CHAPTER II
THEORETICAL CONCEPTS AND FRAMEWORK

In order to understand the theoretical underpinnings of unsafe driving and psychological variables like driving anger, vengeance, boredom proneness, sensation-seeking and impulsiveness, this chapter helps us look at the conceptual framework and theoretical models. A valid theory or model of human behaviour enables us not only to understand why people drive on roads the way they do, but also help to predict driver's reaction to many potential unsafe situations.

Traffic psychology is a young, expanding and a wide field in psychology and is primarily related to the study of behaviour of road users and the psychological processes underlying that behaviour (Rothengatter, 1997) as well as the relationship between behaviour and road crashes. Transportation psychology sometimes referred to as the mobility psychology, focuses on mobility issues, individual and social factors in the movement of people and goods, and travel demand management (TDM). There is no single theoretical framework in traffic psychology, but, instead many specific models are used explaining, for example, the perceptual, attentional, cognitive, social, motivational and emotional determinants of mobility and traffic behaviour (Ahmed, 2013).

Unsafe driving

Unsafe driving can be considered as an intentional act of driving where the individual puts himself and others in a risk mode on the road, such that, there is a great likelihood of aggressive and risky driving behaviour leading to a greater possibility of involvement in a road crash or an accident. Explanation for unsafe driving is provided by the motivational model of Risk homeostasis model of driver behaviour and by the Health Belief Model.

Motivational models of driver behaviour emphasize on motivations of the driver, rather than the driver capacity as a key determinant for driving style and safety. These models assume that most of the time we do not allocate all of our attentional capacities to the safe negotiation of our car. Safety is just one motive, and going by the marketing strategies of the automotive industry, it is not even an important one (Ferguson, Hardy, & Williams, 2003; Schonfeld, Sheehan, & Steinhardt, 2005; Shin, Hallett, Chipman, Tator, & Granton, 2005).
Major challenge for the researchers engaged in the study of driving behaviour is minimization of risk or compensation for risk. The minimization models assume that people do not drive to maximize safety but to minimize risk. An approach offered by Naatanen and Summala (1976) and later revised by Summala (1985, 1988), argued that drivers adjust their driving in order to maintain a zero-risk level. In other words, most drivers often assume and behave as if there is no risk at all, a perception which is not shared by their passengers (Dillon & Dunn, 2005). To modify driving pattern, the perceived risk has to exceed the zero level by some threshold degree whereas most of the time drivers assume their driving to be at a perceived zero-risk level. It is only when this level get seriously compromised that they change their behaviour.

**Risk Homeostasis model of driver behaviour**

The best-known motivational model and the most frequently challenged is the risk homeostasis theory of driving behaviour. The first formulation of this model was probably "risk-speed compensation model," (Taylor, 1964), which postulated that drivers adjust their speeds in accordance with the perceived risk. More recently the model has been expanded by Wilde (1998, 2002) to include and account for a host of driver behaviours. According to Wilde, we strive not to minimize risk (or maximize safety), but to reduce (or increase) it to a non-zero level with which we feel comfortable. Because different driving situations have different levels of inherent dangers and we constantly strive to adjust our behaviour to maintain a relatively constant risk level. The continuous adjustment process, similar to that of a room thermostat, is displayed in Figure 1. The central adjustment processor, labeled as 'comparator' weighs the inputs from the driver's desired risk level and the perceived level of risk posed by the immediate situation. The comparator is part of a feedback loop where the perceived level of risk is continuously revised, based on the crash experience and the driver's contribution to it at each location. Both these inputs are affected by some personal factors. The perceived level of risk is a function that is affected not only by the objective danger in a situation, but also by the driver's skills at handling it. Thus, a given driving task or situation may be perceived as very risky to an old driver who is conscious of his or her reduced skills, much less risky to an experienced younger driver, but hardly risky to a novice driver who may be oblivious to some inherent dangers. The 'target level of risk' also varies among drivers. Some drivers especially young drivers are at more risk due to their sensation-seeking tendency than the other drivers (Jonah, 1997; Zuckerman, 1979, 1983,
1994), and they probably set a higher level of risk that they will tolerate (or even seek) in order to satisfy other needs that are fulfilled by driving. Perhaps the most important aspect of the theory is that the level of risk assumed by a particular driving style is dependent mostly on the perceived danger of the specific driving situation. This is due to the fact that for a given person at a given point of time, the target level of risk and the perceptual skills are fairly constant.

![Homeostatic model diagram](image)

Figure 1. Homeostatic model relating the accident rate per head of population in a jurisdiction to the level of caution in road-user behaviour and vice versa, with the average target level of risk as the controlling variable (cited from Shinar, 2007).

Wilde's model (1982) also leads to the somewhat surprising conclusion that most vehicle and highway improvements in safety will have little or no long term effects on the driver's actual safety. This is because drivers will change the perceived level of risk (by reducing it), which in turn will make the driver assume greater risk (e.g. by speeding) in order to maintain the same target level of risk. Vehicle and highway improvements will have short-term effects because it takes time for the drivers to realize that the inherent danger with the old driving style has now been significantly reduced. This also leads Wilde to conclude that the only effective means of long term improvements in safety is through a change in the target level of risk; that is in having people shift towards a lower risk level than they currently assume. This, as per Wilde, can be achieved only through behaviour modification, i.e. either by positively reinforcing safe behaviours, or by punishing unsafe behaviours. Most societies attempt to increase safety through increased enforcement as a means of punishing drivers for unsafe actions. Wilde et al. (2002) argues, with the support of some examples, that the alternative approach of reinforcing safe driving - when it has been tried, has yielded much more dramatic improvements. Examples cited
by Wilde for the positive approach include crash reductions in California following renewal of driving license by mail for crash-free drivers, and crash reductions of novice drivers in Norway following a promise to reimburse crash-free novice drivers in the amount of young driver insurance surcharge.

The theory of risk homeostasis has a very intuitive appeal. Many living systems, including ourselves constantly strive to maintain a prescribed level of homeostasis, i.e. a gentle balance among the various forces acting upon us. As people are adaptive, they intend to change in response to changes in their environment. In the context of driving this should be obvious from the driver-vehicle-roadway system depicted in Figure 1. Drivers respond to roadway and vehicle characteristics, and they respond to changes in road and vehicle characteristics. The critical issue is not whether the drivers change their behaviour, but whether the net result following the change is a positive one or a negative one. According to Wilde we adjust our driving to actually maintain a certain significant level of risk, and any vehicle-based or road-based change to reduce it is negated by our behavioural adaptation.

Despite its intuitive appeal, the theory has been challenged by many researchers in the field (Evans, 2004; Fuller, 2005; Haight, 1986; Oneill & Williams, 1998), to the extent of being 'ludicrous'. In brief, the main criticisms of the risk homeostasis theory are that:

1. Only a small percent of the drivers in every country actually experience a crash, and so most drivers never accumulate the personal experience with crashes in different situations to assess the differential risk or a crash in different situations.

2. The actual risk of a crash may change momentarily and independently of a driver's actions (for example when another driver in an opposing lane suddenly drifts across the median). There is almost no way to adjust for that.

3. Most of the research that supports the risk homeostasis theory is flawed in its design or analysis, and 'overwhelming contrary findings' negate its results.

4. In nearly all of the industrial countries motor-vehicle death rates per distance traveled have declined dramatically over the past 30-50 years. If as drivers we were to adjust the risk over time of travel, then the more we drive the more crashes and fatalities we should see. (Wilde's argument that the risk level per capita has remained relatively constant does not counter that argument, unless one assumes that people lower the risk level for every
additional kilometer that they drive in order to adjust for their expected total annual mileage; a somewhat difficult assumption to swallow).

5. Crash data indicate that the risk of a crash varies by a factor of over 100 among different countries, and within a given country the rate diminishes greatly when various improvements are made to the infrastructure. If drivers were to adjust for these differences then the crash rates would be similar in all countries and would remain the same over time (Evans, 2004).

But the fact remains that we do adapt ourselves to our environment. If we don't adjust our driving to a certain risk level, is there any other factor which stands responsible for our adaptation? As per Fuller (2005) there is, and it is the task difficulty. In fact, Fuller also found that the perceived difficulty of the driving task correlates very highly with the perceived risk, but the perceived risk is hardly correlated with the actual risk of a crash. Thus, the contribution of the risk homeostasis is not so much in its specific formulation of how we adjust our driving but in the explicit statement that an improvement in non-driver components of the driver-vehicle-roadway system are likely to change driver behaviour as well. The primary goal of driving for most people is mobility, and when safety improvements can actually enhance mobility at the cost of some of the potential safety benefits, drivers may opt for the mobility benefits. Limited access divided highways ‘motorways’ and ‘freeways’ are much safer than the two-lane rural roads and that safety benefit remains even after the increase in speed on the freeway. It is likely that if drivers drove on freeways at the speeds they drive on winding rural roads, the safety benefits of the freeways would be even greater, but that will simply not happen.

However, the model does suggest two approaches to modifying driver behaviour. The most obvious and direct approach is to increase the perceived risk of apprehension for violating the traffic laws. Not surprising, there are ample data to show that increased speed enforcement is almost invariably accompanied by reduced speeds. In fact, it has been shown that excessive speeding can be reduced even without increasing actual levels of enforcement, by managing to increase the perceived level of enforcement (Shinar & McKnight, 1986). Another, more sophisticated approach to increase the perceived risk is by directly affecting the driver's perception of the risk. Three studies, spanning over 30 years and three continents, i.e. in England (Denton, 1973), in the U.S. (Shinar, Rockwelland, & Malecki, 1980); and in Australia (Godley, Triggs, & Fildes, 2004), these researchers demonstrated that manipulation of road markings
designed to directly affect its perceived narrowness, or the speed of travel on it, all significantly cause a reduction of speed, especially at the high end of the speed distribution.

The motivational approach to understanding (and affecting) driver behaviour does not begin and end with risk. Risk is only one motivating (or deterring) factor, albeit the one discussed most often. For example, in the case of speed selection, other factors that have been identified include the achievement of pleasure, risks posed by the surrounding traffic, time, and expenses (Rothengatter, 1988; Shinar, 2001), tendency towards higher speeds, reluctance to reduce speed, conservation of effort (Summala, 1988), desire for comfort (Ohta, 1993; Shinar, 2001) and presence of passengers in the car (Shinar, 2001). Regardless of the motive, it is important to keep in mind that changes in any component of the driving system will most likely be accompanied by changes in the driving behaviour (Elvik, 2004).

A functional model of driving behaviour must allow for interactions among the system's components, and be able to predict how changes in roadways and vehicles will affect driver behaviour. As a general rule of thumb, models that do not allow for such interactions will overestimate the expected utility of safety improvements, whereas models that allow for the interaction will typically be much more conservative in their prediction, but also much more accurate. Evans (2004) typifies the former as being naïve because they are non-interactive, zero feedback, and engineering oriented models. In contrast, the interactive models include behaviour feedback and behaviour change. In that respect the Risk Homeostasis Model is definitely one of the latter, but because of its many shortcomings noted above, it is more useful as a stimulus to more research and as a post-hoc explanatory model than as a model to predict behaviour.

**Health belief model (HBM)**

Health belief model (HBM) is another theoretical framework that helps in understanding safe versus unsafe riding. According to HBM perception of risk, benefits, and barriers influence safe/unsafe riding behaviours such as rule keeping and speed regulation (Watson, Tunnicliff, Deborah, White, Katherine, Schonfeld, Cynthia, & Wishart, 2007). In general, these theories underscore the role of appraisals, beliefs, and attitudes in shaping riding behaviours, such as those associated with riding fast and risk-taking. But it is also proposed that speeding inclination may not be explained as much by attitude towards riding fast or beliefs/perceptions about
consequences of speeding as by the rider's comparison of one's own speed with that of other drivers (contagion theory) (Connolly & Aberg, 1993).

One of the earliest studies which examined the psychological factors associated with motorcycle riding was conducted in the UK in the late 1980s (Rutter & Quine, 1996; Rutter, Quine & Chesham, 1992, 1995). This study applied both the health belief model (Janz & Becker, 1984) and the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980; Fishbein, 1980; Fishbein & Ajzen, 1975) in a postal survey examining the relationship between rider beliefs, characteristics, and self-reported behaviour. The health belief model (HBM) was developed in the 1950s as a response to concerns over people’s unwillingness to take up disease prevention initiatives. Essentially it consists of 4 aspects:

- Perceived susceptibility: the extent to which someone feels that they are likely to contract the condition;
- Perceived severity: how severe the consequences would be if they did contract the condition;
- Perceived benefits: whether the individual feels that taking preventative action would indeed reduce the risk of contracting the condition; and
- Perceived barriers: the estimated negative effects of taking the health action (costs, discomfort, time, pain, difficulty etc.) (Janz & Becker, 1984)

In the preliminary study by Rutter, Quine, and Chesham (1992), 400 questionnaires were posted out to riders; 200 testing the HBM and 200 testing the TRA. The HBM did not show a significant relationship to crashes. In the main study, Rutter, Quine, and Chesham (1995) sent out 2051 postal questionnaires to assess beliefs relating to behaviour and crashes using the HBM and 2050 questionnaires using the TRA.

A second questionnaire was posted 12 months later to examine the self-reported behaviours, crashes, and other measures such as exposure that had occurred during that 12 month period. They found that the best predictor of crashes was the self-reported behaviour of breaking laws and rules (i.e., speeding, breaking traffic laws, breaking the highway code, riding too close). Both the TRA and HBM explained similar amounts of variance (31%) for this behaviour. Once demographic factors such as age, sex, education, experience and training were accounted for, two significant predictive factors of law breaking behaviour (obeying laws and taking care) emerged from the TRA, whilst the HBM produced four factors. These were:
• feeling safe: people who stated that following the road rules and concentrating properly made them feel safe, and that showing consideration for other road users earn them goodwill, and doing what was taught made them feel skillful, were less likely to report breaking laws and rules 12 months later;

• having fun: those who reported that breaking the speed limit is fun, that riding too close to the vehicle in front makes overtaking easier, that riding after drinking gave them increased confidence and who disagreed that bright or reflective clothing helps people to see you better, were more likely to report breaking laws and rules later;

• good bike performance and safety: those who agreed that maintaining their bike makes it perform better, and concentrating while riding makes them feel safer, and who disagreed that riding too close makes overtaking easier, and disagreed that wearing a crash helmet made them feel safe, were more likely to report breaking laws and rules at time two, 12 months later; and

• risk of crash: those who agreed that breaking the speed limit increases their risk of having a crash, and maintaining your bike takes time and expense, and who disagreed that wearing bright or reflective clothing makes you look stupid, or obeying the traffic laws slows you down were less likely to report breaking laws and rules 12 months later.

(Rutter et al., 1995) The health belief model was also compared with the theory of planned behaviour (TPB) (an extension of the TRA) in a UK study of schoolboys (Quine, Rutter, & Arnold, 1998) and a Finnish study of teenage bicycle helmet use (Lajunen & Räsänen, 2004). Both studies found the TPB to be a better predictor of helmet use than HBM. In the Finnish study, only barriers to helmet use and cues to action were significant predictors of helmet use from the HBM; however, subjective norm (from the TPB) was the strongest predictor (Lajunen & Räsänen, 2004). The HBM was also found to be less effective in predicting intentions to drink and drive than the TRA (Beck, 1981). However, this study has come under some criticism due to low response rates and the operationalization of some of the key beliefs (Janz & Becker, 1984). Young adult pedestrian behaviour has also been examined using the HBM (Yagil, 2000). The benefits and barriers to crossing at ‘don’t walk’ signals were predictive of unsafe crossing behaviour, whereas vulnerability and seriousness were not found to be predictive. Normative influences were significant predictors only for males. These studies indicate
that the HBM can be successfully used to examine motorcyclist and other road user behaviour; although it appears that the HBM may not be quite as effective in predicting behaviour as the TRA or its extension, the TPB.

**Figure 2: Health Belief Model**

**Driving Anger**

Anger is a complex emotion and occurs as a result of an interaction between one or more eliciting events, the individual’s pre-anger state, appraisals of the eliciting events, and available coping resources (Deffenbacher, 2006). In the broader sense, anger is composed of inter-related elements of cynical beliefs and attributions, angry emotional states and aggressive or antagonistic behaviour (Martin, Watson, & Wan, 2000). In a narrower sense, however, anger describes the affective experience, which can range from mild annoyance to fury and outrage, and can be differentiated from hostility, which refers to a person's tendency to view the world in a negative, cynical fashion, or aggression, which is used to describe destructive and violent behaviour. In a driving context, anger is one type of emotion that represents a significant and dangerous phenomenon which commonly occurs in our society. As opposed to other manifestations of anger, expression of driving anger (i.e., aggressive driving or “road rage” behaviour) seems to be a frequent and more socially acceptable outlet of expressing negative emotion. The theoretical frameworks of State-trait anger and self-determination were taken into consideration in order to explain driving anger.
**State-trait anger theory**

Many researchers have hypothesized that individual difference in the tendency to become angry while driving can account for aggressive driving (Arnett, Offer & Fine, 1997; Deffenbacher et al., 1994). They suggest that state trait personality theory can account for these differences, in that trait-level emotion (i.e., anger) can predict increased state emotional arousal and behaviour. First defined by Cattell and Scheier (1961), state-trait theory posits that emotional experience can be experienced in one of two-ways: individuals are likely to experience an emotion either as a transient mood state (labeled ‘state’) or as a more chronic, stable personality dimension (a ‘trait’). Although this theory was developed to explain anxiety, this model of emotional experience has been frequently applied to conceptualize anger (Spielberger, Jacobs, Russell, & Crane, 1983; Spielberger, 1988; Spielberger, Krasner, & Solomon, 1988; Spielberger, Reheiser, & Sydeman, 1995).

**State anger**

One predictor of anger and aggressive behaviours may be an individual's mood or state. Although state anger is a more transient phenomenon, some researchers have posited that environmental triggers and mood state can be the strongest predictors of aggressive driving. Thus, James and Nahl (1998) suggest that road rage is a direct consequence of frustration on the roadways. Others point to environmental conditions, such as driver anonymity, driving congestion, and level of impedance as all being symptomatic of driver aggression (Ellison-Potter, Govern, Petri, & Figler, 1995; Novaco, Kliwer, & Broquet, 1991; Novaco, Stokols, & Milanesi, 1990; Novaco, Stokols, Campbell, & Stokols, 1979). For example, a classic study done by Doob and Gross (1968) demonstrated that horn-honking behaviour increased as drivers became more irritated due to immediate provocations in their surroundings. Further, Arnett et al. (1997) hypothesized that various state factors, including situational characteristics and mood, would be predictive of aggressive driving. They found that participants drove faster when in an angry mood (as evidenced by a driving log) and in fact, anger was the only mood state that predicted reckless driving. It is clear that an individual's anger state could prove to be an important predictor of angry behaviour while driving.
Trait anger

Trait anger is currently thought to be a multi-dimensional construct, made up of physiological, cognitive, behavioural, and emotional expression (Eckhardt & Deffenbacher, 1995; Edmondson & Conger, 1996; Eckhardt, Norlander, & Deffenbacher, 2004). Spielberger (1988) defined trait anger as a global or chronic tendency of experiencing anger (i.e., an anger “disposition”). Therefore, individuals high in trait anger are expected to interpret a wide variety of situations as being anger provoking, and to react to situations with an elevated level of anger (Spielberger, 1988). A related construct is that of hostility, also thought to be multi-dimensional in nature and composed of negative cognitions and emotions (Eckhardt et al., 2004). It is possible that measures of hostility like Buss–Durkee Hostility Scale (Buss & Durkee, 1957) and trait anger like Trait Anger Scale (Spielberger, 1988) may be better predictors of aggressive driving than measures of transient or state anger.

Driving anger within state-trait theory

Although research has shown that both emotional and personality factors influence driving behaviour, Deffenbacher et al. (1994) suggested that driving anger is a situation-specific form of anger. Driving anger research has supported the notion that driving anger, as defined by Deffenbacher et al. (1994), often follows a similar pattern to that of general trait anger. Individuals high in driving anger are likely to experience anger more frequently and intensely in situations where they are driving more than those low in driving anger. These individuals are more likely to become angry in driving-specific situations, compared to other anger-provoking situations. They are also more likely to engage in aggressive driving behaviour, resulting in more traffic violations and automobile accidents, compared to low anger drivers (Deffenbacher et al., 2001; Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000).

Although driving anger appears to share some characteristics with trait anger, research has repeatedly shown only moderate correlations (.27<r<.33) between trait anger (as measured by the TAS) and measures of driving anger (Deffenbacher et al., 2000). Moreover, Deffenbacher et al. (2001) demonstrated a significant relationship between state anger (as evidenced by situational provocation measures) and the DAS (.35<r<.50). Because the relationship between driving anger and either trait or state anger ranged from low to moderate at best, it suggests that the DAS may measure a construct unique from that measured by trait or state measures. While
all three types of anger are significantly related to aggressive driving behaviour, it is not yet known if one type is more highly correlated than the others.

Spielberger (1988) in his theory of state-trait anger indicated that individuals high on trait anger are expected to interpret a wide variety of situations as being anger provoking, and to react to situations with an elevated level of anger. How people express their anger is important for example two people may be equally angered by the same situation, but they might express that anger in different ways. One angry driver might scream at the “culprit” driver, give him the finger, drive menacingly up on the other driver’s bumper or initiate a high speed chase where the drivers try to run each other off the highway. The other angry driver might just mutter something under his breath and continue to drive safely without negative outcomes, aside from impermanent negative affect and arousal. Thus, the form of expression as well as the intensity of anger may play an important role in a driver’s safety, health, and wellbeing on the road as well as that of others who ride with him/her or share the road with him/her.

Another theory which sought to explain anger in a driving context is self-determination theory. This theory discusses anger along with aggression and stress in a driving scenario, as it relates to ego-threat (Baumeister, Bushman, & Campbell, 2000), threats to social identity (Tedeschi & Felson, 1994), and emotional reactivity (Caprara, Perugini, & Barbaranelli, 1994) which have been largely ignored in the context of driving anger and aggression.

Self-Determination

Self-determination theory (Deci & Ryan, 1985, 1987, 1991) is a motivational theory that has provided a useful framework for understanding behaviour in many domains, including education (Grolnick & Ryan, 1987; Ryan & Connell, 1989), medical training (Williams & Deci, 1996, 1998), work (Deci, Connell, & Ryan, 1989; Ilardi, Leone, Kasser, & Ryan, 1993), and romantic relationships (Blais, Sabourin, Boucher, & Vallerand, 1990; Hodgins, Koestner, & Duncan, 1996a; Knee, Patrick, Vietor, Nanayakkara, & Neighbors, 2002), specific health-related behaviours, including adherence to medical prescriptions (Williams, Rodin, Ryan, Grolnick, & Deci, 1998), drinking behaviour (Knee & Neighbors, 2002; Ryan, Plant, & O’Malley, 1995), and weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996).

Among the assumptions of self-determination theory is that individuals differ in their general motivational orientations (Deci & Ryan, 1985). These individual differences are in part
due to differential exposure of autonomy-supportive versus controlling environments as well as developmental differences in organismic integration (Deci & Ryan, 1985). Controlled orientation is a global motivational orientation associated with experiencing a lack of true choice and a general tendency to perceive pressure from one’s environment as well as a contingency-based sense of self-worth that results in rigid ego-defensiveness (Deci & Ryan, 1985; Hodgins & Knee, 2002). Previous research has shown that controlled orientation is positively associated with both driving anger and aggressive driving (Knee, Neighbors, & Vietor, 2001). Theoretically, two aspects of controlled orientation can be distinguished: (a) an orientation toward pressure and stress and (b) ego-defensiveness.

**Pressure:** Controlled individuals tend to regulate their behaviour according to pressures toward specific behaviours and outcomes (Deci & Ryan, 1985). These pressures may originate in the environment (e.g., threats or deadlines) or may originate within the individual in the form of internalized introjections (e.g., feeling that one “should” or “ought” to perform in some specific way). Controlled individuals also may be more affected by perceived pressure; for example, Knee and Neighbors (2002) found that non-fraternity college students who were higher in controlled orientation were more susceptible to the effects of peer pressure to drink. This general orientation toward pressure is conceptually and empirically linked to increased levels of stress. Pressure arising from both internal and external sources has been associated with feelings of stress and tension (Ryan, 1982; Ryan, Mims, & Koestner, 1983). In addition, controlled orientation has been associated with displaying the Type- A coronary-prone behaviour pattern (Deci & Ryan, 1985).

**Ego-defensiveness:** In addition to orienting oneself toward pressures, controlled individuals tend to approach events in an ego-involved fashion, with their self-esteem on the line (Ryan, 1982). Controlled individuals show ego-defensiveness and reactivity in a variety of contexts (Hodgins & Knee, 2002). Controlled orientation has been associated with defensiveness in impression management, social interactions, and coping (Hodgins et al., 1996a; Hodgins, Liebeskind, & Schwartz, 1996b; Knee & Zuckerman, 1996, 1998) as well as with higher levels of public self-consciousness (Deci & Ryan, 1985).

Both pressure and ego-defensiveness may play key roles in determining driving anger and associated aggression. Consistent with this idea, Knee et al. (2000) found that individuals who were higher in controlled orientation had higher levels of trait driving anger and reported more
aggressive driving behaviour. Furthermore, trait driving anger was found to mediate the relationship between self-determination and aggressive driving, suggesting that less self-determined individuals drive more aggressively, in large part, because of their tendency to become angry while driving. Although providing an important first step in understanding the motivational origins of aggressive driving, this research was limited in that it examined motivation and driving anger only at the trait level.

Further Vallendar (1997) proposed a hierarchical model of motivation and persuasively argued the importance of simultaneously examining motivation at both the trait (global) level and more specific levels related to the context and situation. This comprehensive model of motivation emphasized on the different motivational types is influenced by a number of social factors. According to Vallendar’s model, there are both top-down and bottom-up effects of motivation. Top-down effects describe the impact that global motivation has on context-specific or situational motivation. Thus, an individual who is generally controlled in his or her orientation toward events is likely to be more ego-defensive and feel more pressured within a given context, such as driving, and will in turn be more likely to feel stressed and respond defensively to specific events that occur while driving. Bottom-up effects suggest the reverse: Experiencing pressure and ego-defensiveness across many driving situations will, over time, affect one’s overall motivation for driving and, in turn, one’s global motivational orientation. Whereas top-down effects may provide a motivational explanation of behaviour in the present, bottom-up effects require relatively long periods of time and/or many situations to become apparent.

Consistent with this area of research, a research study to extend the theory of self-determination and its relevance in a driving context (Neighbours, Vietor, & Knee, 2002) found that slow traffic was linked to greater feelings of pressure and stress. Surprisingly, feelings of pressure and stress, although associated with more subjective aggression, were only weakly, if at all, associated with driving anger. In addition, feeling pressured did not translate into more aggressive action. Perhaps of greater interest, however, is the finding that ego-defensiveness was associated with driving anger and subsequent aggression. Specifically, viewing events as being personally directed at the self was associated with higher levels of anger and subsequent aggression. Furthermore, the effects related to ego-defensiveness, ego-defensiveness appeared to be substantially larger than the effects related to feeling pressured and stressed. Taken together, these results suggest that “road rage” is more often caused by perceiving the actions of other
drivers as personal affronts and subsequently retaliating to vindicate one’s self-esteem rather than being caused by traffic congestion or general feelings of stress and pressure. These findings are consistent with previous research suggesting that aggression often stems from emotional reactivity (Caprara et al., 1994), perceived threats to self-esteem (Baumeister et al., 2000), and social identity (Tedeschi & Felson, 1994). These findings also are consistent with recent work in self-determination theory, which has shown controlled orientation to be associated with ego-defensive and reactive behaviour (Hodgins & Knee, 2002).

Self-determination can be defined as actively choosing behaviours based on one’s integrated and core values. Defensively reacting to perceived threats or challenges to one’s ego based on feeling that one’s ego is threatened or challenged are at the other end of the continuum (Neighbours, Vietor, & Knee, 2002).

**Vengeance**

Wiesenthal et al. (2000) defined driving vengeance as the wish or desire to get even with another within the driving environment in response to a perceived injustice or infraction. For some drivers, this desire is fulfilled through acts of personal aggression and violence (Hennessy & Wiesenthal, 2001). In order to further understand vengeance, the theoretical frameworks of Heider's causal attribution theory, Actor-Observer effect and Driver stress, aggression and violence model was taken into consideration.

The concept of vengeance is understood from the Heider’s causal attribution theory (1958) and Actor-Observer Bias (Jones & Nisbett, 1971). Attributions are the cognitive process by which we attempt to explain the source or cause of others’ behaviour. Heider (1958) proposed that at its basic level, attributions tend to focus either on internal causes (personality/dispositions) or external causes (environment/situations). Typically, categorization of other people's actions is a normal process that can help simplify the cognitive resources needed to evaluate the constant barrage of stimuli in the world around us. However, this process can become problematic when the actions and dispositions of others do not correspond. As a result, our attributions of the causes of their behaviour become incorrect and over simplified. The Actor-Observer Bias is the stable tendency of individuals to overestimate dispositional and underestimate situational causes of the actions of others, but to conversely attribute more situational and less dispositional causes to their own actions (Jones & Nisbett, 1971; Storms, 1973). According to Jones and Nisbett
this biased evaluation occurs due to, differences in visual perspective of an event between actors and observers, and/or differences in knowledge of, and experience with, the self versus others. With the former explanation, our focus of attention when viewing the behaviour of others is on the individual, so our attributions tend to be based on individual factors. In contrast, when evaluating our own actions, our focus of attention is mainly on the situation, so our self attributions tend to be more situational. With the latter explanation, our in-depth knowledge of the self leads to a greater understanding of situational influences on our behaviour and, conversely, our lack of situational knowledge of the behaviour of others leads to greater dispositional attributions.

Storms (1973) conducted a landmark study to demonstrate that attribution biases are due to visual point of view as suggested by Actor-Observer Bias. Participants were placed into dyads and given the opportunity to have a brief conversation with their fellow participant. They were then asked to make attributions of their own and their fellow co-actor's behaviour during the conversation. He found that attributions were consistent with Actor-Observer Bias in that participants tended to believe their own actions were dictated mostly by the situation, while the actions of their co-actor were dictated mainly by internal dispositions. Participants then watched a videotape of their conversation in which the visual point of view was oriented to show events from their co-actors perspective, and were again asked to provide attributions of their own and their co-actor’s behaviour. Storms (1973) found that attributions had reversed and participants made fewer situational attributions for their own behaviour, while making greater situational and fewer dispositional attributions for their co-actor.

Martin and Huang (1984) have argued that reorientation of point of view may not be sufficient to explain Actor-Observer Bias. Rather than use a social task, they had actors conduct a motor coordination task under the scrutiny of an observer, while a video camera recorded the actor and her performance. Their results indicated that both actors and observers provided greater situational attributions after watching the videotaped performance, showing minimal evidence of a reorientation effect. Martin and Huang (1984) suggested that there orientation of attributions found by Storms (1973) may have been a temporal confound, where the time delay between the two rating periods may have led to altered attributions. While this temporal explanation is plausible, there is currently no consistent understanding of the impact of time on attributions. In fact, the same criticism could be made regarding Martin and Huang (1984) in that their method
also required a time delay between ratings of the actual and videotaped events. Without knowledge of its exact influence on attributions, time may have led to “consistency” of attributions in their context, especially given the unique and dynamic task performed by the actors. As they intended, the observed task in their study was one that required more directed attention from both the actor and observer, which would likely create greater dispositional and reduced situational attributions at the onset (especially among the actors). Their failure to find a “switch” in attributional focus following the point of view reorientation may have been a function of the task itself. Specifically, the task may have been so engaging or demanding of cognitive resources that it remained so during the viewing of the videotape, leading to similar attributions as with the original action. In sum, the findings of Martin and Huang (1984) do not necessarily negate the reorientation effect or the impact of visual point of view on attributions, but rather suggest it may be more complex than originally proposed and dependent on the nature of the task, the information available to both actors and observers of events, and temporal or situational constraints.

Attributions and attribution biases are important concepts for understanding driver behaviour. The driving environment is a common context that can have a significant impact on our daily lives. As in any other social setting, all drivers make evaluations about themselves, as well as the events and people they encounter. However, given the transitory nature of driving interactions, high speeds combined with visual isolation and anonymity among drivers, the amount of information available when attributions are formed can be very limited and subject to error. Current research into attribution biases among drivers, including attributions of the self, has found that erroneous judgments can lead to a variety of dangerous attitudes and behaviours, such as vengeful aggression (Wiesenthal et al., 2000), elevated perceptions of personal driving skills (McKenna, Stanier, & Lewis, 1991), downgraded perceptions of other drivers’ skill (Walton & Bathurst, 1998), decreased belief in collisions likelihood (Svenson, Fischhoff, & Maegregor, 1985), reduced belief in risk of injury from traffic collisions and increased perception of driving ability while fatigued (Dalziel & Job, 1997).

Interaction model of driving stress, aggression and violence

This is another theory that helps to understand the role of stress and aggression contributing towards violence which can be understood as a prerequisite of vengeance. As can be
seen in Figure 3, the perception of driver stress is seen as arising from the interaction of both state and trait variables. State variables are those present in the situation and constitute the environment confronting the motorist. State variables are external to the driver and consist of the number of vehicles on the roadway, possible crowding of the roadway, heat, noise, vibration, time urgency etc. Trait variables, internal to the driver, are individual differences and arousal due to driver states. Driving history, age, level of risk preference, weak impulsive on control, Type A behaviour patterns and predisposition to stress (i.e. trait stress) would constitute such traits or individual difference variables. Both state and trait variables have been demonstrated to produce the perception of stress in drivers. These two categories of variables may also influence each other as indicated by the arrows. Individual may change their trait stress levels through experience with commuting, or could increase in severity or extremity of response due to repeated exposure. Once stress is experienced, the driver will engage in a variety of both direct and indirect coping responses.

**Figure 3:** Interaction model of driving stress, aggression and violence.

**Boredom Proneness**

Boredom has been defined by Fisher (1993) as “an unpleasant, transient affective state in which the individual feels a pervasive lack of interest in and difficulty concentrating on the
current activity.” The theoretical framework of the concept of flow was considered in order to explain boredom proneness.

The concept of flow has relevance to driving behaviour (Csikszentmihalyi, 1988, 1990), where flow means the driver is fully immersed in their driving with some energised focus, akin to being ‘in the zone’ for sportspeople. Some of the features of flow not only include more focussed concentration, obtaining a balance between levels of ability and challenge, a sense of personal control, but also a distorted sense of time, the ability to adjust to failure and the activity being intrinsically rewarding. However, this applies to where the skill level is matched by the challenge faced, and, where there is an imbalance or low levels of challenge and skill, apathy, anxiety or boredom will result (Csikszentmihalyi, 1988, 1990). In contrast, boredom is the consequence of the challenge being less than the skill level, presumably leaving some skill unutilised, and this can mean reduced effectiveness in mental and physical capacity (Drory, 1982). Thus, in conditions where the challenge is low, less concentration and focus may be needed, the required level of personal control is reduced and the activity becomes less rewarding, so there is unlikely to be flow, and the motivation then becomes one of reducing boredom or increasing stimulus. Driver boredom is thus associated with cognitive failure and is consistent with theories of optimal arousal and experience (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes & Dodson, 1908). Both these theories indicate that boredom is associated with impaired performance, due to the debilitating effects of low arousal. These results are also consistent with boredom research showing that people more likely to suffer boredom in general are more likely to suffer cognitive failure (Wallace et al., 2003) and deteriorated performance in other contexts (Watt & Hargis, 2010). People more likely to suffer driver boredom are no more likely to drive at high speeds.

The notion of people suffering driver boredom being likely to compromise road safety is consistent with theories of arousal, which indicate that under-arousal leads to deteriorated task performance (Csikszentmihalyi, 2002; Hebb, 1955; O’Hanlon, 1981; Yerkes & Dodson, 1908). The theory of flow raises questions in relation to drivers over or under-estimating their level of skill or the level of challenge they face, as it may be possible for younger drivers especially to be in a flow state when in fact they are driving beyond their capability (Dorn & Barker 2005; McKenna et al., 2006; Rundmo & Iversen, 2004). Similarly, there are implications for people changing their behaviour to increase the challenge in order to obtain a flow state
(Berlyne 1960; Blincoe et al. 2006; Bryant & Zillmann 1984; Dyer-Smith 1992; London et al. 1972; Molstad 1986; Mikulas & Vodanovich 1993; McKenna 2005; Stradling, 2007).

To summarise, the way people drive and the degree of risk they pose on the roads is related to and often predicted by both stable and transient human factors. The stable human factors include learning, personality, age, gender, attitudes, social norms and self-image and the transient human factors include perception and capability, motivation and emotion and interpersonal processes. However, there is a relative absence of research specifically investigating the nature of driver boredom, responses to it and its role in road safety.

Sensation-seeking

Sensation-seeking is “a trait defined by the seeking of 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 via standard self-report questionnaires (e.g. SSS-V). These traits can be partitioned into four dimensions, thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility (Zuckerman, Eysenck, & Eysenck, 1978). Currently, the explanation for sensation-seeking is based on a model influenced by genetic, biological, psychophysiological, and social factors (Zuckerman, 1983, 1984, 1990, 1994, 1996; Zuckerman, Buchsbaum, & Murphy, 1980), which influence certain behaviours, attitudes, and preferences. The theoretical frameworks of the Yerkes-Dodson law and theory of planned behaviour was considered in order to explain sensation-seeking behaviour.

One of the earliest theories that attempted to provide a comprehensive framework on sensation-seeking was arousal theory. Razmjou (1996) provided us with a definition for arousal that seems to encompass most perspectives: “Arousal is a hypothetical construct that represents the level of central nervous system activity along a behavioural continuum ranging from sleep to alertness” (p. 530). Stokes and Kite (2001) have also suggested that arousal be considered, “the basic energetic state of an organism” (p. 113). Combined, these definitions provide an adequate foundation for understanding the rather general and non-specific nature of arousal as it is typically discussed in the research literature. As this theory states, arousal mobilizes and regulates the human stress response. Everyday living informs us that various events and conditions elicit a response. This response frequently incorporates physiological, cognitive,
behavioural, and emotional dimensions. As arousal theory would assert, what facilitates this response is an energetical or activation system that is general and non-specific. Although the arousal response is multidimensional, historically, physiological markers have dominated its measurement. One of the plausible explanations of arousal theory was given by Yerkes-Dodson law which revealed empirical relationship between arousal and performance, and was originally developed by psychologists Yerkes and Dodson in 1908. The law dictates that performance increases with physiological or mental arousal, but only up to a point. When levels of arousal become too high, performance decreases. The process is often illustrated graphically as a curvilinear, inverted U-shaped curve which increases and then decreases with higher levels of arousal.

*Figure 4: The Yerkes-Dodson Law*

**Ajzen’s theory of planned behaviour**

The theory of planned behaviour, proposed by Ajzen, is an attempt to explain behaviour in a social context. It was derived from an earlier formulation of a social behaviour model that of a reasoned behaviour proposed approximately thirty years ago by Fishbein and Ajzen (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). According to the theory of reasoned behaviour, why people are in full control of their behaviour, it can be easily tracked to their intentions, which in
turn are based on their attitudes and subjective (internalized) norms. In short, we are responsible for our actions, and we supposedly behave as we plan. In reality, in most social contexts we do not have full control of our behaviour. In that respect, driving definitely occurs in a social context much of the time (even when other drivers are not present we stop at a stop light because we have internalized the prevailing social norm or, in some parts of the world such as New York City at 3 am, some drivers do not stop for the same reason). To account for this, Ajzen (1991) proposed the theory of planned behaviour that is schematically illustrated in Figure 5.

![Figure 5: Representation of Ajzen's theory of planned behaviour. (Ajzen, 1991; cited from Shinar, 2007)](image)

This Figure 5 illustrates how we formulate our intentions to commit any behaviour (e.g., speeding) on the basis of the attitude we have towards that behaviour (e.g., we enjoy speed), the subjective norm we embrace (e.g., all of our friends do it, except for the 'sissies' and the 'nerds'), and the perceived control on this behaviour (e.g., there is a speed camera immediately up the road, or the road is straight and empty and there is no enforcement in sight). The three factors may provide us with consistent information (e.g., there is no enforcement in sight) in which case the intention and the behaviour follow in a very predictable manner (we intend to and we speed). But often the information from the three sources is not consistent (e.g. there is a speed camera ahead), and then the resulting behaviour is a resolution of the relative risks involved in the
alternative behaviours (e.g., we might restrain ourselves from speeding or we might take a risk and speed in the hope that the camera is inoperative). Ajzen's theory of planned behaviour has been successfully applied to many domains of driver behaviour (Godin & Kok, 1996; Rothengatter, 1997), especially to explain risky driving that involves conscious violations (rather than unintended errors) (Parker et al., 1992), aggressive driving (Özkan & Lajunen, 2005b), and drinking and driving (Johnson & Voas, 2004).

Impulsiveness

Impulsiveness is defined, “as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individuals or to others” (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Impulsiveness in a driving context is explained through rational decision-making model, bounded rationality and arousal-seeking theoretical models.

Rational decision-making model

Many of us like to think that we behave in a rational manner. This is not always the case, and economists often use the 'rational man' model only as a straw man, to demonstrate and understand biases in the actual behaviour of people, especially in their purchasing decisions. Our decisions are biased in many ways, and only recently have some of the psychological biases been understood (Tversky & Kahneman, 1992). Still, there is reason to our behaviour; at least on many occasions, and at least within limits of the information available to us. The challenge to the rational model of driver behaviour is to allow for all our limitations and biases. Conceptual approaches to explaining and predicting driver behaviour in the context of a process of 'rational' decisions have been offered by Parker and Endler (1992), Sivak (2002) and Fuller (2005).

Sivak's application of 'bounded rationality' to driver behaviour

In the context of driving, Sivak (2002) suggests that we consider the economic concepts of 'bounded' and 'unbounded' rationality as tools to understand driver and pedestrian behaviour. Decisions based on unbounded rationality consider all of the alternative options, the use of all the information needed to select among them, unlimited processing capabilities to analyze them, and no restriction of time. Obviously, in driving when decisions often have to be made almost
instantaneously this is not the case. Bounded rationality is what we use when we do not have all the information, processing capacity, and time to consider all of the options. Our rationality is then 'bounded' or restricted by some limits of knowledge and time, and our decisions are further biased by needs and misperceptions. Thus, bounded rationality is a form of experience-based behaviour modification. This is the typical situation we have in driving. Sivak (2002) provides an example of a driver waiting at a stop sign to cross the street. Unbounded rationality would suggest that the driver first calculate the temporal gap needed to cross the street and then observe the opposing traffic for the first opportunity of such a gap based on the speed and distance between cars in the crossing traffic. With bounded rationality, we set a criterion gap that we consider safe, based on our past experience (which may or may not be totally safe), and then observe the traffic for such a gap. However, our estimate of the gaps is actually flawed, and the longer we wait, the greater the risk we might assume by adding other considerations, such as an expectation that a crossing driver will slow down once he or she sees us entering his or her path. By simply observing the behaviour of a driver stopped at an intersection we cannot know how flawed the bounded rationality of the driver is until we observe a collision, something that would never occur with unbounded rationality, because no driver would voluntarily enter the intersection knowing that a collision would result.

**Arousal-Seeking Behavioural Theory**

It was originated by Lindsley (1950) and further researched by many other psychologists and sociologists. This theory states that “for a variety of genetic and environmental reasons, some people’s brain functions differently in response to environmental stimuli” (Lee, 1996). According to Lee, every person tries to reach an optimum level of arousal from the environment and too little stimulation causes a person to be bored while too much stimulation causes anxiety. Anxiety would lead to sensation-seeking. At the center of this theory lies the fact that sensation seekers are more biologically and environmentally prone to engage in deviant activities and to take illicit drugs. Impulsiveness is one of the most important aspects of the Arousal-Seeking Behavioural Theory, because criminologists believe that impulsiveness warrants the most research attention of all psychological factors implicated in juvenile delinquency and crime. Impulsiveness refers to the inability or unwillingness of a person to think of the consequences of their behaviour before making a decision to act (or having time to make their decision). It is
simply a lack of premeditation. A person who is impulsive may lack the ability to correctly process cognitive information (for example, finish a job or paper, easily bored). Impulsiveness also plays a huge role in assessing different forms of psychopathology. Many researchers see impulsiveness as a major component of psychoticism and anti-social personality disorders (Lynam & Miller, 2004).

Even though the arousal theory can explain different types of deviant behaviour, it appears to best explain drug, alcohol or tobacco use. Researchers have found strong correlations with personality traits that include sensation-seeking, impulsiveness and extraversion to drug abuse. This theory can distinguish those people who seek immediate gratification and the physiological stimulation that comes with consuming drugs.