours in Pakistan. The following discussion suggests some of the low-cost ideas to streamline driving behaviour.

Automated traffic enforcement tools: As a complete overhaul of driving environment is nearly impossible, traffic police authorities can introduce speed cameras, breathalyzers, and red light cameras as an instant enforcement measures in any types and levels of roads easily. The effectiveness of such equipment is already tested and proved around the world. For instance, a study evaluating the effectiveness of red-light cameras at signalised intersection in Singapore reported 40-50% reduction in violation rates, 20% in all crashes, and 27% in crashes with injuries (see Chin and Haque 2012). A survey carried out in Pakistan has also noted that Pakistani drivers respect cameras; more than half of the drivers said that speed cameras would improve traffic flow and reduce the number of traffic accidents, while others said that the presence of traffic police would also help (SZABIST 2009).

Traffic police enforcement: Traffic police enforcement can also prove useful in this regard. However, in most developing countries the traffic police are grossly under-resourced and under-trained to deal effectively with road safety violations (The World Bank 2012). The situation is no different in Pakistan. It is criticised that one finds traffic police wardens standing along the roadside chatting with each other and sometimes vanishing from roads (Dawn 2011). Therefore, it is recommended that traffic police enforcement can be improved effectively by increasing human capacity of the police and its professional development.

A large number of studies (OECD, 1974 and Spolander, 1977) have examined the effectiveness of enforcement systems in developed countries, particularly with respect to traffic police operations. Many of them demonstrated that a conspicuous police presence led to improvements in driver behaviour in the vicinity of the police, but the evidence for accident reductions was less convincing. In developing countries, the traffic police are generally less well trained and equipped and often they are non-mobile i.e. stationed at intersections. Traffic police operating under such conditions are likely to find it difficult to influence moving violations and this was certainly shown to be the case in a study by Downing (1985) of the effects of police presence in Pakistan. However, studies of improved training and deployment of traffic police have indicated large reductions in moving violations (see Downing, 1985).

Also, following the introduction of highway patrols on intercity roads, a 6% reduction in accidents was achieved in Pakistan, and a similar scheme in Egypt produced accident reductions of almost 50% (Gaber and Yerrell, 1983). Therefore, it would appear that improvements in traffic policing have considerable potential for both improving driver behaviour and reducing accidents provided that the police's capability to enforce moving violations is enhanced (Baguley and Jacob 2000, p. 13).

Revamping traffic licensing and penalties system: While Study 1 participants were found complaining about the poor licensing system and unfair treatment of offenders, only half of the sample population in Study 2 was noted to have passed the driving test and equally only half a valid driving license. It is reported by Hussain (2011) that not a single traffic licence has been cancelled by the Punjab Traffic Police since its inception despite the fact the province especially the City [of Lahore] witnessed worst traffic accidents during the last two decades. However, two to three licences are being suspended in the provincial capital per month. This situation indicates the urgent need to revamp the traffic licensing and penalties system to hold people accountable for their misdeeds.

For the drivers already on road without a license and driving test (or those who have bought licenses), authorities can rectify the situation by introducing *retrospective training courses* at subsidised rates. A legislative framework to avoid repeat offenders coming on the roads also needs to be established. For that, ideas can be borrowed from countries where such mechanisms already exist e.g. demerit point systems (DPS) in the Europe Union countries (see Goldenbeld *et al.* 2011).

Innovative penalties and rewards system: It is important to note that in Pakistan public resentment for traffic fines has been observed. For instance, in a recent incident in Lahore a motorcycle-rickshaw driver climbed an electricity pylon to protest against his third consecutive challan [fine] by the police. He was later joined by dozens more people, who climbed the tower (see Desk 2012). To address the issue innovative penalties and rewards system are needed to disqualify and ban unlicensed drivers or habitual law offenders without inviting resistance. To do so, firstly, authorities should introduce rewards for drivers with clean driving records. As intrinsic rewards are not always effective, as mentioned earlier, examples of extrinsic rewards of tangible value could be giving recognition to good drivers on roads (e.g. special stickers for them to put on vehicles), promotional vouchers, reduced premium insurance incentives, or some credit points for students.

Secondly, for risky drivers, most countries have found it useful to add various special consequences other than fines and prison terms to non-compliance with traffic law, as well as designing special mechanisms for their application. For instance, driving licence suspension, mandatory medical and psychological tests, re-licensing requirements, rehabilitation programmes, remedial courses, community work are some of the other possible consequences of traffic related non-compliance (Mäkinen *et al.* 2002, p. 13). Implementing such kinds of penalties in the country can not only raise awareness among drivers but make them follow rules and regulations in their true letter and spirit, without creating a perception in the public that enforcement agencies impose fines to collect revenue/taxes.

Government should stop appeasing drivers: Nevertheless the level of enforcement in the country can only be raised if the government stops polices which appease certain sections of the society e.g. students; journalists who easily get away from fines by showing their student or press card (see section 6.6.3). There should be legislation for underage drivers, and no matter what authorities should not show leniency for law-breakers.

9.4.3 Targeting institutional and administrative weaknesses

The following recommendations are based on the understanding of the issues drawn collectively from this whole research exercise.

Road safety development polices: An overview of transport polices (refer to section 2.2.4) informs that in recent years, the Government of Pakistan has begun taking road safety issues seriously and as a result has started addressing it during the formulation of transport polices (such as PTPS and TA). However, no road safety policy or vision for the country has been developed so far. This thesis strongly emphasises the need to concentrate efforts to develop a national road safety policy. It is also recommended to devise a working policy for professional drivers as well as an anti-motorisation transport policy. In this regard an initiative such as two-wheeler polices[83] or carpool policies may prove highly beneficial.

Enhanced inter-departmental co-ordination and resource sharing: It has been learned that different government departments are involved at different levels to control traffic and transport system and road safety related programs with fragmented efforts (refer to sections 2.2.4, 2.4.2, and 6.6.1). It is highly recommended to identify factors and dynamics that serve as communication and coordination barriers between the departments, and to introduce intervention programs cognizant of the institutional culture in the country in order to induce harmony and co-ordination among institutions. Road safety is institutionally very complex with the actions of numerous agencies impacting upon progress. Thus, without, as recommended by Jhonston (2010), meaningful cooperation integrated packages of measures cannot be successfully applied. He further says that coordination is the necessary bedfellow of cooperation, and is vital to integration and synergy across institutional efforts.

Development of road safety department, research and human capital: As the subject of road safety in Pakistan is still at its nascent stage, the country substantially lacks in human, technical as well as financial resources. There is also a dire need of mapping and disseminating the research work carried out in the country. Therefore, development of a road safety department or at least a division at a national level is highly recommended. In parallel, capacity development and thought-reform programs for the concerned officials should also be organised to enhance their technical knowledge and skills. A learning example of one such programme for policy-makers could be Road Safety in 10 Countries (or RS10) (see GRSP 2012).

Egalitarian approach for infrastructure development and application of road safety measures: This thesis observed that drivers' behaviours improve with improvement in the driving environment. However, the problem of unequal distribution of resources in privileged and less privileged areas serves to encourage

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[83] In Malaysia, motorcyclist contributes to almost 60% of the fatal accidents. A pilot project introducing exclusive motorcycle lanes showed reductions up to 39% in the number of crashes (GRSP 2012a).

risky behaviours. A complete overhaul of the poor infrastructure and safety measures in less privileged areas is needed to rectify the issue. For that, a long-term consistent attention and policy is needed from the government. However, to stop the situation deteriorating further, the Government of Pakistan should prioritise small-scale infrastructure development policies.

9.5 Unresolved issues and recommendations for future research

As this research was the first attempt to explore socio-psychometric properties and dimensions of aberrant behaviours in Pakistan, its findings have prompted a series of new research questions to address in future research; some of which are identified as follow:

Direction of causality between attitudes and behaviours: it is important to consider that although segmentation naturally grouped drivers based on their socio-cognitive profiles, the analysis did not inform *to what extent* attitudes of drivers shape their behaviours[84]. The literature review has discussed two-way interaction between attitudes and behaviour relationship, and also the cognitive dissonance phenomenon in which people may actually alter their attitudes in order to better align them with their behaviour (refer to section 3.3.2). Therefore, in order to completely understand the relationship between the attitudes and behaviours of drivers in Pakistan, it is recommended to assess the possibility of whether attitudes change in line with the behaviours works or vice versa in future research[85].

Structure, reliability and standardisation of the attitudinal and behavioural instruments for Pakistan: The general objectives of this thesis were to develop attitudinal and behavioural measures specific to Pakistan and to evaluate their validity and applicability for the country. Unarguably, the instruments helped

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[84] To know more about direction of causality in attitudes and behaviours, read Anable (2002).

[85] To understand the multi-layers causal relationships between attitudes, behaviours and socio-demographic characteristics Structure Equation Modelling (SEM) technique can be used. It is the technique which can properly account for the many simultaneous, multi-directional relationships among the variables, and has been used to successfully identify causal relationship among variables in many sociological, psychological, and increasingly travel studies (Golob 2001; Anable 2002)

to achieve the aims of the research successfully. For instance, the data sets collected using both the attitudinal and behavioural questionnaires (the AQ and DBQ respectively) were successful in yielding statistically reliable attitudinal and behavioural constructs, and distinguishing safe drivers from unsafe in the segmentation. Therefore, this research advocates using this TPB -based attitudinal questionnaire (AQ) and/or the DBQ in future research in the country. Likewise the WF technique was also successful for assessing actual behaviours and explaining the influences of attitudinal dimensions on the behaviour of drivers.

However, there are a few issues which should be taken into account in future research. For instance, as both the AQ and DBQ were applied for the first time in the country, psychometric robustness of their constructs were limited to the assessment of internal reliability. An important task for future research should be to explore the stability of the instruments over time by applying test-retest reliability. Furthermore, this research also recommends that future studies with the aim of identify latent constructs underlying a set of items should use factor analysis rather than principal components analysis in order to not merely achieve data reduction but to asses if the same factor structure produced in this research is replicated.

It should also be noted that the AQ explained about 31% of the variance (see Table 18) in the attitudes of drivers. As the large portion of the variance was left unexplained, this thesis recommends including some other variables (e.g. habit, past behaviour) in its scale and to test its efficacy. It should also be noted that the TPB model has not been applied rigidly in the design of the questionnaire. Due to the exploratory nature of this research, it was considered better not to pick arbitrary behaviours. Therefore information about wide variety of behaviours had been collected through the AQ. However, more conservative application of the theory, can possibly address many of these concerns (e.g. extent to which attitudes of drivers shape their behaviour). It would also be interesting to explore the differences in the results generated through more robust application of the model by following the rule of target, time, and context.

To conclude, further adaptation studies are needed to make the instruments suitable and more appropriate for Pakistan. The instruments have yielded meaningful and empirically plausible constructs. However, replication of these methodologies in future research would prove effective in order to be conclusive about the potential of standardising the instruments for the country.

Investigating the phenomenon of response biases: The results of Study 1 initiated that drivers in Pakistan tend to over-estimate their driving performances. The differences in reported and actual behaviours of drivers in Studies 2 and 3 have further strengthened the argument and suggested that the responses may suffer from optimism or social desirability biases. An important task for future research can be to determine the true strength and dimension of the biases (e.g. optimism bias, social-desirability bias etc.) for drivers in Pakistan in order to empirically falsify or prove the judgment.

Gauging the power of persuasion: The persuasive promotional messages suggested in this thesis are developed considering the power of socio-cognitive mechanism, which statistically differentiated the groups of drivers. In future, it would be interesting to evaluate the effectiveness of the proposed information-specific campaigns when applied and to explore whether (or not) the targeted groups respond to the messages as expected.

9.6 Generalisability of the results

The extent to which the results of this thesis can be generalised is of significant importance. The four groups of drivers identified in the segmentation process can be viewed as a relative representation of the general urban population of Pakistan; considering the fact that the segmentation process was performed on a diverse group of people who were broadly comparable to the general population in terms of socio-demographic characteristics (see section 7.5.2). Therefore, at best it could be argued that it is valid to generalise the findings contained in this thesis and to speculate that they are representative of the general urban population of Pakistan. However, conversely arguments can be raised that perhaps other non-detected segments of drivers exist outside of the sample population, and that drivers in these segments were not approached in the recruitment phase due to the practical limitations of this research (e.g. limited time, resources, and analytical skills). Furthermore if could be argued that the sub-groups of drivers identified in this thesis are possibly only a snapshot of the driving population of Lahore, Pakistan.

However, this thesis can confirm that the groups of drivers identified in this research have salient sets of relationships between their attitudes and their driving behaviours. Therefore, it is clear that this research has provided a detailed understanding of the attitudinal and behavioural characteristics of a range of the groups of drivers driving on Pakistani roads today though may be not all. Confidence in the findings is increased when it is considered that the sample population used to perform the segmentation process were recruited randomly at different locations in the city of Lahore by adopting a quota sampling procedure. This means that the recruitment was not confined or concentrated over a single geographical location nor biased through choice-based selection of participants. This allowed the work to tap the broadest possible diversity in attitudes, behaviour and socio-demographic characteristics of the population under study. For future research, it would be interesting to assess whether the same results could be replicated on an independent sample and whether the results are consistent across the driving population of other urban cities particularly those in the Punjab.

To conclude, this thesis acknowledges that the application or generalisation of these solutions or findings to the urban population of Pakistan as a whole would indeed be difficult, considering its diverse and varied circumstances. Yet, valuable lessons have been learnt about the attitudinal and behavioural dimensions of a section of the society who is most likely to be found on roads. Hence taking the position of 'critical realism perspective', this discussion brings us to the final conclusion.

> ''One can only understand reality to a limited extent; no one can obtain the entire picture of a studied phenomenon. Therefore, reality can be studied to a certain extent and generalisations can be made with a degree of probability.'' (Limpanitgul 2009)

9.7 Final conclusions

There are no universal appeals to change behaviour, but different groups of people need to be served in different ways to optimise the likelihood of affecting behaviour change (Anable 2007). It is hoped that the body of research work presented in this thesis aids in the understanding of the motivation behind drivers' decisions to either behave well or to behave aberrantly on the roads in Pakistan.

Each of the attitudinal and behavioural dimensions identified in this thesis can serve as a point to raise the profile and importance of road safety in the country.

To be specific, the significant contributions of this research are (1) identification of socio-cognitive processes and their differential effects on the driving behaviours of sub-groups in the population, (2) identification of the potential instrumental and statistical ways to understand these process comprehensively for future researches in the country, and (3) identification of the concept-based road safety solutions to improve driving behaviours while addressing the unique characteristics of each of the segments. Aside from its applied utility, the work has prompted the use of multi-method data collection strategies and innovative statistical techniques in attitudes behaviour research. While attitudinal segmentation coupled with subjective and observed measures of behaviours proved useful in recognising the differences between variously motivated sub-groups of drivers in the population quantitatively, qualitative methods provided a valuable insight in explaining contextual details behind those quantified responses. Most significantly, the research has demonstrated the explanatory utility of the market segmentation approach to systematically relate the interaction between attitudes, behaviours and socio-demographic characteristics.

To conclude, this research has provided a timely contribution to the body of work related to improving the status of road safety in Pakistan and has recognised that attitudes towards road safety are unarguably successful in distinguishing safe drivers from unsafe driver and therefore, can legitimately form the basis of road safety interventions. It is hoped that a consistent and a collective effort from national to community level in future can help to achieve sustainable road safety practices in our cities…

> "Where it is pleasant and safe to walk to shops, parks and schools. Where streets are safe to cycle on, cross or even children to play on. Where work is not far away or is easily reached by bus. Where it is safe to take a bicycle to the nearest rail station or bus interchange. Where buses move quickly in bus lanes and get priority at traffic lights. Where you don't need to go away for fresh air and do not have to shout over traffic noise. Where city is quiet but fully alive." (Barter and Raad 2000, p.4)

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Appendices

Appendix A: Study 1 Consent Form

PhD Qualitative Research Study

ATTITUDES TOWARDS ROAD SAFETY AND ABERRANT DRIVING BEHAVIOUR IN PAKISTAN

I hereby grant permission to use the information I provide as data in the PhD research study on *Attitudes towards Road Safety and Aberrant Driving Behaviour in Pakistan*. I allow publishing or presenting of the information provide in any public form. I understand that I have the right to refuse to answer any question or stop participating at any time without any reason. I am aware that the information provided will be kept confidential, and no one else except researcher and her supervisors will have access to the information documented during the interview. I have been informed that I could either choose to keep my identity anonymous or not.

Name of Participant (please print)..

Signature...

Date (dd/mm/yy)...

I ask to keep my job title anonymous (please circle one)...Yes/No

I give permission for this interview to be recorded (please circle one)........................Yes/No

Appendix B: Study 1 Invitation Letter

Office of the Chief Traffic Officer Lahore
Opposite Islamia College Civil Lines
Out Fall Road, Lahore
Pakistan

March 02, 2009

Dear Mr Imtiaz

With reference to our telephone conversation earlier this month, I would like to invite you to participate in an interview based research study. A brief description of the intent of research and an outline of the study is provided below.

Research Study Introduction

I am conducting research on *Attitudes towards Road Safety and Aberrant Driving Behaviour in Pakistan*. My work is based on a problem oriented approach with the intent to recommend research-based solutions to the road safety problems of Pakistan while taking into account personal, cultural and institutional factors that provoke deviant driving styles. To achieve the specified objectives, the research methodology has been devised and both qualitative (interviews) and quantitative approaches (self-reported and observational studies) will be adopted for data acquisition. At the exploratory stage of the research, I am conducting interviews with government officials, academia and the public to map out the potential range of road safety problems in the country, particularly relating to road traffic violations.

Selection of Participant

You have been approached to participate in the study as National Highway Authority is responsible for highway safety in Pakistan with a vision to provide efficient, reliable, and safe National Highway network. Your experience as a highway safety specialist can offer insight to the problems associated with the traffic and transport system as well as the current driving practices in Pakistan that mediate risky situations. Your participation is very important in ensuring that the road safety profile of Pakistan is better understood.

Procedure

At the beginning of the interview, you will be asked to sign the Consent Form to indicate that you give me your consent to participate in the study and allow me to record and transcribe your interview to assist in developing my understanding of road safety in Pakistan. You will be given the option to either go by your actual job title or you can opt to remain anonymous as transport specialist. The interview will take about 60 to 90 minutes. The discussion will follow a semi-structured format of open-ended questions. The interview template is prepared within the framework of road traffic violations and includes questions such as what are the road safety issues of Pakistan, what factors do you think contribute in accident causation and what you think are the best solutions or tools to raise the safety profile. During the interview, I will take some notes of the things that you say and will also record it on audiotape for transcription and coding at a later date. The study outcome forms a part of my PhD thesis and will be published in academic journals. Your participation is completely voluntary, but should you feel concerned you have the right to stop participating at any time. Any parts of the interviews that you want removed will be deleted.

It is hoped that you will enjoy taking part in the study. The tentative timeslot allocated for the study is 10 March 2009 to 20 March 2009 and I will get back to you to coordinate the exact date and time. Should you have any questions or concerns about the study or procedure, please feel free to contact me. From 9 March 2009 to the 10 April 2009, I can be reached in Pakistan at 0333 4355156 or via email at tszb@leeds.ac.uk.

Thank you for your assistance and I look forward to meeting you.

Regards

Zahara Batool

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Institute for Transport Studies
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Appendix C: Study 1 Interview Template

Qualitative section

<u>Opening Questions</u>

- o What do you think is the status of Road Safety in Pakistan?
- o What are the emerging road safety issues of Pakistan?

<u>Transition Questions</u>

- o What are the accidents hotspots in Lahore and why?
- • What are the most commonly reported road traffic violations?

<u>Main Questions</u>

- • Is there any road safety policy operational at a national, provincial or district level?
- • In Pakistan, whose responsibility is road safety (e.g. any specific government department)?
- • Do you know of any research work at present that is going on within the domain of road safety?
- o What are the primary contributory factors hindering safe manoeuvrability on the roads of Pakistan?
- • Is there any accident data available that can highlight the percentage contribution of the factors you have mentioned or if you can suggest yourself?
- o What contribution do you think drivers have in the generation of road safety issues?
- o What do you think are usually the socio-economic and demographic characteristics of unsafe drivers? How do you think these individual factors contribute to accidents?
- o How do you see traffic and transport system of the country in reference to road safety?
- o How much responsibility do you think government bodies share to improve the situation (other than drivers or road users)?

<u>Ending Questions</u>

- o In the light of your knowledge and experience, what improvement measures do you think are the most appropriate to raise the level of road safety?
- o Which steps do you think should be taken at a societal level to integrate road safety into our culture?
- o Is there any other point, recommendation or opinion you would like to share?

Note: • Questions that had been omitted from the driver participants' interview template

Quantitative section

SHOWCARD A

Please rate yourself as a driver on the following scale with point 0 labelled 'dangerous' and point 5 'safe' (tick one):

Dangerous					Safe
0	1	2	3	4	5

Please rate if you break traffic rules on the following scale with point 0 labelled 'Never' and point 5 'nearly all the time' (tick one):

Never					Nearly all the time
0	1	2	3	4	5

Please rate each of the following behaviours on a scale of seriousness with point 0 labelled 'extremely minor' and point 5 'extremely serious' (tick one):

		Extremely minor					Extremely serious
i.	Exceeding the speed limit	0	1	2	3	4	5
ii.	Violation of traffic signals	0	1	2	3	4	5
iii.	Driving at night without proper lights	0	1	2	3	4	5
iv.	Driving on the wrong side of the road	0	1	2	3	4	5
v.	Carrying passengers higher than the permitted capacity	0	1	2	3	4	5
vi.	Carrying goods higher than the permitted capacity	0	1	2	3	4	5
vii.	Drinking and driving	0	1	2	3	4	5
viii.	Driving a car with illegally tinted windows glasses	0	1	2	3	4	5
ix.	Violation of line/lane/zebra crossing	0	1	2	3	4	5
x.	Obstructing traffic	0	1	2	3	4	5
xi.	Reckless and negligent driving	0	1	2	3	4	5
xii.	Driving without license	0	1	2	3	4	5
xiii.	Using a horn in silent zone	0	1	2	3	4	5
xiv.	Emitting excessive smoke	0	1	2	3	4	5
xv.	Driving an unregistered vehicle	0	1	2	3	4	5

xvi.	Driving below the age limit (18 years)	0	1	2	3	4	5
xvii.	Driving under the influence of illegal drugs	0	1	2	3	4	5
xviii.	Use of mobile phone while driving	0	1	2	3	4	5
xix.	Violation of parking rules	0	1	2	3	4	5
xx.	Non-use of seatbelt on a notified road	0	1	2	3	4	5

Please list the three offences which you commit the most:

1. ______________________________
2. ______________________________
3. ______________________________

SHOWCARD B

Please rank the following road safety measures in order of their effectiveness (1 = the most effective measure, 4 = the least effective measure)

- o Road safety education and training _____
- o Use of advanced technology such as safety cameras _____
- o Changes in the road environment such as road layout _____
- o Enforcement of traffic regulations e.g. fines, penalties _____

Appendix D: Study 2 Attitudinal and Behavioural Questionnaires

Surveyors initials __ Survey site ___ Questionnaire

UNIVERSITY OF LEEDS

Dear Participant

Thank you for volunteering to participate in this survey, which is being undertaken as part of PhD research in the Institute for Transport Studies, University of Leeds, UK. The purpose of the survey is to investigate Pakistani drivers' attitudes and behaviours towards road safety. Your responses will be treated in strictest confidence and all information is greatly appreciated. Your participation is completely voluntary, but should you feel concerned you have the right to stop participating at anytime.

PART A: QUESTIONS ABOUT YOU

This section is designed to help us know about the general characteristics of driving population of Lahore.

1. Are you: male □ female □
2. How old are you? prefer not to answer □ under 19 □ 19-34 □ 35-55 □ 55+ □
3. In which area of Lahore do you live? ______________________________
4. Which of these best describe your situation? Self employed □ full time employed □ part-time employed □ retired □ unemployed and seeking work □ student □ government employee □ disable or sick □ looking after home/family □ other □
5. If you are employed, please state your occupation (if retired or not working, please give your last job) ______________________________ Type of company? government □ semi-government □ private □
6. If you do not work, is anyone else in your house in full-time employment yes □ no □
7. Have you passed the driving test? yes□ no □
8. What is the average monthly income in your household? less than 25,000Rs □ 25,000-50,000Rs □ 50,000+□ prefer not to answer □
9. Does your household own or rent your home? Own/in process of buying □ rent (paid by yourself) □ rent (paid by your employer) □ living in joint family □ other □
10. Are you? Single □ married □ separated □ divorced □ prefer not to answer □
11. Do you have children? yes □ no □
12. How many of the following normally in your household? Adults aged 65 years or older ____ Adults aged 36-65years ____ Adults aged 17-35 years____ Children aged between 13 and 17 years____ children aged 5-12 years ____ Children aged under 5 years ____
13. What is the highest level of education you have completed? Primary pass □ middle pass □ matriculation/O-levels □ FA/FSC/A-levels □ bachelor's degree□ master's degree □ more than masters □ prefer not to answer □
14. How many road accidents you have been involved in the last six months? Near misses_____ Accidents_______
15. How long have you been driving? ______ _______________ years, month
16. On average, how many kilometres you drive in a week? _____________kilometres
17. Do you currently hold a driving licence? yes □ no □
18. If yes, then in what year did you get the driving licence? ________________
19. What type of vehicle do you drive? cycle □ motorcycle □ car □ qinqi □ rickshaw □ van □ bus □ other □

Attitudinal and Behavioural Questionnaires

PART B: QUESTIONS ABOUT YOUR DRIVING ATTITUDE

This section is designed to measure your attitude towards road safety. For each statement please circle the appropriate number that reflects your degree of agreement with the statement.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1. If you are a safe driver, it is acceptable to exceed the speed limit	1	2	3	4	5
2. I know exactly how fast I can drive and still drive safely	1	2	3	4	5
3. Driving without a seat belt/helmet does not necessarily increase accident risk	1	2	3	4	5
4. For me to wear seatbelt/helmet each day while driving on roads is unpleasant	1	2	3	4	5
5. I would be happier if helmet and seat-belt wearing regulations were more strictly applied	1	2	3	4	5
6. I know exactly when I can change lane safely across a continuous white line	1	2	3	4	5
7. Even changing your vehicle lane on white line when there is no traffic makes you less safe as a driver	1	2	3	4	5
8. For me to change lane across a continuous white lane is unsatisfying	1	2	3	4	5
9. People stopped by the traffic wardens for changing lane without using the indicator are unlucky because lots of people do it	1	2	3	4	5
10. I think traffic wardens should fine as many people as possible who disregard stop lines at intersections	1	2	3	4	5
11. It is quite acceptable to drive a vehicle at night with poor lights	1	2	3	4	5
12. Some people can drive perfectly safely with improper lights	1	2	3	4	5
13. It is quite acceptable to drive with worn-out tires	1	2	3	4	5
14. I would welcome stringent checks and monitoring of a vehicle safety standards	1	2	3	4	5
15. Waiting time at the signals is often too long, so that it is quite acceptable to drive through red lights if there is no other traffic	1	2	3	4	5
16. Even running a red light when there is no traffic makes you less safe as a driver	1	2	3	4	5
17. I think it is okay to ignore traffic signals	1	2	3	4	5
18. I think it is okay to drive the wrong way on one-way road	1	2	3	4	5
19. I would not dream of driving against traffic on a one-way road	1	2	3	4	5
20. It is ok to take U-turn from anywhere as turnings on roads are often allowed after long gaps	1	2	3	4	5
21. For me to speed, blow horn or overtake to get ahead of	1	2	3	4	5

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
22. I think it is okay to drive with a hand-held mobile	1	2	3	4	5
23. I would be happier if regulations regarding use of mobile phones were more strictly applied	1	2	3	4	5
24. It is quite acceptable to have LCD TVs in vehicles	1	2	3	4	5
25. The law should be changed so that drivers are not allowed to have LCD TVs in their vehicle	1	2	3	4	5
26. I would not dream of driving when I am under the influence of drugs or drunk	1	2	3	4	5
27. I would never ride with someone I knew has been taking drugs or drinking alcohol	1	2	3	4	5
28. Close following isn't really a serious problem	1	2	3	4	5
29. People stopped by the police for close-following are unlucky because lots of people do it	1	2	3	4	5
30. Even driving slightly too close to the car in front makes you less safe as a driver	1	2	3	4	5
31. It is quite acceptable to take a slight risk when overtaking	1	2	3	4	5
32. Stricter enforcement of overtaking regulations on urban roads would be effective in reducing the occurrence of road accidents	1	2	3	4	5
33. Traffic rules are often too complicated to be carried out in practice	1	2	3	4	5
34. Many traffic rules must be ignored to ensure traffic flow	1	2	3	4	5
35. To be able to get places on Pakistani roads, taking a chance now and then is necessary	1	2	3	4	5
36. Traffic conditions on Pakistani roads are often so bad that it is acceptable to drive in an unsafe manner	1	2	3	4	5
37. If the condition of road traffic improves in Pakistan, I will follow rules and regulations more strictly than I do now	1	2	3	4	5
38. It would be easy for you to break traffic rules in absence of traffic police wardens	1	2	3	4	5
39. It is easy for you to get rid of fines, penalties by using your status profile or personal connections	1	2	3	4	5
40. The more other road users respect rules and regulation, the more I will	1	2	3	4	5
41. I will disobey the rules if that is the only way to get place on road	1	2	3	4	5
42. It is hard to remain calm and drive safely if everyone else is not respecting your right of way	1	2	3	4	5
43. I would be happier to take revenge for an impolite driving behaviour	1	2	3	4	5
44. When I see other people breaking the rules, I feel I should as well	1	2	3	4	5
45. I am confident that I can drive safely even I break the rules	1	2	3	4	5
46. I know exactly up to what extent I can ignore the rules and still drive safely	1	2	3	4	5

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
47. I am fully aware of road traffic signs, rules and regulations	1	2	3	4	5
48. I would favour stricter license issuance system	1	2	3	4	5
49. It is too difficult to comply with traffic rules and regulations in low-income areas	1	2	3	4	5
50. My friends and family would think I am not a good driver if I try to follow traffic rules and regulation	1	2	3	4	5
51. To be able to get recognition as a competent driver from other people on road, I think it is necessary to take a chance now and then	1	2	3	4	5
52. It is hard to follow the rules if everyone else is disobeying them	1	2	3	4	5
53. I think it is ok to carry goods/articles in vehicle more than its capacity if vehicle condition allow you to do so	1	2	3	4	5
54. I think traffic wardens should fine as many people as possible who carry goods/articles in vehicle more than its capacity	1	2	3	4	5
55. I think it is ok to use high beam lights during driving at night time in built-up areas	1	2	3	4	5
56. It is quite acceptable to park vehicle in a no parking zone	1	2	3	4	5
57. If you are a safe driver, it is ok to drive vehicle with tinted window glass	1	2	3	4	5
58. For me to follow traffic rules and regulations each day is not enjoyable	1	2	3	4	5

PART C: QUESTIONS ABOUT YOUR DRIVING BEHAVIOUR

This section is designed to measure your driving behaviour. For each driving behaviour described in the table below, please indicate how often the behaviour happened to you in the last three months. Please indicate this by circling the appropriate number.

	Never	Hardly ever	Occasio -ally	Quite often	Frequen t-ly	Nearly all the times
1. How often do you become angered by another driver and give chase with the intention of giving him/her a piece of your mind?	0	1	2	3	4	5
2. How often do you drive when you suspect you might be over the legal blood alcohol limit?	0	1	2	3	4	5
3. How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane?	0	1	2	3	4	5
4. How often do you overtake a slow driver on the inside?	0	1	2	3	4	5
5. How often do you pull out of a junction so far that the driver with right of way has to stop and let you out?	0	1	2	3	4	5
6. How often do you cross a junction knowing that the traffic lights have already turned against you?	0	1	2	3	4	5
7. How often do you drive so close to the car in front that it would be difficult to stop in an emergency?	0	1	2	3	4	5
8. How often do you sound your horn to indicate your annoyance to another driver?	0	1	2	3	4	5
9. How often do you race away from traffic lights with the intention of beating the driver next to you?	0	1	2	3	4	5
10. How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can?	0	1	2	3	4	5
11. How often do you disregard the speed limit on a residential road?	0	1	2	3	4	5
12. How often do you disregard the speed limit on a motorway?	0	1	2	3	4	5
13. How often do you speed, blow horn or overtake to get ahead of female drivers?	0	1	2	3	4	5
14. How often do you give way to pedestrians at crossings?	0	1	2	3	4	5
15. How often do you wear a seatbelt/helmet in built-up areas?	0	1	2	3	4	5
16. How often do you wear a seatbelt on motorways/highways?	0	1	2	3	4	5
17. How often do you ignore continuous white lines while changing a lane on road?	0	1	2	3	4	5
18. How often you do not stop at the stop line?	0	1	2	3	4	5
19. How often do you drive a vehicle with improper lights at nights?	0	1	2	3	4	5

	Never	Hardly ever	Occasio -ally	Quite often	Frequen t-ly	Nearly all the times
20. How often do you change lane without using your indicator?	0	1	2	3	4	5
21. How often do you carry goods/articles in your vehicle more than its capacity?	0	1	2	3	4	5
22. How often do you use high beam lights during driving at night time in built-up areas?	0	1	2	3	4	5
23. How often do you use your status profile or personal connections to get rid of fines, penalties?	0	1	2	3	4	5
24. How often you do not stop at the call of traffic police wardens?	0	1	2	3	4	5
25. How often do you drive with tinted windows glass?	0	1	2	3	4	5
26. How often do you drive against one-way traffic?	0	1	2	3	4	5
27. How often do you park your vehicle in a no parking zone?	0	1	2	3	4	5
28. How often do you use a hand held mobile phone when you are driving?	0	1	2	3	4	5
29. How often do you manage to drive a vehicle within poor maintenance conditions?	0	1	2	3	4	5

Appendix E: DBQ scores for the UK drivers

Violation items sorted in descending Mean score order (type, item number)	PAK Mean (ranking)	UK** Mean (ranking)
• How often do you sound your horn to indicate your annoyance to another driver? (AV, 8)	2.35 (1)	2.42 (5)
• How often do you overtake a slow driver on the inside? (HCV, 4)	2.32 (2)	2.02 (7)
How often do you speed, blow horn or overtake to get ahead of female drivers? (AV, 13)*	2.04 (3)	-
How often do you manage to drive a vehicle with poor maintenance conditions? (HCV, 29)*	1.94 (4)	-
• How often do you pull out of a junction so far that the driver with right of way has to stop and let you out? (AV, 5)	1.93 (5)	2.09 (6)
• How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane? (AV, 3)	1.85 (6)	1.89 (8)
How often you do not stop at the stop line? (HCV, 18)*	1.83 (7)	-
How often do you use a hand held mobile phone when you are driving? (HCV, 28)*	1.78 (8)	-
• How often do you drive so close to the car in front that it would be difficult to stop in an emergency? (HCV, 7)	1.77 (9)	2.09 (6)
• How often do you disregard the speed limit on a residential road? (HCV, 11)	1.76 (10)	3.31 (2)
• How often do you cross a junction knowing that the traffic lights have already turned against you? (HCV, 6)	1.75 (11)	2.09 (6)
How often do you use high beam lights during driving at night time in built-up areas? (HCV, 22)*	1.69 (12)	-
How often do you ignore continuous white lines while changing a lane on road? (HCV, 17)*	1.69 (12)	-
How often do you use your status profile or personal connections to get rid of fines, penalties? (HCV, 23)*	1.67 (13)	-

Note: AV =aggressive violations; HCV=Highway Code violations; • Questions represent Lawton *et al.*'s DBQ; * = newly included items related to Pakistan, ** the results for the UK drivers has been taken from Lawton *et al.* (1997).

Violation items sorted in descending Mean score order (type, item number)	PAK Mean (ranking)	UK** Mean (ranking)
• How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can? (AV, 10)	1.64 (14)	2.89 (3)
How often you do not stop at the call of traffic police wardens? (HCV, 24)*	1.63 (15)	-
How often do you park your vehicle in a no parking zone? (HCV, 27)*	1.52 (16)	-
• How often do you become angered by another driver and give chase with the intention of giving him/her a piece of your mind? (AV, 1)	1.50 (17)	1.31 (10)
How often do you drive against one-way traffic? (HCV, 26)*	1.46 (18)	-
• How often do you race away from traffic lights with the intention of beating the driver next to you? (AV, 9)	1.44(19)	2.43 (4)
How often do you carry goods/articles in your vehicle more than its capacity? (HCV, 21)*	1.38 (20)	-
• How often do you disregard the speed limit on a motorway? (HCV, 12)	1.37 (21)	3.41 (1)
How often do you drive with tinted windows glass? (HCV, 25)*	1.36 (22)	-
• How often do you drive when you suspect you might be over the legal blood alcohol limit? (HCV, 2)	.81 (23)	1.32 (9)

Note: AV =aggressive violations; HCV=Highway Code violations; • Questions represent Lawton *et al.*'s DBQ; * = newly included items related to Pakistan, ** the results for the UK drivers has been taken from Lawton *et al.* (1997).

Appendix F: Attitudinal profiling of the segments (Mean, SD)

Factor 1- Attitudes towards rule-compliance (A1: RULE-COMPLINC)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
People stopped by traffic wardens for changing lane without using indicator are unlucky because lots of people do it (9)*	2.4 (.65)	1.61 (.50)	1.70 (.58)	1.89 (.63)
Waiting time at signals is often too long so it is quite acceptable to drive through red lights if there is no other traffic lights (15)*	1.66 (.72)	1.89 (.75)	1.51 (.55)	1.93 (.65)
Close following is not really a serious problem (28)*	2.09 (.65)	1.78 (.64)	1.77 (.56)	1.95 (.65)
People stopped by police for close-following are unlucky because lots of people do it (29)*	2.06 (.76)	1.67 (.59)	1.89 (.62)	1.95 (.59)
Traffic rules are often too complicated to be carried out in practice (33)*	1.89 (.63)	1.67 (.59)	1.69 (.55)	2.20 (.64)
Traffic conditions on Pakistani roads are often so bad that it is acceptable to drive in an unsafe manner (36)*	2.11 (.63)	1.78 (.55)	1.77 (.54)	1.99 (.58)
I would be happier to take revenge for an impolite driving behaviour (43)*	2.26 (.70)	1.61 (.50)	1.81 (.64)	1.93 (.68)
When I see other people breaking the rules, I feel I should too (44)*	1.94 (.63)	1.33 (.48)	1.58 (.52)	2.03 (.62)
I am confident that I can drive safely even I break the rules (45)*	2.00 (.68)	2.11 (.67)	1.61 (.55)	2.06 (.62)
My friends and family would think I am not a good driver if I try to follow traffic rules and regulations (50)*	2.20 (.71)	1.22 (.42)	1.65 (.53)	1.79 (.65)
To be able to get recognition as a competent driver, I think it is necessary to take a chance now and then (51)*	2.34 (.68)	1.78 (.73)	1.76 (.55)	2.19 (.67)
I think it is ok to carry goods/articles in vehicle more than its capacity if vehicle condition allow you to do so (53)*	2.03 (.56)	1.78 (.64)	1.64 (.56)	1.88 (.64)
For me to follow traffic rules and regulations each day is not enjoyable (58)*	2.23 (.64)	2.00 (.68)	1.77 (.56)	1.86 (.70)

Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5) such that a higher score on any item indicates a safer attitude.

Factor 2- Taking care in driving (A2: CARFUL DRIVING)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
It is quite acceptable to drive a vehicle at night with poor lights (11)*	1.91 (.65)	1.83 (.70)	1.54 (.55)	1.63 (.62)
It is quite acceptable to drive with worn-out tires (13)*	1.86 (.60)	2.00 (.68)	1.63 (.51)	1.59 (.65)
It is okay to ignore traffic signals (17)*	2.06 (.68)	2.00 (.48)	1.48 (.58)	1.46 (.50)
I think it is okay to drive the wrong way on one-way road (18)*	1.94 (.72)	2.22 (.73)	1.50 (.55)	1.53 (.57)
I think it is okay to drive with a hand-held mobile (22)*	1.63 (.69)	1.94 (.80)	1.57 (.57)	1.73 (.69)
I think it is okay to use high beam lights during driving at night time in built-up areas (55)*	2.11 (.71)	2.22 (.54)	1.75 (.55)	1.78 (.63)

Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5) such that a higher score on any item indicates a safer attitude.

Factor 3- Value of enforcement (A3: ENFORCEMENT)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
I think traffic wardens should fine as many people as possible who disregard stop lines at intersections (10)	3.51 (1.22)	2.89 (1.32)	3.98 (1.07)	3.46 (1.26)
I would welcome stringent checks and monitoring of a vehicle safety standards (14)	3.17 (1.27)	3.33 (.90)	4.31 (.78)	3.45 (1.17)
Even running a red light when there is no traffic makes you less safe as a driver (16)	3.34 (.99)	2.61 (1.19)	3.93 (1.08)	3.04 (1.17)
I would be happier if regulations regarding use of mobile phones were more strictly applied (23)	3.09 (1.24)	3.06 (1.39)	4.27 (.85)	3.43 (1.34)
The law should be changed so that drivers are not allowed to have LCD TVs in their vehicle (25)	3.29 (1.29)	2.83 (1.42)	4.15 (1.04)	3.56 (1.1)
Even driving slightly too close to the car in front makes you less safe as a driver (30)	3.11 (1.23)	3.44 (1.19)	4.04 (.90)	3.13 (1.26)
Stricter enforcement of overtaking regulations on urban roads would be effective in reducing occurrence of road accidents (32)	3.69 (1.05)	2.61 (1.42)	4.24 (.81)	3.01 (1.23)
If the condition of road traffic improves in Pakistan, I will follow rules and regulations more strictly than I do now (37)	3.77 (1.14)	3.33 (1.37)	4.45 (.83)	3.55 (1.29)
I think traffic wardens should fine as many people as possible who carry goods/articles in vehicle more than its capacity (54)	3.11 (1.10)	3.56 (1.09)	3.96 (1.13)	3.10 (1.25)

Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5) such that a higher score on any item indicates a safer attitude.

Factor 4- Ability to override peer pressure (A4: PEER PRESSURE)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
It is hard to remain calm and drive safely if everyone else is not respecting your right of way (42)*	2.09 (.65)	2.50 (.61)	1.68 (.51)	1.66 (.57)
It is too difficult to comply with traffic rules and regulations in low-income areas (49)*	2.54 (.61)	1.89 (.83)	1.84 (.56)	1.80 (.60)
It is hard to follow the rules if everyone else is disobeying them (52)*	2.23 (.54)	1.72 (.66)	1.76 (.55)	1.81 (.53)
Factor 5- Regard for personal safety (A5: PERSONAL SAFETY)				
Driving without a seatbelt/helmet does not necessarily increase accident risk (3)*	1.63 (.64)	1.83 (.61)	1.81 (.61)	1.94 (.68)
For me to wear seatbelt/helmet each day while driving on roads is unpleasant (4)*	1.74 (.70)	1.78 (.73)	1.82 (.58)	2.03 (.61)
Some people can drive perfectly safe with improper lights (12)*	1.77 (.73)	1.67 (.76)	1.73 (.60)	1.84 (.60)
It is ok to take U-turn from anywhere as turnings on roads are often allowed after long gaps (20)*	1.63 (.59)	2.00 (.59)	1.75 (.53)	2.16 (.64)
Factor 6- Regard for other road users (A6: ROADUSERS REGARD)				
For me to speed, blow horn or overtake to get ahead of female drivers is satisfying (21)*	1.74 (.50)	2.28 (.57)	1.76 (.60)	1.78 (.61)
It would be easy for you to break traffic rules in absence of traffic police wardens (38)*	1.51 (.56)	2.28 (.82)	1.71 (.54)	1.83 (.65)
I know exactly up to what extent I can ignore the rules and still drive safely (46)*	1.91 (.65)	2.22 (.73)	1.80 (.60)	1.94 (.68)

Note: * indicates reverse scored items and 'high' loading on a factor denotes a strong association (or favourable orientation) towards that particular attitude (and road safety).

Scale ranged from *strongly disagree* (1) to *strongly agree* (5) such that a higher score on any item indicates a safer attitude.

Appendix G: Behavioural profiling of the segments (Mean, SD)

Factor 1- Intimidating other road users (B1-INTIMIDATING)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
How often do become angered by another driver and give chase with the intention of giving him/her a piece of your mind? (AV, 1)	1.43 (1.61)	1.39 (1.78)	1.38 (1.50)	1.83 (1.62)
How often do you overtake a slow driver on the inside? (HCV, 4)	2.24 (1.51)	2.83 (1.54)	2.05 (1.50)	2.71 (1.52)
How often do you drive so close to the car in front that it would be difficult to stop in emergency? (HCV, 7)	2.15 (1.67)	2.39 (1.78)	1.31 (1.36)	2.11 (1.76)
How often do you race away from lights with the intention of beating the driver next to you? (AV, 9)	1.63 (1.35)	1.44 (1.13)	1.13 (1.44)	1.87 (1.55)
How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can (AV, 10)	1.60 (1.31)	2.06 (1.43)	1.40 (1.31)	1.95 (1.54)
How often do you disregard speed limit on residential road? (HCV, 11)	1.65 (1.20)	2.67 (1.87)	1.42 (1.42)	1.95 (1.47)
How often do you disregard speed limit on a motorway? (HCV, 12)	1.62 (1.43)	2.24 (1.75)	.91 (1.32)	1.88 (1.66)
How often do you speed, blow horn or overtake to get ahead of female drivers? (AV, 13)*	1.71 (1.16)	2.53 (1.62)	1.71 (1.64)	2.54 (1.54)

Note: * indicates newly included items in the DBQ.

Scale ranged from *never* (0) to *nearly all the times* (6) such that higher scores on any item indicates aberrant behaviour.

Factor 2- Being above the rules (B2- ABOVE RULES)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
How often do you cross a junction knowing that traffic lights have already turned against you? (HCV,6)	1.80 (1.41)	2.50 (1.65)	1.37 (1.44)	2.03 (1.47)
How often do you use high beam lights during driving at night time in built-up areas? (HCV, 22)*	1.61 (1.27)	2.00 (1.57)	1.43 (1.62)	2.01 (1.55)
How often do you use your status profile or personal connection to get rid of fines, penalties? (HCV, 23)*	1.63 (1.51)	1.50 (1.91)	1.76 (1.68)	1.96 (1.74)
How often do you drive against one-way traffic? (HCV, 26)*	1.71 (1.62)	1.61 (1.33)	1.16 (1.34)	1.58 (1.60)
How often do you park your vehicle in a no parking zone? (HCV, 27)*	1.51 (1.42)	1.78 (1.30)	1.23 (1.42)	1.96 (1.77)
How often do you use a hand held mobile phone when you are driving? (HCV, 28)*	2.14 (1.51)	2.44 (1.75)	1.39 (1.31)	2.13 (1.60)
How often do you manage to drive a vehicle with poor maintenance conditions? (HCV, 29)*	2.09 (1.66)	2.61 (1.81)	1.68 (1.34)	1.95 (1.65)

Note: * indicates newly included items in the DBQ.

Scale ranged from *never* (0) to *nearly all the times* (6) such that higher scores on any item indicates aberrant behaviour.

Factor 3- Risk prone infringements (B3- INFRINGMENTS)	Autonomous M (SD)	Opportunists M (SD)	Regulators M (SD)	Risk-averse M (SD)
How often do you drive with tinted window glass? (HCV, 25)*	1.57 (1.50)	1.50 (1.65)	1.09 (1.48)	1.64 (1.65)
How often do you drive when you suspect you might be over the legal blood alcohol limit? (HCV, 2)	1.24 (1.28)	1.28 (1.44)	.60 (1.24)	.89 (1.35)
How often do you carry goods/articles in your vehicle more than its capacity? (HCV, 21)*	1.65 (1.39)	2.28 (1.80)	1.13 (1.28)	1.74 (1.69)
How often do you not stop at the call of traffic police wardens? (HCV, 24)*	1.83 (1.80)	1.89 (1.74)	1.22 (1.51)	2.16 (1.88)
FACTOR 4- Assertion; this is my space (B4- ASSERTION)				
How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane? (AV, 3)	1.89 (1.20)	2.33 (1.49)	1.73 (1.43)	2.08 (1.24)
How often do you pull out of a junction so far that the driver with right of way has to stop and let you out? (AV, 5)	2.00 (1.47)	2.72 (1.70)	1.56 (1.45)	2.36 (1.40)
How often do you sound your horn to indicate your annoyance to another driver (AV, 8)	2.20 (1.56)	2.28 (1.44)	2.07 (1.43)	2.91 (1.55)
How often do you ignore continuous white lines while changing a lane on road? (HCV, 17)*	1.91 (1.42)	2.39 (1.42)	1.35 (1.31)	2.06 (1.40)
How often do you not stop at the stop line? (HCV, 18)*	1.74 (1.46)	2.17 (1.65)	1.47 (1.48)	2.56 (1.83)

Note: * indicates newly included items in the DBQ.

Scale ranged from *never* (0) to *nearly all the times* (6) such that higher scores on any item indicates aberrant behaviour.

Appendix H: Study 3 Wiener Fahrprobe Coding Sheets

Coding observer coding sheet *(seat in the rear)*

Participant ID & No.	**Name & Details**

Section	**Start:**	**Finish:**

Standardised observation			
	Overtaking or lane change		Speed
	Correctly		Inappropriate
	not correct		Inappropriate for road geometry
	in spite of oncoming traffic		too fast near VRUs
	without sufficient vision		in the platoon
	While forbidden		without platoon
	because of a stationary obstacle		above the speed limit
	lane change in time		at / below the limit
	uses right lane mainly		considerably slower than the limit
	uses left lane mainly		brakes abruptly
			unsteady speed
	Use of the indicator		Distance to the road user ahead
	indicates in time		Correct
	Does not indicate		too short
	Does not indicate in time		Behaviour at traffic lights
	indicates ambiguously		drives against red
	Lane use		drives against amber
	inaccurate, weaving		does not start when it is green
	extremely on the right side of the lane		starts too early
	extremely on the left side of the lane		Checks the situation with respect to other road users
	cuts the curve		Yes
	Lane choice for proceeding		*No*
	correct	*	Careless behaviours
	in time		Use of hand held mobile
	at the last moment		Drive vehicle with poor maintenance
	Incorrect		Drive with tinted window glasses
	Behaviour when merging		Overloading of articles/passengers
	safe		Don't stop at the stop line
	Unsafe		
	with traffic		
	without traffic		
	inappropriate speed		

Note: *. Section is composed of items which have been included in the original sheet to make it relevant to Pakistan.

Free observer coding sheet *(seat in the front)*

Participant ID & No.	Name & Details

Section	Start:	Finish:

	Approaching a place of interaction
	checks the situation
	drives with anticipation
	does not drive with anticipation
	inappropriate speed
	inaccurate lane choice

	Interaction		
	insists on right of way		does not insist on right of way
	does not allow to continue/merge		allows to continue/merge
	does not reduce speed		reduces speed
	presses other cars		
	Obstructs others (e.g. at crossings, etc.)		
	others move into the safety distance of the subject		
	turns right near oncoming traffic		
	obstructs others when turning right		
	obstructs others when turning left		
	makes other road users decelerate		
	makes others accelerate		
	impedes cyclists/pedestrians		
	endangers cyclists/pedestrians		

	Overtakes or changes lane
	cuts up
	too small lateral distance
	Aborted

	Conflict
	subject provokes conflict
	subject does not provoke conflict

	Communication		comments
	Positive		positive
	Negative		negative