A STUDY OF PSYCHOLOGICAL FACTORS INFLUENCING DANGEROUS DRIVING, SPEEDING AND VIOLATION BEHAVIOR OF DRIVERS

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in partial fulfillment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY IN PSYCHOLOGY

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Certificate

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This is to certify that the thesis, entitled '**A STUDY OF PSYCHOLOGICAL FACTORS INFLUENCING DANGEROUS DRIVING, SPEEDING AND VIOLATION BEHAVIOUR OF DRIVERS**', submitted to the Bharathiar University, in partial fulfillment of the requirement for the award of the Degree of **DOCTOR OF PHILOSOPHY** in **PSYCHOLOGY** is a record of original research work done by **MOHAMMED NAJEEB.P.M.** during the period February, 2008 to January 2013 of his research in the Department of Psychology, Bharathiar University, Coimbatore, Tamil Nadu, India under my supervision and guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title of any candidate of any University.

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Head of the Department

Declaration

DECLARATION

I, **MOHAMMED NAJEEB, P.M**. hereby declare that the thesis, entitled "**A STUDY OF PSYCHOLOGICAL FACTORS INFLUENCING DANGEROUS DRIVING, SPEEDING AND VIOLATION BEHAVIOUR OF DRIVERS**" submitted to Bharathiar University, in partial fulfillment of the requirements for the award of the Degree of **DOCTOR OF PHILOSOPHY in PSYCHOLOGY** is a record of original and independent research work done by me during February 2008 to January 2013 under the supervision and guidance of **Dr. S. SUBRAMANIAN, Ph.D.** Professor and Head of the Department of psychology, Bharathiar University, and it has not formed the basis for the award of any Degree/ Diploma/ Associateship/fellowship or other similar title to any candidate in any University.

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Table of Contents

TABLE OF CONTENTS

Chapter No.	Title	Page No.
I	INTRODUCTION	1
II	REVIEW OF LITERATURE	33
III	RESEARCH METHODS	80
IV	RESULTS AND DISCUSSION	107
V	SUMMARY AND CONCLUSIONS	163
	References	
	Appendices	

List of Tables

LIST OF TABLES

Table No.	Title	Page No.
1	Number of Drivers Selected from Each Region	89
2	Demographic profile of the Sample	90
3	Reliability Coefficients Obtained for Various Scales.	100
4	Summary of ANOVA of age groups based on Dangerous Driving Behavior	109
5	Summary of Post hoc test for age groups on Dangerous driving	109
6	Summary of ANOVA of Dangerous Driving by Experience.	111
7	Summary of Post Hoc Test for Experience on Dangerous Driving Behavior	112
8	Summary of ANOVA of Dangerous Driving towards Traffic rules with Respect to the Level of Education.	114
9	Summary of ANOVA of Speeding Behavior with Respect to the Age Groups	115
10	Summary of ANOVA of Speeding Behavior by Experience.	118
11	Summary of ANOVA of Speeding Behavior by Education.	119
12	Summary of ANOVA of Violation Behavior towards Traffic Rules with respect to Age.	121
13	Summary of Post hoc test for Age Groups on Violation Behavior	122
14	Summary of ANOVA of Violation Behavior towards Traffic Rules with Respect to the experience	124
15	Summary of Post hoc test for Violation Behavior towards Traffic rules on Experience.	124
16	Summary of ANOVA of Violation Behavior towards Traffic Rules by Education.	126

Table No.	Title	Page No.
17	Summary of Post Hoc Test for Education Groups on Violation Behavior of Traffic Rules	127
18	Summary of Analysis of Descriptive statistics	129
19	Correlation Matrix of Driving Behavior with all Psychological variables	130
20	Summary of Block wise multiple Regression for Dangerous Driving	145
21	Summary of Regression for Speeding Behavior	151
22	Summary of Multiple Regression for Violation Behavior (VBTR)	156

List of Figures

LIST OF FIGURES

Figure No.	Title	Page No.
1	A Behavior Model of Driving	86
2	Research Design for Establishing Relationship of a Set of Predictors to Criterion Variables	87

Chapter I

Introduction

CHAPTER I

INTRODUCTION

The first chapter is presented in three major sections each attempting to highlight the key aspects of road safety, the theoretical background, the influence of psychological factors on driver behaviors significance of the study, the rationale and the proposed research questions.

Section I presents the introduction showcasing international observations on road safety theoretical background of driving behaviors and road safety.

Section II deals with various driving behaviors and the psychological factors influencing such behaviors.

Section III presents the significance of this study, the rationale and the proposed research questions.

Section I: Introduction

United Nations Regional Expert Group Meeting (2010), held at Bangkok on Implementation of Decade of Action for Road Safety, 2011-2020, reported that road traffic injuries and fatalities are a major social, economic, health and developmental problem. Therefore, there is a continuing need to place road safety high on the global, regional and national agenda while planning and implementing measures for improving road safety. Long before cars were invented, road traffic injuries that were reported involved carriages, carts, animals and people. The number of accidents grew exponentially as cars, buses, trucks and other motor vehicles were introduced. An accident involving a cyclist in New York City on 30th May 1896 was the first recorded case of injury involving a motor vehicle, and a London pedestrian was the first recorded death resulting from a

motor vehicle accident on 17th of August, the same year (Hasselberg *et al*., 2001). Road traffic injuries steadily increased and accounted for 2.1% of all global deaths, making them the ninth cause of deaths globally.

Despite the rate of occurrence of road traffic death and injury, the sufferings of victims have been largely ignored until now. According to annual report of National Crime Record Bureau, (2011) road fatality rates in India are probably among the highest and out of 1.3 million deaths worldwide every year, 10% (133,938 in 2010) of all the road deaths occur in India. Transport and Communications Bulletin (Road Safety) for Asia and the Pacific No. 79, of United Nations (2009) reported that, with the rising purchasing power of average Indians, motorized vehicle ownership is growing at a fast pace and, in some cities; vehicle ownership has reached a level comparable to that of developed countries. The poor and inadequate public transport services in cities, particularly the non-metropolitan cities, have compelled many residents to use private modes of transportation more often than should have been necessary. As a result, the use of private modes of transport for work related trips is very high (Sikdar & Bhavsar, 2009). According to the Kerala State Crime Record Bureau, (2011) road accidents have caused 4,145 deaths during 2011 in the state of Kerala where this study was conducted.

World Reports on Road Safety

World Health Organization in Global Status Report on Road Safety (2009) reported that of all the systems that people have to deal with on a daily basis, road transport is the most complex and the most dangerous. Worldwide, the number of people killed in road traffic crashes each year is estimated at almost 1.3 million while the rate of injured cases could be as high as 50 million. Without increased efforts and new

initiatives, the total number of road traffic deaths worldwide and injuries is forecast to rise by 65% between 2000 and 2020, and in low income and middle income countries deaths are excepted to increase by as much as 80% (Peden *et al*., 2004). The World Health Organization has estimated that fatalities per 100,000 populations in the developing world will grow from 13.3 in 2000 to 19.0 in 2020, while in the developed world during the same period; they will decline from 11.8 to 7.8 (Peden *et al*., 2004). The situation will worsen further if coordinated actions are not planned and implemented to improve the overall road safety. Considering the seriousness of the issue, the General Assembly of the United Nations convened at New York on March 31, 2010 declared 2011-2020 as *A Decade of Action for Road Safety*.

The Dimensions of Road Safety Problem in India

Among an estimated 0.8 billion motor vehicles used worldwide, India has only 100 million vehicles (Sikdar & Bhavsar, 2009). In comparison to the developed world, India has a low vehicle ownership rate. However, the demand for road travel is growing faster than the average income of the population or the growth rate of the GDP. Inadequate road safety provisions and poor travelling conditions (operational control and road use behavior) have created a high level of risk in road travel. Consequently, the fatality rate per 10,000 vehicles in India is 15-20 times higher than that in developed countries. India has just 1% of the world's vehicles, but accounts for nearly 10% of the road traffic fatalities, while Highly Motorized Countries (HMC) having 60% of the world's motor vehicles account for only 14% of the total road fatalities.

National Crime Record Bureau has reported the average death rate due to accidents in India as 32.41 per 100,000 population in 2010 as compared to 21.5 in other

low income countries and 10.1 in high income countries (World Health Organization in Global Status Report on Road Safety (2009).Rate of death per 10,000 vehicles is 14 in India as compared to the level of below two in developed countries. In India number of road accidents, deaths due to road accidents and injuries are increasing every year. Among the 430,600 road accidents that occurred during the year 2010, the death of 133,938 persons and 470,600 were reported fatally injured (NCRB, 2011).

A study by the planning commission in 2002 estimated that the social cost of road accidents in India stands at Rs 550 billion annually, which constitutes about 3%of the GDP (Sunder *et al*., 2007). It is estimated that the country loses around 750 billion rupees per year due to road traffic accidents, which is 2-3 per cent of the gross domestic product (Sikdar & Bhavsar, 2009).

The World Health Organization in the Global Status Report on Road Safety (2009) anticipates that unless immediate action is taken, within the next 15years, the number of people dying annually in road traffic crashes may rise to 2.4 million. The increase may entirely occur in low and middle-income countries and road traffic injuries will become one of the three major causes of death. Globally, road traffic injuries are one among the three major causes of death for the age group 5 to 44 years. Road accident statistics of 2010 (NCRB, 2011) shows an annual increase of 5.5% in road accident deaths in India.

The Driving Task and Human Factor

Driver behavior is the basis for ensuring the safe and efficient flow of traffic on motor ways around the world. Unfortunately, driver behavior is one of the primary causal factors for accidents, traffic snarls and injuries. Driving is a self-regulated activity in

which drivers make more or less conscious choices and decisions that depend up-on both the driving situation at hand and their own driving abilities. Despite the complexity of task, drivers while driving often engage in multi-tasking, such as talking to passengers, listening to the radio, or making phone calls. The Activities that distracts drivers and draws their attention away from the main task (driving) is liable to lower driving performance and seriously impair road safety.

Driving may be viewed as a skill-based, socially regulated, expressive activity. The skill-based component involves balancing capability and task difficulty to avoid loss of control (Fuller, 2005). The socially regulated component involves real time negotiation with co-present transient others with whom the driver is presently sharing the public highway to avoid intersecting trajectories. The expressive component involves maintaining or enhancing the driver's self-image and sense of subjective well-being. In the Task-Capability Interface Model (Fuller, 2005), speed is varied to manipulate perceived task difficulty and maintain a situation where the driver's competence continually exceeds the cognitive demands of the situation in order to avoid loss of control of the vehicle.

Driving a vehicle may be described as a dynamic control task in which the driver has to select relevant information from a vast array of (mainly) visual inputs to make decision and execute appropriate control responses in order to achieve mobility with safety (Fuller, 2002). Although there are occasions when drivers have to react to some unexpected event, they execute planned actions, which are shaped by their expectations of the unfolding road, pedestrian and traffic scenario. However, the driver is not always able to operate at their level of competence due to the limitations of the human factor.

Section II: Psychology and Traffic Safety

Motor vehicle accidents result usually from a complex interaction among the driver, the vehicle and environmental factors. Analysis of traffic accidents indicated that human factors are a sole or a contributory factor in approximately 90% of road traffic accidents (Lewin, 1982; Rumar, 1985). However, less progress has been made in understanding the behavior of the road users as compared to many improvements in road environment and vehicles (Rothengatter, 1997). As a result, psychological analysis has become important in ensuring traffic safety by focusing on emotional, attitudinal, and personality factors that influences driving behavior and causes accidents. Individual differences in accident liability reflect individual differences in cognitive performance, psychosocial factors such as attitudes, and personality (Beirness, 1993; Elander, West, and French 1993; Lester, 1991). As human behavior is assumed to be a major factor behind these accidents (Rumar, 1985) it is not surprising that research in psychology showed an early interest in traffic and traffic safety.

The History of Traffic Psychology

In traffic psychology, one of the main goals has always been to develop theories that can describe the behavioral factors causing, or contributing to, accidents. After World War II research about personality and individual differences gained a lot of attention and the dominating view in traffic psychology was that some drivers cause more accidents than others due to their personality. In the 1960s, research in perception received a lot of interest and the dominating view in traffic psychology was that drivers are victims as they are not able to cope with the complexity of the traffic environment. In the 1970s and 1980s research in cognition became popular and the dominating view in traffic

psychology was that drivers adapt their behavior to the traffic situation and thereby chose the level of risk they are subjected to. Around 1990s a lot of research in automated behavior was also conducted and the dominating view regarding traffic psychology was that experienced drivers are able to automate many driving tasks**.** Finally, today there is a move towards application of social psychological principles in understanding behavior, which is based on the assumption that drivers behave within a social context where they are very much influenced by the behavior of other road users.

Theoretical Background

Whilst understanding the causes of dangerous driving behaviors (e.g., speed, reckless riding behavior, violation issues) assists in the development of initiatives aimed at reducing crashes, the theoretical formulation in this context can play a pivotal role in not only explaining, but also predicting, and ultimately changing the behavior that leads to crashes. Theory can provide a basis for understanding the underlying psychosocial mechanisms inherent in risk-taking behavior and, most importantly, the means for changing them. Theory enables to apply the appropriate strategies at targeted group, which have predictable (theorized) outcomes. If the theory is sound, interventions can be developed with the knowledge that they are reasonably likely to result in behavioral changes and, therefore, play a protective role in preventing such crashes from ever occurring. For this reason, a strong theoretical framework has guided this research.

Accident Proneness

The concept of accident-proneness is based on the observation that some individuals consistently have more accidents than others do. The concept can be traced

back to Greenwood and Woods (1919), who reported that only a small number of the workers accounted for most of the accidents, which are found to be stable over time. Based on the concept of accident proneness, one can expect that only a small number of drivers are responsible for most of the traffic accidents (Farmer & Chamber, 1939; Rawson, (1944). Tillman and Hobbs (1949) also found some evidence for accident proneness in a study of taxi drivers; they attributed the tendency to be accident prone to general characteristics of being socially maladjusted and stated the well-known phrase "a man lives as he drives". Thus, driving was regarded as manifestation of living.

Most evidence for stable individual differences in traffic accident rate comes from a longitudinal study conducted by Hakkinen (1979) who reported that among a selected category of drivers there is a high consistency of accidents involvement between the initial testing and 10-27 years later ($r = .66$). Hakkinen (1979) also found that drivers with high rates differed from drivers with low accident rates on several tests.

The theory of accident proneness in its extreme form, meaning that only a small amount of drivers are responsible for most accidents, is today regarded as inadequate by most of the researchers. Mckenna (1983) has suggested replacing the concept accident proneness with the term "differential accident involvement". According to Mckenna (1983), the central aim should rather be to consider the possibility of predicting and distinguishing those who are involved in accidents than those who are not, based on various Psychological tests.

In the 1950, the focus was shifted from accident proneness towards in-depth studies aiming to re-construct each accident in detail, in order to detect the major cause of the accident, every factor that may have contributed to the accidents (OECD, 1988).

The general conclusion of these studies was that the human factors were the primary cause for majority of traffic accidents, although no single human factor could be identified as more important than others (Elvik, 1991).

Information Processing Model

The development of models of human information processing in the 1950s contributed in a significant way to identify the major causes which are likely to result in traffic accident involvement. Such models emphasize that information processing capacity and its limitations in cognitive aspects such as attention, perception, decision and response have much impact on accident involvement (Broadbent, 1958). When driving, the driver has to continuously process new information and uses this to make appropriate decisions. The failure in the processing of information as a result of inattention, misperception, and slow reaction time may cause unintended errors and thereby result in accidents (Ranney, 1994; Shinar, 1978).

System Theory Approach to Accident Causation

According to System Theory (Marek & Sten, 1977), accidents are rather viewed as a failure of the traffic system than the failure of the driver. One of the fundamental assumptions in system theory is that the demand of the traffic systems to a considerable extent influences the behavior of the driver. System theory also acknowledges that human factor is an important element contributing to accidents, but this is only one of the elements that may influence accident involvement. The traffic system is seen as consisting of three main elements; the road user (the human factor), the vehicle, and the traffic situation. System theory focuses on the interaction among these three elements, and not so much on the unique contribution of each. One of the major problems of system

theory is that the driver is treated more or less as a passive responder to the traffic environment. There is, however, overwhelming evidence pointing towards drivers as active responder to the traffic environment. Several measures introduced to lower the demands of the traffic system to the drivers, such as anti-lock brake system (ABS), road lighting of previously dark roads, and light instead of dark road surfaces, have not lead to fewer accidents, as predicted by system theory (Elvik, Musen & Vaa, 1997). Instead drivers tend to adapt their behavior in traffic by taking more risks than before (e.g. increasing speed) when the demands of the traffic system are lowered.

Motivational Models of Driving Behaviors

Taylor (1964) was one of the pioneers who acknowledged that driving is more than a passive response to the traffic situation. Taylor suggested that the level of emotional tension, and the level of anxiety the driver wishes to tolerate motivates driving behavior. The driver is required to adjust his level of risk taking while driving in order to keep his emotional responses at a constant level.

In the mid-seventies, Naatanen and Summala (1974, 1976) introduced their Zero-risk theory of driving behavior. This theory highlighting the concept called "Subjective risk monitor" outlines different degrees of subjective risk or fear depending on the risk experienced in the traffic situation. Naatanen and Summala (1974, 1976) further emphasized emotions as one of the central motivators of driving behavior. The act of driving is normally motivated to escape or avoid the unpleasant experience of risk in order to feel no risk, for instance by reducing speed while driving on congested roads. Hence, the theory is labeled Zero-risk. Accidents happen, in part, because drivers fail to adapt their driving adequately to the level of complexity in the traffic situation.

Risk Homeostasis Theory

The risk homeostasis theory (Wilde, 1982) is based on a driver's presumed motivation to seek some level of optimal or accepted risk (i.e., target risk), which guides his/her behavior. This target risk depends upon the driver's knowledge of the accident rate. Whenever there is a discrepancy between the target risk and the risk experienced, this will lead to behavioral changes to reduce this discrepancy. This process of risk evaluation is according to the Risk Homeostasis Theory (RHT) a rationally founded cost benefit evaluation of various action alternatives while driving. For instance, when introducing a new safety measure, like ABS, the driver will adjust his/her behavior in order to seek the level of optimal risk.

Risk-Avoidance Model

Fuller's risk-avoidance model (1984) considers that the driver is motivated to avoid an experience of risk and fear while driving. Fuller's model (1984) is based on the assumption that making progress towards a destination and avoiding hazards are the two predominant driver motivations. According to the model, drivers spend most of the time avoiding obstacles and potential accident hazards in order to avoid a feeling of risk or fear. Repeated exposure to obstacles while driving is our basis for learning how to identify risk on the road. Fuller (1984) emphases that actions in traffic are, most of the time performed, automatically and not a result of a conscious, deliberate decision process. Thus, risk taking in traffic may not always be a result of conscious decision-making, but rather a result of the individual's conditioning history.

Theories of Reasoned Action (TRA)

According to cognitive dissonance theory (Festinger, 1957), changing the beliefs that underpin behavior can lead to behavioral changes. This assumption has been integrated in the Theory of Reasoned Action /Planned Behavior (Ajzen & Fishbein, 1980; Ajzen, 1988) and health behavior models such as the Health Belief Model (Rosenstock, 1974). From these theories one can expect that a change in certain attitudes may reduce the probability of accidents.

The Theories of Reasoned Action (TRA) stresses the importance of attitudinal and social factors as predictors of driving behavior (Ajzen & Fishbein, 1980). According to this model, a person's intention to perform a behavior, which in turn influences behaviors, is determined by the person's attitude towards the behaviors and by the subjective norm. The subjective norm is considered to be the person's motivation to comply with these referents. Ajzen (1988, 1991) later extended this model to include perceived behavior control, meaning the extent to which a person believes the behavior in question is under volitional control, as additional determinant of behavior. This model was named as the Theory of Planned Behaviors (TPB).

Hierarchical Model of Driving Behavior

Several theorists have classified driving behavior as a hierarchy (Rasmussen, 1984; Vander Molen & Bottincher, 1988). Although there are several differences among hierarchical models of driving behaviors, they all roughly separate between three levels of driving behaviors (Laapotti *et al*., 2001). The lowest is an operational, vehicle maneuvering level. This involves concrete operations such as braking, changing gear, and turn on indicators etc. Inexperienced drivers typically have most of their mental capacity

directed towards such actions. As such, skills become more familiar and automatized, this allows mental capacity to be freed and more resource is directed towards level higher up in the hierarchy. The next level, the tactical level, involves decisions of how traffic situations are mastered, for instance to overtake a car in front. The highest level, the strategic level, concerns higher-level decision making, such as planning where and when to drive. Most of such decisions are made before the driver is in car. Thus, higher up in the behavioral hierarchy, the more conscious is the decisions making process.

Error and Violations

According to Reason and others (1990), driving behavior resulting in accidents should be divided into two main components; errors and violations. This distinction is regarded as important because different Psychological factors are underlying in these components of driving behavior. Errors are defined as the failure of planned actions in order to achieve their intended consequences. Errors can be divided in to two subtypes: mistakes, which refer to misinterpretation of information, and slips / lapses that concern divergence of planned actions from a satisfactory path towards a desired goal. Errors are hypothesized to originate from deficiencies in judgmental and / or inferential process. These kinds of erroneous behavioral acts correspond to behavior typically involved in the operational and tactical level of the driving behavior hierarchy (Reason *et al*., 1990).

On the other hand, violations concern intentional / deliberate acts of risk-taking in traffic. Such behavior may include intentionally risky acts such as speeding, ignoring a red light, or showing off skills to others. According to Reason *et al*. (1990) violations are

influenced by social and motivational factors such as norms, driving in accordance with a valued social image, or a wish for rapid progress in traffic. Acts of violations are also thought to be more dominant in the higher levels of the driving behavior hierarchy.

Other theorists also acknowledge the separation between driving errors and violations. Näätänen and Summala (1974, 1976) separate between cognitive skills and motivation pertaining to driving behavior. The skill component of driving behavior refers to the driver's cognitive and motor skills, which represents the driver's maximum performance and capabilities while driving. However, the driver's skills do not necessarily predict accident involvement. The driver's motives are, on the other hand, a more predictable measure pertaining to accident involvement. Motives do represent the driver's motivation and permanent personality traits and attitudes towards safety. Contrary to skills, motives determine what drivers chose to do with their skills. The distinction between errors and violations also corresponds to Evans' (1991) separation between driver performance and driving behavior, as well as Elander, West and French's (1993) separation between driving skills and driving style. It should be noted that Reason and others' (1990) separation between violation and error factors of driving behavior has also been confirmed in studies of Swedish drivers conducted by Åberg and Rimmö (1998), Rimmö, and Åberg (1999).

These studies have, however, found empirical support for separating the slips and lapses factor into two new factors, inattention errors and inexperience errors. The authors consequently suggested splitting driving behavior into four factors, *violations*

(e.g., exceeding the speed limit), *mistakes* (e.g., misjudgment of the gap when overtaking), *inattention errors* (e.g., failure to observe traffic signs and signals), and *inexperience errors* (e.g., preparing to reverse while using a forward gear).

Theories of Aggression in Driving

Shinar (1998) proposes that frustrating road situations, such as congestion or delays, mediated by an individual's predisposition for aggression, contribute to a driver's aggressive behavior. In accordance with frustration-aggression theory, congestion or delays are 'goal blocking', interfering with driving progress. In response to goal blocking, drivers experience an increase in frustration, this in turn lowers the driver's aggression threshold increasing the likelihood of road aggression (Shinar, 1998). In the absence of aggressive driving outcomes, it is believed that the expression of aggression is displaced to a later point in time (Lawton & Nutter, 2002).

Speeding

Speeding has been defined as the driver-behavior of exceeding the stipulated speed limit or driving too fast for existing conditions. Speeding has consistently been estimated to be a contributing factor in approximately one third of all the fatal crashes. Speeding has been found to have a great effect on road mishaps, probably larger than any other known risk factors. Because speed at the time of collision is the key determinant of the kinetic energy the human body sustains in a crash, speed is a risk factor for all injury causing accidents. Whichever theory one uses to describe the factors causing, or contributing to accidents there is a strong agreement amidst the research community that driving too fast is a behavior that contributes to both the number and the outcome of accidents. To prevent us from driving too fast, speed limits have been introduced in most countries.

Factors influencing speeding. A multitude of factors that influence speed choice has been identified from previous research, making behavior change a very complex undertaking. Four broad categories can be used to summarize these factors: legal, social, person-related, and situational factors. Legal factors include a range of enforcement initiatives (e.g. speed cameras and related sanctions) which aim to influence the perceived risk of detection and punishment (Homel, 1986). Social factors include the influence of others and can incorporate pressure from family, friends, passengers, and the media, exposure to role models, and the behaviors and traveling speeds of others on the road (Haglund & Aberg, 2000; Rothengatter, 1988; Stradling *et al*., 2003). Person-related factors relate to the individual characteristics of the driver including previous crash involvement, gender, age, attitudes and values (Stradling, Meadows, & Beatty, 2000), and personality characteristics such as a predisposition to sensation seeking (Jonah, 1997). Finally, situational factors refer to the circumstances of a particular driving episode including being late, keeping up with flow of traffic, purpose of the trip, and the opportunity to speed (Stradling *et al*., 2000).

Speeding and Risky Driving Behavior

Risky driving behavior may include self-assertive driving, speeding, and rule violations. Many researchers (Aarts & vanSchagen, 2006; Jonah, 1997; Lam, 2003) have studied speeding as a risky driving behavior. Excessive driving speed for the road conditions is considered one of the most important contributors to road crashes, regardless of the driver's age and level of skill (Elliott *et al*., 2004). Even when aware of the potential consequences for speeding, drivers in Australia still indicate involvement in speeding behavior (Brown & Cotton, 2003). Clarke *et al*. (2002) also suggested that

speed was the most common factor involved in driving offences among young drivers. West and Hall (1997) found that speed was a significant contributor to specific kinds of crashes (that is, active shunts, right of way violations, active reversing, and loss of control crashes) along with both (poor) attitudes towards driving and social deviance. McKenna and Horswill (2006) suggested that involvement in speeding behavior may also be due to a low probability of negative outcomes.

Dangerous Driving

Dangerous driving can be defined as deliberate deviations from safe driving (Malta, 2004). It includes a wide range of on-road violations, such as running red lights, speeding, dangerous overtaking, tailgating etc. As all these behaviors are linked with accident involvement, they deserve attention from a traffic safety perspective (Blows *et al*., 2005). Dangerous driving is associated with demographic variables such as gender, age and driving exposure. Younger males tend to drive more dangerously in comparison with older drivers and females (Asbridge *et al*., 2003; Blows *et al*., 2005). In addition, frequent exposure to driving, in terms of kilometers driven per year, is linked with more frequent manifestations of dangerous on-road behaviors (Harding *et al*., 1998; Wells-Parker *et al*., 2002). Dula and Geller (2004) highlighted problems of dangerous driving which encompasses aggression with intent to harm, negative emotions and cognitions such as anger, frustration, and rumination, as well as risky driving behaviors which are often considered as aggressive, but which lack actual intent to harm.

Violation Behavior of Traffic Rules

Self-reported violations, defined as the deliberate infringement of some regulated or socially accepted code of behavior, have been shown to predict accident rates

(Reason *et al*., 1995; West, French, Kemp, & Elander, 1993). Reason *et al*. (1990), and Parker, Manstead & Stradling (1995) separated risky driving behavior into three components on the basis of a factor analysis; slips, mistakes, and violations. While slips and mistakes were found to originate from faulty information processing, violations were explained by intentional disobedience of traffic rules. Interestingly, they found a clear link between the self-reported tendency to commit violations and accident involvement. This link was not found for driving errors and lapses. Accordingly, they concluded that driving errors originating from insufficient information processing is a relatively unimportant cause of accident involvement. On the other hand, intentional violations are important in this context. A similar conclusion was also reached in a study conducted by Lawton and colleagues (1997).

Personality and Dangerous Behavior

A widespread belief that road accidents are rather due to personality factors than mechanical faults of the vehicles is embodied in the saying that "the nut behind the wheel is the real problem on the road" (Nader, 1965). Following his investigations into roadworthiness of a number of makes of vehicles, Nader (1965) felt that the human contribution to accidents greatly exceeds those of roads or vehicles. Sanchez-Jiminez, (1967) claimed that 90% of road accidents were due to the personalities of the drivers concerned, while Selez and his colleagues estimated that 80-90 percent of road deaths in the United States of America were due to driver errors. Most investigators would agree that personality factors contribute to the prime cause of road accidents (Don, 2005).

A range of personality factors are also related to risky driving and crash involvement. The most prominent ones are mild social deviance, hostility, sensation

seeking (Zuckerman, 1979), aggression, impulsiveness, emotional liability, locus of control, and antisocial motivation (Hilakivi *et al*., 1989; Arthur, Barrett & Alexander, 1991; Beirness, 1993; Elander, West & French, 1993; Lawton *et al*., 1997; West & Hall, 1997; Underwood *et al*., 1999). These traits have, not been so much in focus as compared to sensation seeking. However their impact on driving behavior and accident involvement, are usually studied separately. This indicates that research focusing on the combination of such traits can be advantageous in order to understand the role of permanent underlying motivation (i.e. personality traits) to commit driving violations in traffic.

Gulliver and Begg (2007) reported that personality characteristics are found to be associated with persistent risky driving behaviors, and their potential outcomes, in young adult males. If personality traits can be identified at a young age, perhaps they could be targeted before these individuals start driving, to try and prevent them from developing such behaviors.

Though it is very unrealistic to change one's basic trait of personality than the motivational beliefs, which are more amenable to change, the present study focuses on certain key personality traits that influence the individual's perception and appraisal of the environment (McCrae & Costa, 1995). Several studies have supported this assumption (Matthews & Deary, 1998). A study conducted by Yagil (2001) is worth mentioning in this context. Yagil (2001) studied the impact of personality traits on young male drivers' attitudes and their intention to commit driving violations. Applying path analysis, Yagil (2001) found that sensation-seeking, locus of control and aggressions are more likely to affect drivers' attitudes towards violations, which in turn influence intentions to commit violations.

Sensation Seeking Characteristics

Sensation seeking is "a trait defined as seeking varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (Zuckerman, 1994, p. 27). Sensation seeking traits can be measured using a standard self-report questionnaire (e.g., SSS-V). These traits can be classified into four dimensions such as thrill and adventure seeking, experience seeking, disinhibition and boredom susceptibility (Zuckerman *et al*., 1978).

Sensation seeking individuals engage in behaviors to increase the amount of stimulation they experience. Behaviors and attitudes such as interest in stimulating occupations, drug use, driving recklessly, etc. involve seeking arousal. Satisfying a preference for stimulation can be accomplished through many behaviors, activities, and attitudes (Arnett, 1991; Irwin & Millstein, 1986; Zuckerman, 1985, 1994; Zuckerman & Neeb, 1980). These include recreation, lifestyle choices, sports, social interactions, and occupational choices. These stimulating activities vary in the amount of risk associated. Although risk taking is a correlate of sensation seeking, it is not the primary motive in this behavior (Zuckerman, 1994). Sensation seekers accept risk as a possible outcome of obtaining arousal, yet do not seek out risk for its own sake (Zuckerman, 1994).

Locus of Control (LOC)

Locus of Control (LOC) refers to the relationship between the environment and the individual's evaluation of his or her ability to deal with it effectively and to adjust his behavior accordingly. It is the degree to which, individuals think that they can control events that affect them. Locus of control has two dimensions: the external and internal. Rotter (1966) originally proposed the concept of Internality vs. Externality (locus of control).

He defined locus of control as a personality attribute reflecting the degree to which a person generally perceives events to be under their own control (internal locus of control) or under the control of powerful others or other outside forces (external locus of control).The locus of control summarizes an individual's underlying beliefs about the control of outcomes of various kinds. It assumes that everyone develops a general concept regarding their personal ability to control all aspects of their lives. Individuals who believe that the events that occur in their lives are consequences of their own behavior and/or ability, personality or effort are said to have the expectancy of internal control. Whereas people who believe that the events in their lives are a function of luck, chance, fate, God(s), powerful others and beyond their control or manipulation are said to have an expectancy of external control. People with a high internal locus of control tend to have higher aspirations, and more persistence, respond well to challenge, and see themselves as a source of their success (Vincent & Furnham, 1997).

Type A Behavior Pattern

A crucial aspect of personality, in relation to motor vehicle accident risk, that has only recently achieved recognition is Type-A Behavior Pattern (TABP). Friedman & Rosenman (1974) predicted that the individuals who suffered from heart disease were more likely, as opposed to others who did not suffer from heart disease, to exhibit a behavior style recognized today as TABP. Conversely, Type B Behavior Pattern (TBBP) was very much distinguished from Type-A Behavior Pattern (TABP) by relatively less competitive, hostile and hurried behavior. Individuals who display this form of behavior pattern are inclined to 'take things easier'. Individuals who are of Type A behavior pattern are said to display three distinct features such as (i) Competitive Achievement Orientation:

Type A Individuals tend to be very self-critical and strive toward goals without feeling a sense of joy in their efforts or accomplishments. (ii) A Sense of Urgency: Type A people seem to be in a constant struggle against the clock. Often, they quickly become impatient with delays and unproductive time, schedule commitments too tightly, and try to do more than one thing at a time, such as reading while eating or watching television. (iii) Anger/ Hostility: Type A individuals tend to be easily aroused to anger or hostility, which they may or may not express overtly.

In addition to the above characteristics, Suinn (1977) proposed other two factors, which contribute to the maintenance of TABP: reinforcement and stress. Suinn (1977) put forward that Type A characteristics led to certain outcomes that were profitable. Furthermore, if the rewards were powerful and frequent, the Type A behavior would become over-learned and therefore lead to a strong habit pattern. This pattern would then be generalized across other conditions such as various recreational activities not normally demanding Type A behavior. This is then reflected in the driving situation.

Aggression in Driving

Aggression can be defined as any behavior directed at causing physical or mental injury. However, as Bandura (1983) points out, the classification of an act as aggressive depends on subjective judgments of intention and causality. With reference to the present study, the concept of intent is useful in discriminating between driving acts where the intent was to cause harm and other driving acts, which reveal a willingness to cause dangerous outcomes in order to fulfill the driver's motives. This latter situation necessarily

encompasses behavior in which the driver may not intend to harm other road users and may not be aware that significant risk is involved. Two definitions of aggression in driving are proposed which encompass the range of possible aggressive behaviors.

By definition, aggressive drivers tend to drive faster than others do, they may be more prone to tailgate, cut off, or not allow other drivers to merge in front of them, and they are more likely to run stop signs and red lights. People who admit to being an aggressive driver (at least within the last month) were less likely to be concerned about speeding and aggressive driving than people who did not admit to these activities. Aggressive drivers differed from non-aggressive drivers on the dispositional traits.

The first definition of aggression in driving includes what would normally be classified as extreme behavior. These are acts of murder, suicide and willful and malicious assaults (physical or psychological). The second definition encompasses the concept of risk taking. This driving behavior is aggressive in appearance, but does not necessarily imply intent to cause harm, although it may subsequently put other road users at risk.

Propensity to Become Angry

Another construct that has emerged as a viable predictor of unsafe driving is the propensity to become angry while driving (i.e., a context-specific version of trait anger). Driving anger is generally measured with the Driving Anger Scale (DAS) (Deffenbacher, Oetting, & Lynch, 1994). Several studies have found that high DAS scores are associated with motor vehicle accidents, aggressive driving, traffic violations, intensity of state anger while driving, anger-related damage to vehicles, and less frequent use of seatbelts (Blanchard, Barton & Malta, 2000; Deffenbacher *et al*., 1994; Deffenbacher *et al*., 2000; Deffenbacher *et al*., 2003; Lajunen & Parker, 2001; Underwood *et al*., 1999).

Trait Anger and State Driving Anger

According to Deffenbacher and others (2003), trait driving anger refers to a person's general propensity to become angered frequently and intensely while driving, whereas state driving anger describes angry emotional and physiological arousal stemming from a specific driving event. These two are not independent; however, not surprisingly high trait anger drivers report significantly more anger (2.4 times) in normal traffic, when stuck in rush hour traffic and when yelled at by another driver (Deffenbacher *et al*., 2003).

Hostility

Among the various psychological factors relating to Motor Vehicles Accident (MVA), one particular factor, namely, road hostility or road anger or road aggression, has received an increasing amount of attention in recent years (Hemenway & Solnick, 1993; Lajunen & Parker, 2001; Lowenstein, 1997; Underwood *et al*., 1999). First, it is important to clarify these overlapping concepts. General trait-hostility includes three components: a tendency to behave antagonistically, to think cynically and to feel anger across situations (Barefoot, 1992). Hostility is a view of others as frequent and likely sources of mistreatment, frustration, and provocation and, as a result, a belief that others are generally unworthy and not to be trusted (Smith, 1994).

Road-hostility is a specific form of trait-hostility that includes the behavioral component of aggressive road acts such as rude gestures, arguing with other drivers and in extreme cases forcing other drivers to ‘‘get off the road’’, the cognitive component of cynicism and hostile attributions toward other drivers (e.g., old drivers drive deliberately slow to annoy people) and the affective component of anger in road situations

(e.g., annoyance from a slow car). Parker, Lajunen, and Summala (2002) found that similar situations annoy drivers in three different cultures, and that cross-culturally, drivers report manifesting similar aggressive responses to those situations.

Attitude

Attitude, however understood or operationally defined, has been recognized for many years as having an important influence on driver performance. Eagly and Chaiken (1993) defined that attitudes are tendencies to evaluate an entity with some degree of favour or disfavour, ordinarily expressed in cognitive, affective and behavioral responses. Entity refers to the object of an attitude, which includes various things like individuals, inanimate objects, concepts, social groups, behaviors, and so on. In the traffic psychology, it would include different road users like drivers, pedestrians, and cyclists as well as vehicles, safety equipment, traffic rules, enforcement, driver behavior, etc. (Aberg, 2001).

Attitudes and Their Influence on Risky Driving Behavior

Attitudes, which have been the focus of numerous researches, refer to a predisposition to respond favorably or unfavorably either to an object, person, institution or event (Ajzen, 1988). It is thought that it serves different psychological functions for the person (Katz, 1960) and that it both explains and predicts behavior. However, some of the evidence has been inconclusive and a number of researchers have argued that other variables, apart from attitudes, need to be considered. Fishbein and Ajzen (1975) presented a model called Theory of Reasoned Action (TRA), which also included subjective norms and intentions.

Attitudes are of interest because they are thought to reflect underlying motivations, which subsequently may affect behavior in traffic. This assumption is

supported by several studies by establishing a relationship between risk-taking behaviors in traffic and driving related attitudes (Parker *et al*., 1992; Parker, Manstead & Stradling, 1995; Parker, Lajunen & Stradling, 1998; Rutter, Quine & Chesham, 1995; Åberg, 1999). An effective strategy to increase road safety may thus be to change the attitudes that influence driving behavior.

Attitudes relating to traffic safety are extensive, and may cover different aspects or dimensions of traffic safety. This heterogeneity of traffic safety attitudes should be considered accordingly when studying the relationship between attitudes and behavior in traffic. For instance, some attitudes/beliefs may be more important predictors of risky behavior than others. If so, those attitudes with the highest correspondence with risky behavior could be given special attention in safety programs. Safety campaigns aimed at influencing attitudes do however, have a significant influence on traffic safety in general, and tend not to focus on the specific attitudes most likely to influence risk-taking behavior. This may also be an additional explanation of why several attitude campaigns seem to be unsuccessful in changing behavior in traffic. The studies mentioned above suggest that attitudes towards traffic safety are multidimensional, suggesting that people evaluate various aspects of traffic safety differently. As indicated previously, attitudes may be expressions of some deeper-lying motivations.

According to functional theorists, attitudes are held because they serve different functions to the individual (Katz, 1960; Shavitt, 1989; Snyder & Cantor, 1999; Lavine & Snyder, 2000). These can roughly be divided into five main types of functions: to gain accurate knowledge of the social world (knowledge function), to protect against internal conflicts and external dangers (ego defensive function), to maximize rewards and

minimize punishment (instrumental function), for self-expression and maintenance of self-identity (value expressive function), and to behave in a socially appropriate manner (social-adjustive function). Young drivers' attitudes towards traffic safety may serve several of these functions. An example is the functions served by expressing a favorable attitude towards speeding. Some drivers may be motivated to get ahead quickly in traffic, and the attitude may thus serve an instrumental function. Others may be motivated on basis of ego-defensive and value-expressing functions of attitudes. For instance, young drivers may express favorable attitudes towards speeding in order to express values like independence and rebelliousness. Similarly, young drivers wishing to impress their peers or girlfriends may express favorable attitudes towards speeding in order to present themselves in a socially appropriate manner.

Age, Experience and Education

The risk of involvement in crash seems to depend upon the drivers' age. Young (18 to 25) and elderly are (65+) at risk. However, with regards to accident causation, it seems that young drivers are more likely to commit violations, and the elderly are more prone to slips and lapses (Parker *et al*., 1992; Mathews & Mohan, 1986). Experience is particularly relevant for drivers and riders of two wheeled vehicles. Actually, possessing more driving experience can lead to optimization of driving behavior, ensuring more consistent, more accurate, more rapidly performed, less effortful, and more automatic driving. Moreover, experience leads older drivers to compensate for age-related deterioration of functional capacities, which can improve their chances of correcting errors, provided enough time is available. Studies have found that driving experience is

linked to driving skills (Fuller, 1984). On the other hand, experience can lead to more violations. It seems that drivers who commit violations believe that they are skillful enough to prevent their involvement in an accident.

Young drivers are at particular risk of being involved in traffic accidents (Arnett, 1990; Evans, Wasielewski & Von-Buseck, 1982; Fridstrøm, 1996). Several explanations have been proposed to explain the reasons for this aspect (Gregersen & Bjurulf, 1996). These can roughly be divided into skill-based and motivational factors, each relating to the different components of driving behavior, errors and violations, as well as the different levels in the hierarchy of driving behavior. The first explanation focuses on skill-based factors, which concern young drivers' lack of experience and insufficient cognitive and motor skills. This may cause unintentional errors while driving, which may result in accidents.

General expectation of the effects of education on behavior is positive but research results proved that there is a negative effect on driving behaviors like speeding and rule violation in some studies. Norris *et al*. (2000) and Macmillan (1975) found no significant effect after controlling the age. Popular belief of education as the common remedial measure for behavioral problems also requires further verification.

Section III: Significance of the Study

This project is aimed at exploring the extent to which the psychological factors affecting speeding, dangerous driving behavior and violation behavior of traffic rules among the drivers. Even though this subject is of high relevance and social importance, this has been often neglected and unattended to in India. Every year 1.2 million people all over the world are killed and 50 million severely injured in road traffic accidents (Peden *et al*., 2004).

National Crime Record Bureau of India (2011) reported that in India 430,600 road accidents caused death of 133,938 persons and injured 470,600 human beings during 2010 and the rate of accident and its severities are increasing manifold every year.

Even though it is well known that driving dangerously and too fast is a behavior that contributes to both the number and the outcome of these accidents, the drivers still resort to speeding and dangerous driving behavior. Further, it is more interesting to know why drivers choose to exceed the speed limits. Moreover, why do drivers accept risky dangerous driving behavior and violate traffic rules? The general aim of this study was to further the knowledge about dangerous driving behavior, speeding and violation behavior of traffic rules, and psychological and demographical factors influencing such behaviors.

Rationale of the Study

The *World report on road traffic injury prevention* (2004) is the first major report jointly issued by the World Health Organization and the World Bank on this subject. It underscores their concern that unsafe road traffic systems are seriously harming global public health and development. It contends that the level of road traffic injury is unacceptable and that it is largely avoidable.

Risky driving behavior may include self-assertive driving, speeding, and rule violations. Many researchers (Aarts & vanSchagen, 2006; Jonah, 1997; Lam, 2003) have studied speeding as a risky driving behavior. Excessive driving speed for the existing road conditions is considered as one of the most important contributors to road crashes, regardless of driver age and level of skill (Elliott *et al*., 2004). Even when aware of the potential consequences for speeding, drivers in Australia still indicate involvement in

speeding behavior (Brown & Cotton, 2003). Effective counter measures against dangerous driving cannot be designed and implemented without the proper understanding of underlying factors of this behavior.

Hence, a detailed knowledge of factors affecting speeding, dangerous driving behavior and violation behavior of traffic rules will help in planning, designing and implementing scientific remedial measures like road safety campaigns, driver education and enforcement programs effectively. Moreover, in spite of the fact that India is suffering from the highest road accident death, hardly any research in India have reported about driver behavior so far. Hence this study is more significant to address resolving the serious issues, help the key stakeholders, and ensure road safety forever, which are socially and economically relevant in this *Decade of Action for Road Safety*.

Speed management involves a balanced effort: defining the relationship between speed, speeding and safety; setting speed limits that are safe and reasonable; applying enforcement efforts and appropriate technology that effectively targets crash producing speeders and deters speeding; effectively marketing communication and educational messages that focus on high-risk drivers; and, soliciting the cooperation, support and leadership of traffic safety stakeholders. All the above remedial actions will be possible only with scientific knowledge about the factors affecting speeding behavior. This research is aimed at exploring the key psychological, demographical and personal factors, which affect driving behavior on our roads. Psychological factors including attitude, personality and demographical factors like age, experience and education are some of the prominent factors that are believed to be affecting driving behavior.

India being the most affected country from road accidents and its severities, an empirical research work in this area is required urgently. Worldwide all developed countries have successfully addressed this problem with regular research and utilized its results to minimize road accidents. The World report on road traffic injury prevention (2004) mentioned that research forms the basis for generating data and evidence for informed and effective decision-making. Developing research capacity at state and national levels is important for road traffic injury prevention (Peden *et al*., 2004). Without research capacity, there will hardly be any means to overcome misconceptions and prejudices about road traffic injuries.

Statement of the Research Problem

The research question to be investigated in this study: This research is intended to investigate selected predictors of speeding, dangerous driving behavior and violation behavior of traffic rules and search for descriptive typologies among the drivers who are more likely to drive vehicles recklessly and dangerously. In this connection, the following questions have been raised which need to be addressed in this study.

i. Is there any significant difference of demographic variables including age, experience and education level of drivers with speeding, violation behavior and dangerous driving behavior?

ii. Is there any significant relationship between the predictor variables viz sensation seeking, Type A behavior pattern, external locus of control, propensity to aggression, hostility and attitude to speeding with speeding behavior, dangerous driving behavior and violation behavior of traffic rules?

iii. What is the relationship between attitude to speeding and speeding behavior?

iv. What is the relationship between speeding behavior and dangerous driving behavior?

v. What is the relationship of violation behavior of traffic rules on speeding and dangerous driving?

vi. Can the speeding, dangerous driving behavior and violation behavior of traffic rules of drivers be predicted psychometrically from their responses to the questions on sensation seeking, Type A behavior pattern, External LOC, Propensity to Aggression, Hostility and Attitude to Speeding?

vii. What is the efficacy of select independent variables to predict the dangerous driving behavior, speeding and violation behavior of traffic rules among drivers?

Organization of this Study

This study is organized in to five chapters,

Chapter I deal with Introduction, explaining the road safety and driver behavior scenario - nationally and internationally - along with theoretical perspectives and the significance of this study and its research questions.

Chapter II reviews the literature including similar studies on personality and attitude, and its relations with dangerous driver behavior, speeding, and violation behavior.

Chapter III deals with research methodology, highlighting the hypotheses, research design, sampling techniques, research instruments, method of data collection and statistical techniques employed in this study.

Chapter IV covers Analysis of Results, Discussion, and hypotheses with appropriate statistical techniques.

Chapter V highlights the summary and conclusions including the limitations and implications of this study.

Chapter II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The previous chapter presented the existing road safety conditions and the different psychological factors affecting on-road driver behavior and the theoretical background of the study. The concept of road safety and on-road driver behavior has gained prime importance lately primarily because of the loss of lives and the repercussions thereof. In this chapter the available literature relating to the nature and extent of dangerous driving, speeding behavior and driver's violation behavior of traffic rules is offered.

The following chapter reviews the available literature relating to the nature and extent of dangerous driving, speeding behavior and driver's violation behavior of traffic rules. Interaction of demographic variables like age, experience and education of drivers on driving behaviors is also reviewed critically. Examining relationships between and among personality, attitudes, dangerous driving, speeding and violation behavior can open up the possibility of early identification of those factors, which are more likely to cause accidents, and help formulate counter measures.

This chapter presents the existing literature in five sections highlighting various aspects of road safety and psychological factors influencing on-road behavior of drivers.

Section I presents the international observations on traffic injury prevention and the importance of on-road driver behavior.

Section II presents the findings from studies relating to psychological factors influencing violation behavior of traffic rules.

Section III details the effect of driver characteristics and individual factor influences on dangerous driving.

Section IV presents the lacunae of current research studies and the key objectives of the present investigation.

The objective of this study is to identify determinants of dangerous driver behavior leading to accidents with an aim to develop effective countermeasures to prevent accidents. This chapter also consolidates the available research evidence and identifies the gaps in current knowledge relating to driving behavior that causes serious road safety problems.

Section I: World Report on Road Traffic Injury Prevention

WHO in the World Report on Road Traffic Injury Prevention (2004) reported that road traffic injuries are a major but neglected public health challenge that requires concerted efforts for effective and sustainable prevention. Of all the systems with which people have to deal every day, road traffic systems are the most complex and the most dangerous. Worldwide, an estimated 1.2 million people are killed in road crashes each year and as many as 50 million are injured. Projections indicate that these figures will increase by about 65% over the next 20 years unless there is more commitment to take effective measures for prevention. Nevertheless, the tragedy behind these figures attracts less mass media attention than other, less frequent types of tragedy (Peden *et al*., 2004).

Every day around the world, more than 3000 people die from road traffic injury. Low-income and middle-income countries account for about 85% of the deaths and about 90% of the annual disability adjusted life years (DALYs) are lost because of road traffic injuries. Projections showed that, between 2000 and 2020, road traffic deaths would

decline by about 30% in high-income countries but increase substantially in low-income and middle-income countries (Peden *et al*., 2004). Without appropriate action, by 2020, road traffic injuries are predicted to be the third leading contributor to the global burden of death and injury.

The economic cost of road crashes and injuries is estimated to be 1% of gross national product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries. The global cost is estimated to be US $ 518 billion per year. Low-income and middle-income countries account for US $ 65 billion, more than what they receive in development assistance (Peden *et al*., 2004). Many highly-motorized countries, in response to rising road trauma levels during the 1960s and early 1970s, achieved large reductions in casualties through outcome-oriented and scientific approaches (Peden *et al*., 2004).

Global Status Report on Road Safety

This is the first broad assessment of the status of road safety in 178 countries using data drawn from a standardized survey conducted in 2008. The WHO's Global Status Report on Road Safety (2009) states that over 90% of the world's fatalities on the roads occur in low and middle-income countries, although these countries only have about 48% of the world's registered vehicles. The WHO (2009) anticipates that unless immediate action is taken, the number of people dying annually in road traffic crashes may rise to 2.4 million over the next 15 years. The increase will probably entirely occur in low and middle-income countries and road traffic injuries will become one of the three major causes of death there. Globally, road traffic injuries are already among the three major causes of death for the age group 5 to 44 years.

Significance of Research on Driver Behavior

Considerable human and economic cost incurred in traffic accidents highlights the need for research in to driving behavior (Holland, Geraghty & Shah, 2010). Rakauskas and Ward (2007) examined methods of identifying and measuring the relevant psychosocial factors that influence driver attitudes with the goal of developing a model to change driver attitudes, thereby reducing risky driving behaviors and increasing acceptance of safety interventions. Casualties due to traffic accidents; which occur only one or two at a time attract less attention than other less frequent types of natural or unnatural disasters. Road accidents can easily be called a silent disaster and a national mission is needed to mitigate the menace of this socio-technical problem, just as any other epidemic requires. They are a menace with complex causes and, therefore, a very professional comprehensive approach is needed to combat those (Sikdar & Bhavsar, 2009).

Speeding

Speed is at the core of the road safety problem. Very strong relationships have been established between speed and both crash risk and crash severity (Aarts & vanSchagen, 2006; Elvik *et al*., 2004). Excessive driving speed for the existing road conditions is considered as one of the most important contributors to road crashes, regardless of the driver's age and level of skill (Elliott *et al*., 2004). Even when aware of the potential consequences for speeding, drivers in Australia still indicate involvement in speeding behavior (Brown & Cotton, 2003). Clarke *et al*. (2002) also suggested that speed is the most common factor causing driving offence among young drivers. West and Hall (1997) found that speed is a significant contributor to specific kinds of crashes such as active shunts, right of way violations, active reversing, and loss of control crashes

along with both poor attitudes towards driving and social deviance. McKenna and Horswill (2006) suggested that involvement in speeding behavior may also be due to a low probability of negative outcome.

The consequences of speeding in terms of increasing both the risk and severity of a crash are well documented. For instance, the report of New South Wales Centre for Road Safety (2008) shows that in 2007, speeding in New South Wales was a contributory factor in 32 percent of fatal crashes and 16 percent of all crashes resulting in injuries. Despite this, many motorists still do not consider speeding to be dangerous (Lieb & Wiseman, 2001) with the majority of drivers admitting to exceeding the speed limit at least occasionally by 10 kmph or more (Fleiter & Watson, 2005).

Speed and crash rate

Nilsson (2000) suggested that the ratio of change in accident rate is proportional to the ratio of change in mean speed raised to a power, which depends on the consequence of the accident; injured, severely injured or killed. As a result of this, a decrease in mean speed results in a decrease in accidents of all types of consequences. Aarts and vanSchagen (2006) reported that there is a link between speed and crash rate which not only affects the severity of crashes, but also increases the risk of being involved in a crash. If drivers drive 10–15% above the speed of surrounding traffic, they are much more likely to have an accident (Taylor *et al*., 2000). It is fairly clear that there is a straightforward relationship between speed and crash involvement (Aarts & vanSchagen, 2006; Finch *et al*., 1994; Richter *et al*., 2006). It would appear, therefore, that public safety would benefit from measures that reduce speed. Clearly, then, the enforcement of speed limits would naturally be a significant part of the process of reducing speed.

In England and Wales the primary method by which this enforcement is achieved is through automated safety cameras. In fact, 91% of speeding offences are detected through cameras (Fiti & Murry, 2006). While cameras are effective in reducing speed and crash involvement (Gains *et al*., 2005; Hirst *et al*., 2005), they have received considerable adverse publicity in the media.

Greaves and Ellison (2010) showed that overall twenty percent of the moving distance travelled was above the posted speed limit, with a small but significant number of drivers regularly travelling more than 10 kmph above the speed limit. Exploratory analysis showed that speeding is more prevalent in high (100-110 kmph) and low (40-50 kmph) speed zones, and tends to be higher on weekday mornings and weekend nights. Overall, males speed more than females but there are only marginal differences as far as age is considered. Speeding is more prevalent on weekends than weekdays but weekday speeding is higher in the mornings whilst weekend speeding is higher at night. (Ogle, 2005; Wundersitz *et al*., 2009)

Davey, Freeman and Wishart (2006) reported that drivers were more likely to report engaging in speeding behaviors and believed speeding was more acceptable compared to drunken driving, following too closely or engaging in risky overtaking maneuvers. The results indicated that speeding is the most common form of aberrant behavior reported about the fleet drivers which is similar to previous research on professional drivers (Newnam *et al*., 2004; Sullman *et al*., 2002; Davey *et al*., 2006). While analyzing gender and speeding Stradling (2000) observed that, females appear to sharply reduce their driving speed, in their 20s, and then maintain this reduced speed with increasing age. Males, however, do not appear to reduce their 'normal' driving speed until

their 30s, but still sustain higher speeds than their age-equivalent females. Stradling (2000) also noted that older drivers were less likely to have been penalized for speeding; the highest speeding offenders were aged between 21 and 40, whereas the lowest were for those drivers aged 60 and above. Additionally, Dave, Becki & Steve (2001) reported that the likelihood of having broken the speed limit was highest in the 20 to 24 year-old age group, and that this steadily declined with increasing age thereafter.

Wasielewski (1984) found that drivers aged 20 years and under had the highest observed speeds. Shinar *et al*. (2001) noted that the number of people who reported that they observe the speed limit all the time increased with age, also finding that the tendency to speed decreases with increasing age. Finn *et al*. (1985) further found that younger drivers perceived speeding to be less dangerous than experienced drivers, indicating the younger driver's tend to have greater likelihood to speed. Additionally, French *et al*. (1992) and Parker *et al*. (1992) observed that faster and more deviant driving styles were associated with male and young drivers. Such findings therefore corroborate the association between age and faster average driving speed. Parker *et al*. (1992) reported that younger drivers endorsed speeding and dangerous overtaking more strongly than did older drivers.

Goldenbeld and vanSchagen (2007) observed that the preferred speed of young car drivers (18–25 year-old) was significantly higher than that of older car drivers (40–55 and 56+ year old). At the same time, the preferred speed of 40–55 year old drivers was significantly higher than that of the group who were above 55 years. With regard to safe speed limits, the two youngest age groups differed significantly from the oldest age group with the latter group considering lower speed limits to be safe.

Attitude to Speeding

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". Vanlaar, Simpson and Robertson (2008) reported that the perception of the level of risk associated with certain dangerous driving behaviors – speeding excessively, using a cell phone while driving, distracted driving and using illegal drugs while driving – was found to be high enough to cause concern. Someone who believes these behaviors are risky is more likely to be concerned about them.

Warner and Aberg (2006) examined the application of theory of planned behavior to predict driver's everyday speeding behavior and reported that attitude towards speeding, subjective norm, and perceived behavioral control were significant determinants of self-reported speeding. A majority of studies conducted on speeding behavior have been based on self-reported behavior (Forward, 1997; Parker *et al*., 1992; Straddling and Parker, 1997), but several studies based on measurements of speed under restricted conditions have also been conducted (Aberg, 1997; Vogel & Rothengatter, 1984).

According to Haglund and Aberg (2000) the relationship between self-reported speed and actual speed is strong ($r = 0.58$), reaffirming the theory of planned behavior which is shown to afford a level of prediction of drivers' self-reported speeding as well as of their logged speeding.

Warner and Aberg (2006) found that specific attitude to speeding ("how acceptable is it for you personally to exceed different speed limits" in both urban and rural environments), subjective norm and perceived behavioral control significantly predicted self-reported speeding.

Flieter and Watson (2006) found that approximately 67% of participants reported that speeding is both not OK and not worth the risk, and that these attitudes were also significant predictors of self-reported speeding behavior.

Trantera and Warnb (2008) indicated a significant relationship between gender, age, interest in motor sport, attitudes to speeding and speeding violations. Interest in motor sport had a significant but indirect relationship (mediated through pro-speed attitudes) on speeding violations. Road safety interventions for both sexes need to continue to target attitudes to speeding, and to change the belief that experienced drivers can 'speed safely'.

Davey *et al*. (2006) found that those who engaged in Highway Code violations such as speeding were also more likely to exhibit aggressive acts while driving. Further, the participants who agreed with the seriousness of the specified aberrant driving behaviors were less likely to report engaging in such behaviors over the past six months, which provide evidence that specific driving behaviors and attitudes that have direct links to crash involvement can be identified.

Several studies have illustrated the importance of investigating drivers' attitudes and beliefs in relation to risky driving (Parker *et al*., 1995; Prabhakar *et al*., 1996; Ulleberg & Rundmo, 2002). For example, in a longitudinal study examining self-reported risky driving and traffic safety attitudes, Iversen (2004) found that drivers with more positive attitudes toward rule violations and speeding were more frequently observed to engage in risky driving behavior.

McKenna (2007) found that there was a highly significant positive change in attitudes following the intervention of speed awareness programs. There was a highly significant gender effect indicating that women had a more negative attitude towards speeding.

Among the most significant of these variables influencing drivers' attitudes to speeding, driving violations and accident involvement are age, gender and sensation seeking propensity (Dobson *et al*., 1999; Jonah *et al*., 2001; Laapotti & Keskinen, 2004; Turner and McClure, 2003). There are also important environmental influences on attitudes to speeding and driving behavior, including the influence of alcohol and peer pressure (Elliot *et al*., 2004).

Elliot *et al*. (2004) provided strong support for the Theory of Planned Behavior (TPB) indicating that attitudes, subjective norms and perceived behavioral control were each statistically significant independent predictor of intentions, and together accounted for 54% of the variance. In turn, intentions and perceived behavioral control together accounted for 67% of the variance in self-reported speeding behavior and each was a statistically significant independent predictor.

Trantera and Warnb (2008) reported that the level of interest in motor racing is significantly related to attitudes towards speeding, controlling for age, education level and sensation seeking propensity. Higher levels of interest in motor racing are associated with higher pro-speeding attitudes. Unlike the previous research on young male drivers, there was no significant relationship established between interest in motor racing and speeding violations for this study on mature drivers. Further, the analyses indicated a significant relationship between gender, age, interest in motor sport, attitudes to speeding and speeding violations. The same trend noticed among the mature drivers, as there is an association between interest in motor racing and attitudes to speeding (Trantera & Warnb, 2008).

Watson *et al*. (2007) found that riders appeared to hold positive attitudes to riskier behaviors. Many of the crashes described by these riders appeared to be directly related to their higher risk riding style.

Fildes, Rumbold and Leening (1991) reported that a surprisingly high number of motorists (28%) who tend to believe that exceeding the speed limit by 30 kmph were not dangerous, regardless of whether they reported driving regularly above or below the posted speed limit. Together, these results suggested that while speeding is recognized as a significant contributor to crashes, the actions of many road users indicate that they remain unconvinced, undeterred, or perhaps, that they perceive speeding as acceptable until it reaches a certain threshold.

Rundmo and Iversen (2004) found that attitudes to speeding were not only related to age and gender, but also to risk taking behavior in traffic and involvement in near accidents and accidents. Warner and Aberg (2006) also identified a link between attitudes to speeding and accident involvement.

Iversen (2004) investigated whether attitudes toward traffic safety issues are predictors for future risk behavior in traffic. Results of his research show a high correlation between the dimensions of attitudes and behaviors at the two data collection points. Iversen's model had three exogenous latent variables (1-attitude toward rule violations and speeding, 2- attitude toward the careless driving of others, 3- attitude toward drinking and driving) and an endogenous latent variable; risky driving behavior.

Hatfield and Job (2006) found stronger support for the association between compulsory fitting of speed governors for serious speeding offenders and lower self-

reported speeding likelihood. This may indicate that people with negative attitudes toward speeding are both less likely to do it, and more likely to support heavy penalties for those who do it.

The most recent Australian Transport Safety Bureau's (ATSB) Community Attitudes to Road Safety survey (2004) revealed that speed is still the most frequently cited contributing factor to crashes. Overall, 59% of respondents named it as one of the three main causal factors, and 39% identified it as the primary contributor to road crashes (Pennay, 2005). Further, 96% agreed that an accident at 70 kmph would be more severe than one at 60 kmph (Pennay, 2005). This level of agreement has increased steadily over the past decade from 80% in 1985. This clearly shows a growing recognition of the risks associated with speeding among the community.

Forward (2009) examined two different driving violations by applying the Theory of Planned Behavior and reported that attitudes comprised the largest contribution for driving violations, which is contrary to the findings of Warner and Åberg (2008) and Parker *et al*. (1992) who either found subjective norms or perceived behavioral control to be the most important component.

Speeding Behavior and Dangerous Driving Behavior

Using factor analysis Golias and Karlaftis (2002) revealed that speeding behavior is strongly related to other dangerous driving behavior. The results seem to imply that drivers who speed also tend to drive more dangerously (and vice-versa), while drivers who report driving under the influence of alcohol do not use seat belts.

Dangerous Driving

According to Dula and Geller (2004) driving behaviors that endanger or have the potential to endanger others should be considered as lying on a behavioral spectrum of dangerous driving. Three dimensions of dangerous driving are delineated: (a) intentional acts of aggression toward others, (b) negative emotions experienced while driving, and (c) risk-taking, using Dula Dangerous Driving Index (DDDI). The DDDI measures the likelihood to drive dangerously, consistent with the aggressive driving, negative cognitive/emotional driving, and risky driving aspects.

Dangerous driving includes a broad variety of behaviors, which are often identified as aggressive driving such as showing annoyance towards slow drivers (aggressive intention), and enhancing high and intense sensations (risk-taking motivation).

Furthermore, negative emotional driving is related to irritability, anger while driving, and a tendency to become annoyed with other drivers. However, this emotional state does not necessarily translate into aggression (Galovski *et al*., 2006). Risky driving, on the other hand, denotes a careless style of driving and can be defined as deliberate on-road risk taking not intended to harm other drivers.

Indeed, in contrast to aggressive driving, risky driving has been shown to be positively related with self-regulation tendencies aimed at escaping self-awareness and reducing tension, or in order to compensate for low self-esteem or to maintain a particular self-image (Richer *et al*., 2007). Risky driving behavior may include self-assertive driving, speeding, and rule violations. Many researchers (Aarts & vanSchagen, 2006; Lam, 2003 Jonah, 1997) have studied speeding as a risky driving behavior.

Drunken Driving

Dula (2003) reported that the covariance between risky driving, negative cognitive/emotional driving and aggressive driving on the one hand, and drunken driving on the other hand appeared to be only moderate. Intoxicated driving is a form of dangerous driving behavior that can be distinguished from other risky behaviors, such as speeding, illegal passing, obstructing traffic, aggressive driving, etc. The validity of this statement was confirmed by the fact that drivers convicted for drunk driving scored highest on the drunken driving subscale, but lower on the other dangerous driving subscales.

Section II: Violation Behavior of Traffic Rules

Yilmaz and Çelik (2006) found that violation of traffic rules was the strongest predictor for risk taking behavior as there are significant negative causal relationships between obedience to speed rules and risky driver attitudes, which reaffirms the proposition, "The more obedience to speed rules, the fewer risky driver attitudes."

Applying the model of Theory of Planned Behavior, Wickens, Toplak and Wiesenthal (2008) reported that attitudes, normative beliefs and control beliefs predict violation behavior. The Theory of Planned Behavior, which incorporates both social and personal factors, has therefore been applied to understand and predict this behavior. Drivers usually find speeding behavior as acceptable although this is also related to the context since speeding on a major road is more acceptable than on a minor one. Violators were aware of negative consequences but did not really believe that it would happen to them.

Bener *et al*. (2008) investigated the factor structure of the DBQ and examined the relationships between the factors of the DBQ and accident involvement, and finally to compare DBQ scores between the two gulf countries: Qatar and the United Arab Emirates.

Logistic regression analyses showed that errors, lapses, and aggression-speeding violations predicted accident involvement in Qatar but not in UAE after controlling the effect of the demographic variables such as age, sex, and annual mileage.

Jonah (1997) reported several studies finding a weak relationship between the personality trait of sensation seeking and involvement in traffic accidents, but a relatively strong relationship between this personality trait and the propensity to commit driving violations.

Forward's (2009) study was to assess the effect of more traditional variables used to explain driving violations, namely age, sex and annual mileage. The results showed that age and mileage added to the prediction of speeding in an urban area. This would then indicate that young people are more likely to violate traffic laws, this is something, which is in agreement with a large number of studies (Deery, 1999; Parker *et al*., 1992; Yagil, 1998). The significant contribution of mileage indicated that drivers who used the car on a regular basis are more likely to violate traffic laws. This would confirm the evidence presented by Lawton and others (1997) where violations are related to a higher mileage. Studies have shown that young people believe that violations of norms impress their friends (Rothe, 1992) and that for young men risky driving has become part of establishing their gender identity. In addition to this, Taubman-Ben-Ari and others (1999) found that young men use the car to increase their self-confidence. Thus, violations have become very alluring. This is a trend, which would need to be broken, and its symbolic interpretations need to be deconstructed.

Violations and Crash Involvement

Research stations reported associations between major deviations (both slower and faster) from the average traffic speed and an increase in crash risk (Parker *et al*., 1992). Speeding is not only a common violation; many also regard it with a degree of tolerance. It is rather the propensity to violate; deliberate infringements, than the tendency to make errors of intention or action while driving, which is associated with involvement in accidents (Parker *et al*., 1995 a; Parker, Stradling and Manstead, 1996). However, high scores on the error and lapse factor were found to be predictive of involvement in active accidents among elderly people, while passive accidents was associated with high scores on the lapse factor (Parker *et al*., 2000). Considering these results, we can expect that drivers who have a high score on self-reported risky driving will be more frequently involved in traffic accidents than other respondents.

Malfetti and others (1989), who conducted an extensive work regarding adolescents' risk-taking attitudes related to driving reported that attitudes towards rule violations and belief in accident causation to be significant predictors of risk-taking behavior in traffic.

Errors and violations in traffic may influence accident involvement differently. Based on a review of several studies of the effect of individual differences in road accident risk, Elander West and French (1993) concluded that driving styles (violations) such as fast driving and willingness to commit driving violations could be explained by motivational factors such as personality, anti-social motivation, existing norms, and driving related attitudes. It has also been shown that private car drivers' accident involvement can be predicted by self-reported tendency to commit violations (Gras *et al*., 2006; Özkan & Lajunen, 2005; Parker, Reason *et al*. 1995; Parker *et al*., 1995; Rimmö & Åberg, 1999),

aggressive violations (Özkan, Lajunen, Chliaoutakis *et al*., 2006,) or highway code violations (Kontogiannis *et al*., 2002). In addition, Mesken *et al*. (2002) found that drivers' involvement in passive accidents (where a vehicle hits them) correlated with the drivers' self-reported tendency to commit interpersonal violations.

Lawton *et al*. (1997) and Meadows *et al*. (1998) reported that there is a significant relationship between social deviance and violations suggesting that violating behavior is one way in which social deviance expressed whilst driving. The relationship between violations and crash involvement also been researched, showing that those with a tendency to commit violations tend to be involved in more traffic accidents (Rothengatter, 2000; Lawton *et al*., 1997; Parker *et al*., 1995 a, 1995 b). Parker *et al*. (1995 a, 1995 b) found that violations, i.e. behaviors that involve deliberate deviations from safe driving practice, correlated with both past (Parker *et al*., 1995 a) and future (Parker *et al*., 1995 b) accident rates. Lawton *et al*. (1997) corroborated this by reporting that violation score was a significant predictor of accident rate in their study. Rothengatter (2000) further supported this association by noting that those drivers who regularly committed traffic violations were more involved in road crashes than were other drivers.

Meadows *et al*. (1998) found that both the propensity to commit driving violations and extreme social deviance predicted accident involvement. However, the relationship between extreme social deviance and accident involvement was partly mediated by a tendency to commit driving violations.

Horsthuis *et al*. (2011) demonstrated that psychological factors are better predictors of risky driving behavior than age and gender. Self-efficacy and subjective

norms are the most dominant predictors concerning violations. Concerning dangerous errors, subjective norm and self-efficacy are the most powerful predictors. Self-efficacy is the best predictor as far as inadequate attention and lapses are concerned.

deWinter and Dodou (2010) found that violations and errors predicted accidents significantly. The meta-analysis also showed that errors and violations correlated negatively with age and positively with exposure, and that males reported fewer errors and more violations than females. Supplementary analyses have conducted focusing on the moderating role of age, and on predicting accidents prospectively and retrospectively. The present meta-analysis synthesized the available information and showed that both Driver Behavior Questionnaire (DBQ) errors and violations are significant predictors of self-reported accidents.

Watson *et al*. (2007) examined psychological and social factors influencing motorcycle rider intentions and behavior and reported many riders endorse riding at excessive speeds was 'safe' provided it was done at the right time and place. In addition, several riders reported to have crashed as they were going too fast to deal with an unexpected event.

While examining the independent and combined roles of three personality traits--sensation seeking, conscientiousness, and anger/hostility--in predicting risky driving behavior, Schwebel *et al*. (2006) found that each facet of personality has correlated to risky driving behavior in independent univariate analyses. In multivariate analyses, sensation seeking emerged as the best predictor of self-reported driving violations.

Section III: Personality, Aggression and Violations

Vassallo *et al*. (2007) utilized longitudinal data of the psychosocial development of young people and indicated that high levels of antisocial behavior and aggression, and

low levels of empathy were precursors to young drivers' involvement in risky driving and speeding violations. Low levels of anxiety were also associated with involvement in speeding violations.

A wide range of individual difference variables in the driver influences safe management of a motor vehicle. One set of traits long recognized as relevant to predicting dangerous driver behaviors is the driver's personality (Tillmann and Hobbs, 1949; Fine, 1963; Arthur *et al*., 1991). Machin and Sankey (2008) have shown that the key personality factors have an important influence on both risk perceptions and driving behavior. Adrain and Patric (1999) reported that there appears to be sufficient evidence that personality variables do relate to all kind of accidents in all kind of populations. The two orthogonal factors that appear to be the best predictors of accidents are clearly extraversions / sensation seeking / A-type behavior, and neuroticism / anxiety / instability.

Sommer *et al*. (2008) investigated the utility of combining the personality traits variables in the prediction of safe driving behavior and reported that the relationship between fitness to drive, driving-related ability and personality traits do not necessarily need to be linear. This conclusion is supported by the superiority of the result obtained with artificial neural networks compared to classical multivariate methods.

Personality Traits, Accident Involvement and Driving Behavior

The role of personality traits in traffic accidents has been central in explanations that emphasize accident proneness (Farmer & Chambers, 1939; Tillman & Hobbs, 1949). Wide range of studies has reported that though personality traits are likely to be weak,

they are consistently associated with accident involvement in traffic (Beirness, 1993). There is, however, reason to believe that the role of personality traits pertaining to accident involvement in traffic may be underestimated.

Muhammad and Mati-ur-Rehman (2007) analyzed driver's personality traits and driving style while driving at T-Intersections and reported that the diversity in the drivers' behavior is due to their personal traits such as LOC, tolerance to uncertainty etc.

Ho and Gee (2008) explored the primary motives underlying dangerous driving among young males. Moreover, they found that the decision by young males to engage in risky driving is a joint function of their desire to drive fast and to take risks, an inflated sense of confidence in their driving ability, and a negative attitude; disrespect, towards traffic laws. The overall findings fit well with the growing body of literature that characterizes those who are at greatest driver risk to be: high risk takers, sensation seekers, overconfident in their driving ability, low in danger perception, show disrespect towards traffic laws, and males.

Personality and Speeding

Svensson and Trygg (1994) investigated the relationship between traffic accidents and personality patterns, focusing particularly on professional drivers. In addition, they discovered that there is a clear connection between certain personality factors and both accident frequency and professional adaptation, and are subsequently able to predict the accident frequency of individual drivers with relatively high accuracy, solely based on the results of the personality test used. The link between personality traits and speeding has attracted the attention of many researchers as being a more definitive indicator of speeding.

Several researchers have shown that the 'sensation seeking' propensity of drivers is highly correlated with risky behaviors such as speeding (Jonah *et al*., 2001, Greaves & Greaves & Ellison, 2010). Others have focused on the 'classic' personality types, demonstrating Type A personalities are more likely to speed (Tay *et al*., 2003). Conversely, characteristics such as altruism and aversion to taking risks have been shown to be negatively correlated with speeding (Machin & Sankey, 2008; Greaves & Ellison, 2010).

Machin and Sankey (2008) have shown that personality factors tend to have an important influence on both risk perceptions and driving behavior. Using Structural Equation Modeling as a means of assessing the overall fit of each model, 39% of the variance in young drivers' speeding is found to be accounted for by excitement-seeking, altruism, their aversion to risk taking, and their own likelihood of having an accident, with altruism and aversion to risk taking both showing moderate negative relationships.

Machin and Sankey (2008) explored effects of personality variables on driving behaviors of young drivers and reported that speeding has correlated with four of the personality variables such as anger, excitement seeking, altruism and normlessness. Further, excitement seeking and altruism are significant unique predictors accounting for 2% and 3% of the variance, respectively.

Aggression in Driving

Beck *et al*. (2006) reported that people who admit to being aggressive drivers (at least within the last month) were less likely to be concerned about speeding and aggressive driving than people who did not admit to these activities. Aggressive drivers differed from non-aggressive drivers on dispositional traits. As expected, they reported being more frustrated and hurried when they drive and were less calm and courteous than non-aggressive drivers.

Arthur and Doverspike (2001) have found that crashes significantly correlated with the five-factor model of personality; suggesting that further research is required to uncover the role of the personality factors in engaging in risky driving behavior. Recent research suggested that there exists, a sub group of aggressive adolescent drivers who are significantly at a high risk of engaging in risky driving behavior (Ulleberg, 2001).

Gulliver and Begg (2007) examined the relationships between personality measured in late adolescence and persistent risky driving behaviors between 18 and 26 years of males and reported that aggression, traditionalism, and alienation were the personality factors most frequently associated with risky driving behavior and crash risk. After adjusting for driving exposure, only high levels of aggression predicted a driver being involved in a crash, and alienation predicted a driver involved in an injury crash.

` Beck *et al*. (2006) investigated beliefs, driving personality dispositions, and behaviors that distinguish self-defined aggressive drivers from non-aggressive drivers. He reported that aggressive drivers were more likely to be male and aged 45 and under. Further, compared to non-aggressive drivers, aggressive drivers were more likely to report that they had: used a cell phone while driving, driven while drowsy, had an encounter with an aggressive driver, been ticketed or booked for a traffic offence etc. Aggressive drivers were less likely to report using their seat belt (88.5% vs 97.7%), but more likely to report driving a car every day (89.2% vs 79.3%). Furthermore, in a longitudinal interview study, Begg and Langley (2004) found that aggressive behavior at 18 years of age significantly predicted subsequent self-reported speeding.

Comparing hostile aggressive drivers with normal drivers O'Brien (2011) reported that hostile aggressive drivers tend to have higher levels of trait aggression than

'other' general road users. Further, the results suggest that in response to particular on-road situations the hostile aggressive driver tends to interpret 'other driver' behavior as threatening, aggressive or antagonistic. They would appear to be more likely to experience stronger negative emotions, more negative attributions together with thoughts of taking action against the 'other driver'.

Risky Driving and Driver Anger

Anger and hostility are constructs measured both as stable emotional patterns and as transient dispositional states. Whether considered as states or traits, the tendency toward hostile, frustrated, and angry behavior found repeatedly linked to risky driving (Deffenbacher *et al*., 2001, 2002; Iversen & Rundmo, 2002). The link appears robust and reported in large representative community samples (Iversen & Rundmo, 2002) as well as samples of college students (Deffenbacher *et al*., 2001, 2002). For example, in a study of over 2500 randomly sampled Norwegian drivers, Iversen & Rundmo (2002) reported a significant correlation between a brief self-report measure of risky driving and the short form of the driver anger scale (Deffenbacher *et al*., 1994).

Deffenbacher (2009) reported that while driving, high anger drivers experience more anger triggers, frequent and intense anger, hostile thinking, aggression, risky behavior, and some crash-related conditions than low anger drivers do. These findings supported state-trait theory hypotheses and show that drivers with a high level of anger are at risk. Drivers who have a high level of anger are angered by more things on the road, are more frequently and intensely angered. They think and express their anger in more hostile/ aggressive ways, engage in more aggressive and risky behaviors, are at risk for more anger- and crash-related outcomes, and possess other psychological characteristics

that interact negatively with, and may exacerbate, problems with driving anger. They are a risk to themselves and potentially to those who ride or share the road with them. Anger and aggression while driving decrease with age. If groups differed on age, then age effects could confound the findings.

Propensity to Become Angry

Anger-prone drivers have reported driving at faster speeds and with less speed limit compliance (Deffenbacher *et al*., 2002; Sullman, 2006) as well as more near accidents, less concentration and reduced vehicular control while driving (Deffenbacher *et al*., 2001, 2002). However, when the simulator-based behaviors of high and low level anger experiencing drivers are contrasted, a relationship between trait propensities and behaviors has not always found.

Ellison-Potter, Bell and Deffenbacher (2001) reported that driving anger propensities did not influence overall driver speed choice, behavior at traffic light signals nor likelihood of collisions.

Deffenbacher, Lynch and Richards (2003) found that drivers with high trait anger drove in a more dangerous manner, maintaining shorter time headways and driving faster than low trait anger drivers in non-provoking traffic situations and being twice more likely to have collisions. Thus, although anger-prone drivers were more likely to report dangerous behaviors, the influence of trait driving anger on driving performance was most apparent when considered in specific situations (i.e. high and low impediment) and not coalesced across an entire drive.

Brookings *et al*. (2008) reported that propensity to aggression and self-control correlated significantly with angry driving among undergraduate students.

Amanda *et al*. (2009) found that anger-prone drivers tend to have higher ratings of anger and frustration, but their evaluations and anger tendencies were unrelated to their general driving behaviors. While comparing driving behaviors in high and low anger-provoking situations, the drivers who are higher in trait anger reported to have more anger and frustration and also drove faster and with more sideward movement even in low anger provoking situations. When driving situations are considered separately, behavior and evaluations have been found to be related, when forced to move sideward, drivers reported more frustration; when forced to drive more slowly, they reported more anger, and subsequently increased acceleration, throttle pressure and steering wheel use.

These relationships are not moderated by trait anger. Drivers become angry when impeded, or in other anger-provoking situations, irrespective of trait anger. Only drivers with high trait anger become angry and behave aggressively in circumstances most would not consider provocative. This finding corresponds to that of Mesken *et al*. (2007) who collected data in real traffic conditions.

Mesken *et al*. (2007) reported that, drivers who tend to have anger drove faster and exceeded the posted speed limit more often, but this only occurred in high-speed zones (100 kmph). Considering these studies, one can conclude that an angry driver is more likely to pose a threat to other road users due to lower compliance with speed limits and tendencies to drive faster than any other sort of drivers. In previous studies, feeling angry while driving has related to poorer driving performance. Drivers recall driving faster when angrier (Arnett, Offer & Fine, 1997; Gidron, Gal & Desevilya, 2003) and have reported more erratic speeds and uncooperative behaviors (Deffenbacher *et al*., 2002).

Leal & Pachana (2009) have shown that the propensity for angry driving (PAD) was correlated with behavioral measures, such as yelling at other drivers, gesturing at other drivers, and feeling angry but not doing anything. Aus-PADS scores reliably predicted the frequency of these behaviors over and above other study variables. However, no significant relationship between aggressive driving and crash involvement has been observed.

Dahlen and Ragan (2004) examined the validity of the Propensity for Angry Driving Scale (PADS) and reported that it predicted speeding tickets, minor accidents, aggressive driving, risky driving, and maladaptive driving, anger expression; beyond gender, miles driven per week, and trait anger. These findings suggested that PADS is a useful predictor of aggressive driving and has some advantages over the DAS.

Hostility

Among the various psychological factors investigated in relation to motor vehicle accidents, one particular factor, namely, road-hostility, road anger or road aggression, has received an increasing amount of attention in recent years (Hemenway & Solnick, 1993; Lajunen & Parker, 2001; Lowenstine, 1997; Underwood *et al*., 1999).

Road hostility is found to be related to dangerous driving behavior (Hemenway & Solnick, 1993). Deery and Fildes (1999) found that those young drivers who possess trait hostility tend to exhibit limited driving-skills in a simulation study.

Norris, Matthews and Riad (2000) found that trait hostility was among the best predictor of motor vehicle accident in a prospective study that included drivers between the ages of 19 and 88. A few studies have found that traffic density and congestion play roles in anger and aggressive driving (Parker *et al*., 2002; Underwood *et al*., 1999).

Furthermore, the relationship between anger while driving and ‘‘near accidents’’ was found to be dependent on drivers’ perception of whether they were the cause or the victim in the situation (Underwood *et al*., 1999). It is possible that, certain personality variables will interact with or moderate the effects of road-hostility leading to dangerous driving behavior (DDB).

While examining the combined roles of three personality traits – sensation seeking, conscientiousness, and anger/hostility – in predicting risky driving behavior, Schwebel *et al*. (2006) found that each facet of personality is correlated to risky driving behavior. In multivariate analyses, sensation seeking emerged as the best predictor of self-reported driving violations**.**

Tsuang *et al*. (1985) observed that those involved in crashes generally displayed less control of hostility and anger. In addition, Pelz and Schuman (1968), and Schuman *et al*. (1967) found that young drivers charged with several accidents and violations displayed more physical aggressive tendencies than those with no history of accidents or violations; whilst Underwood *et al*. (1999) also found a link between anger and subsequent near accidents.

Norris *et al*. (2000) investigated the characterological risk factors for motor vehicle accidents (MVAs) and found that high hostility, in combination with poor self-esteem, was one predictors of future MVAs. The authors found that the drivers with this combination of characteristics were strikingly more likely to be in an accident than drivers who had neither characteristic.

Lancaster and Ward (2002) found aggressive drivers, or those with a reduced capacity to manage or control hostility, tend to involve in more traffic accidents. Minor

accident involvement was associated with more aggression and tension. Higher anger / hostility scores were associated with drunken driving. The majority of aggressive drivers were poorly educated.

Type A Behavior Pattern

The type A Behavior Pattern (TABP), characterized by impatience, time urgency, and hostility, is originally developed in relation to coronary heart disease. Since 1986, there has been a debate on whether the TABP is also associated with risky driving behaviors leading to increased risks in road traffic accidents (RTAs). Drivers with Type A personality were found to have higher rates of traffic violations crashes, take more risks, drive more erratically and reported higher incidents of aggressive driving and speeding. These drivers typically have a strong need to reach their points of destinations quickly and to get ahead of others in the traffic flow. (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987; West *et al*., 1993; Perry *et al*., 2000).

Tay, Champness and Watson (2003) examined the influence of sensation seeking and Type A behavior pattern on speeding behavior and reported that self-reported speeding behaviors were positively correlated with both personality traits. Consistent with previous studies, this study found both sensation seeking and Type A behavior pattern positively correlated with self-reported speeding behavior. Furthermore, this study found that the linear association was only slightly stronger for the sensation-seeking driver than for those with Type-A behavior pattern.

Decker and Lester (1990) reported that there is no significant association between Type A personality and self-reported poor driving habits among college students, this was contrary to the expectation.

Nabi *et al*., (2005) examined prospectively the relationship among risky driving behaviors, serious RTAs (road traffic accidents), and the TABP among 20,000 French employees of Électricité de France – Gaz de France and reported that after adjustment for potential confounders, the risk for serious road traffic accidents increased proportionally with TABP scores. The authors concluded that type A drivers had an increased risk of RTAs. However, several studies have demonstrated the relatively long-term stability of the TABP**,** therefore, it seems reasonable to assume that the TABP remained constant during the period covered by the study.

Perry and Baldwin (2000) examined the effects of Type A personality on specific self-reported driving attitudes and behaviors when operating a motor vehicle and reported that Type A personality was significantly related to more traffic accidents, greater frequency of breaking traffic laws, higher impatience when driving, more displays of aggression on the road, and engaging in more risky driving behaviors. When extreme Type A and Type B scores were compared, Type A drivers reported being involved in significantly more motor vehicle accidents and reported displaying more aggression on the road.

Sensation Seeking

Sensation seeking is a type of personality trait most frequently studied in relation to driving behavior and traffic accident involvement. Sensation-seeking is defined as the desire for and engagement in varied, novel, complex, and arousing sensations and experiences (Zuckerman, 1984, 1994) and is consistently linked to risky driving behavior in empirical research (Jonah,1997). A typical characteristic of sensation seeking is the willingness to accept risks for the sake of such experiences, and, as such, sensation seeking is closely linked to risky driving (Jonah, 1997; Jonah, Thiessen & Au-Yeung 2001).

Zuckerman (1994) suggests that sensation seeking is presently the most common purpose of risky driving for young men, aged 16–20 years. Drivers who are high in sensation seeking are more likely to drive in risky manners (Burn & Wilde, 1995; Iverson & Rundmo, 2002; Jonah, Thiessen & Au-Yeung, 2001; Trimpop & Kivkcaldy, 1997).

Sensation Seeking and Speeding A number of studies have suggested that speeding is a type of behavior that is likely to be exhibited by individuals who possess the personality trait known as sensation seeking (Jonah, 1997). Sensation seeking propensity has been found to positively correlate well with many risky driving behaviors including speeding (Jonah, 1997).

Sensation Seeking, Type A Behavior and Speeding Tay, Champness and Watson (2003), found both sensation seeking and Type-A behavior pattern has positively correlated with self-reported speeding behavior. Furthermore, this study found that the linear association was only slightly stronger for sensation seeking than for Type-A behavior pattern. The latter result implied that sensation seeking might be a slightly better predictor of speeding behavior than Type-A personality.

Sensation Seeking, Locus of Control, Hostility, Aggression and Risky Driving Lancaster and Ward (2002) reported that driving behavior was associated with sensation-seeking, thrill-seeking, impulsiveness, hostility / aggression, emotional instability, depression, and locus of control (LOC)**.** Among those drivers who had higher levels of sensation seeking, "risk-taking was associated with drinking and driving". In addition, higher scores on 'venturesomeness' and 'impulsivity' were associated with higher levels of dangerous driving and substance abuse. Gregersen (1996) and Williams (1997) reported that sensation seekers drive very often without a safety belt and under the influence of alcohol.

Sensation seeking has demonstrated in numerous studies linked with risky driving, attitudes to speeding and increased accident rates (Arnett, 1996; Desrichard & Denarie, 2005; Jonah, 1997; Whissell & Bigelow, 2003). Speeding violations were directly linked to being younger, sensation seeking propensity and having attitudes that endorsed speeding above the legal limit (Trantera & Warnb, 2008).

Vanlaar *et al*. (2007, 2008) reported that when person and personality characteristics such as younger the drivers, more speeding tickets received in the past 3 years, more crashes in the past 3 years, and higher the annual mileage, higher will be the levels of sensation seeking.

Burns and Wilde (1995) found there is a link between sensation-seeking and risky driving among a sample of almost 80 professional taxi drivers. Further, such correlational links between self-reported sensation-seeking and risky driving behaviors was supported by others (Jonah *et al*., 2001; Trimpop & Kirkcaldy, 1997; Iversen & Rundmo, 2002). Research with adolescent samples suggests sensation-seeking is related to risky driving practices among young drivers (Arnett, 1990, 1996, 1997). A case-control study comparing drivers convicted and not convicted of offenses such as speeding or reckless driving also yielded significant differences in sensation-seeking measures among the two groups (Furnham & Saipe, 1993)

Schwebel *et al*. (2007) found that personality was a modest but consistent correlate with risky driving behavior. Sensation seeking seemed to be most strongly related to violations and tickets, while temperamental control was more broadly related to a number of risky driving measures. These results held after controlling for the effects of gender, age and years of driving experience.

One of the personality traits that predict accident involvement is sensation seeking. Jonah (1997) pointed out that sensation seeking was significantly related to aberrant driver behaviors such as driving while intoxicated, driving over the speed of 80 mph, driving 20 mph or more over the speed limit, racing the car, passing in a no-passing zone, over speed and low seat belt usage. Studies on the relationship between sensation seeking and risky driving indicated that, high sensation seekers are more likely to report risky driving behaviors (e.g., speeding, not wearing seat belts, driving after drinking, perceiving a low risk of driving while intoxicated, and aggressive driving) than low sensation seekers (Furnham & Saipe, 1993; Jonah, Thiessen & Au-Yeung, 2001; Rimmo & Aberg, 1999; Rosenbloom, 2003).

Several researchers have suggested that risky driving is motivated on the basis of the sensation-seeking thrill (Arnett, 1990, 1991; Jonah, 1997). Several studies have found sensation seeking to be associated with a risky lifestyle and risky driving (Arnett, 1990, 1991, 1996; Wilson & Jonah, 1988; Yu & Williford, 1993; Jonah, 1997). The motivational influence of sensation seeking on risky driving behavior is further supported by findings demonstrating that sensation seeking explains a large part of the variation in the propensity to commit driving violations, but accounts for very little of the variance in the tendency to commit driving errors (Rimmö & Åberg, 1999). Drivers who are high in sensation seeking are more likely to drive in risky manners (Burn & Wilde, 1995; Iverson & Rundmo, 2002; Jonah, Thieesen, & Au-Yeung, 2001; Trimpop & Kivkcaldy, 1997).

Iversen and Rundmo (2002) examined relationships between personality, risky driving and involvement in accidents and found that those who scored high on sensation seeking, recklessness and driver anger reported to have more frequent episodes of risky driving compared to those who scored low on these variables.

White and Dahlen (2001) found that sensation seeking added significantly to the prediction of risky and aggressive driving, independent of driving anger. Given the complexity of driving behavior and the myriad of factors contributing to vehicular accidents, it is likely that multivariate models are needed to predict unsafe driving behavior.

Locus of Control

Locus of control (Rotter, 1966) is a particularly interesting personality factor for those seeking to influence driver behavior towards developing safe driving techniques for life. Since it suggested that drivers who believe outcomes are controlled by external forces such as events controlled by fate and not self, may be less likely to change behavior in response to outcomes (Walker, Stanton & Young, 2008) than those with internal LOC, who perceive outcomes to be dependent on their own skill, efforts or behavior.

Locus of control (LOC) is one of the most crucial psychological factors determining a driver's behavioral adaptation, in general (Rudin-Brown & Noy, 2002). Several researchers (Hoyt, 1973; Phares, 1976; Williams, 1972) supposed that an external locus of control is related to a lack of caution and failure to take precautionary steps to avoid the occurrence of unfavourable outcomes.

Some drivers may feel that they are in overall control of an automated vehicle whilst others may not (Stanton & Stevenage, 1998). People with internal locus of control may take a more active role with automated systems, whereas people with external locus of control may take a more passive role. These differences may help to explain why some people effectively take control in situations where there is an automation failure whereas others fail to react (Stanton & Stevenage, 1998). LOC specific to driving has found to be a better predictor of motor vehicle accidents (Guastello & Guastello, 1986).

However, research findings about locus of control and traffic safety have been mixed. Arthur, Barrett, and Alexander (1991) found that there is a positive relationship between locus of control and accident involvement while Guastello and Guastello (1986) found that there is no direct relation between Rotter's locus of control scale scores and accidents.

Özkan and Lajunen (2005) supposed that the conflicting results could arise from both theoretical and methodological shortcomings, especially the one dimensionality of locus of control scale. They claimed that the original two-factor structure based on internality and externality is too simple for catching the different attributions of causes behind traffic accidents.

Holland, Geraghty and Shah (2010) found that externally oriented persons are more likely to be involved in car accidents, as they would take fewer precautions to prevent road accidents. However, increased internal LOC has also been associated with risky driving style, perhaps due to driver's belief in his or her own ability to avoid an accident (Arthur & Doverspike, 1992). Özkan and Lajunen (2005) found that young drivers who attributed causes of accidents to their own behavior (internality) had been involved in accidents and violations more frequently than those who attributed accidents to external factors (externality).

Holland *et al*. (2010) reported that women had more external LOC than men, and driver stress styles increased with more external LOC, but reduced with increased driving experience, but so did the patience style. High velocity style increased with experience. Controlling for LOC revealed some important gender differences such as positive effects for men (reducing angry and high velocity, increasing carefulness) and negative effects for women (increasing angry and higher velocity, reducing carefulness).

Age and Dangerous Driving

Willemsen *et al*. (2008) reported that older drivers and female drivers tend to have low levels of DDDI dimension which is consistent with international literature, suggesting that drivers seem to become more law abiding and display a tendency to take lesser risks when they grow older (Golias & Karlaftis, 2002).

Schechtman *et al*. (1999) found that when age is considered, drivers seem to be more law abiding and take lesser risks as they grow older. It should also be mentioned that drivers over 55 years, seem to drive distinctly more carefully than younger drivers do, while those below 25 years seem to exert a distinctly less law abiding approach to driving or are more prone to violations.

Norris *et al*. (2000) noted that younger age is one of the predictors of future motor vehicle accidents (MVAs), as younger adults (ages 19 to 39) are twice as likely to have an accident in comparison to older adults (ages 56 to 88). The middle-age range (40 to 55 years) has a crash rate, which is between these two extremes. The importance of such factors is further supported by studies which showed that a relatively large reduction in the accident risk of young drivers (usually a reduction of 50 %) during the first year that they possess a driving license (Maycock, Lockwood & Lester, 1991; Sagberg, 1997*)*. Moreover, young drivers tend to have a persistent bias in perception of risk and evaluation of their own driving skills. Compared to other age groups, they are found to be more likely to underestimate the probability of the specific risks caused by traffic situations (Brown & Groeger, 1988; Deery, 1999), and have a propensity to perceive themselves as invulnerable to negative outcomes (Millstein,1993). They are also prone to failure in perceiving the hazards in traffic (Deery, 1999; Groeger & Brown, 1989;

Milech, Glencross & Hartley, 1989), and overestimate their own driving skills (Moe, 1986). The second explanation emphasizes motivational factors as the main reasons behind young drivers' accidents. According to this view, the reason why the accident rate decreases with advancing age is that the drivers gradually become more socially and emotionally mature, as well as more responsible.

Elander, West and French (1993) noted that younger drivers tend to have an increased crash involvement; the recent studies consistently underlined the younger drivers are at a greater risk of being involved in a traffic accident (Maycock *et al*., 1991; Stewart & Sanderson, 1984; Mayhew *et al*., 1981). Maycock *et al*. (1991) found that 17 year-old drivers have 50% more crashes per year than 25 year-olds, who have 35% more crashes per year than 50 year-olds. Likewise, Dobson *et al*. (1999) observed that the average number of accidents in the last 3 years was three times greater in the young (18-23) than the mid-age (45-50) group.

Pelz and Schuman (1968) reported that 18 and 19 year-old drivers had the highest violation and crash rates in comparison to older drivers, while controlling for exposure and experience. Further, Toomath and White (1982) found that the global accident risk of young drivers does not decrease when annual mileage is taken into account. These studies demonstrated that young drivers are still at a high risk of being involved in an accident, when experience and miles driven are controlled for.

Szlyk *et al*. (1995) found that, although older groups had poorer driving related skills, they did not have significantly higher on-road accidents than the younger groups. They showed that older and younger age groups tend to be involved in different types of traffic accidents; still it is the younger driver groups who are more at risk in terms of crash involvement.

Beck, Wang and Mitchell (2006) found that aggressive drivers were more likely to be male and aged 45 and under. Aggressive drivers were less likely to report using their seat belt, but more likely to report driving a car every day. This effect of age is thought to be reflected in safer driving. It is further strengthened by some studies, which showed that young drivers tend to be more prone to deliberate risk taking in traffic than others. Specifically, they are more likely to drive faster (Jonah, 1986), follow too closely (Baxter *et al*., 1990), overtake dangerously, and run on yellow lights (Koneci, Ebbesen & Koneci, 1976) compared to other drivers (Summala, 1987). Moreover, Reason *et al*. (1990) have found that the tendency to commit driving violations declines with age, whereas the propensity to commit driving errors does not.

Ulleberg and Rundmo (2002) found that those who belong to the age group of 15 – 24 years are at the highest risk of motor vehicle crashes in New Zealand, USA, Canada, and the EU and road crashes are the most common cause of death among those aged less than 25 years. These riskier attitudes may be the result of a general over-confidence that young people have with regard to their driving ability.

Furthermore, in a longitudinal study, Begg and Langley (2004) found that aggressive behavior at 18 years of age significantly predicted subsequent self-reported speeding. It has also been shown to significantly predict self-reported drunk driving (Begg, Langley & Stephenson, 2003; Gulliver & Begg, 2004).

Golias and Karlaftis (2002) reported that drivers seem to be more law abiding and less risks taking, as they grow older. It should also be mentioned that drivers over 55 years, seem to distinctly drive more carefully than younger drivers do, while those below 25 years seem to exert a distinctly less law-abiding approach to driving or are more prone

to violations. Younger drivers are at a greater risk of crash involvement, with a marked difference between 18/19 year and 25 year. Younger drivers displayed the highest driving violation rates. Drivers aged 20 and under showed the highest observed speeds and highest reported 'normal' speeds. Younger drivers tended to overestimate driving ability and underestimate personal risk.

Vassallo *et al*. (2010) found that the majority of young people identified as being in the moderate- and high-level risky driving clusters at 19–20 years showed a reduction in risky driving by 23–24 years. For a small number, this improvement was quite marked, with one in ten high-level risky drivers showing low levels of risky driving by 23–24 years. These findings highlight the fact that young problematic drivers are not destined to continue posing a road safety risk, as they grow older. Rather, it would appear that improvement is not only possible, but also common.

Hatfield and Job (2006) observed that age was significantly negatively associated with self-reported likelihood of speeding, suggesting that younger people are more likely to speed. Younger people were also more likely to deny that speeding increases the risk of a crash on a clear dry day. Thus, overall, results concurred with previous findings that younger drivers have more risky attitudes and behaviors than older drivers do. Many studies have shown younger drivers (under 34 years) are more likely to be speeders, (Fildes *et al*., 1991; Ogle, 2005; Williams *et al*., 2006). In contrast, drivers over 55 years are less likely to be speeders (Fildes *et al*., 1991; Ogle, 2005).

Risky Driving and Experience in Driving

Machin and Sankey (2008) have shown that inexperienced drivers underestimate the risks associated with a range of driving situations. Young people who drove when

fatigued were found to spend longer periods on the road than other drivers, spending more hours each week driving at night and during the day, both on weekdays and weekends. Other Australian research on fatigued driving among young people revealed similar trends (Harrison, 2006). Harrison concluded that fatigued driving appeared to be a consequence of lifestyle-related motivational factors that overrode young people's concerns about the potential negative consequences of driving when fatigued. Respondents believed that the effects of tiredness on driving were manageable except at the most extreme levels and those they could habituate to tiredness with experience.

Yilmaz and Çelik (2006) found that drivers having experience of less than 2 years demonstrate a positive attitude towards obedience to speed rules relative to those experienced over 2 years. According to this result, as drivers get more experienced their self-confidence increases and they abide by the traffic rules. Lancaster and Ward (2002) found inexperienced drivers were shown to be a high-risk group of drivers.

Vassallo *et al*. (2010) indicated that most crashes had occurred when the cohort were less experienced drivers. Likewise, the average number of crashes experienced had risen from 1.36 to 1.6 over this time period. These findings are consistent with past research, which has linked driver inexperience to heightened rates of crash involvement (Cavallo & Triggs, 1996; Engström *et al*., 2003; Triggs & Smith, 1996). Nevertheless, after almost 6 years of licensure, 40% of the sample had not experienced a crash when driving, and a similar percentage had not been detected speeding.

Influence of Age and Experience

Stradling (2000) identified that young, inexperienced drivers are a high-risk group of drivers. Abdel-Aty *et al*. (2000) also noted that teenage drivers have less training and

experience, which leads to more traffic violations. McCartt *et al*. (1999) reported that when controlling for age, driving violations increased with increasing driving experience, and the frequency of drowsy driving decreased with increasing experience. Conversely, when the authors controlled for driving experience, driving violations decreased as age increased, and drowsy driving increased as age increased.

The literature showed that drivers of any age display higher violation and crash rates in the early stages of licensure than they do after more experience has been acquired (Waller *et al*., 2001; Maycock *et al*., 1991; Mayhew & Simpson, 1990). Maycock *et al*. (1991) found evidence that age and experience were both important factors affecting crash risk. Waller *et al*. (2001) found that there is a 5% reduction in total crash odds for each additional year of age at time of licensing, which is consistent with Maycock *et al*. (1991) who reported a 6% risk reduction.

Differences in the Level of Education

Norris *et al*. (2000) showed that those participants who had post-secondary education had more accidents than others did. However, the effect of education on motor vehicle accidents was not found to be significant once age was controlled for. Macmillan (1975) also reported a failure to observe a relationship between education and accidents. Conversely, Dobson *et al*. (1999) observed that those women with tertiary education, in the mid-age group (aged 45-50 years), displayed a significantly higher accident risk, but that education did not have an effect in the younger driver's group (aged 18-23 years).

Shinar *et al*. (2001) found that the number of people who reported that they observed the speed limit decreased with increasing education. This finding was corroborated by Hemenway and Solnick (1993) who reported that drivers with higher

education were more likely to report that they speed more than the other drivers who were with lower levels of education. Dobson *et al*. (1999) further supported these studies in their observations that women with higher scores for violations, speeding, lapses and errors tend to possess tertiary level education. The majority of aggressive drivers were poorly educated (Lancaster & Ward, 2002).

Shinar *et al*. (2001) subsequently suggested that, as the level of education increases, people become more familiar with the conflicting arguments and data, regarding the relationship between speeding and crashes, and believe that they can judge for themselves the merits and risks of speeding.

Lancaster and Ward (2002) reported that those with a higher level of education were more likely to report speeding. Those participants with tertiary level education, in the 45-50 age range, displayed a significantly higher accident risk, but education did not have an effect on the younger drivers. Reported use of seat belts increased with increasing education.

A Study by Beck, Wang and Mitchell (2006) found that young people with differing levels of education significantly differed in several aspects of their driving experiences and behaviors. Those with a university degree were less likely to have had their license cancelled or suspended than those with another type of post-secondary education qualification. However, those with only secondary education were more likely to have been fined or charged because of involvement in a crash.

Hatfield and Job (2006) revealed that, the more the level of education of the respondents, the higher the likelihood to speed, the more the chances to give greater estimate of the number of kmph over a 60 kmph speed limit, the higher the chance of

crashing, and lesser the level of agreement with the statements "speeding can be safe for a skillful driver" and "speeding can be safe in some circumstances", and agreed less strongly with the attitude: "penalties for speeding are genuinely intended to deter people from speeding in order to promote road safety". However, education was significantly negatively associated with the number of kmph over a 60 kmph speed limit required for a driver to be termed irresponsible or criminal. Thus, whilst people with higher education appear to speed more themselves, and are more likely to view speeding as safe, they also appear to be less tolerant of other speeding drivers than less educated people are.

Yilmaz, and Çelik (2006) examined the effect of education, age and experience on driving behavior and found that men are more eager to bend basic traffic rules than women. While 19-29 age groups take the highest average value on violation to traffic rules, the lowest average value is for the 61 and older age group, and for education level and experience, risk taking was not found to be significant.

Section IV: Lacuna of Road Safety Research

World Health Organization in global status report on road safety (2009) revealed that India topped in road accident fatalities, than any other country in the world, including the most populous China. In India number of road accidents, deaths due to road accidents and injuries are increasing every year whereas in European countries such as Germany, Sweden, England, Denmark, and other developed countries, the numbers are either stagnant or reducing. The World Health Organization in global status report anticipates that unless immediate action is taken, during the next 15years, the number of people

dying annually in road traffic crashes may raise to 2.4 million. The increase will probably occur entirely in low and middle income countries and road traffic injuries will become one of the three major causes of death.

National Crime Record Bureau, India (2011) reported the average death rate due to accident in India as 32.41 per 100,000 population as compared to 21.5 in other low income countries and 10.1 in high income countries (World Health Organization in Global Status Report on Road Safety (2009). Rate of death per 10,000 vehicles is 14 in India as compared to below the level of 2 in developed countries. Among the 430,600 road accidents occurred during the year 2010, reported death of 133,938 persons and 470,600 persons were injured fatally (NCRB, 2011). A study by the planning commission in 2002 estimated that the social coast of road accidents in India stands at Rs. 55,000 crore annually, which constitutes about 3% of the GDP (Sunder *et al*., 2007). It is estimated that the country loses around 750 billion rupees ($17 billion) per year due to road traffic accidents, which is 2-3 per cent of the gross domestic product (Sikdar & Bhavsar, 2009).

The world report on road traffic injury prevention (2004) mentioned that research forms the basis for generating data and evidence for informed and effective decision-making. Developing research capacity at state and national levels is important for road traffic injury prevention (Peden *et al*., 2004). Without research capacity, there will hardly be any means to overcome misconceptions and prejudices about road traffic injuries. This extensive review of literature leads us to a number universities and institutions doing relevant and effective research on driver behavior and its impact on road safety. Unfortunately, there are hardly any works published on these subjects from any of the universities or institutions in India; one of the most seriously affected countries with

respect to road accidents and its severities. Much of the research conducted in developed countries, focused on driver behavior research including effect of fatigue, aggression, personality and hazard perception, stress, attitude and drivers behavior modification methods.

Guidelines for road safety research, issued by Asian Development Bank reported that, the study of the causes and prevention of road accidents is justifiable not only on humanitarian grounds, as road accidents are a major cause of death and injury, but also on an economic basis, as road accidents are known to affect between 1 percent and 3 percent of a country's gross domestic product (GDP). As motorization is increasing dramatically in many Asian countries, the number of road accidents is also bound to increase and the need for road safety research will become stronger. Measures that have been successful in developed countries may not always be as successful in the developing world because of the different social, cultural and economic circumstances in developing countries. It is, therefore, necessary to carry out specific research to identify measures that may be useful in the developing world. Road safety research has proven beneficial in documenting the road accident problems and has provided the means to develop and evaluate countermeasures. It has contributed greatly to accident reduction in industrialized countries.

Because of the complexity of factors causing road accidents, the type of organizations involved, and the emotional nature of road accidents, there is a temptation to embark on policies and countermeasures that are visible but superficial in nature with little effect on the level of road safety. A comprehensive road safety research should help road safety policies, which are based on an objective and empirical findings. Indeed, without relevant local research it is likely that countries wishing to invest more resources in road safety will look only at results from other countries and may well adopt measures

inappropriate for their own conditions, thereby wasting valuable resources. Hence, the Asian Development Bank reaffirmed that effective road safety research provides the framework against which informed decisions can be made, and it is essential that every developing country should have some local research activity on road safety issues to aid decision making.

Several factors contribute to accidents, including driver characteristics, the road layout, the design of the vehicle and the weather, although most road accidents are attributed to the human factor. Saby and Taylor (1980) suggested that 95% of road accidents are partly and 65% wholly due to the human factor. This is interesting but insufficient unless we also try to understand what kinds of factors are responsible. Motor vehicle accidents result usually from a complex interaction between the driver, vehicle and environmental factors. Analysis of traffic accidents indicates that human factors are either the sole or a contributory factor in approximately 90% of road traffic accidents (Rumar, 1985).

However, less progress has been made in understanding the behaviors of road users as compared to many improvements in road environment and vehicles (Rothengatter, 1997). This observation is literally true in the Indian context even today. Unfortunately, the present limited research in India is addressing only road engineering. Effective research into the causal factors including human factors and other behavioral problems are hardly ever undertaken by Indian psychological communities and universities.

Institutional framework with multidisciplinary research capacity and required competence is also lacking in India. Media and public concerns arise only for days after each major road crash, which result in many deaths. Sustainable remedies for road trauma has to be generated, which is a regular problem, as far as the road and traffic exists and changes regularly with changes in road, vehicle and human behavior.

The estimated number of deaths due to road accidents in India in 2015 is 154,600 (Sunder *et al*., 2007). Road accident victims are predominantly male, within the age group of 5-44 years (about 70%), the most productive section of our society. Thus, there is an urgent need to recognize the worsening road safety situation, in order to take appropriate action. Road traffic injury prevention and mitigation should be given the same attention and scale of resources that are currently being channeled towards other predominant health issues, if increasing human loss and injury on the roads, with their devastating human impact and large economic cost to society are to be avoided (Sunder *et al*., 2007). Road crashes are predictable and preventable and can be controlled effectively, if safety of people on roads is given importance by the government, professionals, and the civil society.

Key Objectives

Despite the fact that India is at the top with respect to road crashes, hardly any research studies have reported in the Indian context on psychological factors, which are likely to predict dangerous driving and speeding behavior. Review of existing literature showed that various psychological factors including personality, attitude and violation behaviors of drivers, and age, experience and education had sufficient influence on dangerous driving and speeding. The present study is an attempt to understand the effect of a set of different psychological factors and demographic variables on dangerous driving and speeding behavior of drivers. In this context, the following research objectives are proposed:

1. To assess the effects of age, experience and education on dangerous driving behavior, speeding behavior and violation behavior of traffic rules.
2. To identify the relationship between select psychological variables and dangerous driving behavior, speeding behavior and violation behavior.
3. To identify the relationship between speeding behavior and dangerous driving behavior.
4. To identify the relationship between attitude to speeding and speeding behavior
5. To find out the efficiency of select independent variables to predict the, dangerous driving behavior, speeding behavior and violation behavior of traffic rules.

Chapter III

Research Methods

CHAPTER III

RESEARCH METHODS

The comprehensive review of literature on the different perspectives of road safety and psychological factors affecting drivers' on-road behavior and its implications have provided some insightful observations. It has also brought to light many unresolved research issues which needs to be addressed efficiently, therefore it is imperative that empirically based evidence is available to draw meaningful inferences. Based on the review of literature, several hypotheses were formulated and the research design was finalized to meet the key objectives of the study.

The following sections deal with the key aspects of research design and the methods of data collection.

Section I lists the research hypotheses to be tested in the proposed study.

Section II presents the research design and explains the type and nature of the selected predictor and criterion variables.

Section III covers the sample design

Section IV introduces the appropriate research instruments used to assess predictor and criterion variables and the rationale for their selection.

Section V presents the methods of data collection.

Section VI discusses the types of statistical techniques adopted to test the hypotheses.

Section I: Hypotheses

Based on a study of more than 2000 traffic accidents, Sabey and Taylor (1980) concluded that human factors were contributing elements in 95% of the accidents. In particular, driving behavior was the most central of these factors. Thus, promoting

safer driving practices may be one of the important means of reducing traffic accidents. The detailed study of the dangerous driver behavior and the underlying reasons for unsafe behavior will help policy makers and transport authorities to design and implement effective and suitable remedial actions to save millions of human lives.

The review of literature found some personality traits, such as attitude to speeding, violation behavior of traffic rules and demographic variables like age, experience and education to have tremendous impact on driving behavior. Further research studies have indicated that, due consideration must be given to various psychological factors while implementing counter measures against dangerous driving and speeding behavior. The effect of personality and attitudes may not be the same for all drivers. Therefore, to evaluate distinctly the influence of all the above-mentioned variables in dangerous driving behavior, speeding behavior and violation behavior of traffic rules, the following hypotheses have been proposed for verification.

H 1 There is a significant difference in dangerous driving behavior of drivers belonging to various age groups, with different experiences and education levels.

H 1.1 There is a significant difference in the dangerous driving behavior of drivers belonging to various age groups.

H 1.2 There is a significant difference in dangerous driving behavior of drivers, who have varied levels of driving experience.

H 1.3 There is a significant difference in dangerous driving behavior of drivers who have varied levels of education.

H 2 There is a significant difference in speeding behavior of drivers belonging to various age groups, with different experience and education level.

H 2.1 There is a significant difference in the speeding behavior of drivers belonging to various age groups.

H 2.2 There is a significant difference in speeding behavior of drivers, who have varied levels of driving experience.

H 2.3 There is a significant difference in the speeding behavior of drivers, who have varied levels of education.

H 3 There is a significant difference in violation behavior of traffic rules (VBTR) of drivers belonging to various age groups, with different levels of experience and education.

H 3.1 There is a significant difference in the violation behavior of drivers belonging to various age groups.

H 3.2 There is a significant difference in the Violation behavior of drivers, who have varied levels of driving experience.

H 3.3 There is a significant difference in the violation behavior of drivers who have varied levels of education.

H 4 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior Pattern, locus of control and attitude to speeding are significantly correlated with dangerous driving behavior.

H 4.1 Hostility is correlated significantly with dangerous driving behavior.

H 4.2 Propensity to aggression is correlated significantly with dangerous driving behavior.

H 4.3 Sensation seeking is correlated significantly with dangerous driving behavior.

H 4.4 Type A behavior pattern is correlated significantly with dangerous driving behavior.

H 4.5 External locus of control is correlated significantly with dangerous driving behavior.

H 4.6 Speeding behavior and dangerous driving behavior are correlated significantly.

H 4.7 Attitude to speeding and dangerous driving behavior are correlated significantly.

H 4.8 Violation behavior (VBTR) and dangerous driving behavior are correlated significantly.

H 5 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, locus of control and attitude to speeding are significantly correlated with speeding behavior.

H 5.1 Attitude to speeding is correlated significantly with speeding behavior.

H 5.2 Hostility is correlated significantly with speeding behavior.

H 5.3 Propensity to aggression is correlated significantly with speeding behavior.

H 5.4 Sensation seeking is correlated significantly with speeding behavior.

H 5.5 Type A Behavior Pattern is correlated significantly with Speeding Behavior.

H 5.6 External locus of control is correlated significantly with speeding behavior.

H 5.7 Violation behavior (VBTR) is correlated significantly with speeding behavior.

H 6 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior Pattern, locus of control and attitude to speeding are significantly correlated with violation behavior of traffic rules (VBTR) of drivers.

H 6.1 Hostility is correlated significantly with violation behavior (VBTR)

H 6.2 Propensity to aggression is correlated significantly with violation behavior (VBTR)

H 6.3 Sensation Seeking is correlated significantly with Violation Behavior (VBTR)

H 6.4 Type A behavior pattern is correlated significantly with violation behavior (VBTR)

H 6.5 External locus of control is correlated significantly with violation behavior (VBTR)

H 6.6 Attitude to speeding is correlated significantly with violation behavior (VBTR)

H 7 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the dangerous driving behavior.

H 8 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the speeding behavior.

H 9 The select psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the violation behavior of traffic rules (VBTR) of drivers.

Section II: Research Design

The descriptive survey research design was followed in this study to examine the speeding, dangerous driving behavior, and violation behavior of traffic rules of drivers.

Relationship of speeding, dangerous driving behavior, and violation behavior with various personality traits, attitudes to speeding and demographic variables such as age, experience and education were surveyed. Comprehensive standardized questionnaires measuring various dimensions have been administered to the targeted respondents to elicit the required data. The variables chosen for this study are as given below.

Independent variables

A set of key psychological variables such as, hostility, propensity to aggression, sensation seeking, Type A behavior pattern, locus of control and attitude to speeding were tested as predictors of speeding, dangerous driving behavior and violation behavior of traffic rules (VBTR) of motor vehicle drivers. Further, the three demographic factors-such as age, experience and education level- were also tested for their effect on driving behavior.

Dependent Variables

Three types of criterion variables such as dangerous driving behavior, speeding behavior and violation behavior of traffic rules (VBTR) were utilized to understand the nature of driving behavior of motor vehicle drivers in this study. The research design for establishing relationships of six predictors (hostility, propensity to aggression, sensation seeking, type A behavior pattern, locus of control and attitude to speeding) is presented in Figure 1. The model shown below represents the behavioral variables that were measured in this research. These three dependent variables have been identified by social scientists as being important for understanding the driving behavior of drivers leading to accidents.

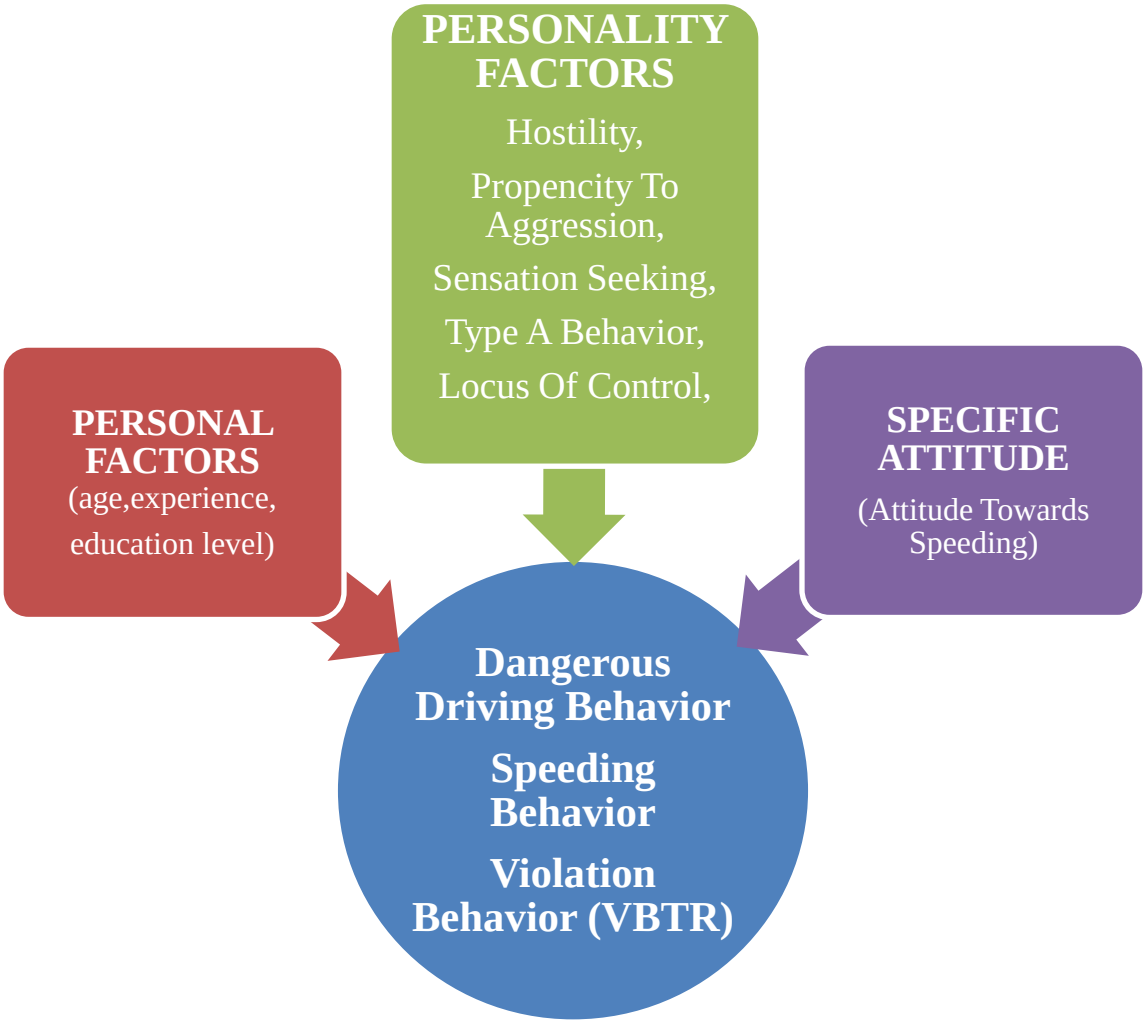

Figure 1 **A Behavior Model of Driving.**

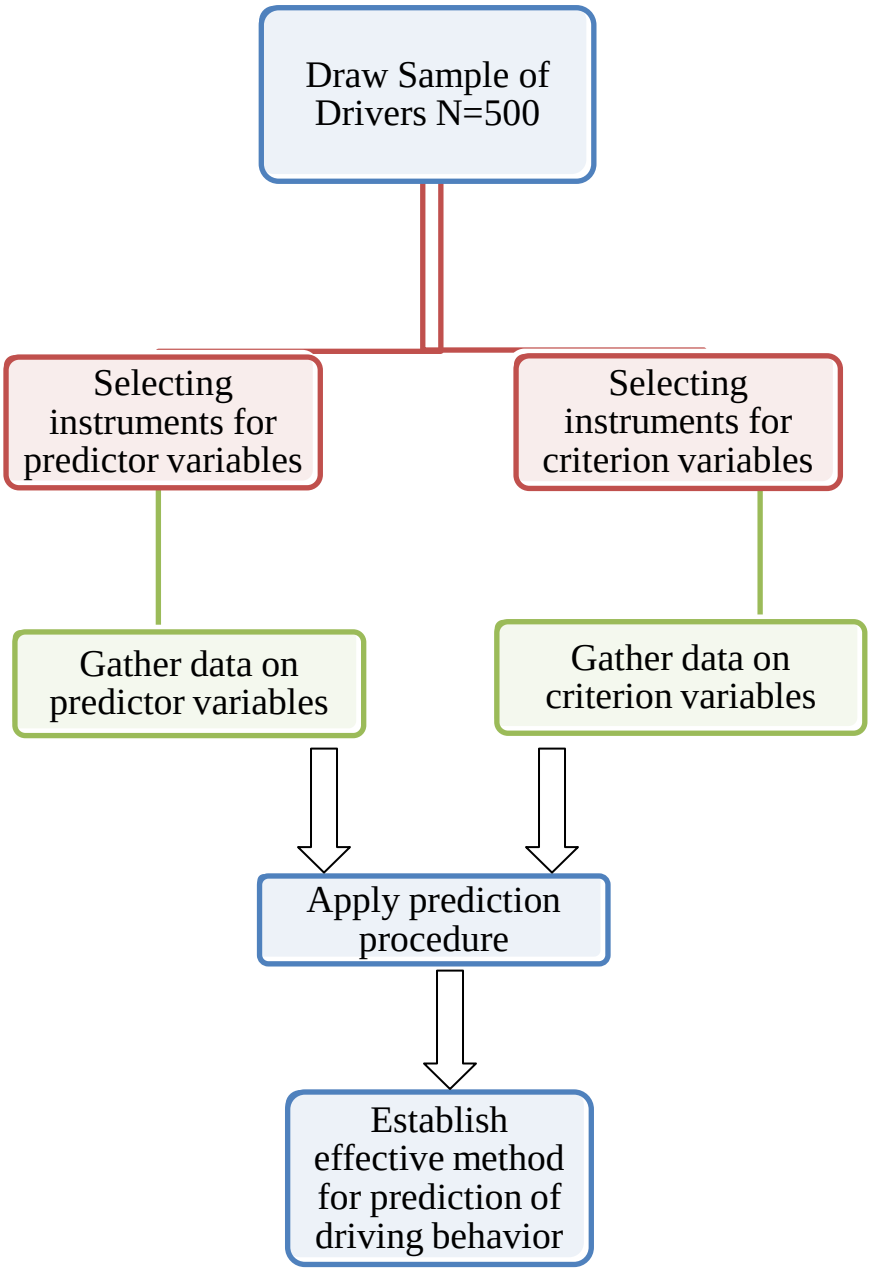

Figure 2 **Research Design for Establishing Relationship of a Set of Predictors to Criterion Variables**.

Section III: Sample Design

Sample selection

According to the administrative report of the Motor Vehicle Department, Kerala, India (2010), around 0.6 million licensed drivers are driving motor vehicles in Kerala State. It has been decided to approach only those drivers who have a valid driving license to drive and possess a sizable number of years of experience in driving the vehicle. The following inclusive criteria were employed while selecting the licensed drivers for this research.

Inclusion criteria

- Only those drivers who are driving about 100 km/day covering various destinations on a regular basis.
- Only those drivers who are more frequently driving in peak hours in busy roads all the time.
- Only those drivers who are holding valid driving license from a licensing authority in Kerala.
- Only those drivers who have experience ranging from 1 to 20 years and more in driving various vehicles.
- Only those drivers whose educational level ranges from seventh standard to graduate level.

Exclusion Criteria The following exclusion criteria were followed to avoid certain drivers from being the respondents in this study.

- Women drivers excluded from this study since the number of licensed women drivers comprised a meager percentage in the population.
- Those drivers who were driving the vehicle only occasionally.

- Those drivers who are driving below 100 km/day and cover only short distances.
- Those drivers who are not holding a license to drive a motor vehicle.

Stratified Random Sampling

As it was intended to collect data from the drivers who have chosen driving as their profession, a complete list of such drivers was gathered from a list of driving license holders issued by the Motor Vehicle Department of Kerala in 10 selected centers. There were around 60 centers /stations, which issue a formal driving license to the eligible and qualified personnel across different parts of Kerala state. Among them 10 stations /centers were chosen. They represent the north, south and central districts of Kerala. The prospective respondents (drivers) were selected from 10 stations/centers who have visited the Licensing Authorities for renewing their driving license or adding another class to their license during the period 2009-10. Due care has been taken to cover drivers from the north and south of Kerala state. A total of 500 drivers were picked up randomly from the three regions of Kerala state as given below.

Table 1 Number of drivers selected from each region

Region	Number of Stations	Number of drivers Selected
South	3	150
Central	4	200
North	3	150
Total	**10**	**500**

On an average, a total of 120,000 drivers had visited the 10 stations of licensing authority of Kerala during the period from April 2009 - March 2010 accounting year for seeking renewal of their driving license or obtaining license to an additional class of vehicle. Among them, 500 drivers were picked randomly from among those who drive various types of vehicles daily, consider driving as their regular profession, and drive

approximately more than 100 km per day. The sample drawn from 10 stations/ centers of three regions of Kerala state made it a true representative of each region. Only men were selected for the study as women hardly report to driving transport vehicles in India and their accident rate is at a negligible level.

Table 2 Demographic profile of the Sample

Category	Count	Percentage
Age group		
18-25 years	232	46.4
26-35 years	146	29.2
36-45 years	90	18.0
46 and above	32	6.4
Experience		
1 - 5 years	246	49.2
5 -10 years	114	22.8
10-20 years	110	22.0
Above 20 years	30	6.0
Education level		
7 to 10 grade	269	53.9
Up to 12 grade	145	29.0
Up to graduation	86	17.2

As it was intended to study the extent to which the personal factors such as age, experience and education have an effect on dangerous driving, speeding and violation behavior, a wide range of respondents were studied. Table 2 showed the demographic profile of the respondents such as age, experience, and educational levels. The sample size of the respondents of 46 years and above are lesser in number perhaps, those category of drivers might have given up their profession as drivers, or might have reduced driving. The same trend was noted with respect to the years of experience of driving the vehicles. Around 83 % of the drivers possess 10^{th}& 12^{th} grade certificates.

Method of Data Collection

Those listed drivers who had visited Motor Vehicle Department for various services were invited well in advance for a training program in connection with road safety at each station. Required data for this study were collected with the respondents' consent, well before the training. Since the total number of items in the nine selected instruments was 110, it was felt that the data collection process should be carried out in two phases. In the first phase, general instructions and the objectives of the research study were explained with a request to complete the demographic details including age, experience and education. Subsequently the first five questionnaires were administered individually to solicit their responses one by one in the given answer sheets. The response sheet was in such a way that there is only minimal effort required to provide responses by putting a tick mark in the respective boxes.

Due care was taken to maintain a good rapport with the drivers and absolutely no identification marks provided on the booklet of questionnaires thereby ensuring anonymity of the respondents. After completing the first part of the booklet, the respondents were given a break with some refreshments and the remaining booklets, which consisted of four questionnaires each was administered during the second session. All the required questionnaires were translated in the regional language (Malayalam) and the quality of translation was crosschecked with the help of experts in Malayalam language.

Operational Definitions

1. Dangerous driving behavior is operationally defined as the sum of the scores obtained by the respondents on Dula Dangerous Driving Index (DDDI).

2. Speeding Behavior is operationally defined as the sum of scores obtained by the respondents on the Speeding Behavior Scale
3. Violation behavior of traffic rules is operationally defined as the sum of scores obtained by the respondents on Violation Behavior of Traffic Rules (VBTR) Scale.
4. Hostility is operationally defined as the sum of scores obtained by the respondents on the Hostility Questionnaire adapted from MMPI.
5. Propensity to aggression is operationally defined as the sum of scores obtained by the respondents on the Propensity to Aggression Scale.
6. Sensation seeking is operationally defined as the sum of scores obtained by the respondents on the Sensation Seeking Questionnaire.
7. Type A Behavior pattern is operationally defined as the sum of scores obtained by the respondents on Type A Behavior Pattern Scale.
8. Locus of control is operationally defined as the sum of scores obtained by the respondents on the Locus of Control Scale.
9. Attitude to Speeding is operationally defined as the sum of scores obtained by the respondents on the Attitude to Speeding Questionnaire.

Section IV: Research Instruments

A set of nine research instruments was used for this study. The investigator administered all the instruments individually and directly after inviting and assembling the respondents (drivers) at the selected offices of Motor Vehicle Department with the help of the officers. The Nine research instruments used in this study are,

- Dula Dangerous Driving Index (Dula, 1999).
- Self-reported speeding behavior scale adapted from Tay *et al*. (2003).

- Violation behavior towards traffic rules scale adapted from Yilmaz and Çelik, (2006).
- Rotter's Locus of control questionnaire (1966),
- Sensation seeking scale (Zukerman, *et al*., 1993).
- Bortner's Short Rating Scale of Pattern A Behavior (1969)
- Hostility scale adapted from Minnesota Multi-phasic Personality Inventory.
- Propensity for aggression scale adapted from Watson, *et al*., (2007).
- Standardized speeding behavior scale adapted from DePelsmacker and Janssens, (2006).

This study was conducted with self-reported measures using standardized scales developed by various eminent research teams of reputed Universities. The scales were translated to local language from English and were tested for its reliability and validity. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures adapted from English versions and some items were included additionally. The design and format of the nine instruments were presented briefly.

Age, Experience and Education

Initially a general information blank sheet was filled in by all participants to reveal their age, experience in driving and education. Only male respondents selected in this study as female drivers are very less in numbers especially in professional driving field for the requisite population.

Dangerous Driving Index - Dula Dangerous Driving Index (1999)

Dangerous Driving Index (DDDI) developed by Dula (2003) was used to assess the individual difference in dangerous driving behavior. Malayalam version of the Dula Dangerous Driving Index, developed by Najeeb (2008), was used in this study to assess the dangerous driving behavior of the drivers. The same Malayalam version of DDDI was

used for testing training effect of drivers in Kerala State Road Transport Corporation (Najeeb, 2008). The 28 item dangerous driving index consisted of three key dimensions such as risky driving behavior (12 items); negative cognitive/ emotional driving (9 items) and aggressive driving (7 items). The Dula and Ballard (2003) summarized a full account of the original development of the DDDI. A principle component factor analysis was performed on all items, suggesting a unitary Dangerous Driving Factor (Dula, 2003) and the reliability coefficient is found to be 0.79. The 28 item DDDI was used to measure the dangerous driving behavior on a 5 point likert scale as composite scale. A typical item of this index would be, *"When I get stuck in a traffic jam I get very irritated".*

Speeding Behavior Scale

The four-item speeding behavior scale developed by Tay, Champness and Watson (2003), was used to assess the extent to which drivers are ready to accept their speed levels while driving vehicles. This self-reported questionnaire elicits response on a 7 point rating scale ranging from 1 to 7. In this study, a speeding score was created using the score of the six items including two items added to original regarding speeding behavior at school zones, for example, "*I often drive greater than 10 km/h over the speed limit in school zones".* The composite score of all the six items was utilized to measure the extent of speeding behavior on both urban and open roads. Spearman- Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measure adapted from English version and the two items were included additionally. The reliability coefficient of Malayalam version was found to be 0.71.

Scale for Violation Behavior of Traffic Rules (VBTR)

The six item scale adapted from Yilmaz and Çelik (2006) was used in this study which measure Violation Behavior of Traffic Rules. For example, *"Sometimes it is necessary to bend the rules to keep traffic going".* The Cronbach's alpha value of the English version was tested and found to be 0.75. The Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures in the Malayalam version of the scale. Reliability coefficient of composite scale was found to be 0.73 and hence this 7-point Likert scale in Malayalam version was used in this study.

Questionnaire on Locus of control

The locus of control questionnaire developed by Rotter (1966) was used to assess the extent to which the drivers tend to have a strong belief that their own actions determine their success in life (internal locus of control) or have a belief system that there is a hand of external forces that controls a large measure of their actions and that their own behavior does not matter as much (external locus of control). The respondents were requested to choose any one of the statements of the given pair, which he or she feels, was correct. Reliability of the 13 item English version was tested and found to be high with alpha values ranging from .62 to .74 for all items. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures adapted to Malayalam from the English version, and the reliability coefficient was found to be 0.63.

Sensation Seeking Scale

Sensation seeking scale developed by Zuckerman-Kuhlman (1993) was used to measure the drivers' level of sensation seeking dispositions. Reliability of the English

version was found to be high as Cronbach's alpha values ranged from .72 to .86 for all items. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures translated to Malayalam from the English version. Reliability coefficient was found to be 0.70 for this 19-item scale in Malayalam. The required response in this test was 'True' or 'False' for each statement.

Type A Behavior Pattern Scale

Type A behavior pattern was measured by using an abridged version of Bortner's Short Rating Scale of Pattern A Behavior. The items were scored from 1 to 10 so that a higher score was associated with a higher likelihood of exhibiting Type-A behavior pattern. Again, a composite score for Type-A personality was created using the total of the four item scores. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures translated to Malayalam from the English version. Reliability coefficient was found to be 0.56.

Hostility Scale - (MMPI-2)

Hostility of drivers was assessed using a 5 point likert scale adapted from the Minnesota Multi-phasic Personality Inventory (English version). The 8 items of MMPI-2 with higher factor loading were selected for this study from the work of re-standardization committee for MMPI-2. The hostility items that have the highest estimated factor loadings for the first factor imply negative attitudes about other people in general. The average alpha value of the items selected was above 0.62 and Cronbach's alpha value of English version was tested and found to be 0.51 to 0.78. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures adapted from English version. Reliability coefficient was found to be 0.68 for this scale in Malayalam.

Propensity for Aggression Scale

While driving, drivers with high levels of anger experience more anger triggers, frequent and intense anger, hostile thinking, aggression, risky behavior, and some crash-related conditions than drivers with low level of anger do (Deffenbacher, 2009). Propensity for Aggression of drivers was assessed using propensity for aggression scale adapted from Watson *et al*. (2007). This scale consists of 6 items; Cronbach's $\alpha = .72$, adapted from the Driver Behavior Questionnaire (Reason *et al*., 1990) using a 7-point Likert scale - Never to Always. For example "*Ridden especially close to the car in front as a signal to its driver to go faster or get out of the way"*. Reliability of the English version was tested and found to have high alpha values ranging from .63 to .79 for all items. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures translated to Malayalam from English version. Reliability coefficient was found to be 0.76 for this scale in Malayalam.

Attitude to Speeding Scale

Attitude to Speeding of drivers was assessed using Scale for attitude to speeding adapted from standardized speeding behavior scale of De Pelsmacker and Janssens (2006). In this study, the specific attitude to speeding was measured as a single measure with 17 questions, which include:

- Affective attitude towards speed limit.
- Attitude towards speeding.
- Attitude towards speed controls.
- Attitude towards accidents.
- Affective attitude towards speeding.

Reliability of the English version was tested and found to be high as alpha values ranged from .78 to .85 for all the items. For this study, a composite scale consisting of 17 items was used to measure attitude to speeding, for example "*Respecting the speed limits in the built-up area makes me nervous"*. Spearman-Brown formula for split half reliability coefficient was applied to evaluate the internal consistency of the measures translated to Malayalam from English version and reliability coefficient was found to be 0.73.

Section V: Data Collection

The Pilot Study

Prior to the main study, the investigator conducted a pilot study to rectify the shortcomings in the survey and the data collection process. This pilot study enabled the main study to have maximum control over minimizing the possible biases and prejudices. It also helped the investigator to minimize non-sampling errors and made the investigator confident with the skills necessary to conduct the survey and to administer the questionnaires. The following were the objectives of the pilot study.

1. To identify possible sources of errors such as non-sampling errors, this might occur in the process of communication, establishing good rapport with the respondents, clarity of statements, difficulty of items etc.
2. To empirically determine, the time taken for responding to the questionnaires, time taken for scoring them, so that the time schedule for the main study could be drawn with precision and accuracy.
3. To acquire adequate skills in conducting the survey, so that the expertise needed for survey could be attained.

4. To find out the reliability of the questionnaires used in this study. This is to ensure that the data to be collected in this investigation are of quality, free from errors, and worthy enough to use for testing the set hypotheses with much confidence.

The pilot study was conducted by administering, the Malayalam version of the standardized English scales to a small sample of 100 drivers, with a purpose of checking the reliability level of the chosen tools and to explore the possibility of noting any defective items. Based on the responses of the pilot study, the minor errors in the questionnaire and in the response sheets were rectified suitably to enable the researcher to administer the questionnaire booklet to the respondents while collecting the data. In order to avoid mental fatigue due to the volume of items in as many as 9 questionnaires, it was felt that the data collection process had to be arranged in two stages with break and refreshment in between. All the respondents were assured of anonymity and confidentiality of their responses.

Reliability of the Questionnaires

The reliability coefficient obtained for various instruments used in the pilot study are presented in the table (3) below. All the reliability coefficients were found to exceed the permissible levels and hence the instruments can be relied on for the purpose of the main investigation.

Table 3 Reliability Coefficients obtained for various scales.

Variable	Reliability coefficient
Dangerous driving behavior	0.79
Speeding behavior	0.71
Violation behavior	0.73
Attitude to speeding	0.73
Sensation seeking	0.70
Locus of Control	0.63
Type A/B behavior pattern	0.56
Hostility	0.68
Propensity to aggression	0.76

Data Collection Process

The dates for administration of a set of questionnaires for the licensing authority of each region had been fixed in advance with prior appointments and accordingly the respondents were requested to select their convenient date. The data collection started from one end of the state and moved to other end progressively for the duration of six to eight months. The Transport Commissioner, Head of the Kerala Motor Vehicle Department issued an order to all district officers to facilitate the data collection process in each station. As the researcher of this project is working as an officer in the State Motor Vehicle Department, he had obtained all the facilities to collect the required data from the respondents belonging to various stations. Incidentally, respondents had a chance to attend driver's training program too.

A questionnaire booklet was administered to each of the selected drivers who possessed a valid driving license from the 10 stations out of the 60 licensing authorities.

The licensing authorities were officially numbered from 1 to 60 in Kerala, starting with the capital city at the southern end and progressing to the northern end of Kerala; approximately 600 kilometers apart.

All the participants had valid driving licenses and drive regularly. All respondents were drawn from the list of drivers registered in the respective stations. Selected respondents were invited to sit in a comfortable room. The required data was collected with the consent of the drivers present, before starting the training program.

A small briefing about the research work was given to the respondents to create rapport and relieve their anxiety. They were informed that participation in this study is not compulsory and they could withdraw at any time even in-between the study. After explaining the importance of the research and necessity of objective data, questionnaires were distributed to the participants present in classrooms in a group of 20 to 30. Only a small number of the respondents denied the invitation and declined to participate. Around 500 drivers had completed the answer sheets and returned them to the investigator. All the participants were assured of anonymity, as there is no question about personal identity.

Due to the onset of fatigue in responding to all the items in 9 questionnaires it was felt that it would be better that the questionnaires were administered in two sets splitting as section-1 five questionnaires with an instruction sheet and section-2 four questionnaires. Initially the first five questionnaires were administered and then light refreshments were given to the participants and then the remaining four questionnaires were administered after the refreshment break.

Following the ethical standards of psychology, the investigator explained the purpose and details of the study with its social and economic relevance and the effort they have to put in. The participants were allowed to decide to participate or withdraw from this study at any stage of the study. The assured anonymity and importance of the study encouraged almost all the drivers to participate successfully except one or two in some stations. Five hundred drivers participated and completed the questionnaires out of the 550 invited.

The completed booklet of questionnaires was deposited in a box provided in the administration room. Before any statistical technique, the raw data had to be organized in such a way so that they are suitable for analysis. This is essential for ensuring that all relevant data are present for making contemplated comparison and analysis. Data was entered in excel format serially and coded and analyzed with SPSS 16 software.

Section VI: Statistical Techniques

The data collected were consolidated, coded, scored and entered into an excel spreadsheet for statistical analysis using SPSS 16 software. The efficient and objective analysis of data requires the use of suitable statistical techniques. The objective of this study is to find out the influence of selected psychological and personal variables on dangerous driving behavior, speeding behavior and violation behavior of traffic rules. The statistical techniques used for the analysis of data in this study are one-way ANOVA, post Hoc (Duncan test), Pearson Correlations, and Multiple linear Regression.

ANOVA - Analysis of Variance

ANOVA has been employed to find out if significant differences exist among three or more mean values. The basic principle of ANOVA is to test differences among the means of the sub groups, by examining the amount of variation between each of these

sub groups, relative to the amount of variation within these sub groups. Two estimates of population variance, one based on between groups and the other one based on with in groups, are made. Then these two estimates are used to compute the value F using the formula,

$$F = \frac{\text{Estimate of population variance based on between group variance}}{\text{Estimate of population variance based on within group variance.}}$$

If the obtained *F* value is equal to or exceeds the *F* limit Value, then it may be assumed that there are significant differences among the sample means. One way ANOVA is done when the sub groups are formed based on one factor (e.g. Age). In the present study, one way ANOVA was used to compare differences among the sub groups of different age, experience and education separately. One of the aims of the study was to test whether difference in age, experience and education level affects the dangerous driving behavior, speeding behavior and violation behavior of traffic rules. Hence, one way ANOVA was conducted with these three dependent variables separately in subgroups of different age, experience and education levels.

Post Hoc Test - Duncan's Method

Post hoc tests, also called multiple comparison tests, are used to determine the significant differences between group means taken in pairs, as a follow up of one way ANOVA. For example, when a significant *F* value has been obtained in one way ANOVA, the investigator often wishes to undertake further tests to determine which particular group means differ and which do not differ from other means. A number of procedures, generally known as multiple comparison techniques, can be employed for this purpose. Such procedures aim to retain the significance level at the required value when undertaking multiple tests. In other words, such tests ensure the researcher from claiming too many significant results; too many false positives.

In this study, we aim at knowing the significant difference of mean of each sub groups with different age, experience and education levels to test whether these independent variables affect the dangerous driving behavior, speeding behavior and violation behavior of traffic rules of drivers. Hence, post hoc test was used where a significant F value was obtained in one way ANOVA. A significant *F* test doesn't tell the details of the differences among the groups. So the Duncan test was used to get the details of the differences among the groups.

Pearson Product Moment Correlation

A correlation is a concomitant variation between two variables in such way that change in one is associated with change in the other. Correlation coefficient is a numerical index of the degree of relationship ranging from -1 to +1. The numerical size of the correlation coefficient is an expression of the strength of the relationship and sign of the correlation coefficient point to the direction of the relationship. Positive correlation indicates that a high standing on one variable is associated with high standing on the other variable. Negative correlation indicates that high standing one variable is associated with low standing on the other variable.

The most common technique for computing coefficient of correlation is the product moment method and it is used in this study to determine the nature and extent of the relationship of dangerous driving behavior, speeding behavior and violation behavior of traffic rules of drivers with selected personality variables and attitude to speeding.

Block Wise Multiple Regression

In multiple regression, a linear composite of explanatory variables is formed in such a way that it has maximum correlation with criterion variables. The technique is

appropriate when there is a single metric criterion variable, which is supposed to be a function of other explanatory variables. The main objective in using this technique is to predict the variability of the dependent variable based on its covariance with the entire independent variable. Using the regression analysis model, the scores on dependent variable can be predicted based on the scores on the independent variable.

In hierarchical (block wise) multiple regression analysis, the researcher determines the order that variables are entered into the regression equation. The researcher may want to control for some variable or group of variables. The researcher would perform a multiple regression with these variables as the independent variables. From this first regression, the researcher has the variance accounted for this corresponding group of independent variables. The researcher will run another multiple regression analysis including the original independent variables and a new set of independent variables. This allows the researcher to examine the contribution beyond the first group of independent variables.

Hierarchical regression adds variables to the regression model in stages. At each stage, an additional variable or variables are added to the model and the change in R^2 is calculated. A hypothesis test is done to test whether the change in R^2 is significantly different from zero. In fact, the computational procedures are the same as for stepwise regression. Hierarchical regression differs only in that the researcher decides on the order in which independent variables are entered and in that more than one independent variable can be entered at a time. Often change in R^2 statistic is of interest when you have a reason for adding independent variables, or blocks of them, in a particular order.

In this study, block wise multiple regression analysis was conducted separately for dependent variables such as dangerous driving behavior, speeding behavior and violation behavior of traffic rules of drivers for ascertaining their predictability on the basis of the entire set of psychological variables considered in the present study. In this study, predictor variables were entered block wise in the regression model for each criterion variable such as dangerous driving behavior, speeding behavior and violation behavior of traffic rules of drivers.

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Chapter IV

Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

This study attempts to explore the effect of various psychological and demographic factors on Dangerous Driving Behavior (DDB), self-reported Speeding Behavior (SB) and Violation Behavior towards Traffic Rules (VBTR). Dangerous driving behavior and the Speeding and Violation behavior of drivers were assessed using standardized self-reported questionnaires. Personality variables such as Locus of control, Sensation seeking, Type-A behavior pattern, Propensity to aggression, Hostility and Attitude to speeding behavior were also assessed using standardized scales.

Further, this study probed the effects of age, experience, and the level of education of drivers on driving behavior, relationships and influence of psychological variables on dangerous driving and speeding behavior**.** The data was analyzed using appropriate statistical methods such as descriptive analysis, ANOVA, correlation and hierarchical multiple regressions.

The results of the study are presented in the following sections.

Section I: Shows the effects of demographic variables on the dependent variable. The effects of age, experience and education level of drivers on Dangerous Driving, Speeding Behavior and Violation Behavior of traffic rules are explored using Analysis of Variance and post hoc tests

Section II: Explores the effects of Psychological variables on the dependent variable. The relationship between dependent variables and psychological variables

are investigated using correlation analysis. Hierarchical multiple regression analysis was employed to investigate the predictive capacity of the predictor variables on the criterion variable.

Section I: Effect of Demographic Variables

One of the aims of this study was to investigate the differences in Dangerous driving, Speeding behavior and Violation behavior towards traffic rules of drivers with respect to their Age, Experience and Education.

Analysis of Variance was conducted for Dangerous driving, Speeding behavior and Violation behavior towards traffic rules on each of the demographic variables.

Dangerous Driving

Age and dangerous driving. The sample was divided into four groups based on their age, such as 18-25 years, 26-35 years, 36-45 years and drivers whose age was greater than 46 years. The 18-25 years age group consisted of 232 drivers with a mean score of 63.74 (*SD* = 14.84) and the Shapiro-Wilk statistic was not significant (W=.990, $p > .05$). The age group 26-35 Years consisted of 146 drivers with mean score of 58.0, (*SD* = 12.00) and the Shapiro-Wilk statistic was not significant (W=.989, $p > .05$). The age group 36-45 years include 90 drivers with mean scores of 57.43 (*SD*=12.41), normality test Shapiro-Wilk statistic was not significant (W=.988 ($p > .05$). The age group 46 and above consisted of 32 drivers with mean score of 57.28 (*SD* = 14.86), and the Shapiro-Wilk statistic was not (W=.970, $p > .05$). Levene's statistic indicated that groups were homogeneous with regard to variance ($F_{(3,496)} = 1.49$, $p > .05$). Appendix C shows the descriptive analysis of data on Dangerous driving behavior by age.

Table 4. Summary of ANOVA of age groups based on Dangerous driving behavior

Sources of Variations	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	4471.577	3	1490.526		
Within Groups	92358.845	496	186.207	8.01	.000
Total	96830.422	499			

Table 4 shows the results of the one way ANOVA for dangerous driving behavior by age groups. The result showed that there were significant difference among the four age groups in dangerous driving behavior ($F_{(3,496)}$ = 8.01; $p <$ 0.01) and hence the hypotheses H:1.1 'There is significant difference in the dangerous driving behavior of drivers belonging to various age groups' is accepted.

Table 5. Summary of Post hoc test for age groups on Dangerous driving

Age	N	Subsets for alpha =0.05	
		1	2
46 Years and above	32	57.28	
36 - 45 Years	90	57.43	
26 - 35 Years	146	58.07	
18 - 25 Years	232		63.74
Sig.		.743	1.000

Result of ANOVA suggested that there were significant differences among age groups on Dangerous Driving Behavior of drivers. Result of the post hoc test presented in Table 5 showed the 18-25 age group (*M* =63.74, *SD*=14.84) have significant differences in Dangerous Driving with 26-35 years age group (*M*=58.07,*SD*=12.00), 36-45 years age group (*M*=57.43, *SD*=12.41) group and 46 years and above group(*M* =57.28, *SD*=14.86). Futher the Means for different age groups suggest that the youngest group indicated a

high level of dangerous driving behavior and the tendency to display this behavior reduced with increasing age. The post hoc test confirmed that age group of 18-25 years significantly differed with all the other groups in dangerous driving behavior. This finding suggests that the dangerous driving behavior of younger drivers was higher and reduced with age significantly.

The high level of accident involvement and death among younger drivers can be attributed to the high level of dangerous driving behavior found in this group. This finding has significant implications in road safety measures.

Dula and others (2008) reported that older drivers and female drivers tend to have low levels of DDDI scores which is consistent with international literature, suggesting that drivers seem to become more law abiding and less likely to indulge in risk taking when they grow older (Golias & Karlaftis, 2002). Elander, West and French (1993) noted that the observation of younger drivers having an increased crash involvement is indeed a robust finding, with studies consistently underlining the younger driver's greater risk at being involved in a traffic accident (Maycock *et al*., 1991; Stewart & Sanderson, 1984; Mayhew *et al*., 1981). This study found a significant effect of age on dangerous driving which concurred with previous studies. High dangerous driving behavior among younger drivers and a high number of accident deaths (Pedan *et al*., 2004) among these groups indicated that these groups have to be specifically targeted in road safety counter-measures.

This study revealed that younger groups showed maximum dangerous driving behavior that gradually decreases with age. Scores of the respondents on dangerous driving behavior showed that only 2.2% scored low (below 25%) in DDDI, 73% responded moderate (25 to 50%) and 27% high (50 to 75%) and no one had very high

scores (above 75 %). The scores in DDDI highlight the drivers' high inclination to dangerous driving. Compared to other age groups, younger groups were found to be more likely to underestimate the probability of the specific risks caused by traffic situations (Brown & Groeger, 1988; Deery, 1999) and to have a propensity to perceive themselves as invulnerable to negative outcomes (Millstein,1993). Sustainable road safety can be realized only through modification of driving behavior among existing drivers and changing the driver education system effectively for future drivers to address this problem.

Experience and dangerous driving. The group having 1 to 5 years' experience included 246 drivers with a mean score of 62.42 (*SD* = 14.72) and the Shapiro-Wilk statistic was not significant (W=.996, *p* >.05). The group with 5-10 years' experience consisted of 114 drivers with a mean score of 60.37 (*SD*=13.43) and the Shapiro-Wilk statistic was not significant (W=.984, *p* >.05). The third group with 10 - 20 years' experience included 110 drivers with a mean score of 57.10 (*SD*= 11.83) and the Shapiro-Wilk statistic was not significant (W=.986, >.05). The group with above 20 years of experience included 30 drivers with a mean score of 58.30 (*SD*=14.06) and the Shapiro-Wilk statistic was not significant (W=.968, *p* >.05). Levene statistic for homogeneity of variance indicated that groups were homogeneous with regard to variance ($F_{(3,496)} = 1.117$, $p > .05$). The descriptive analysis of data on dangerous driving behavior by experience is detailed in Appendix C.

Table 6. Summary of ANOVA of Dangerous Driving by Experience

Sources of variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	2323.822	3	774.607		
Within Groups	94506.600	496	190.538	4.06	.007
Total	96830.422	499			

Table 6 shows the results of ANOVA conducted for Dangerous driving on groups with different years of experience in driving. The results indicated that there were significant differences in dangerous driving behavior among groups of drivers with differences in experience ($F_{(3,496)} = 4.07$, $p < .01$) and hence the hypotheses H:1.2. 'There is significant difference in dangerous driving behavior of drivers, who have varied levels of driving experience' has been accepted.

Table 7. Summary of Post Hoc Test for Experience on Dangerous Driving Behavior

Experience	N	Subset for alpha = 0.05	
		1	2
10 - 20 years	110	57.10	
Above 20 years	30	58.30	58.30
5 - 10 years	114	60.37	60.37
1 - 5 years	246		62.42
Sig.		.181	.090

Results of the post hoc test presented in the Table 7 indicated that the Dangerous driving behavior scores of the group with 5-10 years' experience, the group with above 20 years of experience and the group with 10-20 years of experience were not significantly different. In subset 2, which included groups 1-5 years' of experience, 5-10 years' experience and above 20 years' experience were found not to differ significantly. Drivers who had 1 to 5 years' of experience significantly differed in dangerous driving behavior with those drivers who had 10 to 20 years of experience.

Machin and Sankey (2008) has shown that inexperienced drivers underestimate the risks associated with a range of driving situations. Yilmaz and Celik (2006) found that drivers having less than two years' experience demonstrated a positive attitude towards obedience to speed rules relative to those with over two years of experience.

Vassallo *et al*., (2010) indicated that most crashes had occurred when the cohort were less experienced drivers. These findings are in line with past research, which has linked driver inexperience to heightened rates of crash involvement (Cavallo & Triggs, 1996).

In this study, inexperienced drivers with 1 to 5 years of experience (M = 62.42, SD = 14.72) were higher on Dangerous Driving Profile, and groups with 10 to 20 years of experience reported the lowest mean (M = 57.10, SD = 11.82) in Dangerous driving. Lancaster and Ward (2002) found inexperienced drivers to be in the high-risk taking category. Engström *et al*. (2003) along with Triggs and Smith (1996) found that after almost 6 years of licensure, 40% of the sample had not experienced a crash while driving, and a similar percentage had not been detected speeding. The results of this study also suggest that inexperienced drivers were found to be high on dangerous driving behavior.

Education and dangerous driving behavior. The group with 7 to 10 years of education included 269 drivers with a mean score of 59.25 (SD = 14.66) and the Shapiro-Wilk statistic was not significant (W=.996, p >.05). The group with 12 years of Education consisted of 145 drivers with a mean score of 62.68 (SD = 13.46) and the Shapiro-Wilk statistic was not significant (W=.989, p >.05). The group of drivers with graduation includes 86 drivers with a mean score of 60.94 (SD = 11.88) and the Shapiro-Wilk statistic was not significant (W=.984, p >.05). The Levene statistic indicated that groups were homogeneous with regard to variance ($F_{(2,497)}$ = 1.492, p > .05). Detailed descriptive analysis of data on dangerous driving with regard to education levels is presented in Appendix C.

Table 8. Summary of ANOVA of Dangerous driving towards traffic rules with Respect to the Level of Education.

Sources of variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	1123.635	2	561.817		
Within Groups	95706.787	497	192.569	2.91	.055
Total	96830.422	499			

Table 8 shows the results of one-way ANOVA conducted for Dangerous driving on groups with different years of Education. The result indicated that there were no significant differences in Dangerous Driving Behavior among groups of drivers with differences in the years of Education received ($F_{(2,497)} = 2.91$, $p > .05$) and hence the hypotheses H: 1.3 'There is significant difference in dangerous driving behavior of drivers who have varied levels of education' has been rejected.

Norris *et al*., (2000) showed that those participants who had post-secondary education had more accidents than others did. However, the effect of education on motor vehicle accidents was not found to be significant once age was controlled. Macmillan (1975) also reported a failure to observe a significant relationship between education and accidents. Conversely, Dobson *et al*., (1999) observed that those women with tertiary education, in the mid age group (45-50 years), displayed a significantly higher accident risk, but education did not have an effect in the younger drivers' group (18-23 years).

The result indicated that there was no significant difference for Dangerous Driving Behavior among drivers with differences in their level of education. This suggests that drivers are similar in Dangerous Driving Behavior, irrespective of their level of education. The present investigation found that the dangerous driving behavior to

be high among drivers and the analysis found no significant differences among groups with different levels of education. Therefore, improvement in the present general education level of drivers cannot assure any significant improvements in road safety.

Speeding Behavior

Age and speeding behavior. The 18-25 year age group included 232 drivers with a mean score of 23.15 (*SD* = 5.974) and the Shapiro-Wilk statistic was not significant (W=.991, $p > .05$). The age group 26-35 years included 146 drivers with a mean score of 22.33 (*SD* = 6.18) and the Shapiro-Wilk statistic was not significant (W=.983, $p > .05$). The age group 36-45 years consisted of 90 drivers with a mean score of 21.54 (*SD* = 5.92) and the Shapiro-Wilk statistic was not significant (W=.992, $p > 0.05$). The age group 46 years and above included 32 drivers only with mean of scores 23.50 (*SD*=6.325) and the Shapiro-Wilk statistic was not significant (W=.946 ($p >.05$). The Levene's test indicated that the groups were homogeneous with regard to variance (F (3,496) = .323, $p >.05$). Descriptive analysis of data on speeding behavior by age is presented in Appendix C.

Table 9. Summary of ANOVA of Speeding Behavior with Respect to Age Groups

Sources of variations	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	205.359	3	68.453		
Within Groups	18149.559	496	36.592	1.87	0.134
Total	18354.918	499			

Table 9 shows the results of one way ANOVA depicting the differences in Speeding Behavior for different age groups. The result indicated that there were no

significant differences for speeding behavior among the age groups ($F_{(3,496)} = 1.87$, $p > .05$) and hence the hypothesis H: 2.1. 'There is significant difference in the speeding behavior of drivers belonging to various age groups' has been rejected.

Goldenbeld and Schagen (2007) observed that the preferred speed of young car drivers (18–25 years) was significantly higher than that of older car drivers (40–55 and 56+ years). At the same time, the preferred speed of 40–55 year old drivers was significantly higher than that of the group 56 and above. With regard to safe speed limits, the two youngest age groups differed significantly from the oldest age group with the latter group considering lower speed limits to be safe. Most of the literature reports significant effects for age on speeding behavior and crash involvement (Hatfield & Job, 2006). Many studies have shown younger drivers specifically under 34 years, are more likely to be speeders. In contrast, drivers over 55 years are less likely to be speeders (Fildes *et al*., 1991; Ogle, 2005; Williams *et al*., 2006). Stradling (2000) observed that, older drivers were less likely to have been penalized for speeding; the highest speeding offenders were aged between 21 and 40, whereas the lowest were for those drivers aged 60 years and above. Additionally, Ingram, Lancaster, and Hope (2001) reported that the likelihood of having broken the speed limit was highest in the 20 to 24 year old age group, and that this steadily declined with increasing age.

In the present study, it was clearly revealed that among the population studied, all age groups resort to speeding without any significant differences among them. This may be due to the high social approval of speeding as desirable, possible and not very unsafe. Hence, speed may be at the core of the road safety problem. Very strong relationships have been established between speed and both crash risk and crash severity

(Aarts & van Schagen, 2006; Elvik *et al*., 2004). Contrary to the majority of literature, results of the present investigation found that drivers in all age groups were speeding while driving. Elliot *et al*., (2004) also reported excessive driving speed for given road conditions is considered as one of the most important contributors to road crashes, regardless of driver age and skill level.

Speeding is considered as one of the major reasons for road accidents and for its tragic impacts. Results of this study showed there were no significant differences for Speeding Behavior among age groups; all age groups were similar in speeding behavior. The speeding behavior scores of respondents (*M*= 22.64, *SD*=6.06) showed high self-reported speeding behavior. It was found, from the scores of self-reported speeding behavior, that only 3.4 % drivers scored low in self-reported speeding behavior (below 25% scores), 32% scored moderate (25 to 50% scores), 59% scored high (50 to 75% scores) and 5.6% scored very high (above 75% scores) on self-reported speeding behavior. Since speeding behavior was found to be similar among all age groups, this would be a factor of significant implications. While addressing the road safety problems primary priority must be given for effective speed management.

Speeding behavior and experience. The group with 1 to 5 years of experience group consisted of 246 drivers with a mean of 22.81 (*SD*=6.36) and the Shapiro-Wilk statistic was not significant (W=0.991, $p > .05$). The group with 5-10 years of experience included 114 drivers with a mean of 22.45 (*SD*=5.94) and the Shapiro-Wilk statistic was not significant (W=.981, $p > .05$). The 10- 20 years' experience group included 110 drivers with a mean of 22.26 (*SD*=5.49) and the Shapiro-Wilk statistic was not significant (W=.987, $p > .05$). The group with above 20 years' experience consisted of

30 drivers with a mean of 23.37(*SD*=6.22) and the Shapiro-Wilk statistic was not significant (W=.968, p >.05). Levene statistic indicated that groups were homogeneous with regard to variance ($F_{(3,496)}$ = .971, p >.05). The descriptive analysis of data on speeding behavior by experience is detailed in Appendix C.

Table 10. Summary of ANOVA of Speeding Behavior with Respect to Years of Driving Experience

Sources of variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	43.014	3	14.338		
Within Groups	18311.904	496	36.919	0.39	.761
Total	18354.918	499			

Table 10 shows the results of ANOVA for Speeding behavior on groups with different years of experience in driving. The results indicated that there were no significant differences in Speeding behavior among group of drivers with varied level of driving experience ($F_{(3,496)}$ =.39; p >.05) and hence the hypotheses H:2.2 'There is significant difference in speeding behavior of drivers, who have varied levels of driving experience' has been rejected.

The consequences of speeding in terms of increasing, both the risk and severity of a crash has been well documented. For instance, the report of the New South Wales Centre for Road Safety (2008) shows that in 2007 speeding in New South Wales was a contributory factor in 32 percent of fatal crashes and 16 percent of all crashes resulted in injuries. Despite this finding, many motorists still do not consider speeding to be dangerous (Lieb & Wiseman, 2001) with the majority of drivers admitting to exceeding the speed limit at least occasionally by 10 km/h or more (Fleiter & Watson, 2005).

The present study indicated that drivers with different levels of experience resort to speeding behavior and there are no significant differences among different groups with low experience (1-5 years) to groups with 20 and above years of experience. A positive change in speeding behavior was expected due to experience based on learning due to consequences like involvement in accident, punishments received and the natural effect of maturity and skill acquired by experience. Foregoing results suggest that some or all of the expected mechanisms such as enforcement, education, experience and campaigns failed in bringing about the desired change effectively. This finding has a significant implication in designing future initiatives for road safety.

Speeding behavior and education. The group with 7 to 10 years of education included 269 drivers with a mean score of 22.36 (*SD*=6.02) and the Shapiro-Wilk statistic was not significant (W=.992, *p*>.05). The group with 12 years of education included 145 drivers with a mean of 22.48 (*SD*=6.366) and the Shapiro-Wilk statistic was not significant (W=.986, *p* >.05). The group with of graduate level of education consisted of 86 drivers with a mean of 23.79 (*SD*=5.605) and the Shapiro-Wilk statistic was not significant (W=.984, *p* >.05). Levene statistic indicated that groups were homogeneous with regard to variance ($F_{(2,497)}$ = .793, p >.05). Appendix C shows the detailed descriptive analysis of data on speeding behavior by education.

Table 11. Summary of ANOVA of Speeding Behavior with Respect to Level of Education

Sources of variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	138.223	2	69.111	1.89	.153
Within Groups	18216.695	497	36.653		
Total	18354.918	499			

Table 11 shows the results of one way ANOVA for Speeding behavior on groups with different education levels. The result indicated there were no significant differences in Speeding behavior among groups of drivers with differences in education ($F_{(2,497)} = 1.89$, $p>.05$) and hence the hypotheses H: 2.3. 'There is significant difference in the speeding behavior of drivers, who have varied levels of education' has been rejected.

Hatfield and Job (2006) found that the higher the level of education of the respondents, the higher was the likelihood to speed. Thus, while people with higher education appear to speed more, and are more likely to view speeding as safe, they also appear to be less tolerant of other speeding drivers than are people with lower levels of education. Lancaster and Ward (2002) reported that those with higher levels of education were more likely to report speeding. Those participants with tertiary level education, in the 45-50 age range, displayed a significantly higher accident risk, but education did not have an effect on the younger drivers. Shinar *et al*., (2001) found that the number of people who reported that they observed the speed limit, decreased with increasing levels of education. Hemenway and Solnick (1993) corroborated this finding and reported that, drivers with higher levels of education were more likely to report that they speed more than those drivers with lower levels of education.

The results of the present study suggested that the drivers in all the education groups with lower levels of education (7-10 year's schooling), 12 years of schooling and graduation level shows speeding behavior without any significant difference, it means that all of them resort to speeding. Self-reported speeding behavior scores of respondents' revealed that the majority had high scores in speeding behavior, and hence an inclination

to indulge in high speeding behavior. It was indeed a shocking revelation. In the light of these results, road safety counter-measures should have to consider more effective psychological behavior modification methods to address this problem.

Violation Behavior of Traffic Rules

Age and violation behavior of traffic rules. The 18-25 years age group consisted of 232 drivers with a mean of 32.74 (*SD*=7.02) and the Shapiro-Wilk statistic was not significant (W=.989, *p* >.05). The age group 26-35 years included 146 drivers with a mean score of 30.98 (*SD* =7.079) and the Shapiro-Wilk statistic was not significant (W=.987, *p* >.05). The age group 36-45 years included 90 drivers with a mean of 29.39 (*SD*= 8.107) and the Shapiro-Wilk statistic was not significant (W=.989, *p* >.05). The age group 46 years and above included 32 drivers with a mean of 30.84 (*SD*=8.919) and the Shapiro-Wilk statistic was not significant (W=.946, *p* >.05). The Levene statistic indicated that the groups were homogeneous with regard to variance ($F_{(3,496)}$=1.319, *p* >.05). Appendix C shows the descriptive analysis for violation behavior towards traffic rules by age groups.

Table 12. Summary of ANOVA for Violation Behavior towards Traffic Rules with Respect to Age

Sources of variations	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	809.493	3	269.831		
Within Groups	26977.507	496	54.390	4.96	.002
Total	27787.000	499			

The results of ANOVA depicted in Table 12 showed that there were significant differences ($F_{(3,496)}$ = 4.96; *p*<.01) in Violation behavior towards traffic rules among age groups and hence the hypothesis H: 3.1. 'There is significant difference in the violation

behavior of drivers belonging to various age groups' has been accepted. Post hoc test was conducted to reveal the homogeneity of means in Violation Behavior among different groups.

Table 13. Post hoc test for Age Groups on Violation Behavior

Age	N	Subset for alpha = 0.05	
		1	2
36 - 45 Years	90	29.39	
46 Years and above	32	30.84	30.84
26 - 35 Years	146	30.98	30.98
18 - 25 Years	232		32.74
Sig.		.216	.140

Table 13 indicated that groups listed in the same subset are not significantly different. Therefore, the Violation behavior scores of the 26-35 years group, the 46 and above group and 36-45 years group were not significantly different in violation behavior. In subset 2, 18-25 years group, 26-35 years group and 46 years and above group were found not to differ significantly. Post hoc comparisons showed drivers in 18-25 years age (*M*=32.74, *SD*=7.023) group significantly differed in Violation behavior towards traffic rules with the 36-45 years (*M*=29.39, *SD*=8.107) group. The Mean scores of violation behavior towards traffic rules indicated that the youngest age group had the highest level of violation behavior.

Forward (2009) indicated that young people were more likely to violate rules, which is in agreement with a large number of studies (Deery, 1999; Parker *et al*., 1992; Yagil, 1998). Studies have shown that young people believe that violations impress their friends (Rothe, 1990) and that for young men risky driving has become part of establishing their gender identity. In addition to this, Taubman-Ben-Ari, Florian, and Mikulincer (1999) found that young men use their vehicles to increase their self-

confidence. These studies indicated that violations are attractive and sought after among youngsters. This is a trend, which needs to be broken, and its symbolic interpretations need to be deconstructed.

Results of the present investigation showed that, in self-reported Violation behavior of traffic rules, only 1.8% drivers scored low (below 25%), 23.6% scored moderate (25% to 50%), 66.4% scored high (above 50% up to 75%) and 8.2% drivers who responded were found to be very high (above 75%). The mean value of Violation behavior (M = 31.50, SD = 7.46) also indicated a high score on Violation behavior.

One-way ANOVA of Violation behavior (VBTR) on age groups showed that there were significant differences in Violation behavior towards traffic rules among the groups. The Post hoc test revealed that drivers in the 18-25 years age group significantly differed in Violation behavior towards traffic rules with the 36-45 years age group. Drivers in the youngest age group, 18-25 years, scored the highest in Violation behavior towards traffic rules. The results suggested that the younger age groups were significantly higher in Violation behavior towards traffic rules. This finding has significant implications while deciding the age to issue licenses for drivers and to design road safety measures.

Violation behavior towards traffic rules and experience. The group with 1 to 5 years of experience included 246 drivers with a mean of 32.45 (SD=7.113) and the Shapiro-Wilk statistic was not significant (W=.993, p >.05). The group with 5-10 years of experience included 114 drivers with a mean of 31.49 (SD=7.481) and the Shapiro-Wilk statistic was not significant (W=.990, p >.05). The group with 10- 20 years of experience included 110 drivers with a mean score of 28.80 (SD=7.36) and the Shapiro-Wilk statistic was not significant (W=.986, p >.05). The group with above 20 years' experience included

30 drivers with a mean of 33.63 (*SD*=8.29) and the Shapiro-Wilk statistic was not significant (W=0.949, $p > 0.05$). Levene statistic for homogeneity of variance also indicated that the groups are homogeneous ($F_{(3,496)}$=.546, p >.05). Descriptive analysis of data on Violation behavior towards traffic rules by experience is presented in Appendix C.

Table 14. Summary of Anova for Violation Behavior towards Traffic Rules with

Sources of Variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	1161.027	3	387.009		
Within Groups	26625.973	496	53.681	7.21	.000
Total	27787.000	499			

Respect to Experience

Table 14 shows the results of one-way ANOVA for Violation behavior towards traffic rules on groups with different years of driving experience. The results indicated that there were significant differences in Violation behavior towards traffic rules among drivers with differences in experience ($F_{(3,496)}$ = 7.21, p<.01), hence the hypotheses H: 3.2. 'There is significant difference in the Violation behavior of drivers, who have varied levels of driving experience', has been accepted.

Table 15. Summary of Post hoc test for Violation behavior towards traffic rules on Experience

Experience	N	Subset for alpha = 0.05	
		1	2
10 - 20 years	110	28.80	
5 - 10 years	114		31.49
1 - 5 years	246		32.45
Above 20 years	30		33.63
Sig.		1.000	.097

Table 15 shows that the Violation behavior scores of groups with 1-5 years' experience, 5-10 years' of experience and above 20 years' of experience were not significantly different in Violation behavior. Moreover, in subset 1, there is only one group; 10 to 20 years of experience, therefore the group with 10 to 20 years of experience was found to be significantly different in Violation behavior when compared to the other groups with 1-5 years' experience, 5-10 years' experience and the above 20 years' experience group. The results of the present study showed that there were significant differences in violation behavior between groups with differences in driving experience. The highest mean score in violation behavior (*M*= 33.63, *SD*= 8.298) was found in the group with above 20 years of experience and this significantly varied with next lower group of 10 to 20 years' experience (*M*= 28.80, *SD*=7.362).

Machin and Sankey (2008) have shown that inexperienced drivers underestimate the risks associated with a range of driving situations. Lancaster and Ward (2002) found that inexperienced drivers were a high-risk group of drivers. Vassallo *et al*. (2010) indicated that most crashes had occurred when the cohort were less experienced drivers Likewise, the average number of crashes experienced had risen from 1.36 to 1.6 over this time period. Findings of Cavallo and Triggs (1996), Engström *et al*. (2003), and Triggs and Smith (1996) also linked driver inexperience to heightened rates of crash involvement.

Contrary to the above-cited research findings, the present investigation, based on the effect of experience on violation behavior, indicated that the experienced drivers reported more Violation behavior towards traffic rules in comparison with inexperienced drivers. Yilmaz and Celik (2006) found that drivers having experience of less than

2 years demonstrate a positive attitude towards obedience to speed rules relative to those experienced over 2 years. This finding suggests that as drivers get more experienced their self-confidence increases and they violate traffic rules.

Results of the present study showed that there were significant differences in Violation behavior towards traffic rules between groups and the group with highest experience showed higher violation behavior of traffic rules. Therefore, counter-measures for road safety should not be limited to novice drivers; experienced drivers also require follow-up training on safe driving.

Violation behavior towards traffic rules and education. The group with 7 to 10 years' education included 269 drivers with a mean of 31.09 (*SD*=7.874) and Shapiro-Wilk statistic was not significant (W=.997, $p > .05$). The group with 12 years of education consisted of 145 drivers with a mean of 33.12 (*SD* = 6.36) and the Shapiro-Wilk statistic was not significant (W=.990, $p > .05$). The graduate group included 86 drivers with a mean of 30.07 (*SD* =7.46) and the Shapiro-Wilk statistic was not significant (W=.993, $p > .05$). Levene statistic for homogeneity of variance indicated that the groups were homogeneous ($F_{(2,497)}=.793$, $p > .05$). Appendix C shows the details of descriptive analysis of data on Violation behavior towards traffic rules with respect to the level of education.

Table 16. Summary of ANOVA of Violation behavior towards traffic rules with respect to Education.

Sources of variation	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	601.378	2	300.689		
Within Groups	27185.622	497	54.699	5.50	.004
Total	27787.000	499			

Table 16 shows the results of ANOVA for Violation behavior towards traffic rules on groups with different levels of education. The result showed that there were significant differences in displaying violation behavior towards traffic rules among groups of drivers with differences in education ($F_{(2,497)}$ = 5.50, p<.01) and hence the hypotheses H: 3.3. 'There is significant difference in the violation behavior of drivers who have varied levels of education' has been accepted.

Table 17. Summary of Post Hoc Test for Education groups on Violation Behavior of Traffic Rules

Education	N	Subset for alpha = 0.05	
		1	2
Graduation	86	30.07	
7 to 10	269	31.09	
12 years	145		33.12
Sig.		.260	1.000

The results of the Post hoc test depicted in Table 17 indicated that the Violation behavior scores of the group with 7 to 10 years' schooling and the graduate group were not significantly different. In subset 2, the group with 12 years' schooling was placed and therefore, the group with 12 years' schooling was found to be significantly different in Violation behavior when compared with the group with 7 to 10 years' schooling and the graduate group.

The results of the present study showed that there is a significant difference in Violation behavior in groups with different levels of education. Maximum mean score in Violation behavior (M= 33.12; SD=6.36) was reported by 12 years' of schooling group and this significantly varied with the other two groups with 7 to 10 years' of schooling

and the graduates. Comparatively the group with the lowest level of education and the group with higher education showed less violation behavior and the middle group with 12 years' schooling reported significantly higher violation behavior.

Studies conducted by Beck, Wang and Mitchell (2006) found that young people with different levels of education significantly differed with regard to several aspects of their driving experiences and behaviors. Those with a university degree were less likely to have had their license cancelled or suspended than those with any other type of post-secondary educational qualification. However, those with only secondary education were more likely to have been fined or charged because of involvement in a crash. Yilmaz and Celik (2006) examined the effects of education, age and experience on driving behavior and found that, while 19-29 years age group takes the highest average value on violation to traffic rules, the lowest average value is for the 61 and older age group. Moreover, as for education level and experience, risk taking was not found to be significant.

The results of the present study indicated, significant differences for different levels of education on violation behavior of the drivers were observed. Drivers with low levels of education and drivers with graduation reported less violation behavior towards traffic rules in comparison with the group with 12 years of schooling and the differences observed were statistically significant.

Section II: Relationship between Dependent Variables and Psychological Variables

This section explores the relationship between dependent variables and psychological variables.

Table 18. Summary of Descriptive Statistics

Variable	Mean	SD	KS Z	*p*
Dangerous Driving	60.26	14.28	0.035	0.138
Speeding Behavior	22.64	6.06	0.026	0.150
Violation Behavior	31.78	7.06	0.034	0.150
Locus of Control	07.54	2.127	0.018	0.150
Type of Behavior Pattern	19.87	7.894	0.038	0.078
Sensation Seeking Behavior	09.31	3.20	0.015	0.150
Propensity to aggression	25.35	7.96	0.028	0.150
Attitude towards Speeding	58.43	9.81	0.019	0.150
Hostility	26.12	4.001	0.029	0.150

Note: KSZ: Kolmogrov-Smirnov Z

In parametric statistics, we begin with a test of the underlying assumptions. Our first assumption is the assumption of independence. This assumption was assessed through an examination of the design of the study. Prior to conducting the linear analysis, the normality test was conducted to ensure that the obtained data are normally distributed.

Table 18 shows the descriptive statistics of the variables in this study. The table reveals that, the distribution or the spread of data are normal for all psychological and dependent variables in which p-values were not statistically significant ($p>.05$). Similarly, on examining the normal probability plot for the constructs (Appendix B), the distribution of the plotted points are closely aligned in straight lines implying the linear association thus indicating the normal spread of data. In the case of the demographic variables, test of normality and homogeneity of variance has been conducted with ANOVA and reported for each case.

Correlation among Dependent variables and Psychological Variables

Table 19 depicts the results of correlation analysis of all the psychological variables of the study.

Table 19 Correlation Matrix of Driving Behavior with all Psychological Variables

Variable	1	2	3	4	5	6	7	8
Hostility(1)								
Attitude towards Speeding(2)	.154**							
Propensity to aggression(3)	.236**	.339**						
Sensation Seeking Behavior(4)	.325**	.255**	.488**					
Type of Behavior Pattern(5)	.144**	.261**	.339**	.350**				
External Locus of Control(6)	-.233**	-.189**	-.271**	-.165**	-.005			
Violation Behavior(7)	.203**	.401**	.358**	.344**	.277**	-.151**		
Speeding Behavior(8)	.085	.356**	.292**	.267**	.305**	-.065	.473**	
Dangerous Driving(9)	.298**	.320**	.591**	.477**	.348**	-.192**	.353**	.359**

Note: **p<0.01

Relationship of Dangerous Driving and Psychological Variables

Hostility and dangerous driving. Table 19 indicated that Dangerous driving behavior significantly and positively correlated with Hostility (r=.298, p<.01). Hence, hypothesis H: 4.1, 'Hostility is correlated significantly with dangerous driving behavior' has been accepted.

Hemenway and Solnick (1993) reported that road-hostility was positively related to dangerous driving behavior. Trait-hostility was among the best predictors of accidents in a study that included drivers between the ages of 19 and 88 years of age (Norris, Matthews, & Riad, 2000). Anger and hostility are constructs that are measured as

both stable emotional patterns and as transient dispositional states. Results are in line with the findings of previous studies that indicated a pattern of hostile, frustrated, and angry behavior being repeatedly linked to risky driving (Deffenbacher *et al*., 2001, 2002; Iversen & Rundmo, 2002). This study also suggests the dangerous driving behavior positively correlated with hostility and an increase in dangerous driving can be expected with hostility.

Propensity to aggression and dangerous driving. The results showed that Propensity to aggression (r=.591, p<.01), positively and significantly correlated with Dangerous driving behavior. Hence, the hypothesis, H: 4.2 'Propensity to aggression is correlated significantly with dangerous driving behavior' has been accepted.

Another construct, which emerged as a viable predictor of unsafe driving is trait driving anger or the propensity to become angry while driving; a context-specific version of trait anger. Findings of this investigation confirmed previous findings (Blanchard, Barton & Malta, 2000; Deffenbacher *et al*., 1994; Deffenbacher *et al*., 2000; Deffenbacher *et al*., 2003; Lajunen & Parker, 2001; Underwood *et al*., 1999). Deffenbacher and others (2003) found that drivers who display high trait anger drove in a more dangerous manner and driving faster than drivers with low trait anger in non-provoking traffic situations and were twice more likely to have collisions. Higher positive correlation of Propensity to aggression with Dangerous driving behavior found as a part of this study indicated an increase in Dangerous driving behavior with a propensity to become angered. This finding has important implications in designing counter measures against dangerous driving.

Sensation seeking behavior and dangerous driving. The results of correlation analysis depicted in Table 19 indicated that Sensation seeking behavior was significantly

and positively correlated with Dangerous driving (r=.477, p<.01). Hence, the hypothesis H: 4.3. 'Sensation seeking is correlated significantly with dangerous driving behavior' has been accepted.

Previous studies found links between sensation seeking and risky driving (Burns & Wilde, 1995; Jonah *et al*., 2001; Trimpop & Kirkcaldy, 1997). Iversen and Rundmo (2002) also reported a positive relationship between self-reported sensation seeking and risky driving behaviors. Several researchers have suggested that risky driving is motivated by a sensation-seeking thrill (Arnett, 1996; Jonah, 1997). Findings of the present study are in line with the previous studies indicating a positive relationship between Sensation seeking and Dangerous driving.

Type A behavior pattern and dangerous driving behavior. The results depicted in Table 19 showed that Type A behavior pattern significantly and positively correlated (r =.348, p<.01; Table 19) with Dangerous driving. Hence, the hypothesis H: 4.4. 'Type A behavior pattern is correlated significantly with dangerous driving behavior' has been accepted.

The present study found a significant positive relationship for Type A behavior pattern with dangerous driving behavior and it suggests an increase in Dangerous driving with Type A behavior pattern. Nabi and others (2005) found that after adjusting for potential confounders, the risk for serious RTAs increased proportionally with TABP scores. Type A personality showed a significant relation with traffic accidents, greater frequency of breaking traffic laws, higher impatience while driving, more displays of aggression on the road, and engaging in more risky driving behavior. When extreme Type A and Type B scores were compared, Type A drivers reported being involved in more motor vehicle accidents and reported displaying more aggression on the road (Perry & Baldwin, 2000).

External locus of control and dangerous driving. The results of correlation analysis depicted in Table 19 showed that there is significant negative correlation for External locus of control (r = -.192, p<.01) with dangerous driving, which suggests that, the higher the External locus of control, the lower is the propensity to indulge in dangerous driving. Therefore the hypothesis H: 4.5. 'External locus of control is correlated significantly with dangerous driving behavior' has been accepted.

However, research findings about Locus of control and traffic safety have been mixed. Arthur, Barrett, and Alexander (1991) found a positive relationship between Locus of control and accident involvement. Guastello and Guastello (1986) found no direct relationship between Rotter's locus of control scale scores and accidents. Several researchers (Hoyt, 1973; Phares, 1976; Williams, 1972) posited that an external locus of control is related to a lack of caution and failure to take precautionary steps to avoid unfavorable outcomes. The results of this study showed only a weak and negative relationship for external locus of control with dangerous driving. The finding suggests a slight decrease in dangerous driving with external locus of control.

Speeding behavior and dangerous driving. Table 19 indicated that Speeding behavior significantly and positively correlated (r =.359, p<.01; Table 19) with Dangerous driving. Therefore, the hypothesis H: 4.6 'Speeding behavior and dangerous driving behavior are correlated significantly' has been accepted.

Golias and Karlaftis (2002), by employing factor analysis revealed that speeding behavior is strongly related to other dangerous driving behaviors. Davey *et al*., (2006) found that those who engaged in Highway Code violations such as speeding, were also more likely to exhibit aggressive acts while driving. Driving violations were also linked

to reported speeding violations (Trantera & Warnb, 2008). There were significant negative causal relationships between obedience to speed rules and risky driver attitudes; indicating the more obedience to speed rules, the fewer risky driver attitudes (Yilmaz & Celik, 2006). The results of the present study found that Dangerous driving behavior positively correlated with speeding behavior and this finding suggests an increase in Dangerous driving behavior with speeding behavior.

Attitude towards speeding and dangerous driving. Result of correlation analysis showed that the Attitude towards speeding had a significant positive correlation (r =.320, p < .01) with Dangerous driving behavior. Hence the hypothesis, H: 4.7 'Attitude to speeding and dangerous driving behavior is correlated significantly' has been accepted.

Previous research also suggested attitudes towards speeding were strongly related to high-risk behavior in traffic and involvement in near accidents and accidents (Iversen & Rundmo, 2004; Warner & Aberg, 2006). Recently, Trantera and Warnb (2008) also found out a significant positive link between Attitude to speeding and speeding behavior.

Violation behavior (VBTR) and dangerous driving. Correlation analysis revealed that violation behavior was positively correlated with dangerous driving behavior (r =.353, p<.01). Therefore, the hypothesis H: 4.8 'Violation behavior (VBTR) and dangerous driving behavior are correlated significantly' has been accepted.

Yilmaz and Celik (2006) found violation of traffic rules was the strongest predictor for driving behavior. Mesken *et al*. (2002) found that drivers' involvement in passive accidents; where they are hit, is correlated with the drivers' self-reported tendency to commit interpersonal violations. The relationship between violations and crash involvement has also been widely researched, and the majority of findings showed

that those with a tendency to commit violations tend to be involved in more traffic accidents (Rothengatter, 2000; Lawton *et al*., 1997; Parker *et al*., 1995 a, 1995 b). Studies by Parker and others (1995 a, 1995 b) found that violations; behaviors that involve deliberate deviations from safe driving practice, correlated with both past and future accident rates.

Correlation for Speeding Behavior and Psychological Variables

Table 19 depicted the inter-correlations between Driving Behavior and other Psychological Variables. It indicated that Hostility and External locus of control were not having a significant relationship with Speeding behavior, all the other variables studied such as Propensity to aggression, Sensation seeking, Type A behavior pattern and Attitude to speeding were correlated significantly with the speeding behavior of drivers.

Attitude towards speeding and speeding behavior. The results of correlation analysis showed that Attitude towards speeding and Speeding behavior were significantly and positively correlated (r=.356, p < .01) Hence, the hypothesis H: 5.1 'Attitude to speeding is correlated significantly with speeding behavior' is accepted.

Several studies have illustrated the importance of investigating driver attitudes and beliefs in relation to risky driving (Parker *et al*., 1995; Prabhakar *et al*., 1996; Ulleberg & Rundmo, 2002). In a longitudinal study examining self-reported risky driving and traffic safety attitudes, Iversen (2004) found that drivers with more positive attitudes toward speeding were more frequently engaging in risky driving behavior. Trantera and Warnb (2008) found that Attitudes towards speeding were related to the level of interest in motor racing. Hatfield and Job (2006) found that people with negative attitudes toward speeding are less likely to do it. Warner and Aberg (2006) found Attitudes towards speeding were significant determinants of self-reported speeding. The present study

observed a relationship between Attitude towards speeding and self-reported Speeding behavior and this is in line with previous research findings and has significant implication in initiatives for road safety.

Speeding behavior and hostility. Correlation analysis revealed that Speeding behavior and Hostility had no significant relationship. ($r = .085$, $p < .01$). Hence, the hypothesis H: 5.2 'Hostility is correlated significantly with speeding behavior' has been rejected.

Among the various psychological factors investigated in relation to motor vehicle accidents, one particular factor, namely, road-hostility, road anger or road aggression, has received an increasing amount of attention in recent years (Hemenway & Solnick, 1993; Lajunen & Parker, 2001; Lowenstine, 1997; Underwood *et al*., 1999). However, this study did not find any significant correlation between hostility and Speeding behavior.

Propensity to aggression and speeding behavior. The results depicted in Table 19 showed that there is a significant positive correlation for Propensity to aggression with Speeding behavior ($r = .292$, $p < .01$). This suggests that speeding increases with propensity to aggression. Therefore, the hypothesis H: 5.3. 'Propensity to aggression is correlated significantly with speeding behavior' has been accepted.

Similar to the findings of the present study, several cross-cultural studies also have reported anger-prone drivers driving at faster speeds and with less speed limit compliance (Deffenbacher *et al*., 2002; Sullman, 2006). Ulleberg and Rundmo (2003) indicated that speeding positively correlated with anger. Drivers recall driving faster when angrier (Arnett, Offer & Fine, 1997; Gidron *et al*., 2003) and report having more

erratic speeds and uncooperative behaviors (Deffenbacher *et al*., 2002). The present study indicated a significant positive relationship between Propensity to aggression with Speeding behavior and was in line with previous research findings.

Sensation seeking behavior with speeding behavior. The results of correlation analysis presented in Table 19 revealed that there is a significant positive correlation between Sensation seeking behavior and Speeding behavior (r = .267, p < .01). Hence, the hypothesis H: 5.4 'Sensation seeking is correlated significantly with speeding behavior' has been accepted.

Speeding is likely to be exhibited by individuals who possess the personality trait known as Sensation seeking. Sensation seeking propensity has been found to correlate well with many risky driving behaviors including speeding (Jonah, 1997). Speeding violations were directly linked with sensation seeking propensity and having attitudes that endorsed speeding above the legal limit (Trantera & Warnb, 2008). The results of the present study indicated that Speeding behavior increases with Sensation seeking behaviors of the drivers and this personality dimension is important while designing speed management strategies.

Type A behavior pattern and speeding behavior. A significant relationship between Type A behavior pattern and Speeding behavior(r=.305, p < *.01*) was found from the correlation analysis. The result suggests that Speeding behavior increases with Type A behavior pattern and therefore the hypothesis H: 5.5 'Type A Behavior Pattern is correlated significantly with Speeding Behavior' is accepted.

Several studies suggest the drivers with Type A behavior pattern have a strong need to get from point A to point B quickly and also to get ahead of others in the traffic

flow (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987; West *et al*., 1993; Perry *et al*., 2000). Tay, Champness and Watson (2003) found that self-reported speeding behaviors were positively correlated with Type A behavior pattern. In line with the results of previous studies, the present study also indicated that Type A behavior pattern is significantly and positively correlated with Speeding behavior.

External locus of control and speeding behavior. No significant relationship between External locus of control and Speeding behavior (r = -.065, p >.05) was observed in the correlation analysis depicted in Table 19. The correlation was observed to be negative and weak. Hence, the hypothesis H: 5.6 'External locus of control is correlated significantly with speeding behavior' has been rejected.

Locus of Control (LOC) is one of the most crucial psychological factors determining a driver's behavioral adaptation, in general (Rudin-Brown & Noy, 2002). However, research findings about locus of control and traffic safety have been mixed. Arthur, Barrett, and Alexander (1991) found a positive relationship between locus of control and accident involvement while Guastello and Guastello (1986) found no direct relation between Rotter's locus of control scale scores and accidents. Özkan and Lajunen (2005) posited that the conflicting results could arise from both theoretical and methodological shortcomings, especially the one dimensionality of the locus of control scale. They claimed that the original two-factor structure based on internality and externality is too simple for catching different attributions of causes behind traffic accidents. The present study indicated that external Locus of Control does not significantly correlate with Speeding behavior.

Violation behavior with speeding behavior. Violation behavior (VBTR) was significantly correlated (r = .473, p < .01) with Speeding behavior as indicated in the results presented in Table 19. The finding suggests that speeding increases significantly with Violation behavior of traffic rules. Hence, the hypothesis H: 5.7 'Violation behavior (VBTR) is correlated significantly with speeding behavior' has been accepted.

According to Yilmaz and Celik (2006), Violation of traffic rules was the strongest predictor for accidents (γ = .87). There are significant negative causal relationships between obedience to speed rules and risky driver attitudes (γ = -.30). This finding indicated that the more obedience to speed rules, the fewer risky driver attitudes. Further, Manstead *et al*. (1992) found that speeding was perceived as the most prevalent among eight common driving violations. Rothengatter (2000), Lawton *et al*. (1997) and Parker *et al*. (1995 a, 1995 b) had already indicated that Violation behavior was related significantly and positively with speeding behavior. The results of the present study indicated that Violation behavior (VBTR) is significantly correlated with Speeding behavior of drivers and therefore suggests that drivers who resort to speeding also commit traffic violations.

Relationship of Violation Behavior with Psychological variables

Violation behavior towards traffic rules with hostility. The results of correlation analysis, presented in Table 19, showed that Violation behavior towards traffic rules significantly and positively correlated with Hostility (r = .203, p<.01). This suggests that an increase in Violation behavior towards traffic rules (VBTR) increases with Hostility. The hypothesis H: 6.1 'Hostility is correlated significantly with violation behavior (VBTR)' has therefore, been accepted.

Conger *et al*. (1959) concluded that one factor accounting for crash involvement was a reduced capacity to manage or control hostility. Tsuang and colleagues (1985) found that those involved in crashes generally displayed less control of hostility and anger. The results of the present study indicated an increase in Violation behavior with an increase in Hostility.

Violation behavior towards traffic rules and propensity to aggression. The results of correlation analysis indicated that Violation behavior towards traffic rules correlated significantly and positively with Propensity to aggression (r = .358 p < .01). This suggested an increase in violation behavior towards traffic rules with increased levels of Propensity to aggression. Hence, the hypothesis H: 6.2 'Propensity to aggression is correlated significantly with violation behavior (VBTR)' has been accepted.

Compared to non-aggressive drivers, aggressive drivers were more likely to be ticketed or cited for a traffic offence. Interestingly, aggressive drivers were less likely to report using their seat belts. Further, anger-prone drivers have reported driving at faster speeds and with less speed limit compliance (Deffenbacher *et al*., 2002; Sullman, 2006) as well as more near accidents, less concentration and reduced vehicular control while driving (Deffenbacher *et al*., 2001, 2002). In line with previous research findings (Dahlen & Ragan, 2004; Leal *et al*., 2009), the results of the present study also indicated a positive relationship between Violation behavior and the Propensity to aggression.

Violation behavior towards traffic rules and sensation seeking behavior. The result of correlation analysis presented in the table 19 showed that Violation

behavior towards traffic rules was correlated significantly and positively with Sensation seeking behavior ($r = .344$, $p < .01$). Therefore, the hypothesis H: 6.3 'Sensation Seeking is correlated significantly with Violation Behavior (VBTR)' has been accepted.

Sensation seeking propensity has been found to relate positively with accident involvement and traffic violations (Jonah, 1997; Quimby *et al*., 1999). Schwebel (2007) found sensation seeking to be strongly related with rule violations and tickets. These results sustained well after controlling for the effects of gender, age, and years of driving experience. The results of the present study also indicated an increase in violation behavior with increases in sensation seeking behavior.

Violation behavior towards traffic rules with Type A behavior pattern. Correlation analysis revealed that Violation behavior towards traffic rules correlated positively and significantly with Type A behavior pattern ($r = .277$ $p < .01$). This suggested that an increase in violation behavior towards traffic rules increases with Type A behavior pattern and hence, the hypothesis H: 6.4 'Type A behavior pattern is correlated significantly with violation behavior (VBTR)' has been accepted.

Previous studies (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987; West *et al*., 1993; Perry *et al*., 2000) reported that drivers with Type A personality were found to have higher rates of traffic violations crashes, prone to take more risks, drive more erratically and report higher incidents of aggressive driving and speeding. Such drivers typically have a strong need to get from point A to point B quickly and to get ahead of others in the traffic flow. Perry and Baldwin (2000) found Type A personality was significantly related to more traffic accidents, greater frequency of breaking traffic laws,

higher impatience when driving, more displays of aggression on the road, and engaging in more risky driving behaviors. The results of the present study also indicated an increase in Violation behavior with Type A behavior pattern.

Violation behavior towards traffic rules with external locus of control. Correlation analysis revealed low but significant negative correlation of Violation behavior towards traffic rules with External locus of control (r = -.151, p<.01) hence, the hypothesis H: 6.5 'External locus of control is correlated significantly with violation behavior (VBTR)' has been, accepted. This suggested a decrease in Violation behavior towards traffic rules with an increase in External locus of control.

Since, Locus of control (Rotter, 1966) a personality factor, suggests that drivers who believe outcomes are controlled by external forces or having Locus of control (e.g., events controlled by fate, not self), may be less likely to change behavior in response to outcomes (Walker, Stanton & Young, 2008). On the contrary, individuals with an internal Locus of control perceive outcomes to be dependent on their own skill, efforts or behavior. Guastello and Guastello (1986) found no direct relation between Rotter's locus of control scale scores and accidents. Holland, Geraghty and Shah (2010) found influence of LOC on driving behavior originally suggested that externally oriented persons are more likely to be involved in car accidents, as they would take fewer precautions to prevent road accidents. However, increased internal LOC has also been associated with risky driving style, perhaps due to drivers' belief in their own ability to avoid an accident (Arthur & Doverspike, 1992). Özkan and Lajunen (2005) using a traffic specific LOC scale (T-LOC) found that young drivers who attributed causes of accidents to their own behavior (internality) had been involved in accidents and

violations more frequently than those who attributed accidents to external factors (externality). The weak but significant negative correlation observed in the present study suggested a comparatively low reduction in violation behavior with an increase in externality and this is in line with the findings of Ozkan and Lajunen (2005), and Montag and Comrey (1987).

Violation behavior towards traffic rules with attitude towards speeding. The result of correlation analysis indicated Violation behavior towards traffic rules correlated positively with Attitude towards speeding (r = .203 $p<.01$) and hence, the hypothesis H: 6.6 'Attitude to speeding is correlated significantly with violation behavior (VBTR)' has been accepted. This suggested that an increase in Violation behavior towards traffic rules goes along with a positive Attitude towards speeding.

Several studies have illustrated the importance of investigating driver attitudes and beliefs in relation to risky driving (Parker *et al*., 1995; Prabhakar *et al*., 1996; Ulleberg & Rundmo, 2002). Iversen (2004) found that drivers with more positive attitudes toward rule violations and speeding were more frequently observed to engage in risky driving behavior, indicated by a high correlation between attitude towards rule violations and speeding. Trantera and Warnb (2008) found that speeding violations were directly linked to having attitudes that endorsed speeding above the legal limit. The present study results also concur with previous findings of increases in violation behavior towards traffic rules with positive attitude towards speeding. The above findings have practical implications while designing effective counter-measures against Violation behavior of traffic rules.

Hierarchical Multiple Regression Analysis Predicting Dependent Variables from Psychological Variables

Block wise regression analysis has been employed to evaluate the association of a single criterion variable and predicator variables. Therefore, block wise multiple regressions have been chosen to explore the variance generated by each additional variable entering into the model. In block wise multiple regression, the investigator adds variables to the regression model in stages. At each stage, an additional variable or variables are added to the model and the change in R^2 is calculated. In hierarchical (block wise) multiple regression analysis, the researcher determines the order in which variables are entered into the regression equation based on the strength of relationship between the predictors and the outcomes derived from review of literature.

In the interpretation of the regression output, multiple R square (R^2) was used to explain the proportion of the variance in the dependent, or criterion variables. The size of the standardised regression coefficient (β) for each independent variable in the regression equation relates to the size of the effect that variable has on the dependent variable. By standardising the coefficients, a comparison can be made, based on the magnitude of the coefficients in order to identify which variable has more of an effect on the regression model.

Influence of Psychological Variables on Dangerous Driving Behavior

Multiple regression analysis (block wise) using Dangerous driving behavior as the criterion variable and various psychological variables having a significant correlation with the dependent variables as predictors were employed to observe which variables better predicted Dangerous driving behavior.

Hierarchical multiple regression analysis was conducted in order to see to what degree the psychological variables contributed to the variance in Dangerous driving behavior. Psychological variables were entered into the regression model in six blocks. A summary of regression for predicting dangerous driving behavior is presented in Table 20.

Table 20. Summary of Hierarchical Multiple Regression Predicting Dangerous Driving from External Locus of Control, Type A Behavior Pattern, Sensation Seeking Behavior, Attitude Towards Speeding, Hostility and Propensity to Aggression

Model	Predictors	*β*	*t*	Sig.
1	(Constant)		31.034	.000
	External Locus of Control	-.192	-4.364	.000
2	(Constant)		23.720	.000
	External Locus of Control	-.190	-4.620	.000
	Type of Behavior Pattern(A/B)	.347	8.436	.000
3	(Constant)		16.117	.000
	External Locus of Control	-.128	-3.311	.001
	Type of Behavior Pattern(A/B)	.215	5.273	.000
	Sensation Seeking Behavior	.380	9.213	.000
4	(Constant)		7.689	.000
	External Locus of Control	-.102	-2.631	.009
	Type of Behavior Pattern(A/B)	.181	4.424	.000
	Sensation Seeking Behavior	.355	8.629	.000
	Attitude towards Speeding	.163	4.073	.000

Model	Predictors	*β*	*t*	Sig.
5	(Constant)		4.063	.000
	External Locus of Control	-.079	-2.027	.043
	Type of Behavior Pattern(A/B)	.176	4.343	.000
	Sensation Seeking Behavior	.321	7.601	.000
	Attitude towards Speeding	.158	3.976	.000
	Hostility	.126	3.131	.002
6	(Constant)		3.007	.003
	External Locus of Control	-.008	-.226	.822
	Type of Behavior Pattern(A/B)	.108	2.843	.005
	Sensation Seeking Behavior	.179	4.344	.000
	Attitude towards Speeding	.089	2.400	.017
	Hostility	.112	3.055	.002
	Propensity to aggression	.408	9.729	.000

Note: Model 1: F (1,498) = 19.05**, Adj. R^2 = .035;
Model 2: F (2,497) = 46.45**, Adj. R^2 = .154;
Model 3: F (3,496) = 64.48**, Adj. R^2 = .276;
Model 4: F (4,495) = 54.03**, Adj. R^2 = .298;
Model 5: F (4,495) = 45.95**, Adj. R^2 = .311;
Model 6: F (6,493) = 61.33**, Adj. R^2 = .420;
**p < .01

In the first stage External locus of control alone was entered and was found to be in significant negative relationship with Dangerous driving behavior (β= -.192, t= -4.364, p<.01).

In the second stage, Type A behavior pattern was included in the model and it showed a significant positive association (β = .347, t=8.436, p<.01) with dangerous driving and 15.4 % of the variance (*Adj.* R^2 = .154) was accounted by these two variables in dangerous driving.

In the third stage, Sensation seeking personality was introduced to the model and a significant positive relationship (β=.380, t=9.213, p<.01) with dangerous driving was indicated with an increase in adjusted R^2 (*Adj.* R^2 = .276) and 27.6 % of the variance was accounted by these three variables.

In the fourth stage, Attitude to speeding was added to the model which showed a significant positive association (β=.163, *t*=4.073; *p*<.01) with dangerous driving. Altogether 29.8 % of the variance (*Adj.* R^2 = .298) was accounted for by these four variables.

In the fifth stage hostility was included in the model and it showed significant positive association (β=.126, *t*=3.131, *p*<.01) with dangerous driving. Significance for external locus of control was gradually reduced in each block and was fully lost (β= -.079, *t*=-2.027, *p*>.01) in this stage. Altogether 31.1% of the variance (*Adj.* R^2 = .311) was accounted for by these five variables.

Finally, propensity to aggression was included and a significant association (β =.408, *t*=9.729, *p*>.01) with dangerous driving behavior was indicated.

Overall, the final model of regression analysis demonstrated 42% of the variance in dangerous driving (Model 6: $F_{(6,493)}$ = 61.33, *p*<.01, *Adj.* R^2 = .420). This variance can be accounted by Propensity to aggression (β =.408, *t* = 9.729, *p*<.01), Sensation seeking behavior (β=.179, *t* = 4.344, *p*<.01), Hostility (β= 0.112, *t* = 3.055, *p*<.01), Type A behavior pattern (β= 0.108, *t* = 2.843, p<.01) and Attitude towards speeding (β=.089, *t* = 2.400, *p*<.05).

The results of multiple regressions showed that external locus of control had no direct influence and the influence is through sensation seeking behavior, propensity to aggression and hostility. Therefore, it can be inferred that among six dimensions influencing Dangerous driving behavior, Propensity to aggression, Sensation seeking

behavior, Hostility, Type A behavior pattern and Attitude towards speeding are better predictors of Dangerous driving behavior and accounted for 42 % of the variance in Dangerous driving behavior. The results of the regression analysis indicated that out of six variables tested as predictors, five variables predicted Dangerous driving behavior of drivers significantly. Therefore, the hypothesis H: 7 'The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can significantly predict dangerous driving behavior' is accepted partially.

Propensity to aggression. Findings of this study revealed that propensity to aggression as a strong predictor of dangerous driving behavior and concurred with the results of previous studies. Anger prone drivers have reported more near accidents, less concentration and reduced vehicular control while driving (Deffenbacher *et al*., 2001, 2002). Deffenbacher, Lynch, and Richards (2003) found drivers displaying high trait anger driving in a more dangerous manner, maintaining shorter time headways and being faster than drivers with low trait anger in non-provoking traffic situations and were twice more likely to have collisions.

A recent study by Deffenbacher (2009) reported drivers with a high level of anger are more easily angered on the road, engage in more aggressive and risky behaviors, and are at risk for some accident and injury related outcomes. A driver's ability to control anger is crucial, along with his or her general ability to control emotions. Anger is an acute emotional reaction elicited in traffic by situations often perceived or misinterpreted by the driver as a response to deliberate provocations by other drivers (Björklund, 2007). The results of multiple regression analysis in the present study found that propensity to

aggression significantly influencing dangerous driving behavior. Leal and Pachana (2009), and Dahlen & Ragan (2004) observed similar findings. Therefore, attempts to modify Dangerous driving behavior of drivers should necessarily address the propensity to become angry while driving.

Sensation seeking behavior. Multiple regression analysis revealed that sensation seeking behavior was significantly associated with and was able to predict dangerous driving behavior. Sensation seeking is defined as the desire for and engagement in varied, arousing, novel and complex sensations and experiences (Zuckerman, 1984, 1994). It has been linked to risky driving behavior in empirical research (Jonah, 1997). A typical characteristic of sensation seeking is the willingness to accept risks for the sake of arousing experiences, and as such, sensation seeking is closely linked to risky driving (Jonah, 1997; Jonah *et al*., 2001). White and Dahlen (2001) found that sensation seeking added significantly for predicting risky and aggressive driving; independent of anger, while driving (Dahlen *et al*., 2005). Jonah *et al*. (2001) reported links between self-reported sensation seeking and risky driving behaviors. The present study concurred with the results of previous studies and found sensation seeking to be able to significantly predict dangerous driving behavior.

Hostility. Results of multiple regression analysis showed that hostility was one of the significant predictors of dangerous driving behavior. Road hostility was found to be related to dangerous driving behavior (Hemenway & Solnick, 1993). Lancaster and Ward (2002) found aggressive drivers, or those with a reduced capacity to manage or control hostility tend to be involved in more traffic accidents. Anger and hostility are constructs measured both as stable emotional patterns and as transient dispositional states. Whether considered

as states or traits, the tendency toward hostile, frustrated, and angry behavior is repeatedly linked to risky driving (Deffenbacher *et al*., 2001, 2002; Iversen & Rundmo, 2002). The results of the present study; hostility predicts dangerous driving behavior, are in line with previous studies.

Type A behavior pattern. Multiple regression analysis revealed the association of Type A behavior pattern with Dangerous driving behavior. Drivers with Type A personality were found to have higher rates of traffic violations, crashes, tend to take more risks, drive more erratically and reported higher incidents of aggressive driving and speeding. These drivers typically have a strong need to get from point A to point B quickly and tend to get ahead of others in the traffic flow (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987; West *et al*., 1993; Perry *et al*., 2000). The present study findings show a similar pattern in relation to previous studies where Type A behavior significantly predicted dangerous driving behavior.

Attitude towards speeding. Regression analysis indicated that attitude towards speeding significantly influences dangerous driving behavior. Iverson & Rundmo (2004) found that attitudes towards speeding were strongly related to high-risk behavior in traffic and involvement in near accidents and accidents. Warner and Aberg (2006) also identified a link between attitudes towards speeding and accident involvement. The results of the present study found low but significant associations for attitudes towards speeding and dangerous driving behavior.

The final model of regression analysis with dangerous driving behavior as the criterion variable and psychological variables as predictors accounted for 42 % of the total variance in Dangerous driving. This variance in Dangerous driving behavior was

accounted by the influence of Propensity to aggression, Sensation seeking behavior, Hostility, Type A behavior pattern and Attitude towards speeding. Hence, these predictor variables are important while designing effective counter-measures for dangerous driving behavior.

Multiple Regressions Analysis for Speeding Behavior

Block wise multiple regression analysis was conducted with self-reported speeding behavior as the criterion variable and other psychological variables having significant correlation with the criterion variable as predictors in six blocks to explore which of the variables better predict speeding behavior. The results are presented in Table 21 and discussed in the following section.

Table 21. Summary of Hierarchical Multiple Regression Analysis Predicting Speeding Behavior from External Locus of Control, Type of Behavior Pattern, Sensation Seeking Behavior, Attitude towards Speeding, Hostility and Propensity to Aggression

Model	Predictors	β	t	Sig.
1	(Constant)		24.063	.000
	External Locus of Control	-.065	-1.446	.149
2	(Constant)		17.684	.000
	External Locus of Control	-.063	-1.482	.139
	Type of Behavior Pattern(A/B)	.305	7.144	.000
3	(Constant)		12.701	.000
	External Locus of Control	-.034	-.803	.423
	Type of Behavior Pattern(A/B)	.243	5.403	.000
	Sensation Seeking Behavior	.177	3.883	.000
4	(Constant)		3.870	.000
	External Locus of Control	.010	.249	.804
	Type of Behavior Pattern(A/B)	.186	4.214	.000
	Sensation Seeking Behavior	.134	3.019	.003
	Attitude towards Speeding	.276	6.377	.000

Model	Predictors	β	t	Sig.
5	(Constant)		3.428	.001
	External Locus of Control	.005	.120	.905
	Type of Behavior Pattern(A/B)	.187	4.234	.000
	Sensation Seeking Behavior	.142	3.087	.002
	Attitude towards Speeding	.277	6.395	.000
	Hostility	-.029	-.669	.504
6	(Constant)		3.087	.002
	External Locus of Control	.025	.569	.570
	Type of Behavior Pattern(A/B)	.168	3.756	.000
	Sensation Seeking Behavior	.103	2.108	.036
	Attitude towards Speeding	.258	5.872	.000
	Hostility	-.033	-.754	.451
	Propensity to aggression	.112	2.261	.024

Note: Model 1: F (1,498) = 2.091^{ns}, Adj. R^2 = .002;
Model 2: F (2,497) = 26.66**, Adj. R^2 =. 093;
Model 3: F (3,496) = 23.30**, Adj. R^2 = .118;
Model 4: F (4,495) = 29.04**, Adj. R^2 = .184;
Model 5: F (4,495) = 23.29**, Adj. R^2 = .183;
Model 6: F (6,493) = 20.42**, Adj. R^2 =.189;
**p < .01

Regression analysis was conducted in six blocks to explore the extent to which the various psychological variables contributed to the variance in speeding behavior. In the first stage External locus of control was introduced and the result of regression showed (β= -.065, t = -1.446, p>.05) no significant influence of External LOC in the variance of Speeding behavior (*Adj*. R^2 = .002).

In the second stage Type A behavior pattern was included and results showed a significant association (β= .305, t =7.144, p<.01) with the criterion variable and explained 9% variance of speeding behavior (*Adj*. R^2 = .093).

Sensation seeking behavior was included in the third stage and it contributed (β=.177, t=3.883, p<.01) to speeding behavior significantly and added 2.8% variance (*Adj.* R^2 = .118) and explained 11.8% of the total variance.

The fourth stage introduced attitude towards speeding as a predictor and was found to significantly influence (β= .276, t = 6.377, p<.01) Speeding behavior and accounted for the total variance of 18.4% with an addition of 6.6% variance (*Adj. R2* = .184).

In the fifth stage hostility was introduced and the results indicated no significant influence (β= -.029, t = -.669, p>.05) on speeding behavior (*Adj.* R^2 = .183). Introduction of hostility did not account for the variance in speeding significantly and reduced the variance slightly (.1%).

Finally, propensity to aggression was entered in the model at the sixth stage and the results indicated that the propensity to aggression (β = .112, t = 2.261, p<.05) had a low but significant association with speeding behavior and overall explained 18.9% of the variance in speeding behavior (Model 6: $F_{(6,493)}$ = 20.42, p<.01; *Adj.* R^2 =.189).

The regression analysis indicated that Attitude towards speeding (β =.258, t = 5.872 p<.01), Type A behavior pattern (β =.168, t = 3.756, p<.01), Propensity to aggression (β =.112, t = 2.261, p < 0.05), Sensation seeking behavior (β =.103, t = 2.108, p<.05) were significant predictors of speeding behavior among the psychological variables investigated. The above variables explained 18.9% of the variance in speeding behavior. Introduction of hostility in the model was not found to account for the variance in speeding significantly and it reduced the variance slightly (0.1%). No significant influence was detected for external LOC in the variance of speeding behavior. Therefore, it can be inferred that among six predictors tested for influencing Speeding behavior,

Attitude towards speeding, Type A behavior pattern, Propensity to aggression and Sensation seeking behavior were better predictors of Speeding behavior. Hence, the hypothesis H:8 'The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can significantly predict speeding behavior' is accepted partially.

Attitude towards speeding. The present study indicated that certain key psychological variables including attitude towards speeding significantly influenced speeding behavior. Warner and Aberg (2006) found that specific attitudes to speeding significantly predicted self-reported speeding. Hatfield and Job (2006) indicated that people with negative attitudes toward speeding are less likely to do it. Numerous studies have reported that the positive attitude to speeding is a strong predictor of speeding and crash involvement (Warner & Aberg, 2006; Flieter & Watson, 2006; Trantera &Warnb, 2008; Hatfield &Job, 2006). The findings of the present study also indicated that positive attitude towards speeding was instrumental in significantly predicting self-reported speeding behavior of drivers. The finding has significant implications in attempting to address speeding behaviors and implementing effective road safety campaigns and trainings.

Type A behavior pattern (TABP). Drivers with Type A personality were found to drive more erratically and reported higher incidents of aggressive driving and speeding (Tay *et al*., 2003). Results of the present study indicated that Type A personality significantly predicted self-reported speeding behavior of drivers. Drivers with the Type A behavior pattern have a strong need to get from point A to point B quickly and also to get ahead of others in the traffic flow (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987;

West *et al*., 1993; Perry *et al*., 2000). The present study findings have practical implications for improving road safety, while planning for education and training of new drivers and in correction training for existing drivers.

Propensity to become angry. Another construct that emerged as a viable predictor of unsafe driving was the propensity to become angry while driving; a context-specific version of trait anger. The results of the present study found that the propensity to become angry while driving was influencing and significantly predicting speeding behavior. Previous studies have reported that anger prone drivers drive at faster speeds and with less speed limit compliance (Deffenbacher *et al*., 2002; Sullman, 2006; Amanda *et al*., 2009, Mesken *et al*., 2007). The results of the regression analysis in the present study indicated that propensity to become angry while driving significantly predicted self-reported Speeding behavior among drivers. While designing effective counter-measures to address Speeding behavior this finding has significant implications.

Sensation seeking and speeding. Sensation seeking is one of the personality traits frequently studied in relation to driving behavior and traffic accident involvement. Trantera and Warnb (2008) indicated that Speeding violations were directly linked to sensation seeking propensity. Speeding behavior is likely to be exhibited more frequently by individuals who possess the personality trait, sensation seeking (Jonah, 1997). Tay *et al*. (2003) found that Sensation seeking might be a slightly better predictor of speeding behavior than Type A personality. The results of regression analysis in the present study confirmed that Sensation seeking behavior significantly predictied self-reported Speeding behavior. The result of this study has practical implications in planning and implementing measures for road safety effectively.

Among the six dimensions tested for predicting Speeding behavior, Attitude towards speeding, Type A behavior pattern, Propensity to aggression and Sensation seeking behavior were better predictors of Speeding behavior and these predictor variables explained 18.9% of the variance in Speeding behavior of drivers.

Multiple Regressions for Violation Behavior

Block wise multiple regression analysis was conducted with Violation behavior as the criterion variable and other psychological variables that were having significant correlation with the dependent variables, as predictor variables, in six blocks to investigate which of the variables were better predictors of speeding behavior. The results of the regression analysis are presented in Table 22.

Table 22. Summary of Hierarchical Multiple Regression Predicting Violation Behavior (VBTR) from External Locus of Control, Type of Behavior Pattern, Sensation Seeking Behavior, Attitude towards Speeding, Hostility and Propensity to Aggression

Model	Predictors	*β*	*t*	Sig.
1	(Constant)		29.171	.000
	External Locus of Control	-.151	-3.420	.001
2	(Constant)		22.373	.000
	External Locus of Control	-.150	-3.526	.000
	Type of Behavior Pattern(A/B)	.276	6.477	.000
3	(Constant)		15.886	.000
	External Locus of Control	-.107	-2.563	.011
	Type of Behavior Pattern(A/B)	.184	4.183	.000
	Sensation Seeking Behavior	.262	5.872	.000
4	(Constant)		5.515	.000
	External Locus of Control	-.058	-1.439	.151
	Type of Behavior Pattern(A/B)	.122	2.845	.005
	Sensation Seeking Behavior	.215	4.996	.000
	Attitude towards Speeding	.303	7.239	.000

Model	Predictors	*β*	*t*	Sig.
5	(Constant)		3.344	.001
	External Locus of Control	-.047	-1.135	.257
	Type of Behavior Pattern(A/B)	.119	2.790	.005
	Sensation Seeking Behavior	.198	4.442	.000
	Attitude towards Speeding	.301	7.179	.000
	Hostility	.064	1.511	.131
6	(Constant)		2.924	.004
	External Locus of Control	-.023	-.544	.587
	Type of Behavior Pattern(A/B)	.096	2.223	.027
	Sensation Seeking Behavior	.150	3.174	.002
	Attitude towards Speeding	.277	6.548	.000
	Hostility	.059	1.415	.158
	Propensity to aggression	.138	2.891	.004

Note: Model 1: F (1,498) = 11.69 **, Adj. R^2 = .021;
Model 2: F (2,497) = 27.306**, Adj. R^2 = .095;
Model 3: F (3,496) = 30.922**, Adj. R^2 = .152;
Model 4: F (4,495) = 38.69 **, Adj. R^2 = .232;
Model 5: F (4,495) = 31.49 **, Adj. R^2 = .234;
Model 6: F (6,493) = 28.02 **, Adj. R^2 = .245.
**p< .01

Multiple regression analysis was conducted for Violation behavior towards traffic rules with various psychological variables as predictors in six blocks to explore the influence of psychological variables in Violation behavior towards traffic rules.

In the first stage External locus of control was introduced and the result of regression showed a significant negative influence (β=-.151, t = -3.420, p<.01) of LOC on Violation behavior towards traffic rules (*Adj.* R^2 = .021) explaining for 2.1% of the variance.

In the second stage Type A behavior pattern was included and a significant influence (β= .276, t = .477, p<.01) in Violation behavior towards traffic rules explained 9.5% of the variance (*Adj.* R^2 = .095).

Sensation seeking behavior was included in the third model and the results revealed a significant association (β= .262, t = 5.872, p<.01) with Violation behavior

towards traffic rules was observed. It accounted for 5.7 % of the variance, explaining 15.2% (*Adj.* R^2 = .152) of the total variance in Violation behavior.

The fourth stage introduced Attitude towards speeding variable and it indicated a significant influence (β=.303, t = 7.239, p<.01) in Violation behavior towards traffic rules and explained for 23.2 % of the total variance (*Adj.* R^2 = .232) and an 8 % unique contribution to the variance. External locus of control reduced and lost its significance in the third block, which indicated that its effect is not direct but mediated through Sensation seeking and Attitude towards speeding.

In the fifth stage Hostility was introduced and was found to have no significant influence (β=.064, t =1.511, p>.05) in Violation behavior towards traffic rules.

Finally, Propensity to aggression was entered in the sixth stage and it indicated a significant contribution to the variance (β=.138, t =2.891, p<.01) in Violation behavior. The final model accounted for 24.5 % of the total variance in violation behavior towards traffic rules (Model 6: $F_{(6,493)}$ = 28.02, p<.01, *Adj.* R^2 =.245).

Regression analysis found Attitude towards speeding (β =.277, t = 6.548, p<.01), Sensation seeking behavior (β =.150, t = 3.174, p<.01), Propensity to aggression (β =.138, t = 2.891, p<.01) and Type A behavior pattern (β =.096, t = 2.223, p<.05), were significant predictors of Violation behavior of traffic rules. External LOC (β =.023, t = .544, p>.05) and Hostility (β =.059, t = 1.415, p>.05) did not significantly contribute to the variance in Violation behavior towards traffic rules.

Therefore, among the six dimensions tested for predicting Violation behavior towards traffic rules, Attitude towards speeding, Sensation seeking behavior, Propensity

to aggression and Type A behavior pattern, were better predictors of Violation behavior towards traffic rules. External LOC had no direct influence but influenced the criterion variable through Attitude to speeding and Sensation seeking behavior. Hostility was not a significant predictor of Violation behavior towards traffic rules. The result of the regression showed, four out of six variables predicted Violation behavior towards traffic rules of drivers. Hence the hypothesis H:9 'The select psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can significantly predict the violation behavior of traffic rules (VBTR) of drivers' is accepted partially.

Attitude towards speeding. The present findings indicated that a positive attitude towards speeding emerged as a strong and significant predictor of violation behavior towards traffic rules. Several studies have illustrated the importance of investigating driver attitudes and beliefs in relation to risky driving (Parker *et al*., 1995; Prabhakar *et al*., 1996; Ulleberg & Rundmo, 2002). Iversen (2004) found that drivers with more positive attitudes toward rule violations and speeding more frequently engaged in risky driving behavior. Forward (2009) reported that attitudes made the largest contribution for driving violations. Studies by Hatfield and Job (2006) indicated that people with negative attitudes toward speeding are less likely to speed and more likely to support heavy penalties for those who speed. Trantera and Warnb (2008) indicated a significant relationship between attitudes to speeding and speeding violations.

The result of the multiple regression analysis found that a positive Attitude towards speeding significantly predicted Violation behavior towards traffic rules.

Therefore, attempts to improve traffic rule obedience has to address speed specific attitudes. Road safety campaigns and trainings should consider change in attitude for a sustainable change in violation behavior.

Sensation seeking and violation behavior. The results of the regression analysis indicated that sensation-seeking behavior significantly predicts violation behavior of traffic rules. Sensation seeking is defined as the desire for and engagement in varied, novel, arousing and complex sensations and experiences (Zuckerman, 1984, 1994) and is consistently linked to risky driving behavior in empirical research (Jonah, 1997). Gregersen (1996) and Williams (1997) reported that sensation seekers drive very often without a safety belt and under the influence of alcohol. Sensation seeking has been demonstrated in numerous studies to be linked with risky driving, positive attitudes to speeding and increased accident rates (Arnett, 1996; Desrichard & Denarie, 2005; Jonah, 1997; Whissell & Bigelow, 2003). Trantera and Warnb (2008), and Vanlaar *et al*. (2007, 2008) reported that the higher the levels of sensation seeking, the more speeding tickets received in the past 3 years and the more number of crashes in the past 3 years. Schwebel (2007) found among a sample of older drivers, that sensation seeking seemed to be strongly related to violations and speeding tickets.

The regression analysis showed that sensation seeking behavior significantly predicted the violation behavior of traffic rules. Counter measures against violation behavior towards traffic rules should therefore consider the influence of sensation seeking behavior and the methods to change this dangerous behavioral trait for effectiveness.

Propensity to aggression. The results of regression analysis found that, the propensity to aggression while driving, significantly predicted the violation behavior

towards traffic rules. Deffenbacher (2009) reported that while driving, drivers with a high level of anger experienced more anger triggers, frequent and intense anger, hostile thinking, aggression, risky behavior, and some crash-related conditions, in comparison to drivers with low levels of anger. Whether considered as states or traits, the tendency toward hostile, frustrated, and angry behavior is repeatedly linked to risky driving (Deffenbacher *et al*., 2001, 2002; Iversen & Rundmo, 2002). Deffenbacher, Lynch and Richards (2003) found that drivers with high trait anger drove in a more dangerous manner; maintaining shorter time headways and driving faster than low trait anger drivers in non-provoking traffic situations and were twice more likely to have collisions.

The results of the regression analysis showed that, propensity to aggression while driving, significantly predicted the violation behavior towards traffic rules. This finding has important implications in designing and implementing effective and sustainable counter-measures against violation behavior towards traffic rule.

Type A personality. Results of the regression analysis found that Type A personality significantly predicted violation behavior towards traffic rules. Perry and Baldwin (2000) found type A personality to be significantly related to traffic accidents, greater frequency of breaking traffic laws, higher impatience while driving, more displays of aggression on the road, engaged in more risky driving behaviors, drove more erratically and reported higher incidents of aggressive driving. These drivers typically have a strong need to get from point A to point B quickly and to get ahead of others in the traffic flow (Price, 1983; Shahidi *et al*., 1991; Perry, 1986; Evan *et al*., 1987; West *et al*., 1993; Perry *et al*., 2000). In this study Type A personality significantly influenced and predicted the violation behavior towards traffic rules.

The results of multiple regressions indicated that out of the six psychological factors tested as predictor variables, attitude towards speeding, sensation seeking behavior, propensity to aggression and type A behavior pattern were found to be significantly influencing the violation behavior towards traffic rules and explained 24.5% of the variance in violation behavior towards traffic rules.

Chapter V

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSIONS

This study intended to investigate selected predictors of speeding, dangerous driving behavior and violation behavior of traffic rules and search for descriptive typologies among the drivers who are more likely to drive vehicles recklessly and dangerously.

This chapter summarizes and lists the key findings of the investigation. Conclusions based on the findings and related to the review of the literature are discussed. The chapter concludes with the limitations and implications of this study and recommendations for future research.

Objectives

1. To assess the effects of age, experience and education on dangerous driving behavior, speeding behavior and violation behavior of traffic rules.
2. To identify the relationship between select psychological variables and dangerous driving behavior, speeding behavior and violation behavior.
3. To identify the relationship between speeding behavior and dangerous driving behavior.
4. To identify the relationship between attitude to speeding and speeding behavior
5. To find out the efficacy of select independent variables to predict dangerous driving behavior, speeding behavior and violation behavior of traffic rules.

Hypotheses

H 1 There is a significant difference in dangerous driving behavior of drivers belonging to various age groups, with different experiences and education levels.

H 1.1 There is a significant difference in the dangerous driving behavior of drivers belonging to various age groups.

H 1.2 There is a significant difference in dangerous driving behavior of drivers, who have varied levels of driving experience.

H 1.3 There is a significant difference in dangerous driving behavior of drivers who have varied levels of education.

H 2 There is a significant difference in speeding behavior of drivers belonging to various age groups, with different experience and education level.

H 2.1 There is a significant difference in the speeding behavior of drivers belonging to various age groups.

H 2.2 There is a significant difference in speeding behavior of drivers, who have varied levels of driving experience.

H 2.3 There is a significant difference in the speeding behavior of drivers, who have varied levels of education.

H 3 There is a significant difference in violation behavior of traffic rules (VBTR) of drivers belonging to various age groups, with different levels of experience and education.

H 3.1 There is a significant difference in the violation behavior of drivers belonging to various age groups.

H 3.2 There is a significant difference in the Violation behavior of drivers, who have varied levels of driving experience.

H 3.3 There is a significant difference in the violation behavior of drivers who have varied levels of education.

H 4 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior Pattern, locus of control and attitude to speeding are significantly correlated with dangerous driving behavior.

H 4.1 Hostility is correlated significantly with dangerous driving behavior.

H 4.2 Propensity to aggression is correlated significantly with dangerous driving behavior.

H 4.3 Sensation seeking is correlated significantly with dangerous driving behavior.

H 4.4 Type A behavior pattern is correlated significantly with dangerous driving behavior.

H 4.5 External locus of control is correlated significantly with dangerous driving behavior.

H 4.6 Speeding behavior and dangerous driving behavior are correlated significantly.

H 4.7 Attitude to speeding and dangerous driving behavior are correlated significantly.

H 4.8 Violation behavior (VBTR) and dangerous driving behavior are correlated significantly.

H 5 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, locus of control and attitude to speeding are significantly correlated with speeding behavior.

H 5.1 Attitude to speeding is correlated significantly with speeding behavior.

H 5.2 Hostility is correlated significantly with speeding behavior.

H 5.3 Propensity to aggression is correlated significantly with speeding behavior.

H 5.4 Sensation seeking is correlated significantly with speeding behavior.

H 5.5 Type A Behavior Pattern is correlated significantly with Speeding Behavior.

H 5.6 External locus of control is correlated significantly with speeding behavior.

H 5.7 Violation behavior (VBTR) is correlated significantly with speeding behavior.

H 6 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior Pattern, locus of control and attitude to speeding are significantly correlated with violation behavior of traffic rules (VBTR) of drivers.

H 6.1 Hostility is correlated significantly with violation behavior (VBTR)

H 6.2 Propensity to aggression is correlated significantly with violation behavior (VBTR)

H 6.3 Sensation Seeking is correlated significantly with Violation Behavior (VBTR)

H 6.4 Type A behavior pattern is correlated significantly with violation behavior (VBTR)

H6.5 External locus of control is correlated significantly with violation behavior (VBTR)

H 6.6 Attitude to speeding is correlated significantly with violation behavior (VBTR)

H 7 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the dangerous driving behavior.

H 8 The selected psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the speeding behavior.

H 9 The select psychological variables such as hostility, propensity to aggression, sensation seeking, Type A behavior pattern, external locus of control and attitude to speeding can predict significantly the violation behavior of traffic rules (VBTR) of drivers.

Research and Sample Design

The descriptive survey research design was followed in this study to examine the speeding, dangerous driving behavior, and violation behavior of traffic rules of drivers. Relationship of speeding, dangerous driving behavior, and violation behavior with various personality traits, attitudes to speeding and demographic variables such as age, experience and education were surveyed.

As it was intended to collect data from the drivers who have chosen driving as their profession, a complete list of such drivers was gathered from a list of driving license holders issued by Motor Vehicle Department of Kerala in 10 selected centers. There were around 60 centers /stations, which issue a formal driving license to the eligible and qualified personnel across different parts of Kerala state. Among them 10 stations /centers were chosen. They represent the north, south and central districts of Kerala. The prospective respondents (drivers) were selected from 10 stations/centers who have visited the Licensing Authorities for renewing their driving license or adding another

class to their license during the period 2009-10. Due care has been taken to cover drivers from the north and south of Kerala state. A total of 500 drivers were picked up randomly from the three regions of Kerala state as given below.

Instruments

The following instruments were used in this study

- A facing sheet with instructions gathered demographic data.
- Dula Dangerous Driving Index (1999).
- Self-reported speeding behavior scale adapted from Tay *et al*. (2003).
- Violation behavior towards traffic rules scale adapted from Yilmaz and Çelik, (2006).
- Rotter's Locus of control questionnaire (1966),
- Sensation seeking scale (Zukerman, *et al*., 1993).
- Bortner's Short Rating Scale of Pattern A Behavior (1969)
- Hostility scale adapted from Minnesota Multi-phasic Personality Inventory.
- Propensity for aggression scale adapted from Watson, *et al*., (2007).
- Standardized speeding behavior scale adapted from De Pelsmacker and Janssens, (2006).

Statistical Analysis: The data was subjected to Analysis of Variance, Duncan's Post hoc test, Correlation analysis, and Multiple Regression analysis to test the hypotheses. SPSS version 16 and Minitab version 15 were used to conduct statistical analysis.

Results

The results showed that the majority of the drivers in the sample scored high in dangerous driving, speeding and violation behavior towards traffic rules. Dangerous driving significantly varied with age and experience. For instance younger, inexperienced

drivers showed high dangerous driving behavior. Speeding behavior did not significantly vary with differences in age, experience and education level. Significant effect was found for age, experience and education on violation behavior of drivers. Drivers with younger age, more experience and with moderate education were high on violation behavior of traffic rules.

The results revealed that all the variables studied established a significant relationship with dangerous driving behavior. The psychological variables studied showed significant correlation with speeding, except for hostility and external locus of control. On examining relations of violation behavior of traffic rules with the variables, it was found that all the variables correlated significantly.

Multiple Regression results for dangerous driving indicated that propensity to aggression was the strongest predictor of dangerous driving behavior followed by sensation seeking behavior, hostility, type A behavior pattern, and attitude towards speeding. The final regression model accounted for 42% of the variance in dangerous driving.

Regression for speeding behavior explained that attitude towards speeding emerged as the strongest predictor of speeding behavior followed by type A behavior pattern, propensity to aggression and sensation seeking behavior. The model explained 18.9% of the variance in speeding behavior.

Finally regression analysis for violation behavior showed that attitude towards speeding emerged as the strongest predictor of violation behavior towards traffic rules followed by sensation seeking behavior, propensity to aggression and type A behavior pattern and explained 24.5% of the total variance in violation behavior towards traffic rules.

Key Findings

The results showed that majority of the drivers in the population were maintaining high scores in dangerous driving, speeding and violation behavior towards traffic rules. The effect of demographic variables on this dependent variable was tested with ANOVA and post hoc test. The relationship of psychological variables was examined by bivariate correlations and finally the influence, and predictive validity was tested using block wise multiple regressions. Result of this study showed that dangerous driving behavior, speeding and violation behavior towards traffic rules were related and influenced by psychological variables studied. The demographical variables such as age, experience and education also showed significant effect on dangerous driving behavior and violation behavior of traffic rules.

Contrary to results reported in previous studies, result of the present study showed that there was no significant difference for speeding behavior between age groups. Hence in the present study, it was clearly revealed that among the population studied, all age groups resort to speeding without any significant difference.

The present study revealed that inexperienced drivers with 1 to 5 years' experience were higher on dangerous driving profile, and the group with 10 to 20 years of experience showed the lowest mean score.

The results showed that there were no significant differences in speedingbehavior among the group of drivers with difference in experience. It showed there were highly significant differences in violation behavior towards traffic rules between groups with differences in experience. The group with more experience showed higher violation behavior of traffic rules.

The results revealed that there were no significant differences in the speeding behavior of drivers with different level of education, which means all equally indulge in speeding.

It showed significant effect for education on violation behavior of the drivers. Drivers with low level of education and graduation level reported less violation behavior of traffic rules and the middle group with 12 years schooling was high on violation behavior.

Propensity to aggression and sensation seeking showed high positive correlation with dangerous driving behavior. Attitude to speeding, type A behavior pattern, hostility, violation behavior and speeding behavior showed moderate positive correlation with dangerous driving behavior of drivers. External locus of control showed significant negative correlation with dangerous driving behavior.

Propensity to aggression, sensation seeking behavior and type A behavior pattern moderately and positively correlated with speeding behavior. Hostility and external locus of control were not significantly correlation with speeding behavior. Dangerous driving behavior, propensity to aggression and sensation seeking behavior showed moderately significant positive correlation with violation behavior. Type A behavior pattern and hostility were also showed significant positive correlation with violation behavior. External locus of control showed significant negative correlation with violation behavior.

Multiple regression analysis revealed that, among the psychological dimensions studied; propensity to aggression, sensation-seeking behavior, hostility, type of behavior pattern and attitude towards speeding are better predictors of dangerous driving behavior. Apparently, propensity to aggression emerged as the strongest predictor of dangerous

driving behavior followed by sensation seeking behavior, hostility, type A behavior pattern, and attitude towards speeding. Overall, the final model of regression analysis demonstrated 42 % of variance in dangerous driving.

Attitude towards speeding, type A behavior pattern and propensity to aggression and sensation seeking were better predictors of speeding behavior among the psychological dimensions studied. Attitude towards speeding emerged as strongest single predictor of speeding behavior among the psychological variables studied followed by Type A behavior pattern, propensity to aggression and sensation seeking behavior. Over all it explained was 18.9% variance in speeding behavior.

Attitude towards speeding, sensation seeking behavior, propensity to aggression and Type A behavior pattern were better predictors of violation behavior of traffic rules. Apparently attitude towards speeding emerged as the strongest single predictor of violation behavior towards traffic rules followed by sensation seeking behavior, propensity to aggression and Type A behavior pattern and it explained a total of 24.5 % variance in violation behavior of traffic rules.

Conclusions

This study revealed that the majority of the respondents reported comparatively high speeding behavior, dangerous driving behavior and violation behavior towards traffic rules. This investigation explored and established the effect of demographic variables, relationship and influence of psychological variables on speeding behavior, dangerous driving behavior and violation behavior towards traffic rules.

Dangerous driving varied with age and experience. Young, inexperienced drivers showed significant high dangerous driving behavior. No significant variation in speeding

behavior was found in groups with differences in age, experience and education level. There was significant effect for age, experience and education on violation behavior of drivers. Drivers with younger age, more experience and with moderate education were high on violation behavior of traffic rules.

The result showed that all variables studied established significant relationship with dangerous driving behavior. The psychological variables studied established correlation with speeding except hostility and external locus of control. On examining relations of violation behavior of traffic rules with variables studied, it was found that all variables showed statistically significant correlation with violation behavior.

Multiple Regression analysis for dangerous driving concluded that propensity to aggression was the strongest predictor of dangerous driving behavior followed by sensation seeking behavior, hostility, type of behavior pattern, and attitude towards speeding. Overall, the final model of regression analysis demonstrated 42 % of variance in dangerous driving. Regression for speeding behavior explained that attitude towards speeding emerged as the strongest predictor of speeding behavior among the psychological variables studied followed by type A behavior pattern, propensity to aggression and sensation seeking behavior. Over all, it explained 18.9% variance in speeding behavior. Finally regression for violation behavior demonstrates that attitude towards speeding emerged as the strongest predictor of violation behavior towards traffic rules followed by sensation seeking behavior, propensity to aggression and type A behavior pattern and explained total 24.5 % variance in violation behavior towards traffic rules.

The result of this study confidently concluded, that there were significant effects of age and experience on dangerous driving behavior, and age, experience and education

on violation behavior of traffic rules. There were significant relationships of psychological variables with speeding, dangerous driving and violation behavior. This study revealed predictive values of certain significant psychological variables for speeding behavior, dangerous driving and violation behavior of traffic rules. It revealed that dangerous driving behavior, speeding and violation behavior of traffic rules were related and influenced by the psychological variables studied. This knowledge has high relevance and implications in future road safety program and evolving driver behavior interventions in order to ensure sustainable road safety.

Limitations of the Study

This study is also not free from limitations. The major limitation was the smaller sample size; a sample of 500 drivers may be statistically good, but not sufficient to include large band of experience, age and education level for a more generalizable result. Private owned car drivers with higher education and from higher income groups were not included in the sample. Manpower, time and financial constraints compelled the investigator to limit the sample size to 500.

The effect of gender difference is also given relevance in the driving scenario and hence the all-male sample is a limitation of this study. Though, the investigator took maximum care to ensure full anonymity to avoid the effect of desirability bias, self-reported survey has its own inherent limitations. Factors like accident involvement, actual detection of speeding, dangerous driving and violation behavior were not investigated due to the non-availability of objective data.

In the case of demographic variables, there is a chance for *v*ariables like age to vary systematically with the experimental manipulation and influence the result of experience and education.

Implications

This study is an investigation about factors influencing dangerous driving, speeding behavior and violation behavior of drivers in a population highly affected by accidents. The present driver behavior in this population was very dangerous, high speeding and high on violation behavior of traffic rules. Hence, it requires urgent remedial action in order to save thousands of lives every year. In India the number of road accidents, deaths due to road accidents and injuries due to road accidents are increasing every year. During the year 2010; 430,600, road accidents caused death of 133,938 persons and injured 470,600 human beings (NCRB, 2011). In India, the socio-economic cost of road accidents in 1999-2000 was estimated at 3% of GDP. It is estimated that the country loses around $17 billion per year due to road traffic accidents, which is 2-3 per cent of the gross domestic product (Sikdar & Bhavsar, 2009). This shows the shocking dimension of the problem and the urgent and pressing need for serious studies in the field of road safety in India to formulate suitable countermeasures.

This study is a rare one of its kind on road safety and about driver behavior in India and the results showed that there are various psychological factors contributing to dangerous driving, speeding and violation behaviors towards traffic rules. Today, knowledge of psychology is well developed to deal with traits like aggression, sensation seeking, typeAbehavior pattern and attitude towards speeding etc. Hence, road safety interventions

can be planned and designed in future, taking into consideration various psychological aspects for better effectiveness as it has been successfully done in most of the developed countries.

This study indicates that enforcement, driver education, driver training, correction training, student road safety education, and road safety campaigns have to be planned with the aim of inculcating a rational attitude towards speeding, reduction of aggression, imparting coping strategies to handle the hostility and other relevant personality problems. Moreover, positive attitudes towards safety have to be encouraged and conditioned, using suitable scientific methods of psychology among all road users.

The current beliefs about road accidents are that they are inevitable and that it is impossible to reduce the rate of accidents. This is not true and the reasons behind these behaviors can be traced out and scientifically addressed to improve driving behavior and foster safety. Most of the responsible people believe that better road and vehicle alone can solve the problem of road safety. However, the result of this study shifts the focus to the importance of driver behavior, its relationship and its influence on psychological variables.

It was argued that, people will more likely refrain from engaging in dangerous driving practices if they are concerned about it or that they will demand action to do something about it. Concern thus serves as a lever that can be used by social engineers to increase the level of traffic safety (Ward *et al*., 2008). Changes in human behavior with changing systems, laws and traffic situations including congestion, stress and innovations in engineering of vehicle and roads necessitates regular studies about driver behavior to plan and design appropriate road safety counter measures.

This study found that psychological factors were influencing speeding, dangerous driving and violation behavior of traffic rules significantly. Psychology has defined these traits and devised effective methods to deal with them. So while thinking about driver licensing, driver education and driver testing and selection, psychology can provide methods that are more effective. Developed countries improved road safety using evidence based results and regularly investigating for methods that are more effective.

It is very relevant to add that The United Nations declared this decade (2011-2020) as *A Decade of Action for Road Safety* and the present high road accident death in India has to be addressed to stabilise, increase awareness and bring down the accident rates and its severities. We have to start effective work in this direction to save millions of lives.

This study concluded that dangerous driving behavior and violation behavior towards traffic rules were higher among younger drivers and reduced among older drivers. The highest level of accident involvement and death among younger drivers can be attributed to the high dangerous driving behavior of this group. This finding has significant implications in road safety work.

This problem can be addressed in two ways; one, increasing age for driving or by a new method that has been successfully introduced by some countries like Australia called 'Graduated Licensing System'. This system extends the licensing procedure to several years involving regular training and follow up actions under strict conditions gradually leading to final full licensing. Improving the general competence, safety and rational thinking of younger groups during their schooling including compulsory road safety training before 12^{th} standard is highly essential.

Improved driver education system is also required urgently to save this highly productive population. Effect of experience and education also indicates the need for improved training, effective education and efficient and objective enforcement. Considering the result of higher involvement of younger group in more dangerous and violation behavior while driving, increase the age limit for transport drivers, mainly heavy passenger vehicles and cargo vehicles carrying dangerous substances can be considered as an immediate countermeasure. Compared to other age groups, younger groups are found to be more likely to underestimate the probability of the specific risks caused by traffic situations (Brown & Groeger, 1988; Deery, 1999), and to have a propensity to perceive themselves as invulnerable to negative outcomes (Millstein,1993).

It is obvious that speeding is the major reason for road accidents and for its severities. This study revealed that speeding behavior did not vary significantly in groups with differences in age, experience and education level, which means that all groups were similar in speeding behavior. The speeding behavior scores of respondents showed high self-reported speeding behavior. In the light of the highest crash rate and death rate in this population, high speeding behavior among all age groups has significant implications. While addressing the road safety problem, first priority must be given for effective speed management.

A positive change in speeding behavior was expected due to learning from involvement in accidents, punishments received, natural effect of maturity and skill acquired by experience. The results suggested that some or all of the expected mechanisms failed and desirability, utility and safety of speeding are not challenged among the drivers by enforcement, education and campaigns so far. This result has significant implication in designing future road safety initiatives scientifically with evidence based methods.

This investigation about various personality factors revealed that they were related to dangerous driving, speeding and violation behavior of drivers. Hence, it is obvious that any attempt to improve road safety and driver's behavior has to consider the underlying psychological reasons and devise counter measures to modify these basic problems also. The negative results of interventions can mainly be attributed to failures in considering the reasons behind the behavior.

Propensity to aggression emerged as the main predictor of dangerous driving followed by sensation seeking behavior, hostility, type A behavior pattern, and attitude towards speeding. Regression for speeding behavior explained that attitude towards speeding emerged as the strongest predictor of speeding behavior among the psychological variables studied followed by type A behavior pattern, propensity to aggression and sensation seeking behavior. Finally, regression for violation behavior demonstrated that attitude towards speeding emerged as the strongest predictor of violation behavior of traffic rules followed by sensation seeking behavior, propensity to aggression and type A behavior pattern.

Hence, driver education and training can be effective if it also addresses management of aggression, hostility, type A behavior and attempts to persuade positive attitude towards speeding. Road safety campaigns and advertisements should be designed with the aim of persuading specific attitudes and changing dangerous driving, violation and speeding behaviors. Development of psychological methods for Driver Behavior Modification has already proved the efficiency of cognitive behavior therapy in this context (Najeeb, 2008; Deffenbacher, J. L., Filetti, L. B., Lynch, R. S., Dahlen, E. R., & Oetting, E. R., 2002; Deffenbacher, J. L.,2009).

Suggestions for Further Research

This study did not include variables like stress in driving, risk perception, distraction and fatigue in driving. Such variables have to be included in future studies for better evaluation of factors affecting dangerous driving behavior.

Age groups including above 60 have to be addressed with better samples to see the driving behavior of the aging population and it is an emerging problem in all developing societies. Women were excluded in this study due to obvious reasons, but in the case of personal vehicles, this category is also increasing and hence inclusion of women becomes quintessential in future studies.

Effect of experience, education and age on dangerous driving, speeding and violation behavior have to be investigated with better samples and more objective dependent variables like accident involvement, detection for speeding, and other actual observation. Experimental errors due to covariate factors have to be avoided by controlling potential confounders like age in future studies. There is a possibility that age influences the effect of experience and education. Sensation seeking and aggression were reported as reducing with age and hence suitable change in design is required in future studies.

Interventional studies about remedial measures for violation, speeding and dangerous driving behavior, considering effect of relevant psychological variables influencing driving behavior with follow up study and actual observation and performance indicators like involvement in accidents are also required in this serious subject. Propensity to aggression, sensation seeking, hostility, type A behavior pattern,

and attitude towards speeding have emerged as major predictors of speeding, dangerous driving and violation behaviors in this study. Therefore, suitable interventions addressing these factors also should be devised and tested for effectiveness.

A comprehensive, relevant and valid scale to measure driving behavior with multiple dimensions has to be developed with relevant psychological factors that influence driving behavior. For better utility, it has to be adapted to varied Indian languages and cultures. More than being a mere academic exercise, research in this subject requires dedication to reveal the scientific truth behind the dangerous behavior of drivers on roads causing serious pain and irreparable loss to millions of innocent people every year and wasting a great amount of resources of the nation. This subject warrants regular studies to investigate the behavior of drivers with regular changes like introduction of mobile phone, improvements in vehicle technology, effect of enforcement methods including speed cameras, speed governors and changes in road engineering. The changes in life style including income, education, and vehicle types are also reported to have influence upon driving behavior.

Most of the road accidents are predictable and can be avoided with evidence-based knowledge liberated through scientific studies. Research in this subject is expensive but as it is important and relevant, proper funding from concerned departments and stakeholders is required to attract more researchers to this life saving area.

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Appendices

Appendix: A

Questionnaires

DEPARTMENT OF PSYCHOLOGY
BHARATHIAR UNIVERSITY, COIMBATORE
INDIA- 641046

Study of Psychological Factors that Influencing Dangerous Driving, Speeding and Violation Behaviour of Drivers

Instructions

Dear Sir,

This study is to investigate about the reasons behind the road accidents and hence highly relevant and important. A detailed knowledge of factors affecting Driving Behaviour will help in planning, designing and implementing scientific remedial measures like road safety campaigns, driver education and enforcement programs effectively. This study is not compulsory and you can decide to participate or not, even you can withdraw in-between the test. This test requires only minimum effort to answer for questions with a tick mark. In this test personal details of respondents are not necessary including name and driving license number. Your answer will be fully confidential. Read questions and put a tick mark in most appropriate answer for you. Please answer all questions carefully.

Age a) 18-25 ◯ b) 26-35 ◯ c) 36-46 ◯ d) 46 + ◯

Experience a) 1-5 years ◯ b) 5-10 ◯ c) 10-20 ◯ d) 20 + ◯

Education a) 7-10 years ◯ b) 10+2 ◯ c) Graduation ◯

Thank you for your kind cooperation and concern in road safety

P.M.MOHAMMED NAJEEB najeeb.blossom@gmail.com; 944779841

1. Dula Dangerous Driving Index (©1999, Dula, C.S.) 5 point likert scale

Note: DDDI Dangerous Driving Total Score = Add all items;

1) Never ☐
2) Rarely ☐
3) Sometimes ☐
4) Very Often ☐
5) Always ☐

1. I drive when I am angry or upset.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

2. I lose my temper when driving.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

3. I consider the actions of other drivers to be inappropriate or "stupid."

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

4. I flash my headlights when I am annoyed by another driver.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

5. I make rude gestures (e.g., giving "the finger"; yelling curse words) toward drivers who annoy me.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

6. I verbally insult drivers who annoy me.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

7. I deliberately use my car/truck to block drivers who tailgate me.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

8. I would tailgate a driver who annoys me.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

9. I "drag race" other drivers at stop lights to get out front.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

10. I will illegally pass a car/truck that is going too slowly.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

11. I feel it is my right to strike back in some way, if I feel another driver has been aggressive toward me.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

12. When I get stuck in a traffic jam I get very irritated.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

13. I will race a slow moving train to a railroad crossing.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

14. I will weave in and out of slower traffic.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

15. I will drive if I am only mildly intoxicated or buzzed.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

16. When someone cuts me off, I feel I should punish him/her.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

17. I get impatient and/or upset when I fall behind schedule when I am driving.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

18. Passengers in my car/truck tell me to calm down.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

19. I get irritated when a car/truck in front of me slows down for no reason.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

20. I will cross double yellow lines to see if I can pass a slow moving car/truck.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

21. I feel it is my right to get where I need to go as quickly as possible.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

22. I feel that passive drivers should learn how to drive or stay home.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

23. I will drive in the shoulder lane or median to get around a traffic jam.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

24. When passing a car/truck on a 2-lane road, I will barely miss on-coming cars.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

25. I will drive when I am drunk.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

26. I feel that I may lose my temper if I have to confront another driver.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

27. I consider myself to be a risk-taker.

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

28. I feel that most traffic "laws" could be considered as suggestions

(1) ☐ (2) ☐ (3), ☐ (4) ☐ (5) ☐

II. Self-Reported Speeding Behavior Questionnaire (Tay, et al, (2003)

1) Disagree Very Strongly 2) Disagree Strongly 3) Disagree
4) Undecided 5) Agree 6) Agree Strongly 7) Agree Very Strongly

1) I often drive greater than 10 km/h over the speed limit on urban roads.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

2) I often drive greater than 20 km/h over the speed limit on urban roads.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

3) I often drive greater than 10 km/h over the speed limit on open roads or highways.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

4) I often drive greater than 20 km/h over the speed limit on open roads or highways.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

5) I often drive greater than 10 km/h over the speed limit on school zone.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

6) I often drive greater than 20 km/h over the speed limit on school zone.

(1) ☐(2) ☐(3) ☐(4) ☐(5) ☐(6) ☐(7) ☐

III VIOLATIONS OF BASIC TRAFFIC RULES

Source: Veysel YILMAZ, H. Eray ÇELİK (2006) and DBQ

Note: Coded from 1 = disagree very strongly to 7= Agree Very Strongly.

1) Disagree Very Strongly
2) Disagree Strongly
3) Disagree
4) Undecided
5) Agree
6) Agree Strongly
7) Agree Very Strongly

1) Sometimes it is necessary to bend the rules to keep traffic going.

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

2) Sometimes it is necessary to ignore violations of traffic rules.

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

3) It is more important to keep up the traffic flow rather than always follow the traffic rules

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

4) Sometimes it is necessary to bend the traffic rules to arrive in time.

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

5) It is better to drive smooth than always follow the traffic rules.

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

6) Sometimes it is necessary to overtake a slow driver on the overtaking prohibited curves*

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

7) It is better to pull out of a junction so far that the driver with right of way has to stop and let you out*

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

8) Legally helmet and seatbelts are compulsory but it is not that much beneficial**

   (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

*From DBQ, ** Additional item

IV HOSTILITY QUESTIONNAIRE (ADAPTED FROM MMPI)

(5 Point Likert Scale rating from Strongly Agree to Strongly Disagree)

1) Disagree Strongly 2) Disagree 3) Undecided 4) Agree 5) Agree Strongly

1.I have often met people who were supposed to be experts who were no better than I

1		2		3		4		5	

2. I have often had to take orders from someone who did not know as much as I did.

1		2		3		4		5	

3. A large number of people are guilty of bad sexual conduct.

1		2		3		4		5	

4. I think a great many people exaggerate their misfortunes in order to gain sympathy and help from others.

1		2		3		4		5	

5. I have at times had to be rough with people who were rude or annoying.

1		2		3		4		5	

6. Most people make friends because friends are likely to be useful to them.

1		2		3		4		5	

7. It takes a lot of argument to convince most people of the truth.

1		2		3		4		5	

8. People often disappoint me.

1		2		3		4		5	

9. People generally demand more respect for their own rights than they are willing to allow for others.

1		2		3		4		5	

10. Most people are honest chiefly because they are afraid of being caught.

1		2		3		4		5	

V. Type of Behaviour Pattern Scale, Source: Bortner (1969)

Please indicate with an X on the line where you belong between these two descriptions of some common behaviours.

a. Not competitive	< _ _ _ _ _ _ _ _ _ _ _ > Very competitive
b. Can wait patiently	< _ _ _ _ _ _ _ _ _ _ _ > Impatient when waiting
c. Take things one at a time	< _ _ _ _ _ _ _ _ _ _ _ > Try to do many things at once
d. Fast (eating, walking, etc)	< _ _ _ _ _ _ _ _ _ _ _ > Slow doing things

Source: Bortner (1969)

Lines Divided into equal segments, and coded such that 1.0 = least Type-A and 11.0 = most Type-A. Item **d** was reverse scored.Composite score is the sum of the four items

VI. Attitude to Speeding Scale,

Source: Patrick De Pelsmacker & Wim Janssens (2006)
Scale-items in (sub-) constructs
All items are measured on a 7-point Likert-type scale

1) Disagree Very Strongly 2) Disagree Strongly 3) Disagree

4) Undecided 5) Agree 6) Agree Strongly 7) Agree Very Strongly

Unless otherwise indicated.

Question in the questionnaire was: 'please indicate in the following table whether it is agree or disagree when you are in the following situations.

Attitude towards Speeding Scale

Affective attitude towards speeding limit

Respecting the speed limits in the built-up area makes me nervous.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Respecting the speed limits in the built-up area limits my pleasure.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Respecting the speed limits in the built-up area makes driving less fun.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Respecting the speed limits in the built-up area irritates me.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Attitude towards speeding

Exceeding the speed limits with more than 10km/h is reckless. (r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Speeding is one of the most important problems in our society.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Speeding (more than 10km/h above the limit) is macho behaviour.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

I become mad when others are speeding in the built-up area.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Attitude towards speed controls

Higher fines incite to not speeding.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

More speeding cameras incite to not speeding.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

More police controls incite to not speeding.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Attitude towards accidents

Respecting the speed limits in the built-up area lowers my chance on an accident with material damage.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Respecting the speed limits in the built-up area enables me to stop faster in case of an emergency.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Respecting the speed limits in the built-up area lowers my chance on an accident with physical damage.(r)

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Affective attitude towards speeding

Speeding (more than 10km/h above the limit) cheers me up.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Speeding (more than 10km/h above the limit) gives me a kick.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

Speeding (more than 10km/h above the limit) gives me a sense of excitement.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

VII. Sensation seeking scale,

(Zuckerman-Kuhlman Personality Questionnaire).

For each statement, choose either true or false. If you do not like either choice, mark the choice you dislike the least.

ANS: True / False

1. I like to have new and exciting experiences and sensations even if they are a little frightening.
2. I like doing things just for the thrill of it.
3. I sometimes do "crazy" things just for fun.
4. I sometimes like to do things that are a little frightening.
5. I enjoy getting into new situations where you can't predict how things will turn out.
6. I'll try anything once.
7. I prefer friends who are excitingly unpredictable.
8. I like "wild" uninhibited parties.
9. I would like the kind of life where one is on the move and traveling a lot, with lots of change and excitement.
10. I am an impulsive person.
11. I like to explore a strange city or section of town by myself, even if it means getting lost.
12. I would like to take off on a trip with no preplanned or definite routes or timetables.
13. Before I begin a complicated job, I make careful plans.
14. I very seldom spend much time on the details of planning ahead.
15. I tend to begin a new job without much advance planning on how I will do it.
16. I usually think about what I am going to do before doing it.
17. I often do things on impulse.

18. I often get so carried away by new and exciting things and ideas that I never think of possible complications.
19. I tend to change interests frequently.

00 - 27% = Very Low, 28 - 41% = Low,42 - 70% = Average, 71 - 84% = High,
85 - 100 = Very High

VIII. Locus of Control Scale

Based on J.B. Rotter (1966)

Instructions: For each question, select ✓ the one statement that best describes how you feel.

Scoring pattern

Int=0 And Ext=1 ;

Full internal=0

Full External=13

Above 7 Scores =External

Below 7= Internal

1) A) Many of the unhappy things in people's lives are partly due to bad luck.

B) People's misfortunes result from the mistakes they make.

2) A) One of the major reasons why we have wars is because people don't take enough interest in politics.

B) There will always be wars, no matter how hard people try to prevent them.

3) A) In the long run, people get the respect they deserve in this world.

B) Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

4) A) the idea that teachers are unfair to students is nonsense.

B) Most students don't realize the extent to which their grades are influenced by accidental happenings.

5) A) without the right breaks, one cannot be an effective leader.

B) Capable people who fail to become leaders have not taken advantage of their opportunities.

6. A) No matter how hard you try, some people just don't like you.

B) People who can't get others to like them don't understand how to get along with others.

7. A) I have often found that what is going to happen will happen.

B) Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

8. A) In the case of the well prepared student, there is rarely, if ever, such a thing as an unfair test.

B) Many times exam questions tend to be so unrelated to course work that studying is really useless.

9) A) Becoming a success is a matter of hard work; luck has little or nothing to do with it.

B) Getting a good job depends mainly on being in the right place at the right time.

10) A) the average citizen can have an influence in government decisions.

B) This world is run by the few people in power, and there is not much the little guy can do about it.

11) A) When I make plans, I am almost certain that I can make them work.

B) It is not always wise to plan too far ahead because many things turn out to be a matter of luck anyway.

12) A) in my case, getting what I want has little or nothing to do with luck.

B) Many times we might just as well decide what to do by flipping a coin.

13) A) what happens to me is my own doing.

B) Sometimes I feel that I don't have enough control over the direction my life is taking.

IX. Propensity for aggression scale

Source: Barry Watson (2007): 6 items ***[Cronbach's α = .72]*** the three asterisked items are adapted from the Driver Behaviour Questionnaire (Reason et al., 1990). Measured on a 7-point Likert scale - Never to Always.

1) Never 2) Very Rarely 3) Rarely 4) not known 5) Occasionally 6) Very Frequently 7) Always

Participants were asked to think about their driving on public roads in the last 12 months and asked how often they:

1) Felt frustrated by other road users

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

2) Felt angry and aggressive towards another road user

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

3) Indicated your hostility towards another road user by whatever means you could.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

4) Gave chase when angered by another rider or road user.

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

5) Physically attacked another vehicle or rider/driver when angered

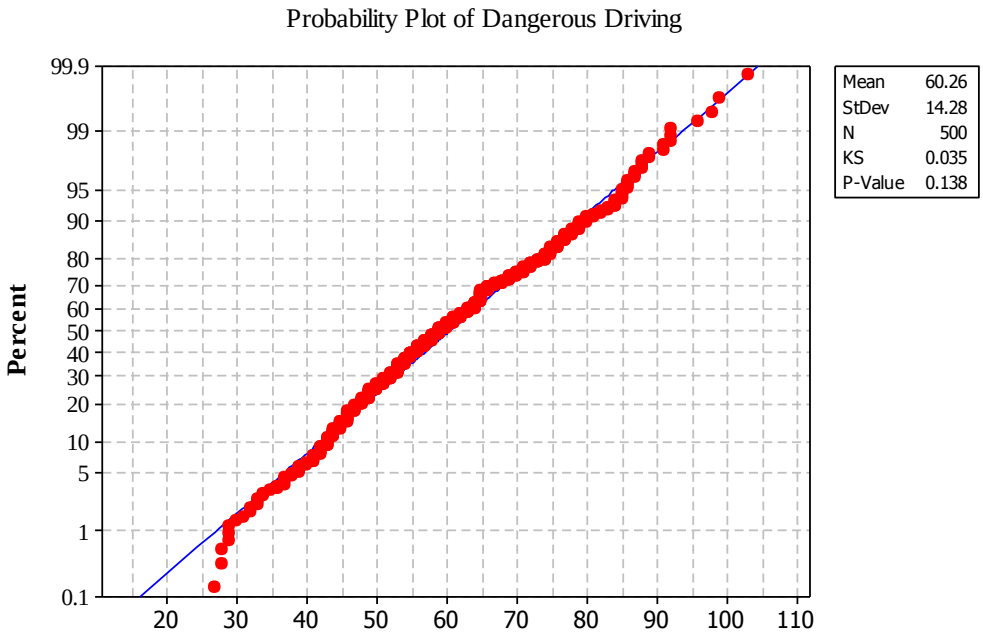
(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

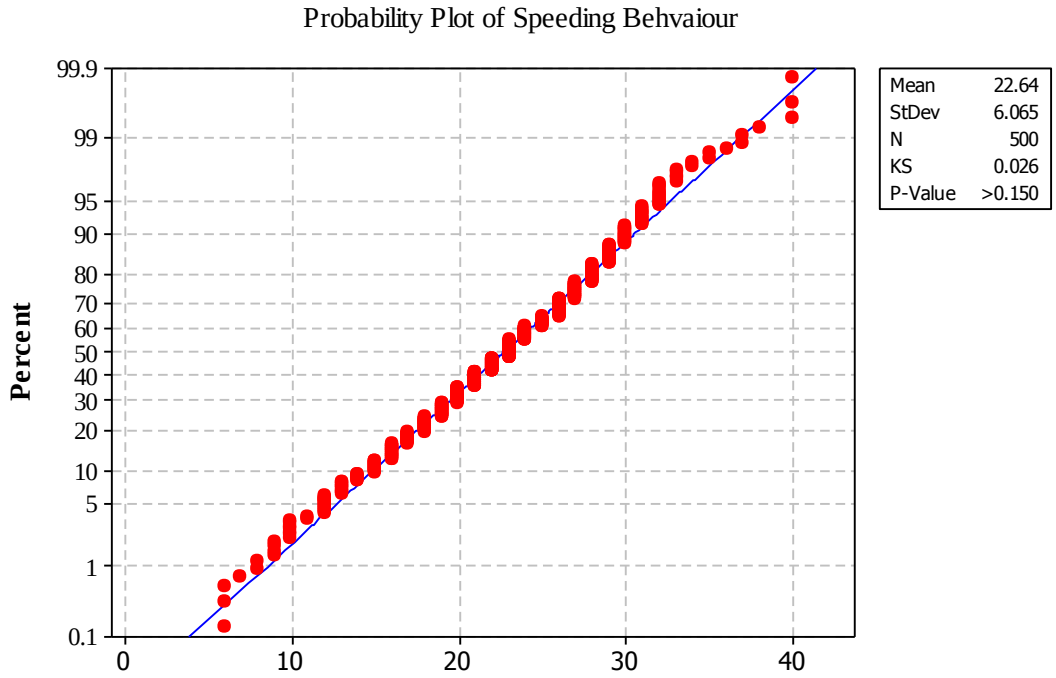
6) Ridden especially close to the car in front as a signal to its driver to go faster or get out of the way*

(1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐

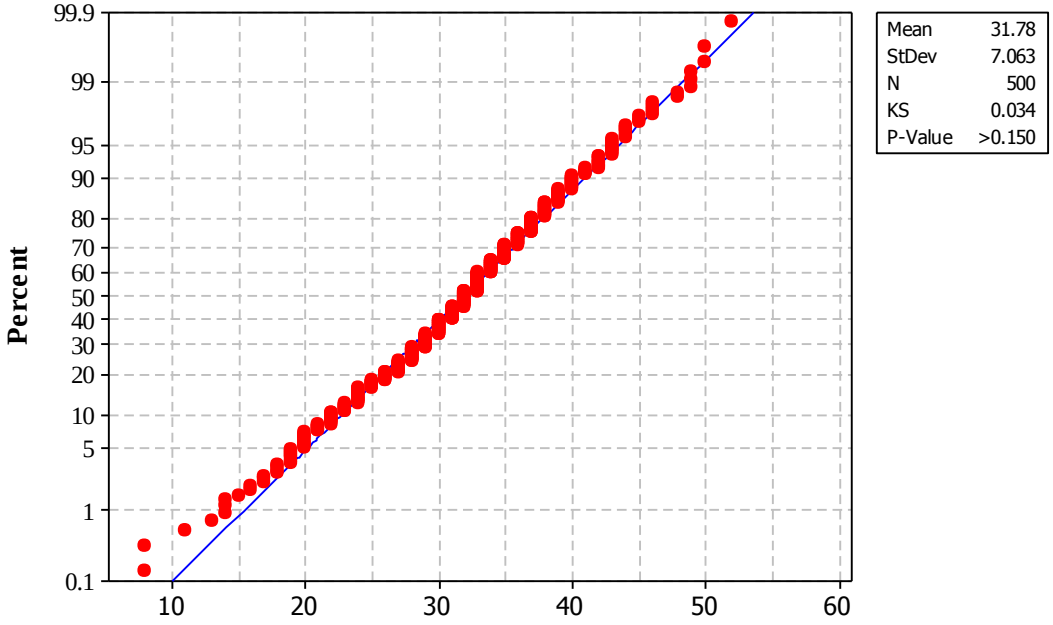
Appendix B.

Graphs

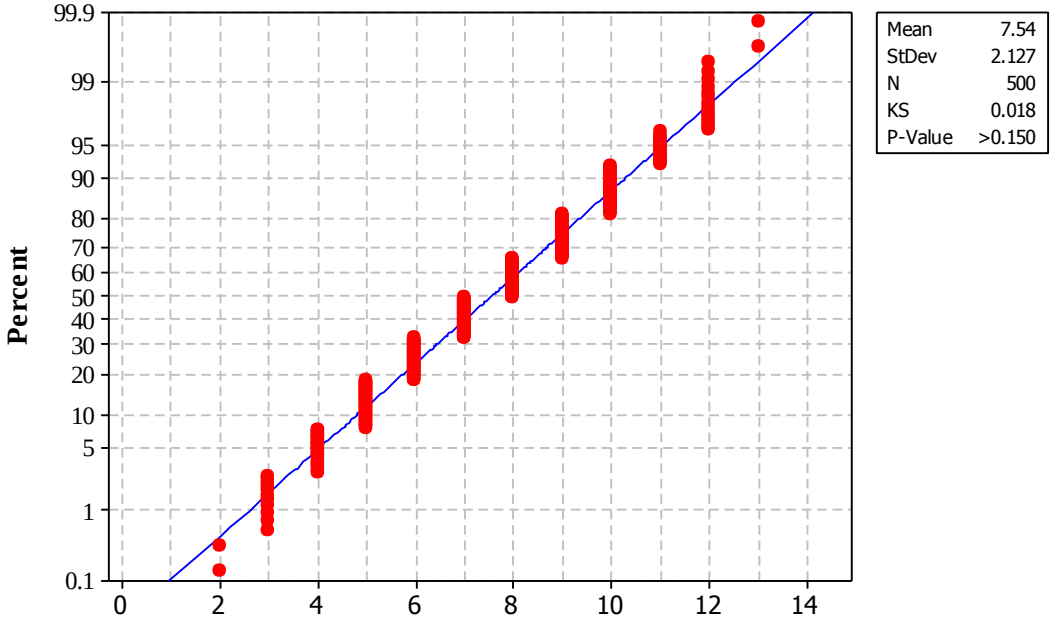




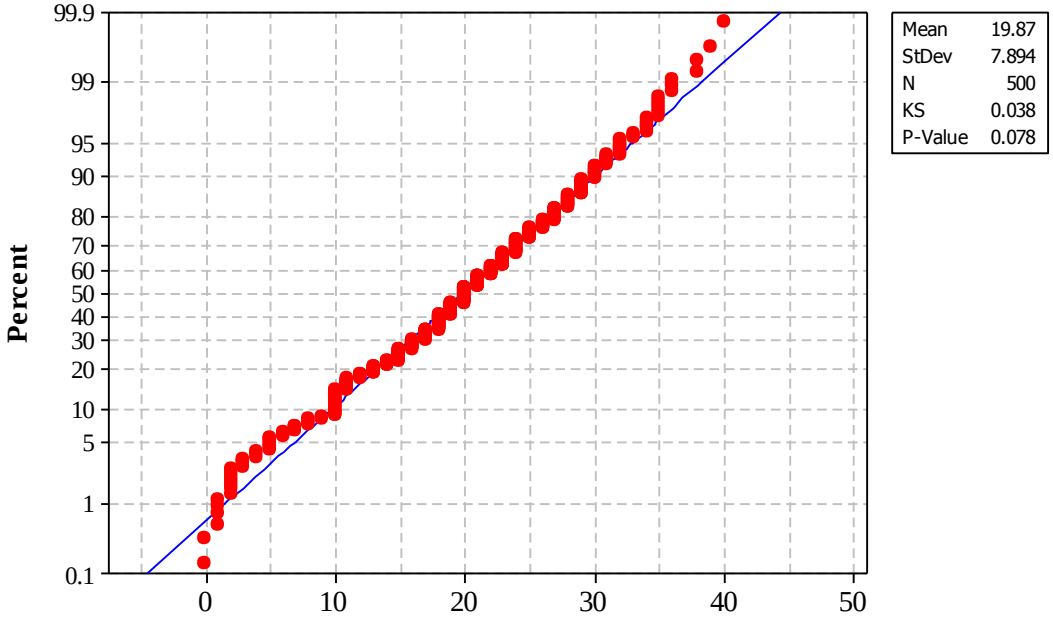
Probability Plot of Violation Behaviour



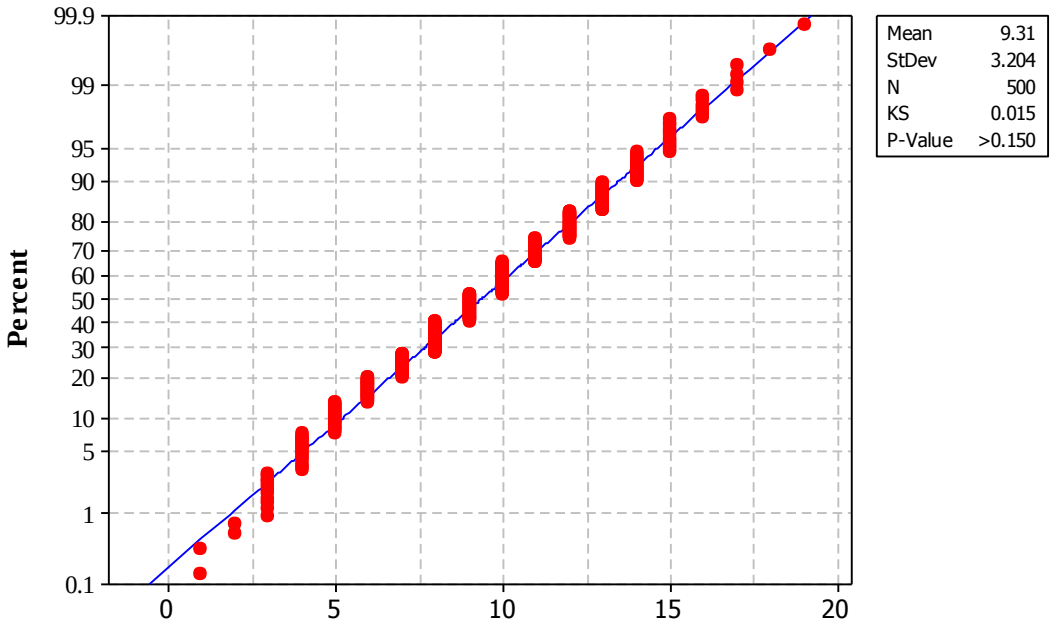
Probability Plot of Locus of Control



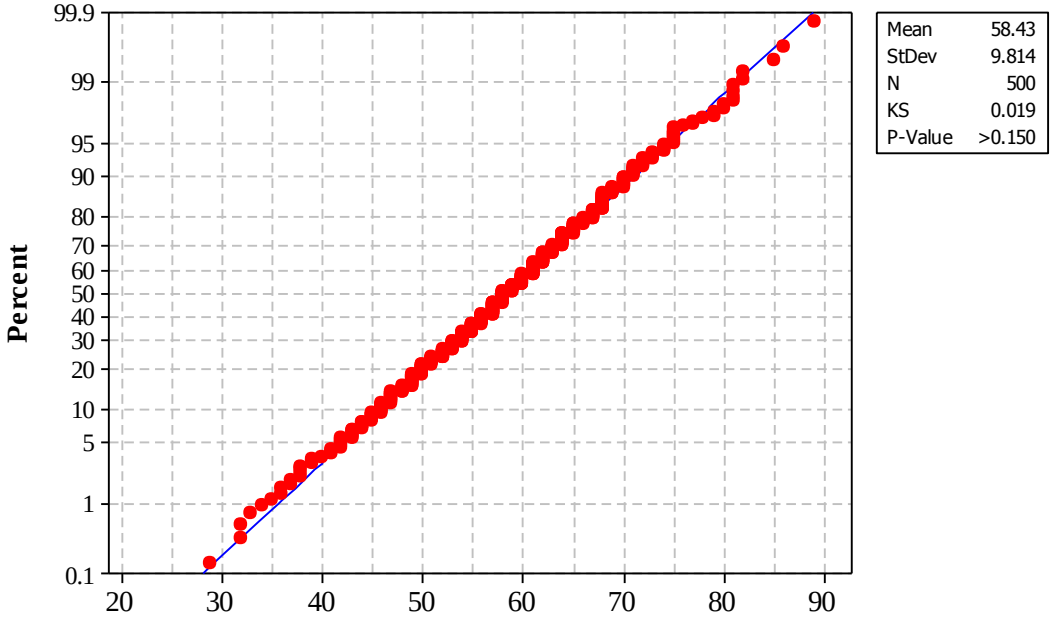
Probability Plot of TBP



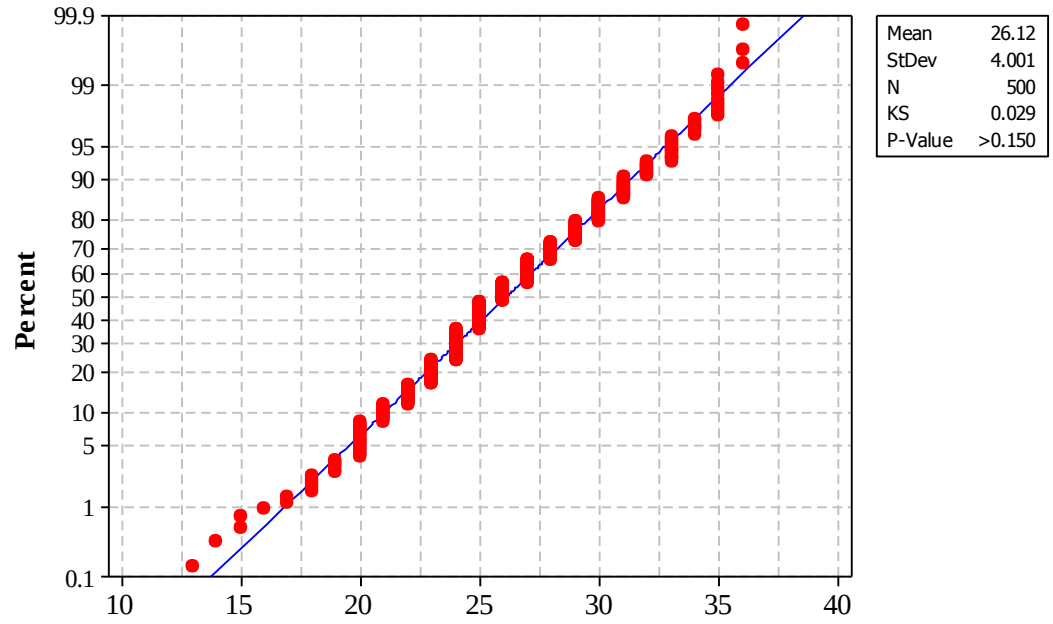
Probability Plot of Sensation seeking Behaviour

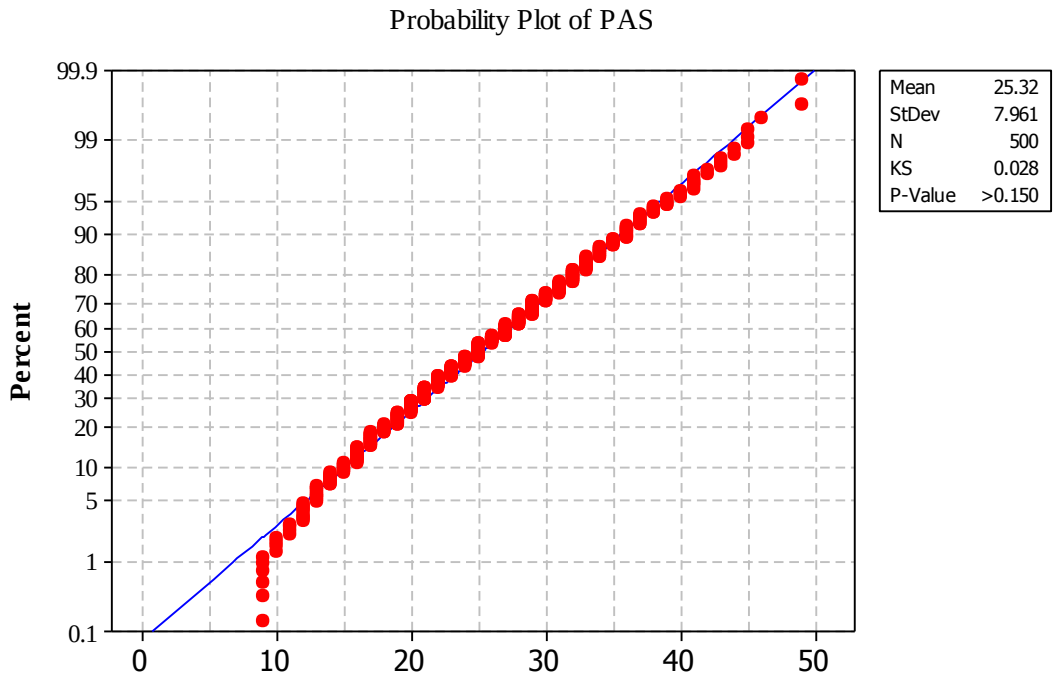


Probability Plot of Attitude towards speeding



Probability Plot of Hostility




Probability Plot of PAS
Percent
99.9
99
95
90
80
70
60
50
40
30
20
10
5
1
0.1
0
10
20
30
40
50
Mean 25.32
StDev 7.961
N 500
KS 0.028
P-Value >0.150

Appendix C.

Tables

Summary of Descriptive analysis of Dangerous Driving with respects to the Age groups and test of normality and homogeneity of variance.

Variable	Age	N	Mean	SD	Shapiro-Wilk	Levene' F
Dangerous Driving	18 - 25 Years	232	63.74	14.84	.990	1.493
	26 - 35 Years	146	58.07	12.00	.989	
	36 - 45 Years	90	57.43	12.41	.988	
	46 Years and above	32	57.28	14.86	.970	

$p >.05$

Summary of Descriptive analysis of Speeding Behaviour with respects to the Age groups and test of normality and homogeneity of variance.

Variable	Age	N	Mean	SD	Shapiro-Wilk	Levene' F
Speeding Behaviour	18 - 25 Years	232	23.15	5.974	.991	0.323
	26 - 35 Years	146	22.33	6.180	.983	
	36 - 45 Years	90	21.54	5.927	.992	
	46 Years and above	32	23.50	6.325	.946	

$P > 0.5$

Summary of Descriptive analysis of Violation Behaviour of Traffic Rule with respects to the Age groups and test of normality and homogeneity of variance.

Variable	Age	N	Mean	SD	Shapiro-Wilk	Levene' F
Violation Behaviour of Traffic Rule	18 - 25 Years	232	32.74	7.023	.989	1.319
	26 - 35 Years	146	30.98	7.079	.987	
	36 - 45 Years	90	29.39	8.107	.989	
	46 Years and above	32	30.84	8.919	.946	

$P > 0.5$

Descriptive analysis of Dangerous Driving with respects to the Experience.

Variable	Experience	N	Mean	SD	Shapiro-Wilk	Levene' F
Dangerous Driving	1 - 5 years	246	62.42	14.725	.996	1.117
	5 - 10 years	114	60.37	13.434	.984	
	10 - 20 years	110	57.10	11.828	.986	
	Above 20 years	30	58.30	14.064	.968	

$P > 0.5$

Descriptive analysis of Speeding Behaviour with respects to the Experience.

Variable	Experience	N	Mean	SD	Shapiro-Wilk	Levene' F
Speeding Behaviour	1 - 5 years	246	22.81	6.362	.991	0.824
	5 - 10 years	114	22.45	5.941	.981	
	10 - 20 years	110	22.26	5.492	.987	
	Above 20 years	30	23.37	6.217	.971	

$P > 0.5$

Descriptive analysis of Violation Behaviour of Traffic Rules with respects to the Experience.

Variable	Experience	N	Mean	SD	Shapiro-Wilk	Levene' F
Violation Behaviour of Traffic Rule	1 - 5 years	246	32.45	7.113	.993	0.546
	5 - 10 years	114	31.49	7.481	.990	
	10 - 20 years	110	28.80	7.362	.986	
	Above 20 years	30	33.63	8.298	.949	

$P > 0.5$

Descriptive analysis of Dangerous Driving, with respects to the Education.

Variable	Education.	N	Mean	SD	Shapiro-Wilk	Levene' F
Dangerous Driving	7 to 10	269	59.25	14.660	.996	1.492
	12 years	145	62.68	13.464	.989	
	Graduation	86	60.94	11.882	.984	

$P > 0.5$

Descriptive analysis of Speeding Behaviour with respects to the Education.

Variable	**Education.**	N	Mean	SD	Shapiro-Wilk	Levene' F
Speeding Behaviour	7 to 10	269	22.36	6.019	.992	0.793
	12 years	145	22.48	6.366	.986	
	Graduation	86	23.79	5.605	.984	

$P > 0.5$

Descriptive analysis of Violation Behaviour of Traffic Rules with respects to the Education.

Variable	Education.	N	Mean	SD	Shapiro-Wilk	Levene' F
Violation Behaviour of Traffic Rule	7 to 10	269	31.09	7.874	.997 ^{ns}	1.869
	12 years	145	33.12	6.366	.990 ^{ns}	
	Graduation	86	30.07	7.463	.993 ^{ns}	

$P > 0.5$