Driver Boredom: Its Human Antecedents and Behavioural Consequences

Simon Heslop

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Abstract

This programme of research was designed to investigate the role of driver boredom in road safety. It aimed to determine whether driver boredom is prevalent and whether and how it mediates relationships between human factors [e.g. age, sex, personality] and driver behaviour [e.g. speed, distraction, error].

The research comprised two phases. A preliminary phase of the research explored the value of and developed a larger study. Focus group discussions were held with a sample of eight drivers and transcripts were analysed using thematic analysis. The results indicated that driver boredom is likely to be prevalent, compromise road safety, and vary between individuals. This phase of research provided the foundation upon which the questionnaire used in the main phase of the study was based.

The qestionnaire was used to test whether driver boredom mediates relationships between human factors and driver behaviour. The sample comprised 1,550 male and female drivers aged between 17-65+ years. The self-report questionnaire provided data pertaining to human factors, driver boredom, and driver behaviour. Results indicate that some people [specifically those younger, female, more easily bored generally, with a higher sense of time urgency, and less enthusiastic about driving] are likely to pose a higher threat to road safety, at least in part because they are more likely to suffer driver boredom.

The results of this programme of research indicated that driver boredom warrants attention in efforts to understand driver behaviour and its impact on road safety. The results show that those more enthusiastic about driving are much less likely to suffer driver boredom. Because those more enthusiastic about driving are likely to be more engaged in the driving task, they are likely to have more complex knowledge relating to the task, and perceive higher levels of stimulation therein. Further research could be conducted to test whether engagement in the driving task, knowledge relating to it, and levels of perceived stimulation therein mediate relations between driver enthusiasm and driver boredom. Assuming this is the case, intervention programmes could be designed to educate people such that they drive in a more engaged style, are more knowledgeable about the driving task, and perceive higher levels of stimulation therein. Intervention

programmes would need to be tested and if they could be shown to be effective, they could be used to minimise driver boredom and its negative implications for road safety.

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Chapter 1

Introduction

This chapter details the rationale for and aims of the studies reported in this thesis. The first section (1.1) considers the likely importance of driver boredom in road safety. The next section (1.2) outlines a robust definition of driver boredom. The following sections (1.3 and 1.4) consider the potential prevalence of driver boredom and its potential effects on road safety. The potential effects of human factors including age and sex on driver boredom are explored next (Section 1.5). The next section (1.6) explores relationships between the same human factors and driver behaviour. The final section (1.7) summarises the rationale for this programme of research and details the specific aims therein.

1.1 Applied context

There are many road traffic crashes on the roads of Great Britain each year and many associated deaths and injuries. Findings detailed in the annual report on road casualties in Great Britain in 2009 (Department for Transport, 2010) illustrate this well. According to the document, there were 128,185 reported road traffic crashes in Great Britain in 2009 and 222,146 associated human casualties. Among the casualties, 2,222 people were killed and 24,690 were seriously injured (ibid.). Apparently, reported crashes in Great Britain in 2009 cost the economy £15.8 billion[1]. Including those crashes not reported to the police, the cost to the economy is likely to be circa £30 billion (ibid.). Road traffic crashes in Great Britain are thus a large social problem.

Road safety researchers have attempted to identify contributory factors to road traffic crashes, to find possible ways of reducing the number of crashes and associated casualties. Behavioural failures, environmental failures, and vehicular failures are the main classifications of contributory factors (Sabey and Taylor, 1980). According to the annual report on road casualties in Great Britain in 2009, behavioural failures [e.g. *travelling too fast for conditions*] caused 82 percent[2] of crashes attended by the police (Department for Transport, 2010). Incidentally, driver error or reaction [e.g. *failed to*

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[1] That sum includes direct economic costs of lost output and medical expenses. It also includes human costs, which reflect pain, grief, and suffering (Department for Transport, 2010).
[2] Road traffic crashes are often attributed as being caused by more than one contributory factor [128,185 crashes in Great Britain in 2009 as reported to the police were attributed as being caused by 223,673 factors] but contributory factor percentages as reported here have been adjusted such that environmental, vehicular, and behavioural causes total 100 percent.

look properly], injudicious action [e.g. *travelling too fast for conditions*], behaviour or inexperience [e.g. *careless, reckless, or in a hurry*], and impairment or distraction [e.g. *distraction in vehicle*] are behavioural failures which caused crashes in Great Britain in 2009, in decreasing frequency of causality (ibid.). In contrast, environmental failures [e.g. *slippery road surfaces*] only caused 17 percent[3] of crashes (ibid.). Furthermore, vehicular failures [e.g. *defective brakes*] only caused one percent[4] of crashes (ibid.). Road traffic crashes are thus most often a function of behavioural failure.

Further to statistics showing that road traffic crashes are most often a function of behavioural failure, scientists have conducted and reported a great deal of research to develop understanding of driver behaviour as related to road safety. For example, they have investigated the extent to which driver behaviour as related to road safety varies as a function of attitudes[5], subjective norms[6], and perceived behavioural control[7]. Elliott et al. (2007) report testing relations between these constructs and intentions to adhere to speed limits. They used data from a sample of 150 male and female drivers based in Great Britain and found that attitude, subjective norm, and perceived behavioural control [in relation to adhering to speed limits] were all independently related to intentions to adhere to speed limits[8]. Specifically, their results suggest that those with a more positive attitude towards adhering to speed limits, those with higher perceived social support for adhering to speed limits, and those who feel more able to adhere to speed limits, are more likely to intend to adhere to speed limits.

Scientists have also investigated relationships between sensation seeking[9] and driver behaviour, again with the aim of furthering understanding of driver behaviour and road safety. Jonah (1997) reports a thorough review of literature pertaining to these relations. He found that all studies investigating relations between sensation seeking and risky driving [e.g. *speeding, racing other drivers, unsafe passing*] showed positive relations

[3] See preceding footnote.
[4] See preceding footnote.
[5] Attitudes toward a particular behaviour are positive or negative evaluations of that behaviour (Ajzen, 2005).
[6] Subjective norms are perceived social pressures to either engage or not in a particular behaviour (Ajzen, 2005).
[7] Perceived behavioural control is a perception of whether or not one has the means and opportunities to perform a particular behaviour (Ajzen, 2005).
[8] Elliott et al. (2007) found that attitude, subjective norm, and perceived behavioural control explained 54 percent variance in intentions to avoid exceeding speed limits in the next week and independently predicted intentions with standardised beta weights of **.44**, **.23**, and **.28.**
[9] Sensation seeking is a pattern of behaviour defined by the seeking of varied, novel, complex and intense sensations and experiences and the willingness to take risks for the sake of such experiences (Zuckerman, 1994).

between the two. In addition, he found that 94 percent of studies investigating relations between sensation seeking and the consequences of risky driving [e.g. *crashes, traffic violations*] showed positive relations between the two. Essentially, Jonah (1997) found that people who need more varied, novel, complex, and intense sensations, and are more willing to take risks for the sake of such experiences, are more likely to seek high levels of stimulation in the driving task. He also found that they are more likely to make mistakes whilst driving.

Interestingly, researchers have shown that sensation seeking and boredom proneness[10] are related. Kass and Vodanovich (1990) tested relations between sensation seeking and boredom proneness using data from a sample of 210 male and female students at an American university. They found that scores on the total sensation seeking scale and external boredom proneness[11] scale correlated positively. Their findings suggest that people who need more varied, novel, complex, and intense sensations, and are more willing to take risks for the sake of such experiences, are more likely to suffer boredom in general. In addition, one of the main facets of sensation seeking is boredom susceptibility. Boredom susceptibility is a measure of aversion to repetitive and/or boring tasks and/or people [e.g. *Looking at someone's home movies or travel slides bores me tremendously*]. The fact that boredom susceptibility is one of the main facets of sensation seeking is further evidence of an association between needs for varied, novel, complex, and intense sensations, and an inclination to suffer boredom.

Research showing that sensation seeking relates positively to the adverse consequences of risky driving and [external] boredom proneness suggests that driver boredom could compromise road safety. Despite this notion, driver boredom has received little attention in efforts to understand driver behaviour and further road safety. Prior to the publication of academic papers relating to this programme of research (e.g. Harvey et al., 2011; Heslop et al. 2010) the only published scientific literature directly addressing the issue of driver boredom was a paper authored by Drory (1982). Drory (1982) used data from a sample of 93 male heavy truck drivers working in Israel to test relations between driver boredom and performance on the job. He found that driver boredom and job

[10] Boredom proneness is a measure of proclivity to suffer boredom in general (Farmer and Sudberg, 1986).

[11] External boredom proneness is one of the main facets of boredom proneness and captures a tendency to suffer boredom in general due to needs for high levels of variety (Vodanovich et al., 2005); Kass and Vodanovich (1990) found that sensation seeking and external boredom proneness correlated with a coefficient of **.28** [All statistics reported in bold are significant at $p < .05$].

performance related negatively [amongst some]. Specifically, he found that [some of] those who reported higher levels of driver boredom were more likely to have damaged their vehicles through negligent vehicle maintenance and careless manoeuvring into loading stations[12]. The results reported by Drory (1982) are certainly not strong evidence of associations between driver boredom and impaired road safety, but are at least consistent with this idea.

The lack of existing literature addressing the issue of driver boredom is a shortcoming in efforts to understand driver behaviour and further road safety. The research reported in this thesis aims to address this deficiency and, in this way, further understanding of driver behaviour and enhancement of road safety.

1.2 Definition of driver boredom

Definitions of boredom are plentiful in the literature. O'Hanlon (1981) defined boredom as an aversion to monotonous elements of the situation identified as being the source of the feeling, and motivation to change the environment, vary the activity, or escape the situation. Davies et al. (1983) defined boredom as an emotional response to an environment perceived as being monotonous[13]. Perkins and Hill (1985) defined boredom as subjective monotony and a high level of frustration. Fisher (1993) defined boredom as an unpleasant transient affective state in which one feels a pervasive lack of interest in and difficulty concentrating on the current activity. Conrad (1997) defined boredom as under-stimulation and disconnection from the situation. Furthermore, Loukidou et al. (2009) defined boredom as a low activation affect that is also

[12] Drory (1982) found that self-reported boredom and property damage were related [with correlation coefficients as indicated in parentheses] amongst participants who were old [**.53**], of low educational achievement [**.63**], of low military rank [**.67***], with poor health [**.72***], with low levels of intellectual activity [**.56***], and with short tenure on the job [**.43***]; he also found that self-reported boredom and property damage were not related [with correlation coefficients as indicated in parentheses] amongst participants who were young [-.15], of high educational achievement [-.21], of high military rank [.15], with good health [.15], with high levels of intellectual activity [.08], and with long tenure on the job [-.04]; correlations marked with an asterisk were not marked as significant in the paper but have been inferred as being significant due to their size.

[13] Monotony is a characteristic of an environment as perceived by an individual; it is the opposite of variety; further, it is usually associated with an environment which is unchanging, or which only changes in a repetitive and highly predictable fashion (Davies et al., 1983).

unpleasant. Considering each of these definitions, it seems clear that boredom is a state of low arousal[14] and dissatisfaction.

Theories of optimal arousal (Csikszentmihalyi, 2002) and optimal experience (Hebb, 1955; Yerkes and Dodson, 1908) indicate that people always desire a state of optimal arousal[15]. Further to the idea of people always desiring a state of optimal arousal, these theories indicate that low levels of arousal always manifest as dissatisfaction and boredom (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908). In contrast, reversal theory indicates that people switch between states of arousal-seeking and arousal-avoidance [i.e. desiring either high or low levels of arousal] (Apter, 2001). Further to the idea of people needing either high or low levels of arousal, reversal theory indicates that feelings of low arousal manifest as boredom and dissatisfaction when in a state of arousal-seeking but as relaxation when in a state of arousal-avoidance (ibid.). Theories of arousal are thus consistent with the notion of boredom being a state of low arousal and dissatisfaction.

The most encompassing and robust definition of boredom seems to be that offered by Mikulas and Vodanovich (1993). These authors defined boredom as a state of low arousal and dissatisfaction attributed to an inadequately stimulating situation. In support of their definition of boredom as a [transient] state [of mind], these authors argued that a person might be in a state of boredom in one instant and not the next. Furthermore, in support of their definition of boredom as [a state of] low arousal, these authors argued that if a person is in a state of high arousal then at that instant the person is not bored. In support of their definition of boredom as [a state of low arousal and] dissatisfaction, they argued that a person can be in a state of low arousal and not be bored and furthermore made the point that for someone to be bored they must not like it. They stated that a person might have sought out a state of low arousal and feel relaxed, to illustrate the concept of someone being in a state of low arousal and not being bored. Last, in support of their definition of boredom as a case of attribution, these authors argued that if a person were to attribute feelings of low arousal and dissatisfaction to

[14] The state of arousal experienced is a measure of an individual's sensory excitations [i.e. physical and psychological activity] and is understood to be a function of the [perceived] complexity of [i.e. stimulation from] a situation relative to their [perceived] capability in that situation (Csikszentmihalyi, 2002).

[15] Optimal arousal is a moderate state of arousal [neither high nor low] and is understood to occur when [perceived] challenges and [perceived] capability are evenly matched (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908).

anything other than the current situation, the person would not label the experience as boredom.

A degree of research pertaining to the nature of boredom is reported in the literature. Harris (2000) found that people in a sample of 170 male and female students at an American university reported suffering boredom up to ten times per day. She also found that some of the most frequently reported causes of boredom were having nothing to do; a lack of challenge or irrelevance of the task; repetition or monotony; and, interestingly in the context of this programme of research, driving and traffic. Furthermore, she found that some of the most frequently reported feelings associated with boredom were restlessness, frustration, emptiness, and sadness. In addition, she found that some of the most frequently reported techniques for coping with boredom included thinking or daydreaming, refocusing attention, and doing something else. She also found that relaxation was one of the most frequently reported benefits associated with boredom.

Results as reported by Harris (2000) support the definition of boredom proposed by Mikulas and Vodanovich (1993). Results showing that people are bored up to ten times per day and that one of the benefits of boredom is relaxation are consistent with the notion of boredom being a transitory state of consciousness. Results showing that boredom occurs due to having nothing to do, a lack of challenge, and so on, are consistent with the definition of boredom as a state of low arousal and attribution of feelings of low arousal to an inadequately stimulating situation. In addition, results showing that boredom is associated with feelings of restlessness, frustration, and such like, are consistent with the definition of boredom as a state of dissatisfaction.

In accordance with the definition of boredom posed by Mikulas and Vodanovich (1993) and evidence supporting their definition, *driver* boredom is defined in this thesis as a state of low driver arousal and driver dissatisfaction attributed to an inadequately stimulating driving task.

1.3 Prevalence of driver boredom

Excluding work published as a product of this programme of research (Harvey et al., 2011; Heslop et al., 2010) there is a lack of literature pertaining to the prevalence of driver boredom. Driver boredom seems likely to be prevalent on the roads of Great Britain though.

People designated as main drivers in households in Great Britain made 832 trips and covered 7,031 miles [as drivers] in 2010, on average (Department for Transport, 2011b). People designated as other drivers made 321 trips and covered 2,657 miles [as drivers] (ibid.). Commuting and shopping trips accounted for 39 percent of all distance covered by drivers of cars and vans in Great Britain in 2010 (ibid.). Commuting and shopping trips are likely to be regular journeys, and routes used on these trips are hence likely to be familiar. Statistics thus suggest that driving is likely to be a well-practised and familiar task amongst many.

Levels of arousal decline with increasing practice and familiarity. Indeed, Fisher (1993) claims in her review of literature on the subject of boredom at work, that prolonged exposure reduces physiological arousal. Similarly, Thackray (1981) summarises in his review of evidence on the stress of boredom and monotony, that continued performance of repetitive or vigilance-type tasks is associated with declining arousal[16]. Given the definition of driver boredom as a state of under-arousal (after Mikulas and Vodanovich, 1993) statistics indicating that the driving task is likely to be well-practised and familiar amongst many suggest that driver boredom is likely to be prevalent.

Further to the notion of many people being likely to suffer low levels of arousal whilst driving, due to the often well-practised and familiar nature of the task, a lot of driving is understood to take place on motorway and urban road networks. Indeed, people drove a total of 61 and 117 billion miles on the motorway and urban road networks respectively in Great Britain in 2010[17] (Department for Transport, 2011). Motorway and urban road networks are designed to be negotiated safely at high and low speeds, respectively. The motorway network comprises long, straight, wide stretches of road, where sight lines are good and levels of vehicle conflict are low, whilst speeds are highly restricted on the

[16] Driving is clearly a repetitive vigilance-type task.
[17] Distances driven on motorway and urban road networks equate to 20 percent and 38 percent of the distance driven on all road types respectively (Department for Transport, 2011).

urban road network. In this context and given that the driving task is increasingly challenging at higher speeds (Fuller, 2005b) the task of driving on motorway and urban road networks seems likely to be relatively unchallenging.

Some of the literature addressing boredom in general touches on driver boredom. Harris (2000) found that her participants reported driving and traffic as being a cause of boredom, as mentioned (Section 1.2). Specifically, she found that 10 percent of her sample volunteered driving and traffic as causing boredom. Given that there are more than 35 million driving licence holders in the UK alone (Department for Transport, 2011b), this suggests that a substantial number of people are likely to suffer driver boredom.

Despite a lack of research in the area of driver boredom, there is thus reason to believe that driver boredom might affect a substantial number of people. As such, further research investigating this issue is warranted.

1.4 Implications of driver boredom for road safety

Excluding papers published in connection with this programme of research (Harvey et al., 2011; Heslop et al., 2010) and the paper by Drory (1982) there is a lack of literature pertaining to the effects of driver boredom on road safety. However, as argued below driver boredom does seem likely to compromise road safety.

Following the definition of driver boredom as a state of under-arousal (after Mikulas and Vodanovich, 1993) a person suffering it seems likely to be motivated to rectify the situation. According to Fisher (1993), people are likely to cope with boredom in several ways: by refocusing attention on the boring task [e.g. by forcing oneself to attend to the task, setting goals for task accomplishment, and reducing distractions]; by seeking additional stimulation within the task [e.g. by increasing the pace of the task or altering its method of execution]; and by adopting subsidiary thoughts and behaviours [e.g. by daydreaming, singing, playing mental games, fidgeting, and looking around]. Boredom theory as posed by Fisher (1993) thus indicates that people are likely to attempt to cope with driver boredom by refocusing on the driving task; increasing their speed or somehow changing the way they drive to make it more interesting; and by adopting subsidiary thoughts and behaviours.

Boredom attributed to the driving task therefore, might be expected to have a detrimental effect on road safety. The seeking of additional stimulation in the driving task using approach strategies to cope with driver boredom might lead drivers to commit violations. Although no studies have investigated the link between driver boredom and driver behaviour, research shows that general boredom proneness is positively related to aggressive and risky driving (Dahlen et al., 2005). In short, people who are prone to boredom in general seem more likely to pose a risk on the road through overtly dangerous driving behaviours (Section 1.6.1).

The adoption of subsidiary thoughts and behaviours by people whilst driving is likely to manifest as driver distraction. This is likely to have implications for road safety too. Harbluk et al. (2007) tested the effects of driver distraction on behaviour in an on-road study using a sample of 21 male and female participants. They found that when drivers engaged in difficult cognitive secondary tasks [i.e. were distracted] they spent more time looking straight ahead and less time looking to the periphery; monitored vehicle instruments and mirrors less; made fewer inspections of traffic lights; and braked hard more often[18]. Findings reported in the literature hence suggest that driver boredom is likely to compromise road safety when people suffering it attempt to cope by adopting subsidiary thoughts and behaviours. They also suggest that driver boredom might benefit road safety when people suffering it attempt to cope by refocusing attention on the driving task [i.e. reducing distraction].

Nett et al. (2010) report the design and testing of a boredom coping scale. The scale comprises items capturing boredom coping [in mathematics classes] using approach and avoidance strategies[19]. These authors used data from a sample of 976 male and female German school pupils with an average age of 14 years to test the structure of the scale. They found that a four-factor structure best represented their data. The factors

[18] Harbluk et al. (2007) found that engaging in [difficult] cognitive secondary tasks related to: the amount of time spent looking straight ahead (t = **2.20**); the amount of time spent inspecting the periphery (t = **2.18**); the amount of time spent monitoring instruments (χ^2 = **16.38**); the amount of time spent viewing the mirrors (χ^2 = **7.25**); the number of glances at traffic lights (F = **21.34**); and the number of heavy braking events (F = **3.21**).

[19] The scale was developed to capture boredom coping using approach and avoidance strategies further to research indicating that people cope with stress using such strategies (e.g. Holahan et al., 1996) [and boredom, a state of dissatisfaction, is a form of stress (Nett et al., 2010)].

comprised a cognitive approach strategy [e.g. *When I am bored… I make myself aware of the importance of the issue*]; a behavioural approach strategy [e.g. *When I am bored… I ask my teacher for more interesting tasks*]; a cognitive avoidance strategy [e.g. *When I am bored… I study for another subject*]; and a behavioural avoidance strategy [e.g. *When I am bored… I talk to my classmates*].

Approach boredom coping strategies are akin to what Fisher (1993) labelled refocusing of attention and seeking additional stimulation in the task. Avoidance boredom coping strategies are akin to what she labelled subsidiary behaviours. Existing research (Nett et al., 2010) is thus consistent with theory indicating that people suffering driver boredom are likely to cope by focussing on the driving task, seeking additional stimulation therein, and seeking additional stimulation elsewhere.

Interestingly, Nett et al. (2010) found that different people are likely to cope with boredom using different strategies. They used latent profile analysis to identify people with similar patterns of boredom coping. They found three distinct groups: reappraisers [with high scores on the use of cognitive approach strategies]; criticisers [with high scores on the use of behavioural approach strategies]; and evaders [with high scores on the use of avoidance strategies]. Reappraisers represent 43 percent of the sample, evaders, 42 percent, and criticisers, 15 percent. Assuming these findings are applicable to the case of driver boredom, they suggest that whilst a slight majority of the driving population are likely to cope with driver boredom using approach strategies, the rest are likely to use avoidance strategies.

In another study, Mann and Robinson (2009) investigated how a sample of 211 university students in America cope with boring lectures. Their sample reported coping by daydreaming; doodling; colouring in hand-outs; talking to their neighbours; sending text messages on their mobile phones; writing notes to friends; working out finances; playing games on their mobile phones; and writing shopping lists. These methods of coping capture subsidiary behaviours as defined by Fisher (1993) and avoidance strategies as defined by Nett et al. (2010). None of the students in Mann and Robinson's sample reported coping with boredom by seeking additional stimulation in the lecture itself. In the words of Fisher (1993), none of the students in Mann and Robinson's sample reported coping with boredom by refocusing attention on the task or by seeking additional stimulation in the task. In the words of Nett et al. (2010), none of the students reported coping using cognitive or behavioural approach strategies.

Whilst the findings of Nett et al. (2010) suggest that drivers are likely to attempt to cope with boredom using approach and avoidance strategies, those of Mann and Robinson (2009) suggest that drivers are likely to attempt to cope using avoidance strategies only. This divergence in findings may be a function of participants in both samples being different ages and nationalities. Alternatively, it may be a function of these studies asking participants to report on boredom coping in different contexts. In either case, divergent findings relating to boredom coping strategies mean that the extent to which drivers are likely to cope with boredom using approach and avoidance strategies warrants investigation.

More generally, theories of arousal such as optimal arousal theory and optimal experience theory state that task performance decreases when people are suffering under-arousal (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908). Research on boredom is consistent with this notion. Wallace et al (2003) used data from samples of male and female American military personnel (N = 126) and undergraduates (N = 137) to test relations between facets of boredom proneness and both cognitive failure[20] and sleepiness. They found that [between both samples] 48 out of 50 relations between facets of boredom proneness and cognitive failure or sleepiness were positive and that 25 of those relations were statistically significant. Similarly, Watt and Hargis (2010) used data from a sample of 110 male and female healthcare employees to test independent relations between total boredom proneness and job performance. These authors found that total boredom proneness related negatively to job performance and explained six percent variance therein[21]. Furthermore, in accordance with findings of both studies reviewed here, O'Hanlon (1981) argued that research shows monotonous work tasks [inferred as being boring] cause both gradual performance decrements and sustained low levels of performance. Although no research has examined the effects of driver boredom on driving task performance specifically, the above cited evidence raises the possibility that driver boredom might compromise road safety.

[20] Cognitive failures are defined as lapses in perception, memory, and muscle function (Broadbent et al., 1982).
[21] Incidentally, Watt and Hargis (2010) found that sex, race, and education level together did not explain a significant proportion of variance in job performance; this indicates that boredom proneness is a better predictor of performance than all these other factors together.

1.5 Individual difference effects on driver boredom

Some people seem more likely than others do, to suffer boredom. O'Hanlon (1981) argues that different people in the same monotonous environment experience vastly differing degrees of boredom. Conrad (1997) argues that whether or not someone experiences a situation as boring depends upon his or her interpretation of the situation. He further argues that boredom is in the eye of the beholder and that what may be boring to one person may be fascinating to another. The notion of some people being more likely than others are, to suffer boredom, might suggest that some people are more likely than others are, to suffer driver boredom. It is important to understand which people are most likely to suffer driver boredom to ensure that road safety campaigns that could be designed to address the issue of driver boredom are targeted appropriately. This section of the thesis addresses the question of who is most likely to suffer driver boredom.

1.5.1 Boredom proneness effects on driver boredom

Boredom proneness is a measure of proclivity to suffer boredom in life in general, as mentioned (Section 1.1). It is a personality trait[22]. The measure comprises internal and external boredom proneness subscales (Vodanovich et al., 2005). External boredom proneness, again as mentioned (Section 1.1) is a measure of inclination towards boredom due to a need for variety [e.g. *It would be very hard for me to find a job that is exciting enough*] (Vodanovich et al., 2005). In contrast, internal boredom proneness is a measure of inclination towards boredom due to a perceived inability to generate sufficient stimulation for oneself [e.g. *I do not find it easy to entertain myself*] (ibid.). People with higher levels of external boredom proneness may be more prone to boredom while driving because they are more likely to need high levels of stimulation from the driving task [i.e. because they are seeking variety rather than monotony]. Similarly, people with higher levels of internal boredom proneness may be more likely to experience driver boredom because they are less likely to generate sufficient stimulation from the driving task.

[22] Personality traits are aspects of personality that underlie prevalent patterns of thinking and behaviour and differentiate one person from another (Martin et al., 2007).

External boredom proneness seems likely to relate more strongly to driver boredom than internal boredom proneness. This is because perceived levels of stimulation from the driving task are understood to be a function of the position of the vehicle on the road and its trajectory as well as the speed of the vehicle, the vehicle itself, other road users, and the driving environment (Fuller, 2005b). In this context, a general inclination to suffer boredom due to needs for high levels of variety seems more likely to manifest as driver boredom than a general tendency to suffer boredom due to an inability to amuse oneself.

There is a lack of literature reporting relations between boredom proneness and driver boredom. However, the literature does report relations between boredom proneness and boredom at work. Work is a situation, like driving, where people more likely to suffer boredom in general seem more likely to suffer context specific boredom. Farmer and Sudberg (1986) and Kass et al. (2001) both tested relations between boredom proneness and job boredom. The former used data from a sample of 42 male and female undergraduates at an American university. The latter used data from a sample of 292 male and female workers at an American manufacturing plant. Both found that those who reported higher levels of boredom in general were more likely to have reported high levels of boredom at work[23]. It is possible, therefore, that those more likely to suffer boredom in general [i.e. those higher in boredom proneness] will be more likely to suffer driver boredom.

1.5.2 Age, sex, and experience effects on driver boredom

Age, sex, and driving experience seem likely to affect levels of driver boredom. Younger people seem more likely to need high levels of stimulation from the driving task due to adolescence[24] (Arnett, 1995) and ageing [25] (Martin et al., 2007). Males seem more likely than females to need high levels of stimulation from the driving task due to

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[23] Farmer and Sudberg (1986) and Kass et al (2001) found that boredom proneness and job boredom were related with correlation coefficients of **.49** and **.50** respectively.

[24] Adolescence is a period in life between puberty and young adulthood when people often engage in reckless behaviour that involves psychological, physical, and social risks (Arnett, 1995).

[25] It is known that as people age [beyond young adulthood] the acuity of their senses declines, their ability to move quickly is reduced, and there is a decline in various cognitive functions [e.g. the manipulation of information in memory, reaction times, and information processing] (Martin et al., 2007).

their being less sensitive to stimulation (Ellis, 2011). Males also seem more prone to tire of stable environmental surroundings (ibid.). More experienced drivers seem more likely to need high levels of stimulation from the driving task, as they are likely to have developed higher skill levels[26] (Csikszentmihalyi, 2002). Younger people, those with higher levels of driving experience, and males therefore, may be more likely to suffer under-arousal and boredom whilst driving.

Research does show that age and experience relate to driver boredom. Drory (1982) tested relations between both age and length of tenure on the job as a heavy truck driver, and levels of boredom whilst driving. He found that length of tenure on the job and age related to self-reported driver boredom on a stretch of road offering low levels of stimulation[27]. Specifically, he found that younger people and people with higher levels of experience were more likely to have reported high levels of driver boredom.

There is a lack of literature pertaining to relations between sex and driver boredom. There is a body of literature reporting relations between sex and boredom proneness, however. Vodanovich and Kass (1990b) tested sex differences in facets of boredom proneness. They used data from a sample of 385 male and female students at an American University, aged between 17-63 years. They found that sex related to external boredom proneness such that males were more likely than females to have reported suffering boredom in general due to high needs for variety [28]. Similarly, Vodanovich et al. (2005) tested sex differences in facets of boredom proneness. These authors used data from a sample of 280 male and female Americans employed in skilled and unskilled jobs at an American University. They found that sex related to facets of internal and external boredom proneness such that males were more likely to have reported high levels of boredom in general due to both needs for high levels of variety and a perceived inability to amuse themselves[29].

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[26] To illustrate this point, consider Alex, a boy who is learning to play tennis: When Alex first starts playing tennis, he has practically no skills and is likely to find the challenge of hitting the ball over the net sufficiently difficult; if Alex keeps practicing, though, his skills are bound to improve and he will grow bored of just hitting the ball over the net; as Alex practices and his skills improve, he will need increasingly complex challenges [i.e. increasingly difficult and stimulating tasks] to avoid under-arousal and boredom (Csikszentmihalyi, 2002).

[27] Drory (1982) found that age and length of tenure on the job were related to self-reported boredom on a boring stretch of a regular route with correlation coefficients of **-.37** and **.23**, and furthermore that age and length of tenure on the job independently explained 14% and 11% variance in boredom.

[28] Vodanovich and Kass (1990b) found that sex related to external boredom proneness [F = **12.86**].

[29] Vodanovich et al. (2005) found that sex related to facets of internal boredom proneness [F = **4.18**] and external boredom proneness [F = **4.59**].

1.5.3 Main personality trait effects on driver boredom

Neuroticism, extraversion, openness, agreeableness, and conscientiousness are five main personality traits (McCrae and Costa, 1987). Table 1.1 contains descriptions of these traits.

Table 1.1 Descriptions of neuroticism, extraversion, openness, agreeableness, and conscientiousness

Trait	High scorers are typically	Low scorers are typically
Neuroticism	Worrying, nervous, highly strung, insecure, self-conscious, self-pitying, vulnerable	Calm, at ease, relaxed, secure, comfortable, self-satisfied, hardy
Extraversion	Sociable, affectionate, talkative, fun loving, friendly, warm, joiners	Retiring, reserved, quiet, sober, aloof, cold, loners
Openness	Original, creative, daring, imaginative, with broad interests, complex, independent	Conventional, uncreative, unadventurous, down to earth, with narrow interests, simple, conforming
Agreeableness	Soft hearted, forgiving, acquiescent, selfless, sympathetic, lenient, trusting	Ruthless, vengeful, antagonistic, selfish, callous, critical, suspicious
Conscientiousness	Careful, conscientious, reliable, well organised, hard working, self-disciplined, persevering	Careless, negligent, undependable, disorganised, lazy, weak willed, quitting

Trait descriptions are from McCrae and Costa (1987)

There is a lack of research reported in the literature pertaining to relations between the five main personality traits and driver boredom. However, Culp (2006) tested relations between each of the traits and facets of internal and external boredom proneness. He used self-report data from a sample of 316 male and female students at a Canadian university. He found that conscientiousness related quite strongly and negatively to facets of internal and external boredom proneness. Furthermore, he found that although openness and extraversion related quite strongly and negatively to internal boredom proneness, they did not relate to external boredom proneness. In addition, he found that although neuroticism related negatively to external boredom proneness, it did not relate to internal boredom proneness. Last, he found that agreeableness did not relate to either facet of boredom proneness[30].

Results showing that conscientiousness related negatively to internal and external boredom proneness might suggest that people more conscientious are less likely to

[30] Culp found that neuroticism, extraversion, agreeableness, conscientiousness, and openness correlated [with respective correlation coefficients as indicated in parentheses] with internal boredom proneness [-.02; **-.34**; -.05; **-.44**; **-.36**]; and external boredom proneness [**-.24**; -.11; -.12; **-.33**; .09].

suffer driver boredom. Similarly, results showing that agreeableness did not relate to either facet of boredom proneness might suggest that the effects of agreeableness on driver boredom are likely to be marginal. Given that external boredom proneness is likely to relate more strongly to driver boredom than internal boredom proneness (Section 1.5.1) results showing that openness and extraversion are not related to external boredom proneness suggest that the effects of these traits on driver boredom are likely to be marginal. Last, results showing that neuroticism related negatively to external boredom proneness suggests that people who are more neurotic might be less likely to suffer driver boredom.

1.5.4 Type A behaviour pattern effects on driver boredom

The type A behaviour pattern is characterised by an excessive competitive drive, an intense disposition, impatience, hostility, fast movements, and rapid speech (Friedman and Rosenman, 1986). The type A behaviour pattern is a trait that rewards those who can think, perform, communicate and live more rapidly and aggressively than their peers (ibid.). In contrast, the type B behaviour pattern is characterised by low competitive drive and low hostility, patience, easygoingness, tolerance, and slow movements and speech (ibid.).

Type A behaviour pattern seems likely to relate to the experience of driver boredom. People with a type A behaviour pattern seem more likely than their counterparts with a type B behaviour pattern to need high levels of stimulation from the driving task. People with a type A behaviour pattern seem more likely to need to save time in reaching their destinations. In the context of reversal theory, people with a type A behaviour pattern seem more likely to be in a state of arousal-seeking whilst people with a type B behaviour pattern seem more likely to be in a state of arousal-avoidance. People with a type A behaviour pattern thus may be more likely to suffer under-arousal and boredom whilst driving.

There is a lack of research reported in the literature addressing relations between type A behaviour pattern and driver boredom. However, Kass and Vodanovich (1990) used data from a sample of 210 male and female students at an American university, aged between 18-63 years, to test relations between type A behaviour pattern and facets of boredom proneness. They found that type A behaviour pattern related to facets of internal and external boredom proneness[31]. Specifically, their results suggest that those with a type A behaviour pattern are more likely to suffer boredom due to a need for variety but less likely to suffer boredom due to their being able to amuse themselves.

In one respect, these results might suggest that drivers with type A personalities may be likely to suffer boredom while driving because they are in search of stimulation from the task [i.e. to counter external boredom proneness]. However, in another respect people with a type A [versus type B] behaviour pattern may be less likely to suffer boredom when driving because they can generate stimulation from the task. Overall, however, type A behaviour pattern is likely to relate positively to driver boredom if driver boredom relates more strongly to external boredom proneness than internal boredom proneness (Section 1.5.1).

1.5.5 Dislike of driving effects on driver boredom

Dislike of driving is a facet of driver stress (Westerman and Haigney, 2000). It is captured in items such as *In general I do not enjoy driving; usually driving does not make me happy; in general too much driving is a waste of time; driving usually makes me feel frustrated;* and *I usually get bored during a motorway journey* (ibid.). It is a stable human factor[32] (ibid.).

Dislike of driving is likely to relate to driver boredom. Dyer-Smith (1995) argued that people do not find tasks they like boring. This seems to be because people who are more enthusiastic about particular tasks are more likely to engage in them (Conrad, 1997). They are thus likely to have more complex knowledge and schemas[33] relating to the tasks (Loukidou et al., 2009; Fisher, 1993). This in turn is likely to mean that people more enthusiastic about particular tasks are likely to perceive and understand more of

[31] Kass and Vodanovich (1990) found that type A behaviour pattern as captured in total scores on the Jenkins Activity Survey (Jenkins et al., 1979) related to facets of internal and external boredom proneness with correlation coefficients of **-.31** and **.26**.
[32] Westerman and Haigney (2000) found that dislike of driving test-retest correlation coefficients over a period of five months were .79.
[33] Schemas are mental frameworks that organise and synthesise information (Martin et al., 2007)

the stimulation therein[34]. Essentially, people more enthusiastic about driving may be more likely to engage in the driving task and derive high levels of stimulation therefrom. They hence may be less likely to suffer under-arousal and boredom whilst driving.

There is a lack of research reported in the literature pertaining to the effects of dislike of driving on driver boredom. However, one of the items loading highly on the dislike of driving scale captures driver boredom[35]. This clearly lends support to the notion of people less enthusiastic about driving being more likely to suffer driver boredom. In further support of this notion, research relating to boredom in other domains shows that disinterest in the activity is an important antecedent of boredom in that activity. For example, Caldwell et al. (1999) found that people who engaged in activities because they wanted to suffered lower levels of boredom and had higher levels of intrinsic motivation than those participating because they felt they had to. In addition, Landon and Suedfeld (1969) found that lack of meaning was a more important determinant of boredom than physical monotony.

1.6 Individual difference effects on driver behaviour

The purpose of this section is simply to review the evidence showing that the individual differences addressed in the last section are associated with risky driver behaviour. Given that driver boredom might increase the performance of risky driving behaviours (section 1.4) and vary as a function of a number of individual differences (section 1.5) driver boredom might explain [at least in part] the effects of those individual differences on risky driving behaviour. Establishing that driver boredom mediates these effects is important because it would provide strong support for driver boredom as a proximal determinant of risky on-road behaviour. Additionally, individual differences [e.g. personality traits and demographic variables] are not possible to change using safety

[34] The potential relationship between interest in an activity and the level of perceived stimulation whilst engaged in that activity is well illustrated in an example cited by Fisher (1993); consider the task of watching a game of American football: an individual with a complex schema for this task will be able to perceive, judge, enjoy, and recall the subtleties of play and the expertise of play by individuals in different positions; however, a viewer with simple or nonexistent schema for football will see 22 men running around and falling down, which will quickly lose its entertainment value.
[35] Westerman and Haigney (2000) found that the item reading *I usually get bored during a motorway journey* loaded on the dislike of driving subscale with a value of .40.

interventions. Therefore, there is a need to identify variables, such as driver boredom, which mediate the effects of individual differences on driver behaviour and are possible to modify using road safety interventions [e.g. driver education].

1.6.1 Boredom proneness effects on driver behaviour

Research reported in the literature shows that boredom proneness and driver behaviour are related. Dahlen et al. (2005) tested relations between facets of boredom proneness and measures of driver behaviour using data from a sample of 224 male and female students at an American university. They found that external boredom proneness related to loss of control whilst driving, near misses, aggressive driving, and risky driving[36].Their results suggest that those more likely to suffer boredom in general due to needs for high levels of variety are more likely to have reported loss of control whilst driving, near misses, aggressive driving, and risky driving.

Aside from the study by Dahlen et al. (2005), the boredom proneness construct has received little attention in relation to driver behaviour. The boredom susceptibility construct has received more attention however. Incidentally, Kass and Vodanovich (1990) found that boredom susceptibility related positively and quite strongly to external boredom proneness[37]. Further to relatively strong relations between boredom susceptibility and external boredom proneness, boredom susceptibility is considered here as a proxy measure of [external] boredom proneness.

Research also shows that boredom susceptibility and driver behaviour are related. Furnham and Saipe (1993) tested relations between boredom susceptibility and driver behaviour using data from 73 male and female undergraduate and professional drivers based in London. They found that boredom susceptibility related to having incurred driving offence convictions, law breaking [e.g. *Do you care if you violate an important highway law*], confidence [e.g. *Do you feel you take dangerous situations in your stride when driving*], and risk [e.g. *Do you take driving risks assuming you will get away with*

[36] Dahlen et al. (2005) found that internal and external boredom proneness were related [with correlation coefficients as indicated in parentheses] to loss of control whilst driving [.08, **.16**], close calls [.07, **.21**], aggressive driving [-.06, **.18**], and risky driving [.00, **.20**].
[37] Kass and Vodanovich found that boredom susceptibility related to external boredom proneness but not internal boredom proneness with respective correlation coefficients of **.45** and -.06.

them][38]. Specifically, they found that participants who reported higher levels of boredom susceptibility were more likely to have reported having driving offence convictions, breaking the rules of the road, feeling confident in taking risks whilst driving, and taking risks whilst driving.

Similarly, Harris and Houston (2010) tested relations between boredom susceptibility and measures of driver behaviour. In this case, data came from a sample of 152 male and female undergraduates at an arts college in America. These authors found that boredom susceptibility independently explained significant proportions of variance in conflict and speeding behaviours. Specifically, they found that those who reported higher levels of boredom susceptibility were more likely to have reported engaging in aggressive behaviours directed toward other drivers and high speed driving.

1.6.2 Age, sex, and experience effects on driver behaviour

Research reported in the driver behaviour literature shows that age, sex, and driving experience are important determinants of driver behaviour. Stradling et al. (2002) tested the effects of these human factors[39] on measures of driver behaviour using data from a representative sample of 791 drivers based in the UK. They tested age, sex, and experience effects on the following: speed; Highway Code violations [e.g. *I often drive especially close to the car in front as a signal to its driver to go faster or get out of the way*]; aggressive violations [e.g. *I often become angered by another driver and give chase with the intention of giving him/her a piece of my mind*]; and thrill seeking [e.g. *I enjoy cornering at high speed*]. They found significant age, sex, and experience effects on each measure of behaviour[40]. Specifically, they found that younger, more experienced, and male drivers were more likely to have reported driving fast, committing Highway Code and aggressive violations, and seeking thrills whilst driving.

[38] Furnham and Saipe (1993) found that boredom susceptibility related [with correlation coefficients in parentheses] to having driving convictions [**-.31**]; law breaking [**.29**]; confidence [**.31**]; and risk [**.27**].
[39] Experience was captured in a measure of annual mileage.
[40] Stradling et al. (2002) found that age, sex, and annual mileage were related to normal speed [F = **4.95**; **4.71**; **38.56**]; preferred speed (F = **4.50**; **12.37**; **39.98**]; Highway Code violations [F = **13.47**; **22.65**; **42.83**]; aggressive violations [F = **13.21**; 3.76; **7.74**]; and thrill seeking [F = **28.40**; **64.89**; **22.94**].

Boyce and Geller (2002) tested relations between age and sex and engagement in off-task behaviour. These authors gathered data using an instrumented vehicle and a sample of 61 male and female American drivers aged 18-82 years. They found that age related to engagement in off-task behaviour[41]. Specifically, they found that whilst young drivers engaged in off-task behaviour 34 percent of the time, middle-aged and older drivers did the same only 22 and 12 percent of the time respectively[42]. They also found that although sex effects were not significant, young and middle-aged females consistently engaged in off-task behaviour more often than did their male counterparts. Indeed, Boyce and Geller (2002) report that whilst young and middle-aged males engaged in off-task behaviour 29 and 21 percent of the time, their female equivalents engaged in the same 39 and 34 percent of the time.

Mesken et al. (2002) used data from a sample of 1,126 male and female drivers based in Finland to test relations between demographic and experience measures, and aspects of driver speed seeking and cognitive failure. They found that age, sex, and annual mileage related variously to self-reported lapses [e.g. *How often do you, intending to drive to A, instead drive to B?*]; errors [e.g. *How often do you miss give way signs?*]; speeding violations [e.g. *How often do you exceed speed limits on residential roads?*]; at-fault crash involvement; and speeding penalty histories[43].

1.6.3 Main personality trait effects on driver behaviour

The main five personality traits [neuroticism, extraversion, openness, agreeableness, conscientiousness] have received some attention in efforts to understand driver behaviour. For example, Dahlen and White (2006) tested independent relations between the main five personality traits and measures of driver behaviour using data from a sample of 315 American college students. They regressed risky driving, aggressive

[41] Boyce and Geller (2002) found that age related to off-task behaviour (F = **8.20**).
[42] Boyce and Geller (2002) classed drivers aged 18-25 years as young, those aged 35-45 years as middle-aged, and those aged 65 years and above as older.
[43] Mesken et al. (2002) found that age correlated [with correlation coefficients as indicated in parentheses] with lapses [**-.09**] errors [**-.06**] and speeding violations [**-.45**] and also predicted at-fault crash involvement [Wald statistic = **11.76**]; they also found that sex correlated [with correlation coefficients as indicated in parentheses] with lapses [**-.10**] and speeding violations [**.15**] and also predicted having received a speeding penalty [Wald statistic = **7.32**]; furthermore, they found that annual mileage correlated [with correlation coefficients as indicated in parentheses] with lapses[**.10**], errors [**.13**] and speeding violations [**.14**], and also predicted having received a speeding penalty [Wald statistic = **32.77**].

driving, losses of concentration, losses of vehicular control, close calls, moving penalties, and minor accidents onto each trait, with age, sex, and annual mileage controlled. Only three of the 35 relations Dahlen and White (2006) tested between the main five personality traits and measures of driver behaviour reached significance[44]. Whilst providing only limited evidence for relationships between the big five personality traits and driver behaviour, their findings did show that people more neurotic, more open, and less agreeable are more likely to engage in risky driving practices.

In another study, Lansdown (2012) tested relations between four of the main personality traits [neuroticism, extraversion, agreeableness and conscientiousness] and scores on a driver distraction index[45]. This study is pertinent, given that people are likely to cope with driver boredom using avoidance strategies (Nett et al., 2010). Lansdown regressed driver distraction onto the four traits, with age and sex controlled. He used data from a sample of 482 male and female drivers based in the UK. He found that extraversion and conscientiousness related independently to driver distraction, but that neuroticism and agreeableness did not[46].His results suggest that less conscientious and more extraverted people are more likely to be distracted whilst driving.

1.6.4 Type A behaviour pattern effects on driver behaviour

Type A behaviour pattern and aspects of driver behaviour seem related. Boyce and Geller (2002) tested relations between type A behaviour pattern and driver behaviour using data gathered in an instrumented vehicle study, as mentioned before (Section 1.6.2). They found that type A behaviour pattern related to mean speed and mean

[44] Dahlen and White (2006) found that emotional stability [i.e. neuroticism], extraversion, openness, agreeableness, and conscientiousness were related [with respective beta values as indicated in parentheses] to: risky driving [-.12; .01; **-.17**; -.05; -.02]; aggressive driving [**-.21**; .01; .02; -.10; -.01]; losses of concentration [-.13; -.06; .06; .04; -.11]; losses of vehicular control [not given; .02; .05; **-.16**; -.12]; close calls [-.13; -.06; .04; -.06; -.07]; moving penalties [.07; .08; -.06; -.08; .00]; and minor accidents [-.13; .00; -.04; -.10; .06].

[45] The index was calculated by summing scores relating to self-reported frequency of undertaking activities including: writing a text message, reading a text message, using a hand held telephone, interacting with adult passengers, interaction with child passengers.

[46] Lansdown (2012) regressed driver distraction onto age, sex, neuroticism, extraversion, agreeableness, and conscientiousness, and found that only extraversion and conscientiousness were significantly related to driver distraction with respective beta values of **.19** and **-.11**.

following distance[47]. Their findings suggest that people with a type A behaviour pattern are more likely to drive at high speeds and with short following distances. West et al. (1993) also tested relations between type A behaviour pattern and speed. They used self-report measures of both and data from a sample of 108 male and female drivers based in the UK. They also found that type A behaviour pattern related to speed, such that those with a type A behaviour pattern were more likely to have reported driving at high speeds.

Nabi et al. (2005) also tested relations between type A behaviour pattern and measures of driver behaviour. They used data from a large sample of 11,965 people associated with the French National Electricity and Gas Company. They found that type A behaviour pattern related to risky use of a mobile phone whilst driving, driving at high speeds, and serious at-fault crash involvement. Specifically, they found that people with a type A behaviour pattern were more likely to have reported using mobile phones whilst driving; driving above 145 kph on highways; driving above 100 kph on rural roads; driving above 55 kph on urban roads; and causing serious crashes.

1.6.5 Dislike of driving effects on driver behaviour

Dislike of driving has received some research attention in relation to driver behaviour. For example, Matthews et al. (1996) tested relations between dislike of driving and facets of driver behaviour using data from UK and US samples. Facets of driver behaviour considered were as follows: speed [e.g. *Do you drive fast?*]; violations [e.g. *How often do you drive especially close to the car in front as a signal to its driver to go faster or get out of the way?*]; major errors [e.g. *How often do you attempt to overtake someone you hadn't noticed to be signalling a right turn?*]; and minor errors [e.g. *How often do you, realise that you have no clear recollection of the road along which you have just been travelling?*]. The UK sample comprised 363 male and female students and working participants whilst the US sample comprised 219 male and female students.

[47] Boyce and Geller (2002) found that type A behaviour pattern explained significant proportions of variance [with correlation coefficients as indicated in parentheses] in mean speed [**.33**] and mean following distance [**-.30**].

Matthews et al. (1996) found that dislike of driving related negatively to violations and speed but positively to minor and major errors[48]. Their findings suggest that people more enthusiastic about driving are more likely to drive fast and violate the rules of the road. Despite this, their findings also suggest that people more enthusiastic about driving are less likely to make mistakes whilst driving.

Rowden et al. (2011) also tested relationships between self-reported dislike of driving and errors [i.e. major errors] and lapses [i.e. minor errors]. They found that dislike of driving related to errors and lapses. Specifically, they found that those more enthusiastic about driving are less likely to report high levels of lapse- and error-proneness[49].

1.7 Summary and conclusions

This chapter has shown that road traffic crashes are a serious problem (Section 1.1). Furthermore, it has shown that road traffic crashes are usually a function of driver behavioural failures, including travelling too fast, carelessness, and distraction (ibid.).

The possibility has been raised that driver boredom, defined as a state of under-arousal attributed to an inadequately stimulating driving task (Section 1.2), is an important antecedent of behavioural failures amongst drivers. People are likely to suffer boredom whilst driving due to a combination of needs for high levels of stimulation and perceived low levels of stimulation in the driving task (Section 1.3). Furthermore, driver boredom is likely to manifest as impaired performance due to a combination of the use of approach and avoidance coping strategies (Section 1.4).

Some people may be more likely than others to suffer boredom whilst driving (Section 1.5). Essentially, this chapter suggests that the following might be more likely to suffer driver boredom: those more likely to suffer boredom in general (Section 1.5.1); those younger, male, and more experienced (Section 1.5.2); those less conscientious and with

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[48] Matthews et al. (1996) found that dislike of driving correlated [with correlation coefficients as indicated in parentheses, for UK and US samples respectively] with: violations [-.10; **-.24**]; speed [**-.26**; **-.21**]; major errors [**.18**; **.19**]; and minor errors [**.28**; **.32**].

[49] Rowden et al. (2011) found that dislike of driving related [with correlation coefficients as indicated in parentheses] to lapses and errors with correlation coefficients of **.42** and **.36** respectively.

a type A behaviour pattern (Sections 1.5.3 and 1.5.4); and those less enthusiastic about driving (Section 1.5.5).

Existing research demonstrates that people who suffer higher levels of boredom in life in general are more likely to engage in driving practices that compromise road safety (Section 1.6.1). Similarly, existing research demonstrates that younger, male, and more experienced drivers are more likely than their older, female and less experienced counterparts to exhibit driving behaviours that pose a threat to road safety (Section 1.6.2). Less conscientious and more extraverted drivers seem more likely to drive such that they pose a threat to road safety as well, based on existing research (Section 1.6.3). In addition, drivers with a type A behaviour pattern seem more likely than their opposites with a type B behaviour pattern to indulge in driving practices that threaten road safety (Section 1.6.4). Last, people with a stronger dislike of driving seem more likely to compromise road safety as well (Section 1.6.5).

It is interesting to know that drivers who are younger, male, more experienced, less conscientious, and with a type-A behaviour pattern are likely to drive such that they pose an increased threat to road safety. This information can be used to target road safety campaigns. It is important, though, to identify human factors that mediate relations between these stable individual differences and driver behaviour. Only by identifying proximal human factors that mediate relations between the stable human factors [age, sex etc.] and driver behaviour can understanding of how best to influence driver behaviour be developed such that road safety might be enhanced. Notably, driver boredom might mediate relations between stable human factors considered here and risky driver behaviour. It seems likely to do so because it is likely to cause risky driver behaviour and is likely to vary as a function of the individual differences considered here.

There is a lack of research reported in the literature pertaining to the role of driver boredom in road safety (Section 1.1). Indeed, prior to the publication of academic papers relating to this programme of research only one study addressing the subject of driver boredom existed in the literature. This is an important shortcoming because there is reason to believe that driver boredom might be prevalent (Section 1.3) and compromise road safety (Section 1.4). As such, driver boredom warrants attention in efforts to further road safety.

The research reported in the rest of this thesis addresses the lack of driver boredom research. The aims of this programme of research are as follows:

1. To investigate the prevalence of driver boredom, in order to develop understanding of the extent to which it might compromise road safety;
2. To investigate relations between driver boredom and driver behaviour as related to road safety, in order to develop understanding of whether driver boredom is likely to compromise road safety;
3. To investigate relations between human factors and driver boredom, in order to develop understanding of who is most likely to suffer it and thus compromise road safety; and
4. To investigate whether and how driver boredom mediates relations between human factors and driver behaviour as related to road safety, in order to develop understanding of how human factors affect driver behaviour and road safety.

Chapter 2 reports the aims, method, and results pertaining to a preliminary qualitative study designed to explore the prevalence of driver boredom; its potential effects on road safety; and whether different people are differentially susceptible to it. Chapter 3 reports the aims, method, and results pertaining to a main quantitative study designed to test the prevalence of driver boredom; its likely effects on road safety; and why different people are differentially susceptible to it. Both Chapter 2 and Chapter 3 include discussion of results. The last chapter (Chapter 4) comprises a general discussion of the main findings of this programme of research in relation to existing research, including a discussion of the study's implications for theory and road safety. The last chapter also includes a review of limitation of this study and avenues for further research on the subject of driver boredom.

Chapter 2

Preliminary qualitative study

The previous chapter has reviewed the literature and shown that there is little evidence of the prevalence of driver boredom in the driving population or of whether road safety is compromised as a consequence. This chapter reports the preliminary qualitative study, designed to explore the importance of driver boredom in road safety and help develop a main study. The first section (2.1) details the aims of this study. Section 2.2 details the method by which the study was conducted. Section 2.3 presents and discusses results of this study in the context of the aims. The final section (2.4) summarises findings and discusses their implications for this programme of research.

2.1 Aims

Driver boredom is likely to be prevalent (Section 1.3) and likely to compromise road safety (Section 1.4). In addition, different people seem likely to be variously susceptible to suffering driver boredom (Section 1.5).

The aims of this study are as follows:

1. To explore the prevalence of driver boredom amongst the sample, in order to determine whether driver boredom merits further investigation[50];
2. To explore relations between driver boredom and road safety, in order to a) determine whether driver boredom merits further investigation[51] and b) develop understanding of how to further explore relations between these constructs;
3. To explore whether different people are differentially susceptible to experiencing driver boredom, in order to determine whether further research should consider individual difference effects[52]; and
4. To explore relations between driver enthusiasm and driver boredom, in order to determine whether further research should consider driver enthusiasm effects[53].

[50] There would be little point in conducting further research to develop understanding of driver boredom including its antecedents and behavioural implications if results of this phase of research indicated that people were unlikely to experience driver boredom.
[51] There would be little point in conducting further research to develop understanding of driver boredom including its antecedents and behavioural implications if results of this phase of research indicated that driver boredom was unlikely to compromise road safety.
[52] There would be little point in conducting further research to develop understanding of human factor antecedents of driver boredom if results of this phase of research indicated that participants are equally likely to experience boredom whilst driving.

2.2 Method

Eight UK drivers participated in this study. Six participants were male. All participants were aged between 17-65 years.

This study was exploratory in nature and as such used a qualitative approach. Focus group discussions were used to gather data for this phase of research due to their interactive nature and potential for the generation of rich data. Participants all drove at least once per week, wanted to talk about their driving, and included a demographic spread[54]. They knew each other well[55].

Focus group discussions were held on the 1st of May and 8th June 2007 in meeting rooms at Newcastle University. Participants were told that the purpose of the study was to investigate the most important immediate determinants of driver behaviour. They were not told that the purpose of the study was actually to develop understanding of driver boredom and its implications in terms of road safety[56].

The author moderated focus group discussions in which participants were asked to talk about how they usually drive as well as how and why their driving styles change between and within trips. Probing questions were asked to encourage participants to illustrate any points of discussion with examples where applicable[57].The study lead instigated new themes of discussion by talking about how and why he adopts various styles of driving between and within trips.

The first focus group discussion comprised academic staff within the schools of Psychology and Civil Engineering and Geosciences at Newcastle University. The second focus group discussion comprised postgraduate students and research staff in the same schools. Participants were informed of the nature of the study in line with ethical

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[53] There would be little point in conducting further research to develop understanding of how enthusiasm for driving relates to driver boredom if results of this phase of research indicated that enthusiasm for driving was unlikely to be related to driver boredom.

[54] The sample included young [17-25 years] and older [56-65 years] participants as well as male and female participants; these constraints were imposed to ensure that focus group discussions generated rich data.

[55] This was considered important to ensure that participants were able to engage in free-flowing and enthusiastic discussion of salient and often socially taboo issues, which included drink-driving and speeding.

[56] This precaution was taken to ensure that the subject of discussion did not bias conclusions made about the importance of driver boredom [amongst the sample].

[57] The study lead knew each of the participants well and was able to ensure that discussions were relaxed.

requirements. Specifically, they were informed that discussions were being recorded and would be transcribed. They were assured, though, that their data would be treated with confidentiality and that they would remain anonymous. Furthermore, they were told that they could withdraw themselves and their data from the research at any time.

Focus group discussions were transcribed and analysed. Attributional statements[58] were extracted from transcripts and coded for the following: focus group; location in the transcript; speaker; age and sex; and behavioural cause and effect themes [further to their development]. In total 1,026 attributional statements were extracted for analysis. Where several different causes or effects, were given for a particular relationship, attributions were extracted separately[59]. Statements were coded for as many cause and effect themes as appropriate. Chi-squared analyses were used to test relationships between cause and effect themes [e.g. whether state of arousal as coded was related to implications for road safety as coded]. An alpha level of .05 was used for all statistical tests.

2.3 Results and discussion

2.3.1 Prevalence of driver boredom

Attributional statements were coded as reflecting desired and perceived levels of stimulation and state of arousal, to enable testing of relations between level of arousal [including boredom] and other themes [e.g. implications for road safety]. Desired and perceived levels of stimulation were inferred from statements and the surrounding transcript and coded as being either high, moderate, or low. Statements were coded as

[58] Attributional statements are statements in which an outcome is indicated as having happened or being present, because of some event or condition (Munton et al., 1999).

[59] To illustrate how attributional statements were extracted from the transcript, here is a section of transcript [with statements as indicated in parentheses]: *I mean, being behind this trailer, I was behind it for what felt like ages, so I was missing out on all these great bends* [I was behind it for ages, so missing great bends/] *'cause I was just having to go slowly round them* [/(I was missing great bends) 'cause having to go slowly], *so I was looking to get past it* [(I was having to go slowly) so was looking to get past/]*; umm, and I was right up close* [(I was having to go slowly) so was right up close/]*; I mean I was no more than five meters away from it* [(I was having to go slowly) so was < 5m away/]*, just crawling round these bends; and the, then I saw a straight, and, usually, I wouldn't have said it was safe to go past, but I, just because I'd been behind it for so long, and I, I, had it in my mind that this was a great road and I wanted to go fast, I took a risk that I wouldn't usually have taken and nipped past it* [I saw a straight and took a risk/ because I'd been behind it for so long (I took a risk)/ because it was a great road (I took a risk)/ (because) I wanted to go fast, I took a risk/ (I saw a straight) and nipped past it/].

reflecting relaxation where desired and perceived levels of stimulation had been coded as low [e.g. *With a line of traffic on the A1/A69, I think I'm just going to sit here and tootle along at fifty*]. They were coded as reflecting optimal arousal where desired and perceived levels of stimulation had been coded as moderate [e.g. *Outside of town I think I drive at the speed I'm comfortable driving at*]. In addition, they were coded as reflecting excitement where desired and perceived levels of stimulation had been coded as high [e.g. *I like driving fast on bendy country roads*]. Statements were coded as reflecting boredom where desired levels of stimulation had been coded as higher than perceived levels [e.g. *When I'm stuck in traffic, I'm just thinking about something else*]. Last, they were coded as reflecting anxiety where desired levels of stimulation had been coded as lower than perceived levels [e.g. *I would definitely stick to the speed limit if it was wet*].

Statements coded as reflecting each state of arousal were summed to determine how often drivers attributed boredom to the driving task relative to other states of arousal. In total, 315 statements reflected driver boredom. In contrast, 105, 159, 239, and 206 statements reflected driver relaxation, optimal arousal, excitement, and anxiety respectively. A one-sample Chi-squared test was conducted in order to ascertain whether differences in the extent to which statements were coded as reflecting each state of arousal are significant. Results show that boredom was attributed to driving significantly more than any other state of arousal ($\chi^2(4) = 123.77$, $p < .001$). This suggests that participants often experience boredom whilst driving, which is consistent with literature suggesting that driver boredom is likely to be widespread (Department for Transport 2011b, 2011; Harris, 2000; Fisher, 1993; Thackray, 1981).

Attributional statements were coded as reflecting situational factors, to enable testing of relations between these factors and state of arousal amongst participants. Statements were coded as reflecting a long journey where it was inferred as appropriate [e.g. *on motorways I set myself challenges*]. Otherwise, they were coded as reflecting a journey of undefined length. Statements were coded as reflecting a high traffic level where it was inferred that they relate to high levels of traffic and/or being held up by other vehicles [e.g. *If there's a lot of traffic I'll drive miles round it*]. Otherwise, they were coded as reflecting undefined levels of traffic. Statements were coded as reflecting an urban road where it was inferred that they relate to driving on either major or minor urban roads [e.g. *I have poor concentration [driving] on fast urban roads*]. They were coded as reflecting a rural road where it was inferred that they relate to driving on either major or minor rural roads [e.g. *I'll drive very fast on country roads*]. In addition, they were coded as reflecting a motorway where it was inferred that they relate to driving on motorway or dual carriageway [e.g. *Motorway driving is the most bloody tedious awful thing*]. Otherwise, road type was coded as missing.

Chi-squared tests were used to test how situational factors relate to the experience of driver boredom. Results show that state of arousal is related to journey length ($\chi^2(4) = 93.31$, $p < .001$); traffic level ($\chi^2(4) = 41.38$, $p < .001$) and road type ($\chi^2(8) = 95.96$, $p < .001$). Table 2.1 details the number of attributional statements coded for each state of arousal [and expected count] by journey length, traffic level, and road type.

Table 2.1 Number of attributional statements coded for each state of arousal [and expected counts] by journey; traffic; and road

Situation		Bored	Relaxed	Optimally aroused	Excited	Anxious	Total
Journey	Long	80 [37]	16 [12]	4 [19]	2 [28]	19 [24]	121 [121]
	Undefined	237 [280]	89 [93]	155 [140]	237 [211]	187 [182]	905 [905]
Traffic	Yes	106 [86]	39 [28]	17 [43]	49 [65]	66 [56]	277 [277]
	Undefined	211 [231]	66 [77]	142 [116]	190 [175]	140 [150]	749 [749]
Road	Urban	71 [57]	15 [20]	6 [12]	28 [32]	27 [26]	147 [147]
	Motorway	67 [41]	15 [15]	4 [9]	2 [23]	18 [19]	106 [106]
	Rural	26 [66]	28 [23]	24 [14]	62 [37]	31 [31]	171 [171]

Counts show that statements reflecting long journeys and high traffic levels or being held up are more likely to reflect boredom than those reflecting journeys of an undefined length or traffic of an undefined density. In addition, counts show that statements reflecting driving on motorways and urban roads are more likely to reflect boredom than those reflecting driving on rural roads. These findings suggest that people are especially likely to suffer boredom when driving on long journeys, in heavy traffic, and on motorways and urban roads.

Findings showing that people are especially likely to suffer boredom when driving on long journeys are consistent with the notion posed by Fisher (1993) of boredom being more likely to occur as time progresses, when involved in monotonous and/or vigilance type tasks. Results showing that people are especially likely to suffer boredom when driving in slow and heavy traffic are consistent with the notion of driver boredom being a state of under-arousal. Levels of arousal are likely to be especially low in such situations due to low speeds. Findings showing that people are more likely to suffer boredom when driving on motorways and urban roads than when driving on rural roads are further evidence for driver boredom being a state of under-arousal. Motorways and urban roads are likely to offer low levels of stimulation compared to rural roads due to their being designed for safety at high speeds in the case of motorways, and due to their having low speed limits in the case of urban roads.

2.3.2 Individual difference effects on driver boredom

Chi-squared tests were used to test the notion of different people being differentially susceptible to the experience of driver boredom. Results show that state of arousal is related to the participant ($\chi^2(28) = 258.14$, $p < .001$). Table 2.2 details the number of each participant's attributional statements which were coded as reflecting boredom, relaxation, optimal arousal, excitement, and anxiety [and expected counts][60].

Table 2.2 Number of attributional statements coded for each state of arousal [and expected counts] by participant

Participant	Bored	Relaxed	Optimally aroused	Excited	Anxious	Total
Angus	28 [31]	1 [10]	19 [16]	33 [24]	20 [20]	101 [101]
Catherine	34 [27]	3 [9]	11 [14]	16 [21]	24 [18]	88 [88]
Hector	15 [22]	2 [7]	16 [11]	13 [16]	24 [14]	70 [70]
Ivan	46 [54]	24 [18]	22 [27]	35 [40]	46 [35]	173 [173]
Jane	108 [58]	33 [19]	13 [29]	6 [44]	29 [38]	189 [189]
Justin	9 [20]	2 [6]	2 [10]	33 [15]	17 [13]	63 [63]
Nigel	19 [26]	11 [9]	28 [13]	5 [19]	20 [17]	83 [83]
Scott	58 [80]	29 [27]	48 [40]	98 [60]	26 [52]	259 [259]

Actual and expected counts show that some participants are more likely than others to have spoken about their driving in relation to boredom. Specifically, results show that whilst Jane was more likely than expected to have talked about driving in relation to boredom, Scott was less likely to have done the same. Results showing that some

[60] Participants' names have been changed to protect their identities.

participants were more likely to attribute boredom to driving than others, are consistent with Conrad's (1997) claim that what may be boring to one person may be fascinating to another.

To explore potential relations between enthusiasm for driving and the experience of driver boredom, the transcripts of participants most and least likely to reflect driver boredom were examined[61]. Specifically, transcripts of Jane and Scott were examined to determine the extent to which both participants like driving.

Jane's transcript shows that the benefits she derives from driving relate to the most basic utility of driving: getting her to her destinations. She claimed *I drive fast because I want to get there quicker*; and furthermore stated *I'm simply driven by the desire of I don't wanna be late.* These quotes together illustrate that the purpose of driving for Jane is simply to get to where she wants to be. Consistent with this notion, Jane stated in relation to the Hartside Pass, a steep hill climb on the A686, *I just see it as a bit of a frustrating length of journey.*

Jane does occasionally derive an emotional benefit from driving though. She said *because all the daffodils were out, it was all very pretty, and you're lolling about in the Northumberland country lanes, on a Sunday afternoon… then I can enjoy the driving, but I'm in a high up car, I can see over the hedgerows, it's all pretty and rolling countryside and flowers and trees and stuff like that… that's what I enjoy.* Here, the scenery and the opportunity for relaxation is an emotional benefit Jane derives from the driving task. Similarly, Jane claimed *I actually unwound driving home… I saw the drive home, including traffic jams, as a means of winding down.* This quote from Jane's transcript again implies that she can derive an emotional benefit from the driving task. Interestingly though, in both cases, the emotional benefit relates to disconnection from the driving task.

Overall, Jane's transcript suggests that she has low enthusiasm for driving and does not like engaging in the driving task. Her low enthusiasm is captured in the fact that although she claimed to like driving on sunny Sunday afternoons on Northumberland country lanes with the flowers out, she also claimed *I'm bored driving home [from*

[61] Given that dislike of driving is a trait-like characteristic (Section 1.5.4) it was necessary to consider Jane and Scott's transcripts in their entirety, to develop an understanding of the degree to which both participants are enthusiastic about driving.

work]. Her low engagement is captured in the fact that she said *I play games [whilst driving] because it's boring otherwise.*

In contrast, Scott's transcript shows that he likes driving due to an emotional benefit associated with engagement in the driving task. This is captured in the fact that he claimed *I'll turn off the music [and] I'll rise to the challenge on a bendy country road that's got no other traffic on it… I want to improve my skills [and] find my limit*. In further support of the fact that Scott likes driving due to the opportunity for engagement in the driving task, he said the following: *Although I like driving fast on bendy country roads, I don't particularly like other people driving me fast on bendy country roads*. Hartside Pass, which Jane said she sees as *a bit of a frustrating length of journey,* Scott described as *a great road [with] glorious hairpin bends.* Overall, Scott's transcript suggests that he has high enthusiasm for driving and likes engaging in the driving task.

Results showing that Jane is unenthusiastic about driving and likely to suffer driver boredom, and that Scott is enthusiastic about driving and unlikely to suffer driver boredom, are consistent with the notion of people more enthusiastic about driving being less likely to suffer driver boredom (after Dyer-Smith, 1995). Further to the notion of boredom being a state of under-arousal (after Mikulas and Vodanovich, 1993) these results are also consistent with the notion of those more enthusiastic about driving having more complex knowledge and schemas relating to the task (Loukidou et al., 2009; Fisher, 1993). In the same way, these results are consistent with the notion of people more enthusiastic about driving perceiving higher levels of stimulation in the driving task (ibid.).

2.3.3 Driver boredom effects on driver behaviour

Attributional statements reflecting driver boredom were explored, to develop understanding of the likely effects of driver boredom on road safety. Considering attributional statements coded as reflecting driver boredom, it seems to cause the following:

- frustration [e.g. *Getting stuck behind people who treat advisory speed limit signs like a speed limit frustrates me*];

- day dreaming [e.g. *There's no challenge on the motorway; that's when I daydream*];
- driving fast [e.g. I drive fast [on the motorway] because I want to get there quicker];
- distraction [e.g. *I know that when I get bored I don't concentrate*];
- setting challenges [e.g. *On motorways I'm either bored or I've set myself a challenge*];
- pushing out into traffic [e.g. *I become a lot braver in that [Land Rover] and will push out into traffic when held up at junctions*];
- acceptance of smaller gaps [e.g. *I'd accept a smaller gap, if I was waiting to get out*];
- irritation [e.g. *Here, old dears come in, and go terribly slowly, and irritate people like me*];
- putting the radio on [e.g. *If I'm bored on the motorway I might put the radio on*];
- turning the radio up [e.g. *If I'm in a traffic jam and it's boring I turn the radio up*];
- playing games [e.g. *I used to play, and still do play games; it partly comes about because it's boring otherwise*];
- singing [e.g. *If I'm in a traffic jam and it's boring I find something on [the radio] that I can sing to*];
- annoying other drivers [e.g. *If I'm in a traffic jam and it's boring I turn the windows down, and annoy all the other drivers*];
- close following [e.g. *Sometimes when someone's going slower than the speed limit, I find myself deliberately driving closer than you should*]; and
- risky overtaking [e.g. *I was looking to get past [this trailer], just crawling round these bends, and then I saw a straight, and I wouldn't have said it was safe to go past, but because I'd been behind it for so long, I took a risk that I wouldn't usually have taken and nipped past it*].

Essentially, results imply that driver boredom is likely to manifest as dissatisfaction with the driving task and the seeking of additional stimulation in the task itself and elsewhere, using approach and avoidance strategies respectively (Nett et al., 2010).

Findings implying that driver boredom is a state of dissatisfaction are consistent with the definition of driver boredom as a state of low arousal and dissatisfaction (after Mikulas and Vodanovich, 1993). They are also consistent with theories of optimal arousal (Hebb, 1955; Yerkes and Dodson, 1908), optimal experience (Csikszentmihalyi, 2002), and reversal (Apter, 2001), all of which indicate that boredom is a state of dissatisfaction. Furthermore, they are consistent with existing boredom research showing that boredom manifests as restlessness, frustration, emptiness and sadness (Harris, 2000).

Attributional statements coded as reflecting driver boredom also tend to reflect cognitive failure. For example, Angus said *In slow moving traffic, I almost back-end the car in front of me*. Similarly, Scott said *When I get on the motorway, it just puts me to sleep*. Essentially, statements coded as reflecting driver boredom show that this state is associated with almost crashing into the car in front; not remembering stretches of the route; poor concentration; automation; lack of control; shunts; not paying attention; feeling tired; crashing; and falling asleep.

Results showing that driver boredom is associated with cognitive failure are consistent with theories of optimal arousal and experience (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908). Both these theories indicate that boredom is associated with impaired performance, due to the debilitating effects of low arousal (ibid.). 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 and Hargis, 2010).

Attributional statements were coded in terms of implications for road safety, to enable testing of relations between driver boredom and road safety. Statements were coded as negative if they could be inferred as relating to negative implications for road safety [e.g. *I'll burn rubber on the motorways*]. Furthermore, statements were coded as positive if they could be inferred as relating to positive implications for road safety [e.g. *Driving round streets where people live, I'm much more cautious*].

The chi-squared test was used to test relations between driver boredom and road safety. Results show that state of arousal is significantly related to implications for road safety ($\chi^2(4) = 449.16$, $p < .001$). Table 2.3 details the number of attributional statements coded as capturing boredom, relaxation, optimal arousal, excitement, and anxiety [and expected counts] by implications for road safety.

Table 2.3 Number of attributional statements coded for each state of arousal [and expected counts] by implications for road safety

Road safety implications	Bored	Relaxed	Optimally aroused	Excited	Anxious	Total
Positive	21 [86]	88 [28]	36 [26]	2 [68]	116 [54]	263 [263]
Negative	266 [201]	6 [66]	51 [61]	226 [160]	65 [127]	614 [614]

Results in Table 2.3 show that statements reflecting driver boredom are more likely to reflect negative implications for road safety than they are positive implications. Results also show that ‘boredom’ was attributed as a causal factor in 43 percent of statements reflecting negative implications for road safety. In contrast, results show that ‘relaxation, optimal arousal, and anxiety’ were attributed as being causal factors in only one percent, eight percent, and eleven percent of statements reflecting negative implications for road safety. Only ‘excitement’ was attributed as a causal factor in statements reflecting negative implications for road safety to a similar extent as boredom. Results of this study thus suggest that driver boredom is likely to compromise road safety. They even go as far as to suggest that driver boredom might be as likely as driver excitement seeking to compromise road safety.

2.4 Summary and conclusions

Results of this phase of research show that driver boredom is an important antecedent of behaviour amongst the sample used. Furthermore, results show that driver boredom is most likely to occur in situations offering low levels of stimulation. Such situations are likely to include long journeys, heavy traffic, motorways, and urban roads. With statistics showing that much driving takes place in such situations (Section 1.3), results suggest that driver boredom is likely to be prevalent amongst the wider driving population.

Results of this study show that some participants are more likely than others to suffer driver boredom. This is consistent with the notion of boredom being a function of one’s interpretation of a situation (Mikulas and Vodanovich, 1993). It perhaps suggests that there are likely to be individual differences in the experience of driver boredom amongst the population. Results also show that participants most and least likely to suffer driver boredom are respectively unenthusiastic and enthusiastic about driving. This is consistent with the notion of people more enthusiastic about driving being less likely to suffer it as boring. It is as expected given research suggesting that those more enthusiastic about driving are likely to have more complex knowledge and schemas relating to the driving task (Loukidou et al., 2009; Fisher, 1993). It is also as expected further to research suggesting that those more enthusiastic about driving are likely to be more engaged in the driving task (Conrad, 1997). Complex knowledge and schemas relating to the driving task as well as high levels of engagement therein of course mean that enthusiastic drivers are more likely to perceive high levels of stimulation in the driving task (Loukidou et al., 2009; Fisher, 1993). This in turn suggests that they are less likely to suffer driver boredom (Csikszentmihalyi, 2002).

Results of the study reported in this chapter suggest that bored drivers are likely to seek additional stimulation and arousal using approach and avoidance strategies. These results are consistent with theory and research indicating that people are likely to cope with boredom using approach and avoidance strategies (Nett et al., 2010; Fisher, 1993). Results also indicate that driver boredom is associated with behaviours that are likely to have negative implications for road safety [e.g. driving fast; close following; risky overtaking; adjusting the radio; and day dreaming].

Results showing that driver boredom is likely to be prevalent, likely to cause arousal-seeking using approach and avoidance strategies, and likely to compromise road safety indicate that further research should test relationships between driver boredom, driver distraction, and driver behaviour as related to road safety. Results showing that some people are more likely than others are to suffer driver boredom indicates that further research should test relations between individual differences and driver boredom. Particularly, results showing that those most and least likely to suffer driver boredom are respectively unenthusiastic and enthusiastic about driving indicate that enthusiasm for driving should be tested as an antecedent of driver boredom. Results showing individual differences in the experience of driver boredom also indicate that further research should test whether driver boredom mediates relations between human factors and driver behaviour typical of boredom and related to road safety.

The knowledge gained from the preliminary study reported in this chapter provided the knowledge base and the foundations upon which to develop the main quantitative study reported in the next chapter.

Chapter 3

Main quantitative study

Building on the outputs from the focus groups presented in the previous chapter, this chapter reports the main quantitative study, designed to test relations between human factors, driver boredom, and driver behaviour. The first section (3.1) details the aims of this study and the nature of expected relations. The next section (3.2) describes the method used in this study. Section 3.3 reports results and discusses their meaning in the context of the aims of the study and existing research. Finally, Section 3.4 summarises findings of this phase of research.

3.1 Aims

Driver boredom seems likely to be prevalent (Sections 1.3 and 2.3.1). In addition, it seems likely to compromise road safety (Sections 1.4 and 2.3.3). Human factors seem likely to affect susceptibility to the experience of driver boredom (Sections 1.5 and 2.3.2). It is therefore possible that driver boredom will mediate [at least in part] the effects of individual differences [e.g. age, sex, personality] on driver behaviour, as previously established in the literature (Section 1.6).

The aims of this study are:

1. To further investigate how prevalent driver boredom is, in order to develop understanding of the extent to which it is likely to compromise road safety;
2. To further investigate relations between driver boredom and driver behaviour as related to road safety, in order to develop understanding of whether and how it is likely to compromise road safety;
3. To further investigate relations between human factors and driver boredom, in order to develop understanding of who is most likely to suffer it and thus compromise road safety; and
4. To investigate whether and how driver boredom mediates relations between human factors and driver behaviour as related to road safety, in order to develop understanding of how human factors affect driver behaviour and road safety.

In the context of the second aim, driver boredom is likely to relate negatively to age, neuroticism, conscientiousness, and driver enthusiasm. Furthermore, driver boredom is likely to relate positively to sex [male], driving experience, type A behaviour pattern, and facets of internal and external boredom proneness. Younger people seem more likely to suffer driver boredom due to both adolescence and ageing (Section 1.5.2). Males seem more likely than females to suffer driver boredom due to their being less sensitive to stimulation and more likely to tire of stable environments (ibid.). People with higher levels of driving experience seem more likely to suffer driver boredom because they are likely to have more highly developed driving skills (ibid.). Neurotic and conscientious people seem more likely than their emotionally stable and undirected opposites to suffer driver boredom due to their respective worrying and careful natures (Section 1.5.3). People with a type A behaviour pattern seem more likely than those with a type B behaviour pattern to suffer driver boredom, due to the former being more likely to be in a state of arousal-seeking (Section 1.5.4). In addition, people who are more enthusiastic about driving seem less likely to suffer driver boredom due to their being more likely to have complex knowledge and schemas relating to the driving task (Section 1.5.5).

In the context of the third aim, driver boredom is likely to relate positively to speed, distraction, error-proneness, at-fault crash history, and speeding penalty history. People more likely to suffer driver boredom seem prone to drive at higher speeds due to their attempts to cope by seeking additional stimulation in the driving task using approach strategies (Sections 1.4 and 2.3.3). They also seem more likely to drive in a distracted fashion due to their attempts to cope by seeking additional stimulation elsewhere using avoidance strategies (ibid.). Furthermore, people more likely to suffer driver boredom seem more likely to suffer cognitive failure due to a combination of distraction and reduced performance (ibid.). They hence seem more likely to make mistakes, cause crashes and be penalised for speeding.

Last, in the context of the fourth aim, driver boredom is likely to explain, at least in part, relations between human factors [age, sex, driving experience, neuroticism, conscientiousness, type A behaviour pattern, facets of internal and external boredom proneness, and driver enthusiasm] and driver behaviour as related to road safety [speed, distraction, error-proneness, at-fault crash history, and speeding penalty history]. Specifically, driver boredom is likely to explain relationships between human factors and driver behaviour because it is likely to compromise road safety (section 1.4) and vary as a function of those human factors (section 1.5).

3.2 Method

In this section, the method by which the data were collected for this quantitative study is described. This includes the sampling, mechanism for collecting the data, the type of measures and procedures.

3.2.1 Participants

Participants were recruited using opportunity sampling. Participants consented to take part in the study and received no payments. The sample (N = 1,550) comprises UK-based drivers of which 56 percent were male. Six age bands were used, namely 17-25, 26-35, 36-45, 46-55, 56-65, and 65+ year old age groups, and were represented respectively by 15, 22, 19, 19, 14, and 12 percent of the sample. Participants reported driving between 0-175,000 miles annually[62] (mean: 11,823 miles; Standard Deviation (SD): 13,246 miles).

3.2.2 Measures

A self-report questionnaire was used to gather data for this study[63]. The questionnaire included measures of personality, demography, driver boredom, and risky driver behaviour including at fault crash history.

The Ten Item Personality Inventory (TIPI) (Gosling et al., 2003) was used to gather data pertaining to each of the five main personality traits [neuroticism, extraversion, openness, agreeableness, conscientiousness]. This scale was deemed suitable in light of it having shown adequate convergence with the 44-item Big-Five Inventory (John and Srivastava, 1999; Benet-Martínez and John, 1998), test-retest reliability, and convergence between self and observer ratings (Gosling et al., 2003). Two items were

[62] Those who reported driving zero miles qualified responses with comments like *I don't own a car at present* and *I haven't driven for over a year but previously drove a lot*; those who reported the highest annual mileages also reported driving for a living.

[63] This method of data gathering was used rather than alternative means such as on road studies, simulator studies, and driving diaries, because of temporal and financial constraints.

added to the Ten Item Personality Inventory in the same style to measure type A behaviour pattern. Participants were asked *Please rate how far the personality characteristics on each line apply to you* using a 7-point Likert scale. Table 3.1 details the scoring key for the adapted Ten Item Personality Inventory.

Table 3.1 Personality trait scale and scoring key

	Strongly disagree	Disagree	Slightly disagree	Neither Agree nor disagree	Slightly agree	Agree	Strongly agree
1. Sympathetic, warm	1	2	3	4	5	6	7
2. Extraverted, enthusiastic	1	2	3	4	5	6	7
3. Open to new experiences, complex	1	2	3	4	5	6	7
4. Not rushed	7	6	5	4	3	2	1
5. Critical, quarrelsome	7	6	5	4	3	2	1
6. Calm, emotionally stable	7	6	5	4	3	2	1
7. Conventional, uncreative	7	6	5	4	3	2	1
8. Never enough time	1	2	3	4	5	6	7
9. Dependable, self-disciplined	1	2	3	4	5	6	7
10. Disorganised, careless	7	6	5	4	3	2	1
11. Reserved, quiet	7	6	5	4	3	2	1
12. Anxious, easily upset	1	2	3	4	5	6	7

Five factor trait measures are adapted from Gosling et al. (2003); extraversion: 2 + 11; agreeableness: 1 + 5; conscientiousness: 9 + 10; neuroticism: 6 + 12; openness: 3 + 7; type A: 4 + 8

Similarly, the [short form] boredom proneness scale (Vodanovich et al., 2005) was used to gather data on facets of internal and external boredom proneness. It has been demonstrated that internal and external boredom proneness subscales within the [short form] boredom proneness scale are consistent measures of the two most important and reliable facets of boredom proneness[64] (ibid.). Participants were asked *Please rate how far each of the following statements apply to you* using a 7-point Likert scale. Table 3.2 details the scoring key for the slightly adapted [short form] boredom proneness scale[65].

[64] Vodanovich et al. (2005) found that alpha values for internal and external boredom proneness subscales were respectively .86 and .89, such that both subscales are with high consistency.

[65] One of the items measuring internal boredom proneness [*When I was young, I was often in monotonous and tiresome situations*] was removed due to its apparent oddness, leaving a total of 11 items; furthermore, to make the scale [designed for a US sample] more suitable for a UK sample, wording of two items was changed slightly [*Having to look at someone's home movies or travel slides bores me tremendously* was changed to read: *Having to look at someone's home videos or travel pictures bores me tremendously*; *It seems that the same old things are on television or the movies all the time; it's getting old* was changed to read: *It seems that the same things are on TV or the pictures all the time*].

Table 3.2 Boredom proneness scale [short form] and scoring key

	Strongly disagree	Disagree	Slightly disagree	Neither Agree nor disagree	Slightly agree	Agree	Strongly agree
1. It is easy for me to concentrate on my activities	7	6	5	4	3	2	1
2. Having to look at someone's home videos or travel pictures bores me tremendously	1	2	3	4	5	6	7
3. I find it easy to entertain myself	7	6	5	4	3	2	1
4. Many things I have to do are repetitive and monotonous	1	2	3	4	5	6	7
5. I get a kick out of most things I do	7	6	5	4	3	2	1
6. In any situation I can usually find something to do to keep me interested	7	6	5	4	3	2	1
7. It would be very hard for me to find a job that is exciting enough	1	2	3	4	5	6	7
8. Many people would say that I am a creative or imaginative person	7	6	5	4	3	2	1
9. Among my friends, I am the one who keeps doing something the longest	7	6	5	4	3	2	1
10. Unless I am doing something exciting, even dangerous, I feel half-dead and dull	1	2	3	4	5	6	7
11. It seems that the same things are on TV or the pictures all the time	1	2	3	4	5	6	7

Scale adapted from Vodanovich *et al.* (2005); internal boredom proneness = 1 + 3 + 5 + 6 + 8 + 9; external boredom proneness = (2 + 4 + 7 +10 +11) x 1.2 [internal boredom proneness scores were factored up by 1.2 to account for a missing item]

Measures of driver enthusiasm, driver boredom, and driver behaviour were constructed for this study, to gather data pertaining to these constructs. First, pools of items capturing driver enthusiasm, driver boredom, and driver behaviour pertinent to driver boredom were compiled. Next, these measures were refined by piloting amongst friends, colleagues, and small samples of respondents. The scales were reduced via the piloting process such that items were meaningful and interesting to participants; generate agreement and disagreement, were not ambivalent; addressed a single issue; were not repeated; and were not too many.

Table 3.3 lists items in each of the driver enthusiasm, boredom, and behaviour scales. Items in the driver enthusiasm scale capture enthusiasm for driving and driver pleasure. Items in the driver boredom scale capture boredom in various driving situations. Items in the driver behaviour scale capture driver distraction and error-proneness.

Items in the driver enthusiasm, boredom, and behaviour scales were combined and mixed within the questionnaire to make it more interesting to complete. Participants were told *These statements relate to your driving behaviours and feelings about driving* and they were asked *Please rate your agreement with each by ticking the relevant box on each line,* on a 7-point Likert scale.

Table 3.3 Driver enthusiasm, boredom, and behaviour scales

Driver enthusiasm scale
In general, I find driving relaxing
I sometimes go driving just for the sake of it
I really like feeling in control of the vehicle when driving
In general, I really like driving
I often find that time has flown by when driving
I really enjoy driving on scenic roads
Driver boredom scale
I find slow traffic really boring
In general, I find driving boring
I find that I get bored when the roads are very quiet
I find driving on narrow roads tedious
I find driving on motorways dull
I find sticking to speed limits boring
I find that driving gets more boring as time passes on long journeys
Being stuck in a traffic jam is really boring
I generally find that I become less alert when driving for a long time
I generally find it hard to remain interested in a journey after an hour or so of driving
Driver behaviour scale
I sometimes make the mistake of trying to drive off in the wrong gear (Parker *et al*., 1995)
I sometimes get in the wrong lane when approaching a roundabout or junction (Parker *et al*., 1995)
I often daydream whilst driving
I often think about other things on my mind when driving
I often can't remember the road section I have just been driving along (Parker *et al*., 1995)
I have sometimes stopped at a green light by mistake (Kass *et al*., 2008)
I have sometimes failed to notice a red light and driven straight through (Kass *et al*., 2008)
I sometimes make the mistake of trying to drive off without releasing the handbrake (Kass *et al*., 2008)
I generally talk a lot to my passengers when driving
I can forget which way to turn on a road I know well but haven't used recently (Broadbent *et al*., 1982)
I find that my concentration lapses when driving a familiar route

Measures of speed were designed to capture the degree to which participants seek stimulation in the driving task. Figure 3.1 contains photographs used in the questionnaire to obtain data pertaining to speed. Participants were asked *Please imagine you are driving in the direction of the arrow [on photographed stretches of free-flowing motorway, main rural road, minor rural road, and urban road] and indicate the speed in mph at which you would normally drive*.

Figure 3.1 Stretches of road for which participants were asked to nominate speeds at which they would normally drive

Measures of speeding penalty and at-fault crash histories were included in the questionnaire to capture objective data pertaining to the degree to which participants pose a threat to road safety. The questionnaire asked participants *How many [speeding] penalties have you received in the last three years?* Similarly, it asked participants to *Please indicate how many [at-fault] accidents you have been involved in as a driver in the last three years*.

The questionnaire included measures of age, sex, and driving experience, to capture data pertaining to these demographic variables amongst participants. Participants were asked *Are you male or female?* and they were required to circle either male or female in response. Participants were also asked *Which age group are you in?* and they were required to circle 17-25, 26-35, 36-45, 46-55, 56-65, or 66+[66]. Participants were also asked *Approximately how many miles do you drive in a typical year?*

3.2.3 Procedure

The survey was available both online and in hard copy. SurveyMonkey.com (1999-2008) hosted the online survey. It was live from 03.10.08 – 10.02.09 and could be accessed at http://tinyurl.com/driverboredomsurvey. The paper-based survey was available over the same period. The first page of both online and paper-based surveys was a covering letter. The letter detailed the nature of the survey and requested that people participate. It also informed participants that the survey was voluntary and that they could withdraw from the research at any time and for any reason. Furthermore, it informed them that their data were anonymous and would be treated with full confidentiality. Once participants submitted the online survey, they were directed to the study lead's profile on the School of Civil Engineering and Geosciences website. Here participants were presented with contact details and could read about the aims of the study. Participants who completed the paper-based survey were encouraged to keep the covering letter that included contact details.

The survey was publicised widely. Four hundred paper-based questionnaires with covering letters and stamped addressed return envelopes were distributed amongst the study lead's friends, family, and contacts. Furthermore, 2,300 paper-based questionnaires with covering letters and stamped addressed return envelopes were distributed to members of the Newcastle Elders' Council in a December 2008 issue newsletter supplement. The online survey was publicised as widely as possible using the following: Emails to School mailing lists within Newcastle University, Newcastle City Council staff and Durham Constabulary staff; a link on the Newcastle University internal website; threads on motoring forums; and articles in local newspapers.

Data from paper responses were input via the online survey facility using a 'manual data entry' option[67]. When data collection had finished the full dataset was downloaded in

[66] Participants were asked to nominate their age group rather than their age because it was felt that asking them to reveal their age was too intrusive and would put people off responding.

Excel format. Incomplete and duplicate entries were removed from the dataset. Outliers were considered in the context of other responses by the same participants. Mistakes were deleted whilst genuine outliers were retained[68].

3.3 Results and discussion

Following much effort to reach as many of the driving population as was possible in the timescales of the research, data from the questionnaires was entered, checked for error and then subjected to rigorous analyses. The results are presented in this section.

3.3.1 Response rates and sample bias

The sample comprised 29% paper-based survey responses and the remainder online. Paper-based surveys distributed amongst friends, colleagues and contacts, were returned completed in 51% of cases. Paper-based surveys distributed via the Elders Council were returned completed in 11% of cases[69]. For the online survey, no response rate can be calculated because the number of people who chose not to take part is unknown.

The sample was not entirely representative of the UK driving population in terms of age and sex (Table 3.4). The sample was therefore weighted to correct for its misrepresentation of the population in terms of age and sex, and to allow the results to be generalised to the UK driving population.

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[67] This was to ensure that there was no room for error in the coding of paper responses.

[68] Outliers were deemed to be mistakes if they looked odd in the context of other responses by the same participant

[69] The low response rate achieved via the Elders Council is, in part, a reflection of the fact that a large proportion of Elders Council members do not drive; the exact number of drivers is unknown but all Elders Council members are aged 60 years or above and Department for Transport figures (2008a) indicate that only 75% and 52% of those aged 60-69 and 70+ years, respectively, drive; even so, Department for Transport figures do not account for such a low response rate; the proportion of drivers in the Newcastle Elders Council may be less than Department for Transport figures indicate; in addition, the low response rate from Elders Council members may reflect the fact that surveys were distributed just before Christmas, 2008.

Table 3.4 Population and sample demographic group proportional representations and weighting factors applied to participants, by group, to correct for sample misrepresentation

			Age (years)					
			17-25	26-35	36-45	46-55	56-65	66+
Sex	Male	Population	.062	.090	.115	.099	.088	.089
		Sample	.086	.125	.110	.105	.072	.057
		Weighting	0.715	0.720	1.051	0.948	1.227	1.555
	Female	Population	.051	.081	.104	.086	.070	.063
		Sample	.063	.098	.083	.081	.063	.056
		Weighting	0.812	0.823	1.257	1.064	1.107	1.128

Population demographic group proportional representations were calculated using data from the National Travel Survey (2007) (Department for Transport, 2008a) and population estimates (Office for National Statistics, 2008); weighting factors were calculated by dividing the proportional representation of each demographic group in the population by the proportional representation of each demographic group in the sample (after Elliot, 1991)

Table 3.4 details the age and sex profiles of the driving population of Great Britain and of the sample. It also details the weighting factors applied to each participant according to their demographic grouping, to correct for sample age and sex biases. All results reported henceforth are based on analyses using the weighted sample.

3.3.2 Reduction of driver enthusiasm, boredom, and behaviour scales

Table 3.5 details the frequency distributions and measures of central tendency for each of the items in the driver enthusiasm, boredom, and behaviour scales. These statistics show that whilst 83 percent of the sample agreed with the item *In general, I really like driving*; only 26 percent agreed with the item *I sometimes go driving just for the sake of it*. Furthermore, they show that whilst only 18 percent agreed with the item *In general, I find driving boring*; 83 percent agreed with the item *Being stuck in a traffic jam is really boring*. Results hence show that although most are generally enthusiastic about driving, few go driving just for the sake of it. They also show that while few find driving boring generally, most find driving in situations typical of low levels of stimulation boring.

Therefore, given that many driving situations are likely to provide low levels of stimulation (Section 1.3), results suggest that driver boredom is likely to be widespread. These results are thus consistent with findings of the qualitative study showing that boredom was a common manifestation amongst that sample. They are also consistent with statistics indicating that the driving task is likely to be well-practised and highly familiar amongst many (Department for Transport, 2011b) as well as the notion of driving being a monotonous vigilance-type task.

Table 3.5 Driver enthusiasm, boredom, and behaviour scale item frequency distributions and measures of central tendency

	Agreement (valid %)							
	Disagree						Agree	Mean (SD)
	1	2	3	4	5	6	7	
Driver enthusiasm								
In general, I find driving relaxing	4	11	13	21	19	27	6	4.45 (1.6)
I sometimes go driving just for the sake of it	32	27	7	7	10	11	5	2.91 (2.0)
I really like feeling in control of the vehicle when driving	2	3	2	14	13	41	25	5.57 (1.4)
In general, I really like driving	4	6	6	13	16	34	23	5.24 (1.6)
I often find that time has flown by when driving	2	8	9	23	26	28	6	4.69 (1.4)
I really enjoy driving on scenic roads	1	2	2	11	17	43	25	5.69 (1.2)
Driver boredom								
I find slow traffic really boring	4	11	7	13	18	29	17	4.91 (1.7)
In general, I find driving boring	19	33	13	17	10	6	2	2.93 (1.6)
I find that I get bored when the roads are very quiet	25	38	11	12	9	4	1	2.59 (1.5)
I find driving on narrow roads tedious	14	33	13	21	10	8	3	3.14 (1.6)
I find driving on motorways dull	5	17	11	19	22	18	8	4.21 (1.7)
I find sticking to speed limits boring	13	26	11	20	16	10	5	3.48 (1.7)
I find that driving gets more boring as time passes	4	16	9	14	25	25	7	4.43 (1.7)
Being stuck in a traffic jam is really boring	2	4	4	9	16	37	30	5.64 (1.4)
I find that I become less alert when driving for a long time	2	12	8	16	32	25	5	4.60 (1.5)
I find it hard to remain interested after an hour of driving	7	28	17	18	16	12	3	3.56 (1.6)
Driver behaviour								
I sometimes try to drive off in the wrong gear	28	29	7	3	22	10	2	2.99 (1.9)
I sometimes get in the wrong lane at junctions	11	26	13	9	28	13	1	3.61 (1.7)
I often daydream whilst driving	11	23	12	9	27	14	4	3.76 (1.8)
I often think about other things on my mind when driving	3	9	9	9	29	33	8	4.86 (1.5)
I often can't remember the road I have just driven along	11	29	13	10	23	12	3	3.53 (1.7)
I have sometimes stopped at a green light by mistake	36	37	7	4	12	5	1	2.35 (1.6)
I have sometimes missed a red light	34	34	9	5	13	4	1	2.43 (1.6)
I sometimes forget to release the handbrake	32	36	8	5	15	3	0	2.46 (1.5)
I generally talk a lot to my passengers when driving	7	23	15	26	15	12	3	3.66 (1.6)
I can forget which way to turn	17	35	12	13	15	7	1	2.99 (1.6)
I find that my concentration lapses on familiar routes	4	19	12	15	31	15	3	4.08 (1.6)

Statistics reported in Table 3.5 also show that large proportions of the sample engage in thoughts subsidiary to the driving task. For example, frequency distributions show that 70 percent agreed with the item *I often think about other things on my mind whilst driving*. This suggests that most of the sample seeks additional stimulation whilst driving using avoidance strategies (Nett et al., 2010; Fisher, 1993). High levels of agreement with items capturing arousal-seeking using avoidance strategies are consistent with results showing that most of the sample suffers boredom when driving in situations offering low levels of stimulation.

Last, frequency distributions reported in Table 3.5 show that large proportions of the sample suffer cognitive failure whilst driving. For example, 49 percent of participants agreed with the item *I find that my concentration lapses on familiar routes*. Given that boredom is related to impaired performance (O’Hanlon, 1981) high levels of agreement with items capturing cognitive failure are consistent with statistics showing that most people suffer boredom whilst driving in situations offering low levels of stimulation. They are also consistent with results showing high levels of behaviour typical of the use of avoidance coping strategies and disconnection from the driving task [e.g. *I often think about other things on my mind when driving*].

Driver enthusiasm, boredom and behaviour scales were subject to principal components analyses [with varimax rotation] to explore the factor structures underlying the scales and to develop reliable and valid measures of the underlying factor(s). The scree plot pertaining to principal components analysis of items in the driver enthusiasm scale indicated that these items were best represented by a one-factor solution. All driver enthusiasm items loaded strongly onto this factor (see Table 3.6). Scores on this composite measure of driver enthusiasm were calculated by summing each participant’s score on each of the items in the scale. Resulting scores on the composite measure of driver enthusiasm (Cronbach's alpha = .72) were used in subsequent data analyses.

Table 3.6 Driver enthusiasm scale one-factor solution

	F1
In general, I really like driving	.820
In general, I find driving relaxing	.740
I sometimes go driving just for the sake of it	.651
I often find that time has flown by when driving	.580
I really enjoy driving on scenic roads	.544
I really like feeling in control of the vehicle when driving	.514
Number of items	6
Eigenvalue	2.538
% of variance	42.301
Cronbach’s alpha	.718

The scree plot relating to principal components analysis of the driver boredom items indicated that these items were best represented by a one-factor solution as well. All the driver boredom items loaded strongly onto this single factor (see Table 3.7). Scores for each participant on the composite measure of driver boredom were calculated by summing their scores on each of the driver boredom items. Scores on the driver boredom scale (Cronbach's alpha = .78) were used in subsequent data analyses.

Table 3.7 Driver boredom scale one-factor solution

	F1
I find that driving gets more boring as time passes	.757
I find it hard to remain interested after an hour of driving	.754
In general, I find driving boring	.640
I find that I become less alert when driving for a long time	.602
I find slow traffic really boring	.555
I find driving on motorways dull	.550
I find that I get bored when the roads are very quiet	.515
Being stuck in a traffic jam is really boring	.515
I find driving on narrow roads tedious	.456
I find sticking to speed limits boring	.391
Number of items	10
Eigenvalue	3.415
% of variance	34.149
Cronbach's alpha	.776

Table 3.8 Driver behaviour scale rotated two-factor solution

	F1	F2
F3 Driver distraction		
I often think about other things on my mind when driving	.814	
I often daydream whilst driving	.810	
I often can't remember the road section I have just driven	.673	
I find that my concentration lapses driving on familiar routes	.672	
I generally talk a lot to my passengers when driving	.461	
F4 Driver error-proneness		
I sometimes try to drive off without releasing the handbrake		.671
I sometimes fail to notice red lights and drive straight through		.671
I sometimes stop at green lights by mistake		.650
I sometimes mistakenly try to drive off in the wrong gear		.539
I sometimes get in the wrong lane approaching a junction		.538
I can forget which way to turn on a road I know well		.512
Number of items	5	6
Eigenvalue	2.624	2.404
% of variance	23.859	21.853
Cronbach's alpha	.771	.680

The scree plot relating to principal components analysis of the driver behaviour items indicated that these items were best represented by a two-factor solution. Further to varimax rotation of the factors, items capturing driver distraction [e.g. *I often think about other things on my mind when driving*] loaded highly on the first factor whilst items capturing driver error-proneness [e.g. *I have sometimes failed to notice a red light and driven straight through*] loaded highly on the second factor (see Table 3.8). Scores for each participant on composite measures of driver distraction and error-proneness were computed by summing their scores on each of the items loading highly on each of the factors. Scores on composite measures of driver distraction (Cronbach's alpha = .77) and error-proneness (Cronbach's alpha = .68) were used in subsequent analyses.

An alpha level of .05 was used for all subsequently reported analyses. Missing values were left as missing.

3.3.3 Descriptive statistics and univariate effects

Table 3.9 details for each of the continuous study variables, the number of responses, means, standard deviations, and ranges. It also details correlation coefficients pertaining to relations between each of these variables. Participants reported, on average, low scores on measures of neuroticism, extraversion, openness, type A, internal boredom proneness, and external boredom proneness; high scores on measures of agreeableness, conscientiousness, and driver enthusiasm; moderately high scores on the measure of driver boredom; and moderately low scores on measures of driver distraction and error-proneness. On average, participants reported driving below the speed limit on all road types and driving 11,620 miles annually (SD = 11,700 miles).

Significant correlation coefficients [as indicated in parentheses] show that driver boredom is related to age [-.20], annual mileage [-.21], agreeableness [-.11], conscientiousness [-.18], neuroticism [.22], openness [-.07], type A behaviour pattern [.22], facets of internal and external boredom proneness [.23; .28], and enthusiasm for driving [-.25]. Specifically, results show that drivers are more likely to have reported finding driving boring if they also reported the following: being younger; driving shorter distances annually; being less agreeable, conscientious, and open; being more

Table 3.9 Main continuous study variable means, standard deviations, ranges, and correlation matrix (Spearman's rho)

	N	Mean	SD	Range	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Age (years)	1549	46.32	15.8	17–66+																	
2. Annual mileage (x1000)	1478	11.62	12.7	0-175	**-.07**																
3. Extraversion	1525	4.18	1.4	1-7	**-.07**	**.06**															
4. Agreeableness	1528	5.03	1.1	1-7	**.13**	**-.06**	**.10**														
5. Conscientiousness	1514	5.50	1.0	1-7	**.13**	-.03	.01	**.21**													
6. Neuroticism	1520	2.98	1.2	1-7	-.04	**-.07**	**-.15**	**-.29**	**-.31**												
7. Openness	1525	4.84	1.0	1-7	**-.09**	**.07**	**.38**	**.10**	.04	**-.17**											
8. Type A behaviour pattern	1530	3.93	1.2	1-7	**-.11**	.03	**.09**	**-.16**	**-.12**	**.37**	-.03										
9. Internal boredom proneness	1506	2.93	0.7	1-6.5	**-.12**	.04	**-.23**	**-.16**	**-.31**	**.30**	**-.39**	**.10**									
10. External boredom proneness	1509	3.76	0.9	1-6.8	**-.12**	**.07**	**-.07**	**-.23**	**-.18**	**.17**	**-.05**	**.08**	**.12**								
11. Driver enthusiasm	1510	28.57	5.9	9-42	**-.12**	**.24**	.04	-.04	-.02	**-.11**	**.10**	**-.07**	**-.15**	**.10**							
12. Driver boredom	1451	39.52	9.2	10-65	**-.20**	**-.21**	-.01	**-.11**	**-.18**	**.22**	**-.07**	**.22**	**.23**	**.28**	**-.25**						
13. Driver distraction	1506	19.90	5.9	5-35	**-.33**	**.05**	**.08**	**-.07**	**-.20**	**.18**	.02	**.20**	**.15**	**.18**	**-.09**	**.56**					
14. Driver error-proneness	1509	16.83	6.1	6-39	**-.06**	**-.06**	-.03	**-.06**	**-.23**	**.24**	**-.09**	**.14**	**.18**	**.08**	**-.17**	**.36**	**.42**				
15. Urban road speed	1514	23.56	5.4	5-45	**-.11**	**-.05**	.01	.04	.00	-.02	-.01	.01	.02	.02	-.01	.07	**.10**	.01			
16. Minor rural road speed	1534	38.77	9.6	15-70	**-.27**	**.11**	.01	**-.11**	-.04	-.02	**.07**	.05	.01	**.06**	**.17**	.04	**.08**	**-.10**	**.40**		
17. Main rural road speed	1532	53.93	8.7	30-100	**-.28**	**.16**	.01	**-.11**	-.05	-.02	.04	**.05**	.03	**.08**	**.17**	.05	**.07**	**-.11**	**.22**	**.63**	
18. Motorway speed	1529	68.82	7.4	40-120	**-.36**	**.16**	.05	**-.13**	**-.07**	.02	**.07**	**.07**	.05	**.10**	**.18**	**.11**	**.18**	**-.05**	**.15**	**.43**	**.62**

All correlation coefficients reported in bold are significant at $p < .05$ (two-tailed) neurotic; being with a type A behaviour pattern; being more likely to suffer boredom in general [both internal and external boredom proneness]; and being less enthusiastic about driving. Significant correlation coefficients [as indicated in parentheses] also show that driver boredom correlates strongly with driver distraction [.56] and error-proneness [.36], and less strongly with motorway speed [.11]. These results show that people who reported suffering higher levels of driver boredom are more likely to have reported being distracted whilst driving, making mistakes whilst driving, and driving at higher speeds on the stretch of motorway.

Table 3.10 contains statistics relating to one-way ANOVA tests of difference by sex for all continuous study variables. Females were significantly more likely than males to have reported finding driving boring; having a type A behaviour pattern; and suffering driver distraction. On the other hand, males were significantly more likely than females to have reported needs for high levels of variety; high levels of enthusiasm for driving; and high speeds on rural roads and motorways.

Table 3.10 One-way ANOVAs testing relations between continuous variables and sex

	Sex				*F*
	Male (N = 833)		Female (N = 698)		
	Mean	SD	Mean	SD	
Age (years)	46.62	15.9	45.67	15.5	1.41
Annual mileage (x1000)	13.84	15.4	8.85	6.6	**59.82**
Extraversion	3.96	1.4	4.43	1.4	**44.59**
Agreeableness	4.85	1.1	5.24	1.0	**53.09**
Conscientiousness	5.45	1.1	5.56	1.0	3.61
Neuroticism	2.84	1.1	3.14	1.2	**24.12**
Openness	4.78	1.1	4.92	1.0	**6.96**
Type A behaviour pattern	3.70	1.2	4.20	1.2	**65.67**
Internal boredom proneness	2.98	0.7	2.89	0.7	**5.73**
External boredom proneness	3.92	0.9	3.55	0.8	**66.99**
Driver enthusiasm	29.58	5.9	27.36	5.8	**53.19**
Driver boredom	38.84	9.1	40.34	9.2	**9.36**
Driver distraction	18.93	5.7	21.16	5.9	**54.34**
Driver error-proneness	16.24	6.0	17.53	6.1	**16.75**
Urban road speed	23.57	5.4	23.53	5.3	0.02
Minor rural road speed	40.05	10.2	37.27	8.4	**32.37**
Main rural road speed	55.39	8.7	52.33	8.4	**47.77**
Motorway speed	69.63	8.0	67.91	6.5	**20.59**

F = ANOVA test statistics; all *F* statistics in bold are significant at $p < .05$ (two-tailed)

Table 3.11 One-way ANOVAs testing relations between continuous variables and speeding penalty history

	> 1 speeding penalty				
	No (N = 1228)		Yes (N = 170)		F
	Mean	SD	Mean	SD	
Age (years)	46.23	15.8	45.64	15.8	0.25
Annual mileage (x1000)	11.22	11.6	14.22	17.0	**9.66**
Extraversion	4.15	1.4	4.35	1.3	3.60
Agreeableness	5.03	1.1	4.98	1.0	0.40
Conscientiousness	5.52	1.0	5.35	1.0	**4.46**
Neuroticism	2.98	1.2	2.97	1.1	0.00
Openness	4.83	1.1	4.90	1.0	0.83
Type A behaviour pattern	3.90	1.2	4.12	1.2	**5.66**
Internal boredom proneness	2.94	0.7	2.90	0.7	0.48
External boredom proneness	3.75	0.9	3.80	0.9	0.58
Driver enthusiasm	28.48	6.0	29.30	5.4	3.27
Driver boredom	39.14	9.1	42.13	8.9	**17.46**
Driver distraction	19.63	5.9	21.86	6.1	**23.59**
Driver error-proneness	16.62	6.0	18.13	6.1	**10.55**
Urban road speed	23.49	5.3	23.82	5.7	0.65
Minor rural road speed	38.66	9.5	39.45	9.8	1.20
Main rural road speed	54.02	8.6	53.45	9.8	0.74
Motorway speed	68.66	7.2	70.01	8.3	**5.72**

F = ANOVA test statistics; all F statistics in bold are significant at $p < .05$ (two-tailed)

Tables 3.11 and 3.12 contain statistics relating to one-way ANOVA tests of difference for all continuous study variables by whether or not participants had reported having been penalised for speeding or at-fault in a crash over the last three years. People who reported having been penalised for speeding (Table 3.11) and having caused at least one crash in the last three years (Table 3.12), were more likely to have reported suffering high levels of driver boredom than were people who were free of speeding penalties and at-fault crash involvement. These findings are consistent with the notion of driver boredom being likely to compromise road safety.

Driver distraction and error-proneness relate to speeding penalty and at-fault crash histories. Those who reported high levels of distraction and error-proneness are more likely than those who reported low levels to have been penalised for speeding and to have caused at least one crash in the last three years. These findings are consistent with the notion of driver distraction and error-proneness being indicators of road safety.

Table 3.12 One-way ANOVAs testing relations between continuous variables and at-fault crash history

	> 1 at-fault crash				
	No (N = 1228)		Yes (N = 170)		F
	Mean	SD	Mean	SD	
Age (years)	46.32	15.5	42.38	15.7	**9.46**
Annual mileage (x1000)	11.20	10.8	15.16	21.2	**14.15**
Extraversion	4.15	1.4	4.19	1.4	0.10
Agreeableness	5.04	1.1	4.86	1.0	**3.75**
Conscientiousness	5.53	1.0	5.28	1.1	**8.54**
Neuroticism	2.94	1.2	3.22	1.3	**8.35**
Openness	4.84	1.0	4.80	1.1	0.23
Type A behaviour pattern	3.88	1.2	4.09	1.3	**4.28**
Internal boredom proneness	2.93	0.7	2.98	0.8	0.72
External boredom proneness	3.73	0.9	3.84	0.9	2.33
Driver enthusiasm	28.58	5.9	28.94	6.3	0.50
Driver boredom	39.26	9.1	41.57	8.8	**8.36**
Driver distraction	19.69	5.9	21.60	5.8	**15.17**
Driver error-proneness	16.58	6.1	18.46	6.1	**13.59**
Urban road speed	23.62	5.4	23.06	5.7	1.53
Minor rural road speed	38.88	9.7	38.65	9.8	0.08
Main rural road speed	54.07	8.6	53.93	9.6	0.04
Motorway speed	68.88	7.3	69.02	7.4	0.05

F = ANOVA test statistics; all F statistics in bold are significant at $p < .05$ (two-tailed)

Sex is not related to having been penalised for speeding ($\chi^2(1) = 0.23$, $p > .05$) or having been at-fault crash involved ($\chi^2(1) = 0.21$, $p > .05$). Having been penalised for speeding is however related to at-fault crash involvement ($\chi^2(1) = 3.90$, $p < .05$). Those who reported being penalised for speeding at least once in the last three years are more likely than those who did not, to have also reported causing one or more crash in the same period. In this context, speeding penalty history is an important indicator of road safety.

3.3.4 Individual difference effects on driver boredom

Driver boredom was regressed onto age, sex, annual mileage, the main five personality traits, type A behaviour pattern, main facets of boredom proneness, and enthusiasm for driving, to test independent relations between these human factors and driver boredom. Table 3.13 details results pertaining to this regression analysis.

Table 3.13 Regression of driver boredom onto human factors and experience: proportions of variance accounted for by model, model statistics, predictors, and significance

	Driver boredom
R^2	.25
F	**34.25**
Age (β_i)	**-.15**
Sex [male] (β_i)	**-.06**
Annual mileage (x 1000) (β_i)	-.04
Extraversion (β_i)	.03
Agreeableness (β_i)	.01
Conscientiousness (β_i)	**-.09**
Neuroticism (β_i)	.02
Openness (β_i)	-.03
Type A (β_i)	**.14**
Internal boredom proneness (β_i)	**.10**
External boredom proneness (β_i)	**.27**
Driver enthusiasm (β_i)	**-.25**

R^2 = proportion of variance accounted for by model; F = model statistic; β_i = standardised regression coefficient; all coefficients in bold are significant at $p < .05$ (two-tailed)

Human factors considered here explain 25 percent variance in driver boredom. Age [-.15], sex [-.06], conscientiousness [-.09], type A behaviour pattern [.14], facets of internal and external boredom proneness [.10; .27], and driver enthusiasm [-.25] all relate independently to driver boredom [with standardised beta values as indicated in parentheses]. External boredom proneness and driver enthusiasm relate most strongly to driver boredom. Sex and conscientiousness relate weakly to the same. None of extraversion, agreeableness, neuroticism, openness, or annual mileage relate to driver boredom.

Enthusiasm for driving is one of the human factors most strongly related to driver boredom. Results show that those who reported higher enthusiasm for driving are less likely to suffer driver boredom. This is consistent with the notion of people not suffering boredom when doing something they like doing, as claimed by Dyer-Smith (1995). The relationship between enthusiasm for driving and driver boredom is also consistent with the fact that items loading highly on a dislike of driving scale include an item capturing high levels of boredom (Westerman and Haigney, 2000). Furthermore, it is consistent with research showing that children who engaged in activities because they wanted to were less likely to suffer boredom than children taking part either because they had to or because they had nothing else to do (Caldwell et al., 1999).

Those who reported being more likely to suffer boredom in general, due to needs for high levels of variety [external boredom proneness], are much more likely to have reported suffering high levels of driver boredom. In contrast, those who reported being more likely to suffer boredom in general due to a perceived inability to amuse themselves [internal boredom proneness] are only slightly more likely to have reported suffering high levels of driver boredom. Positive relations between facets of boredom proneness and driver boredom are consistent with the definition of boredom proneness as a proclivity to suffer boredom in general (Vodanovich et al., 2005). They are also consistent with results showing that boredom proneness related strongly to job boredom (Kass et al., 2001; Farmer and Sudberg, 1986). Stronger relations between external boredom proneness and driver boredom than between internal boredom proneness and the same are consistent with the notion of driving being a function of external stimulation, as suggested by Fuller (2005b).

Those who reported a type A behaviour pattern are more likely to have reported suffering driver boredom. This suggests that those with a higher sense of time urgency are more likely to suffer driver boredom. This is consistent with the definition of the trait as a chronic and excessive struggle to obtain an unlimited number of things from any situation in the shortest period of time or against opposing things or people (Friedman and Rosenman, 1986). It is also consistent with research showing that type A behaviour pattern and external boredom proneness are positively related (Kass and Vodanovich, 1990). The positive relation between type A behaviour pattern and driver boredom is inconsistent, however, with research showing that type A behaviour pattern and internal boredom proneness are negatively related (ibid.). Interestingly, results of this study show that type A behaviour pattern and internal boredom proneness relate positively [$r = .10$] (Table 3.9). This is more consistent with the definition of the trait and calls into question the findings of Kass and Vodanovich (1990).

Younger people are more likely to have reported suffering driver boredom. This is consistent with theory indicating that younger people are more likely to need high levels of stimulation in general (Arnett, 1995). Those who need higher levels of stimulation are, of course, more likely to suffer under-arousal and boredom. This finding is also consistent with existing research showing that age related negatively to driver boredom amongst a sample of professional truck drivers in Israel (Drory, 1982).

Results of this study show that females are more likely than males to have reported suffering high levels of driver boredom. This is inconsistent with results showing males are much more likely to have reported high levels of internal and external boredom proneness (Table 3.10). Furthermore, it is inconsistent with literature that reports relationships between sex and boredom proneness. More specifically, Vodanovich et al. (2005) found that males scored significantly more than females on both main facets of boredom proneness. Results showing that females are more likely than males to have reported suffering driver boredom are likely to be explained by lower levels of enthusiasm for driving amongst females, given that driver enthusiasm is strongly negatively related to driver boredom (Table 3.10).

Results show that less conscientious people are more likely to have reported suffering driver boredom. This is consistent with the notion of conscientious people [described as being careful] being more likely than their undirected counterparts [described as being careless] to perceive high levels of risk and stimulation in the driving task (McCrae and Costa, 1987). It is also consistent with existing research showing that conscientiousness related quite strongly and negatively to main facets of internal and external boredom proneness (Culp, 2006).

Interestingly, experience is unrelated to driver boredom. This finding is inconsistent with optimal arousal theory. Optimal arousal theory indicates that more experienced drivers are likely to be more skilled in the task, hence more likely to need high levels of stimulation in the task, and hence more likely to suffer under-arousal and boredom (Csikszentmihalyi, 2002). It is also inconsistent with results reported by Drory (1982). Drory found that those with longer tenure on the job as heavy truck drivers are more likely to suffer driver boredom on a stretch of road offering particularly low levels of stimulation.

3.3.5 Driver boredom effects on driver behaviour

Measures of driver distraction, error-proneness, speed [on stretches of urban road, minor rural road, main rural road, and motorway], speeding penalty history, and at-fault crash history were regressed onto human factors [step 1] to control for their effects. Measures of driver behaviour were further regressed onto driver boredom [step 2] to test whether driver boredom is independently related to driver behaviour over and above human factors entered previously. Logistic regressions were used to test independent relationships between driver boredom and speeding penalty and at-fault crash histories, as both these dependent measures are dichotomous. Otherwise, multiple linear regression analysis was used.

Table 3.14, 3.15 and 3.16 respectively summarise results pertaining to regression of driver distraction and error-proneness, of speed on four stretches of road and of speeding penalty and at-fault crash histories onto human factors including driver boredom.

Table 3.14 Regression of driver distraction and error-proneness onto human factors and experience [step 1], and driver boredom [step 2]: proportions of variance accounted for by models, model statistics, predictors, and significance

	Road safety			
	Driver distraction		Driver error-proneness	
	Step 1	Step 2	Step 1	Step 2
R^2	.20		.11	
F	**24.88**		**12.91**	
Age (years) (β_i)	**-.24**	**-.16**	-.04	.01
Sex (male) (β_i)	**-.16**	**-.13**	**-.08**	-.05
Mileage (x 1000) (β_i)	.04	**.06**	.02	.03
Extraversion (β_i)	**.07**	**.06**	.02	.01
Agreeableness (β_i)	.02	.02	**.07**	**.06**
Conscientiousness (β_i)	**-.10**	**-.05**	**-.17**	**-.14**
Neuroticism (β_i)	.04	.03	**.11**	**.10**
Openness (β_i)	-.02	.00	**-.07**	**-.07**
Type A (β_i)	**.10**	.03	.05	.00
Internal boredom proneness (β_i)	.05	.00	.04	.01
External boredom proneness (β_i)	**.17**	.02	**.06**	-.03
Driver enthusiasm (β_i)	**-.10**	.05	**-.13**	-.04
ΔR^2		.23		.09
R^2		.43		.21
ΔF		**481.57**		**140.15**
Driver boredom (β_i)		**.55**		**.35**

(Δ)R^2 = (change in) proportion of variance accounted for by model; (Δ)F = (change in) model statistic; β_i = standardised regression coefficient; all coefficients in bold are significant at $p < .05$ (two-tailed)

Results relating to regression of driver distraction onto human factors (Table 3.14) show that the factors entered in step 1 account for 20 percent of the variance in the dependent variable. Age [-.24], sex [-.26], extraversion [.07], conscientiousness [-.10], type A behaviour pattern [.10], external boredom proneness [.17], and driver enthusiasm [-.10] all relate independently to driver distraction [with standardised beta values as indicated in parentheses]. Those most likely to be distracted whilst driving are likely to be younger; female; more extraverted; less conscientious; with a type-A behaviour pattern; more prone to suffering boredom in general due to needs for higher levels of variety [external boredom proneness]; and less enthusiastic about driving. These findings are in line with previous research on driver behaviour (Section 1.6).

Results relating to regression of driver distraction onto human factors (Table 3.14) show that, at step 2 of the analysis, driver boredom accounts for an additional 23% of the variance in driver distraction over and above the factors entered at step 1. Driver boredom was the strongest predictor of driver distraction in the final regression equation, with a standardised beta value of .55. In contrast, age, the human factor with the next largest effect on driver distraction, had a standardised beta weight of -.16.

The regression of driver error-proneness onto human factors (Table 3.14) shows that the factors entered in step 1 account for 11 percent of the variance in this dependent measure. Sex [-.08], agreeableness [.07], conscientiousness [-.17], neuroticism [.11], openness [-.07], external boredom proneness [.06], and driver enthusiasm [-.13] all relate independently to driver error-proneness [with standardised beta values as indicated in parentheses]. Those most likely to make mistakes whilst driving are likely to be female; more agreeable; less conscientious; more neurotic; less open; more likely to suffer boredom in general due to needing high levels of variety [external boredom proneness]; and less enthusiastic about driving. As with human factor effects on driver distraction, results relating to human factor effects on driver error-proneness are in line with previous research (Section 1.6).

Regression of driver error-proneness onto human factors also showed that at step 2 of the analysis, driver boredom accounts for additional variance in error-proneness over and above the factors entered in step 1. In this case, driver boredom accounts for an additional 11 percent variance in the dependent variable. In the final regression equation, driver boredom was the strongest predictor of error-proneness, in this case with a standardised beta value of .35. Conscientiousness was the next strongest predictor with a standardised beta value of -.14.

The findings here showing that bored drivers are likely to be distracted are consistent with existing research showing that people use avoidance strategies to cope with boredom (Nett et al., 2010). They are also consistent with theory suggesting that people are likely to cope with boredom by adopting subsidiary behaviours (Fisher, 1993). Furthermore, they are consistent with results as reported by Mann and Robinson (2009) showing that students cope with boring lectures using avoidance strategies only.

The results showing that bored drivers are likely to suffer cognitive failure are consistent with theories of optimal arousal and experience, which indicate that boredom is associated with impaired performance (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908). They are also consistent with research showing that people who suffer high levels of boredom in general are less likely to perform well at work (Watt and Hargis, 2010) and more likely to suffer cognitive failure (Wallace et al., 2003). These results are consistent too with results showing that bored drivers are likely to be distracted, given existing research suggesting that driver distraction is likely to compromise performance (Harbluk et al., 2007).

The regression of speed on the stretch of urban road onto human factors (Table 3.15) showed that factors entered in step 1 account for three percent variance in this dependent variable. Age [-.10], sex [.07], annual mileage [-.13], and agreeableness [.06] relate independently [with standardised beta values as indicated in parentheses] to speed on the stretch of urban road. The following are likely to drive faster on this stretch of road: younger people; males; those who drive shorter distances annually; and those less agreeable. Driver boredom, entered in step 2 of the analysis, does not account for any additional variance in the dependent variable over and above the factors entered at step 1.

The regression of speed on the stretch of minor rural road onto human factors (Table 3.15) shows that factors entered in step 1 account for 11 percent variance in this dependent variable. Speed on this stretch of road was predicted at step 1 [with standardised beta values as indicated in parentheses] by age [-.22], sex [.16], annual mileage [-.11], agreeableness [-.08], and driver enthusiasm [.11]. Younger people, males, those who drive shorter distances annually, those less agreeable, and those more enthusiastic about driving are likely to drive at higher speeds on this stretch of narrow rural road. Driver boredom, entered in step 2 of the analysis, does not account for any additional variance in speed on this stretch of road either, over and above those human factors entered previously.

The results of the regression analysis relating to human factor and driver boredom effects on speed on the stretch of main rural road (Table 3.15) show that factors entered in step 1 account for 10 percent variance in this dependent measure. Speed on this stretch of road was predicted at step 1 of the analysis [with standardised beta values as indicated in parentheses] by the following: age [-.20]; sex [.17]; annual mileage [-.09]; agreeableness [-.09]; and driver enthusiasm [.10]. The following are likely to drive at high speeds on this stretch of main rural road: younger people; males; those who drive shorter distances annually; those less agreeable; and those more enthusiastic about driving. Driver boredom, entered at step 2 of the analysis, does not account for any additional variance in the dependent measure over and above those variables entered in step 1.

The final set of results, relating to regression of speed on the stretch of motorway onto human factors (Table 3.15) shows that factors entered in step 1 account for 14 percent variance in speed on this stretch of road. Speed on this stretch of road was predicted at step 1 of the analysis by the following [with standardised regression coefficients as indicated in parentheses]: age [-.24], sex [.14], annual mileage [-.13], agreeableness [-.07], and driver enthusiasm [.14]. Younger people, males, those who drive shorter distances annually, those less agreeable, and those more enthusiastic about driving are likely to drive at higher speeds on this stretch of motorway. Driver boredom, entered in step 2 of the analysis, explains a significant but small proportion of additional variance in speed on this stretch of road over and above human factors entered previously [less than one percent]. The standardised beta value relating to driver boredom as a predictor of speed on this stretch of road is .07. People more likely to suffer driver boredom are more likely to drive at high speeds on this stretch of motorway.

The results reported in relation to human factor effects on measures of driver speed suggest that younger people, males, people who drive shorter distances annually, those who are less agreeable, and those who are more enthusiastic about driving are more likely to drive at high speeds on stretches of road considered here. These findings are

Table 3.15 Regression of speed [on four stretches of road] onto human factors and experience [step 1] and driver boredom [step 2]: proportions of variance accounted for by models, model statistics, predictors, and significance

	Urban road speed		Minor rural road speed		Main rural road speed		Motorway speed	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
R^2	.03		.11		.10		.14	
F	**2.76**		**12.84**		**11.77**		**16.91**	
Age (years) (β_i)	**-.10**	**-.09**	**-.22**	**-.22**	**-.20**	**-.19**	**-.24**	**-.23**
Sex (male) (β_i)	**.07**	**07**	**.16**	**.16**	**.17**	**.17**	**.14**	**.15**
Annual mileage (x1000) (β_i)	**-.13**	**-.13**	**-.11**	**-.11**	**-.09**	**-.09**	**-.13**	**-.13**
Extraversion (β_i)	.01	.01	.01	.01	.00	.00	.05	.05
Agreeableness (β_i)	**.06**	**.06**	**-.08**	**-.08**	**-.09**	**-.09**	**-.07**	**-.07**
Conscientiousness (β_i)	-.01	.00	-.01	.00	.01	.01	.01	.01
Neuroticism (β_i)	.03	.03	-.02	-.02	-.02	-.02	.02	.02
Openness (β_i)	-.01	-.01	.05	-.02	.02	.02	.05	.06
Type A behaviour pattern (β_i)	.02	.01	.03	.05	.04	.03	.03	.02
Internal boredom proneness (β_i)	-.03	-.03	-.01	.03	.01	.01	.03	.03
External boredom proneness (β_i)	.01	-.01	.00	-.01	.00	-.01	.05	.03
Driver enthusiasm (β_i)	-.01	.01	**.11**	**.11**	**.10**	**.11**	**.14**	**.16**
ΔR^2		.00		.00		.00		.00
R^2		.03		.11		.11		.15
ΔF		2.55		0.56		1.37		**5.59**
Driver boredom (β_i)		.05		.02		.04		**.07**

(Δ)R^2 = (change in) proportion of variance accounted for by model; (Δ)F = (change in) model statistic; β_i = standardised regression coefficient; all coefficients in bold are significant at $p < .05$ (two-tailed)

Table 3.16 Regression of speeding penalty and at-fault crash histories onto human factors and experience [step 1], and driver boredom [step 2]: proportions of variance accounted for, model statistics, predictors, and significance

	Speeding penalty history		At-fault crash history	
	Step 1	Step 2	Step 1	Step 2
Cox & Snell R^2	.02		.03	
Nagelkerke R^2	.03		.05	
χ^2	**21.03**		**31.25**	
-2 Log likelihood	915.04		793.50	
Age (years) (*b*, Wald)	0.00, 0.01	0.00, 0.46	-0.02, **10.84**	-0.02, **9.11**
Sex (male) (*b*, Wald)	-0.13, 0.40	-0.18, 0.83	0.19, 0.82	0.19, 0.59
Annual mileage (x 1000) (*b*, Wald)	0.01, **5.41**	0.01, **5.92**	0.02, **9.85**	0.02, **10.20**
Extraversion (*b*, Wald)	0.07, 1.08	0.06, 0.84	-0.01, 0.03	-0.02, 0.06
Agreeableness (*b*, Wald)	0.03, 0.15	0.03, 0.13	-0.05, 0.25	-0.05, 0.26
Conscientiousness (*b*, Wald)	-0.19, **4.18**	-0.15, 2.69	-0.16, 2.52	-0.14, 2.03
Neuroticism (*b*, Wald)	-0.06, 0.51	-0.08, 0.77	0.13, 2.00	0.13, 1.95
Openness (*b*, Wald)	0.02, 0.02	0.03, 0.07	0.00, 0.00	0.01, 0.00
Type A behaviour pattern (*b*, Wald)	0.14, 3.30	0.10, 1.52	0.01, 0.01	-0.02, 0.04
Internal boredom proneness (*b*, Wald)	-0.14, 1.01	-0.19, 1.64	-0.24, 2.43	-0.27, 3.09
External boredom proneness (*b*, Wald)	-0.03, 0.09	-0.15, 1.70	-0.05, 0.19	-0.12, 0.91
Driver enthusiasm (*b*, Wald)	0.02, 1.24	0.04, **4.66**	-0.01, 0.28	0.00, 0.00
Cox & Snell R^2		0.03		0.03
Nagelkerke R^2		0.05		0.06
$\Delta\chi^2$		**14.72**		**3.98**
χ^2		**35.75**		**35.22**
-2 Log likelihood		900.32		789.52
Driver boredom (*b*, Wald)		0.04, **14.11**		0.02, **3.91**

R^2 = proportion of variance accounted for by model; $(\Delta)\chi^2$ = (change in) model statistic; *b* = regression coefficient; Wald = Wald statistic, testing whether the regression coefficient is different from zero; all Wald statistics in bold are significant at $p < .05$ (two-tailed) generally consistent with those reported in the literature (Section 1.6). One exception is the finding that people who drive further annually are likely to drive at lower speeds. As reviewed (Section 1.6.2), Stradling et al. (2002) found that people who drive further annually are likely to drive at higher speeds.

Results appertaining to driver boredom effects on measures of driver speed suggest that people more likely to suffer driver boredom are no more likely to drive at high speeds. This finding is inconsistent with theories of arousal, which indicate that people are likely to cope with driver boredom by seeking additional stimulation in the driving task (Csikszentmihalyi, 2002; Apter, 2001; Hebb, 1955; Yerkes and Dodson, 1908). Also, it is inconsistent with boredom theory which presents similar evidence (Fisher, 1993). In addition, it is inconsistent with existing research of Nett et al. (2010) who found that 58 percent of their sample avowed to coping with boredom using approach strategies. Interestingly, results suggesting that people suffering driver boredom are unlikely to seek additional stimulation in the driving task are consistent with the definition of boredom as disconnection (Conrad, 1997). They are also consistent with the findings of Mann and Robinson (2009). These authors found that people are likely to cope with boring lectures using avoidance strategies only.

Regression of speeding penalty history onto human factors (Table 3.16) showed that factors entered in step 1 account for a small but significant proportion of the variance in the dependent variable. At step 1 of the analysis, speeding penalty history was predicted independently [with beta values as indicated in parentheses] by annual mileage [0.01] and conscientiousness [-0.19]. People who reported driving further annually and being less conscientious are more likely to have been penalised for speeding in the last three years. Driver boredom, entered in step 2 of the analysis, explains a significant proportion of additional variance in speeding penalty history over and above human factors entered previously. The beta value relating to the effect of driver boredom on speeding penalty history is 0.04. People who reported suffering higher levels of driver boredom are more likely to have been penalised for speeding. Interestingly, in the final equation driver boredom is the strongest predictor of speeding penalty history with an associated Wald statistic of 14.11. The next most important predictor is annual mileage with an associated Wald statistic of 5.92.

Regression of at-fault crash history onto human factors (Table 3.16) also showed that human factors entered in step 1 account for a small yet significant percentage of variance in this dependent variable. At step 1 of the analysis, results show that age [-0.02] and annual mileage [0.02] are independently related to at-fault crash history [with beta values as indicated in parentheses]. People who reported being younger and driving further annually are more likely to have caused a crash within the last three years. Driver boredom [entered in step 2] explained a significant proportion of additional variance in the dependent variable over and above those human factors entered in step 1. The beta value relating to the effect of driver boredom on at-fault crash history is 0.02. Those who reported being more likely to suffer driver boredom are more likely to have caused a crash within the last three years.

The regressions of speeding penalty and at-fault crash histories onto driver boredom show that people suffering driver boredom are more likely to be penalised for speeding and more likely to cause crashes. These findings hence suggest that people suffering driver boredom are likely to compromise road safety. The relationship between driver boredom and speeding penalty history is particularly interesting because driver boredom does not relate to speed. In this context, results suggest that people suffering driver boredom are less likely to be aware of the speed at which they are travelling and/or less likely to notice speed cameras. 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; O'Hanlon, 1981; Hebb, 1955; Yerkes and Dodson, 1908). They are consistent also with existing research showing that boredom is likely to compromise performance (Watt and Hargis, 2009; Wallace et al., 2003; O'Hanlon, 1981).

3.3.6 Mediation effects of driver boredom

The analyses reported above (Section 3.3.5) show that driver boredom relates significantly to driver distraction, error-proneness, speed [on a stretch of motorway], speeding penalty history, and at-fault crash involvement. Given that driver boredom correlates significantly with each of the individual difference measures used in this study [with the exception of extraversion] (Table 3.9), it is possible that driver boredom mediates the effects of individual differences on these measures of driver behaviour[70]. This section of the thesis reports results of formal mediation analyses testing the extent to which driver boredom mediates significant relationships between individual differences and measures of driver behaviour (Section 3.3.5).

Simple mediation analyses were conducted in SPSS. The 'indirect' macro (Preacher and Hayes, 2008) was used to estimate path coefficients pertaining to relations between human factors, driver boredom, and measures of driver behaviour. Five thousand bootstrap samples were used to estimate confidence intervals for the indirect effects. Indirect effects were marked as significant when zero was not included within the confidence interval. All independent variables apart from the one being tested were entered as covariates in each mediation analysis to control for their effects[71].

Table 3.17 summarises results of analyses testing whether driver boredom mediates significant relations between human factors [age, sex, extraversion, conscientiousness, type A behaviour pattern, external boredom proneness, and driver enthusiasm] and driver distraction. Results show that driver boredom mediates relations between the following human factors and driver distraction [with significant regression coefficients relating to indirect effects as indicated in parentheses]: age [-0.03]; conscientiousness [-0.21]; type A behaviour pattern [0.35]; external boredom proneness [0.99]; and driver enthusiasm [-0.14]. These results suggest that the following are more likely to be distracted whilst driving in part because they are more likely to suffer driver boredom: those who are younger; less conscientious; with a type-A behaviour pattern [as opposed to type B]; in need of higher levels of variety [external boredom proneness]; and less enthusiastic about driving. Additionally, indirect effects relative to total effects show that driver boredom explains large proportions of variance shared between the following human factors and driver distraction: type A behaviour pattern; external boredom proneness; and driver enthusiasm. In contrast, indirect effects relative to total effects show that driver boredom explains small proportions of variance shared between the following human factors and driver distraction: age; sex; extraversion; and conscientiousness.

[70] Mediation is said to occur when an independent variable (*X*) affects a dependent variable (*Y*) indirectly through a mediating variable (*M*) (Preacher and Hayes, 2004).
[71] Independent variables are age, sex, annual mileage, neuroticism, extraversion, openness, agreeableness, conscientiousness, type A behaviour pattern, internal boredom proneness, external boredom proneness, and driver enthusiasm

Table 3.17 Summary of simple mediation analyses testing whether driver boredom mediates significant relations between human factors and driver distraction

Independent variable (IV)	Mediating variable (*M*)	Dependent variable (DV)	Effect of IV on *M* (*a*)	Effect of *M* on DV (*b*)	Direct effect (*c'*)	Indirect effect (*c* – *c'*)	Total effect (*c*)
Age (years)	Boredom	Distraction	**-0.09**	**0.35**	**-0.06**	**-0.03**	**-0.09**
Sex (male)	Boredom	Distraction	-0.90	**0.35**	**-1.53**	-0.31	**-1.84**
Extraversion	Boredom	Distraction	-0.90	**0.35**	**-1.53**	-0.31	**-1.84**
Conscientiousness	Boredom	Distraction	**-0.62**	**0.35**	-0.25	**-0.21**	**-0.47**
Type A	Boredom	Distraction	**0.99**	**0.35**	0.11	**0.35**	**0.46**
External BP	Boredom	Distraction	**2.82**	**0.35**	0.15	**0.99**	**1.14**
Enthusiasm	Boredom	Distraction	**-0.39**	**0.35**	0.03	**-0.14**	**-0.10**

Effects are unstandardised regression coefficients; all coefficients in bold are significant at $p < .05$ (two-tailed)

Table 3.18 Summary of simple mediation analyses testing whether driver boredom mediates significant relations between human factors and driver error-proneness

Independent variable (IV)	Mediating variable (*M*)	Dependent variable (DV)	Effect of IV on *M* (*a*)	Effect of *M* on DV (*b*)	Direct effect (*c'*)	Indirect effect (*c* – *c'*)	Total effect (*c*)
Sex (male)	Boredom	Error-prone.	**-1.13**	**0.23**	**-0.90**	**-0.26**	**-1.15**
Agreeableness	Boredom	Error-prone	0.21	**0.23**	**0.39**	0.05	**0.44**
Conscientiousness	Boredom	Error-prone.	**-0.67**	**0.23**	**-0.83**	**-0.15**	**-0.99**
Neuroticism	Boredom	Error-prone	0.11	**0.23**	**0.54**	0.03	**0.57**
Openness	Boredom	Error-prone.	-0.15	**0.23**	-0.31	-0.03	-0.34
External BP	Boredom	Error-prone.	**2.78**	**0.23**	-0.18	**0.63**	**0.45**
Enthusiasm	Boredom	Error-prone.	**-0.39**	**0.23**	-0.06	**-0.09**	**-0.14**

Effects are unstandardised regression coefficients; all coefficients in bold are significant at $p < .05$ (two-tailed)

Table 3.18 summarises results of analyses testing whether driver boredom mediates significant relations between human factors [sex, agreeableness, conscientiousness, neuroticism, openness, external boredom proneness, and driver enthusiasm] and driver error-proneness. Results show that driver boredom mediates relations between the following human factors and driver error-proneness [with significant regression coefficients relating to indirect effects as indicated in parentheses]: sex [-0.26]; conscientiousness [-0.15]; external boredom proneness [0.63]; and driver enthusiasm [-0.09]. These results show that the following are more likely to make mistakes whilst driving in part because they are more likely to suffer driver boredom: those who are female; less conscientious; in need of higher levels of variety external boredom proneness; and less enthusiastic about driving. Indirect effects relative to total effects show that driver boredom explains large proportions of variance shared between the following human factors and driver error-proneness: external boredom proneness; and driver enthusiasm. In contrast, indirect effects relative to total effects show that driver boredom explains small proportions of variance shared between the following human factors and driver error-proneness: sex; agreeableness; conscientiousness; neuroticism; and openness.

Table 3.19 Summary of simple mediation analyses testing whether driver boredom mediates significant relations between human factors and motorway speed

Independent variable (IV)	Mediating variable (*M*)	Dependent variable (DV)	Effect of IV on *M* (*a*)	Effect of *M* on DV (*b*)	Direct effect (*c'*)	Indirect effect (*c* – *c'*)	Total effect (*c*)
Age	Boredom	MW speed	**-0.09**	**0.06**	**-0.10**	**-0.01**	**-0.11**
Sex	Boredom	MW speed	-0.96	**0.06**	**2.24**	**-0.06**	**2.18**
Annual mileage	Boredom	MW speed	**-0.03**	**0.06**	**-0.07**	0.00	**-0.07**
Agreeableness	Boredom	MW speed	0.14	**0.06**	**-0.39**	0.01	**-0.38**
Enthusiasm	Boredom	MW speed	**-0.39**	**0.06**	**0.22**	**-0.02**	**0.19**

MW speed = motorway speed; effects are unstandardised regression coefficients; all coefficients in bold are significant at $p < .05$ (two-tailed)

Table 3.19 summarises results of analyses testing whether driver boredom mediates significant relations between human factors [age, sex, annual mileage, agreeableness, and driver enthusiasm] and driver speed choice on a stretch of motorway. Results show that driver boredom mediates relations between the following human factors and driver speed choice [with significant regression coefficients relating to indirect effects as indicated in parentheses]: age [-0.01]; sex [-0.06]; and driver enthusiasm [-0.02]. These results show that people who are younger, female, and less enthusiastic about driving are more likely to drive at high speeds on the stretch of motorway in part because they are more likely to find driving boring. Additionally, indirect effects relative to total effects show that driver boredom explains small proportions of variance shared between these human factors and driver speed on the stretch of motorway.

Table 3.20 summarises results of analyses testing whether driver boredom mediates significant relations between human factors [annual mileage and conscientiousness] and speeding penalty history. Results show that driver boredom mediates the relationship between conscientiousness and speeding penalty history with a significant indirect effect of -0.03. This suggests that less conscientious people are more likely to be penalised for speeding in part because they are more likely to suffer driver boredom.

Indirect effects relative to total effects show that driver boredom explains a small proportion of variance shared between conscientiousness and speeding penalty history.

Table 3.20 Summary of simple mediation analyses testing whether driver boredom mediates significant relations between human factors and speeding penalty history

Independent variable (IV)	Mediating variable (*M*)	Dependent variable (DV)	Effect of IV on *M* (*a*)	Effect of *M* on DV (*b*)	Direct effect (*c'*)	Indirect effect (*c* – *c'*)	Total effect (*c*)
Annual mileage	Boredom	Speeding P	-0.02	**0.04**	**0.01**	0.00	**0.01**
Conscientiousness	Boredom	Speeding P	**-0.62**	**0.04**	-0.15	**-0.03**	**-0.18**

Speeding P = speeding penalty history; effects are unstandardised regression coefficients; all coefficients in bold are significant at $p < .05$ (two-tailed)

Table 3.21 Summary of simple mediation analyses testing whether driver boredom mediates significant relations between human factors and at-fault crash history

Independent variable (IV)	Mediating variable (*M*)	Dependent variable (DV)	Effect of IV on *M* (*a*)	Effect of *M* on DV (*b*)	Direct effect (*c'*)	Indirect effect (*c* – *c'*)	Total effect (*c*)
Age (years)	Boredom	AF crash	**-0.09**	0.02	**-0.02**	0.00	**-0.02**
Annual mileage	Boredom	AF crash	-0.02	0.02	**0.02**	0.00	**0.02**

AF crash = at fault crash history; effects are unstandardised regression coefficients; all coefficients in bold are significant at $p < .05$ (two-tailed)

Last, Table 3.21 summarises results pertaining to analyses testing whether driver boredom mediates significant relations between human factors [age and annual mileage] and at fault crash history. Results show that driver boredom does not explain relationships between either of these human factors and at fault crash history. Indirect effects are not significant.

Results of the mediation analyses reported above show that whilst driver boredom explains large proportions of variance shared between some human factors and some measures of driver behaviour it explains small proportions or no variance shared between other human factors and measures of driver behaviour. Driver boredom explains large proportions of variance shared between measures of driver behaviour [particularly driver distraction and error-proneness] and the following human factors: type-A behaviour pattern; external boredom proneness; and driver enthusiasm. In contrast, driver boredom explains small proportions of variance shared between measures of driver behaviour [particularly driver distraction and error-proneness] and the following human factors: age; gender; and conscientiousness. Furthermore, driver boredom does not explain the effects of driving experience, neuroticism, extraversion, openness, and agreeableness on driver behaviour as considered in this study. These findings suggest that whilst the threat some groups [e.g. those less enthusiastic about driving] pose to road safety might be reduced by moderating the extent to which they suffer driver boredom, the threat other groups [e.g. high mileage drivers] pose to road safety is unlikely to be reduced by moderating the extent to which they suffer driver boredom.

3.4 Summary and conclusions

Results of the study reported in this chapter show that a relatively small proportion of the sampled driving population find driving boring in general. However, they also show that the majority find driving in situations offering particularly low levels of stimulation boring. Such situations include being held up by traffic, driving for extended periods, and driving on stretches of motorway. This suggests that driver boredom is prevalent. In parallel, results show that whilst the majority of the sample like driving, only a small proportion go driving just for the sake of it and really enjoy it. People who really enjoy driving could be the ones who never find driving boring. Those who dislike driving could be the ones who find driving boring in general.

Human factors considered explain a quarter of the variance in driver boredom. Those younger, female, less conscientious, with a higher sense of time urgency, more likely to suffer boredom in general, and less enthusiastic about driving, are all more likely to suffer driver boredom. Results suggesting that people who are younger, less conscientious, with a higher sense of time urgency, more likely to suffer boredom in general, and less enthusiastic about driving are all more likely to suffer driver boredom are consistent with theory and existing research, as argued (Section 1.5). Results suggesting females are more likely than males to suffer driver boredom are inconsistent with theory and existing research. This inconsistency is likely to be explained by males being more enthusiastic about driving.

Results reported in this chapter suggest that people suffering driver boredom are more likely to be distracted and make mistakes whilst driving. Furthermore, results suggest that people suffering driver boredom are unlikely to seek additional stimulation in the driving task by increasing the pace of the task, except on motorways where they appear marginally more likely to do so. These results are generally consistent with boredom theory and existing boredom research (e.g. Mann and Robinson, 2009; Fisher, 1993).

Findings show that people suffering driver boredom are more likely to be penalised for speeding and more likely to cause crashes. The fact that they are more likely to be penalised for speeding is particularly interesting because they are no more likely to drive at high speeds. This discrepancy might be explained by the fact that self-report measures of speed were used in this study. There is a chance that people who suffer high levels of driver boredom underestimate or at least underreport the speeds at which they drive. It seems more likely, though, that people suffering driver boredom are more likely to be penalised for speeding because they are less focussed on the driving task and less likely to notice [and slow down for] speed cameras. In any case, results showing that people suffering driver boredom are more likely to be penalised for speeding and more likely to cause a crash suggest that people suffering driver boredom are likely to pose a high threat to road safety.

Last, mediation analyses show that driver boredom in part explains the effects of age, sex, conscientiousness, type A behaviour pattern, external boredom proneness, and enthusiasm for driving on driver behaviour. Specifically, they show that people who are younger, less conscientious, with a higher sense of time urgency, in need of higher levels of variety, and less enthusiastic about driving are more likely to be distracted and make mistakes whilst driving because they are more likely to be suffering driver boredom. They also show that driver boredom is a proximal determinant of driver behaviour, particularly driver distraction and error-proneness.

Findings of the study reported in this chapter show that driver boredom warrants further attention in efforts to advance road safety. The next chapter includes further discussion of these findings as well as consideration of the limitations of this study and avenues for further research.

Chapter 4

General discussion

This chapter presents a general discussion of the findings of this programme of research as detailed in the last two chapters. The first part (Section 4.1) summarises the rationale for the research. It also summarises the aims and nature of two studies conducted as part of the research programme. Section 4.2 addresses limitations of this programme of research. The next four sections (4.3 - 4.6) briefly summarise main findings as they relate respectively to the prevalence of driver boredom; the effects of driver boredom on road safety; individual difference effects on driver boredom; and the role of driver boredom as a mediator in relations between human factors and driver behaviour. These sections discuss findings in relation to existing literature and implications for theory and road safety. Section 4.7 considers further research needed to develop fundamental understanding of driver boredom including its human antecedents and behavioural consequences. It also considers further research required to develop measures to mitigate driver boredom. The final section (4.8) reports the conclusions of this programme of research.

4.1 Rationale and research design

Rationale

Road traffic crashes are a major source of human and economic woe. They kill or seriously injure more than 25,000 people per year in Great Britain (Department for Transport, 2010). They also cost British society upwards of £15,000,000,000 each year (ibid.). Behavioural failures [e.g. *travelling too fast for conditions*], environmental failures [e.g. *slippery road surfaces*], and vehicular failures [e.g. *defective brakes*] all cause road traffic crashes (ibid.). Behavioural failures, though, are consistently the most frequently reported causal factor. Statistics show that 82 percent of crashes in Great Britain in 2009 were attributable to behavioural failure alone (ibid.). It is therefore essential to understand driver behaviour if road safety is to be meaningfully improved.

Although there is an extensive body of research addressing the issue of driver behaviour, there is a distinct lack of literature focussing on driver boredom. Prior to publication of academic papers relating to this programme of research (e.g. Harvey et al., 2011; Heslop et al., 2010) the only paper reporting a scientific study of driver boredom was one by Drory in 1982. Drory reported having tested relations between age, tenure on the job as a heavy truck driver, and truck damage, amongst a sample of 93 male drivers based in Israel. He found that younger drivers and those with longer tenure on the job were more likely to have reported suffering driver boredom on a stretch of road offering low levels of stimulation. He also found that some of those who reported suffering higher levels of driver boredom were more likely to have damaged their vehicles through negligent maintenance and careless manoeuvring.

Literature suggests that people are likely to perceive low levels of stimulation in the driving task often, due to it often being well-practised, familiar, and monotonous for example (Department for Transport, 2011b). It also suggests that people are likely to need high levels of stimulation from the driving task often, due to needs to reach their destinations or save time in getting there for example (Gabaney et al., 1997). Literature hence suggests that people are likely to suffer under-arousal often whilst driving. Given that driver boredom is a state of under-arousal attributed to an inadequately stimulating driving task (after Mikulas and Vodanovich, 1993) literature suggests that people are likely to suffer driver boredom often.

Literature also suggests that low levels of driver arousal, typical of driver boredom, are likely to compromise driver performance (Csikszentmihalyi, 2002; O'Hanlon, 1981; Hebb, 1955; Yerkes and Dodson, 1908). Furthermore, literature suggests that people are likely to cope with driver boredom by adopting subsidiary thoughts and behaviours as well as by seeking additional stimulation in the driving task (Nett et al., 2010; Fisher, 1993). The adoption of subsidiary thoughts and behaviours by drivers suffering boredom amounts to diversion of attention from the driving task, which is likely to further compromise performance. Indeed, research reported in the literature supports the idea of driver distraction compromising performance (Harbluk et al., 2007). Literature reviewed thus suggests that driver boredom is likely to compromise road safety.

O'Hanlon (1981) argued that different people in the same monotonous working environment experience vastly differing degrees of boredom. It follows that different people in the same driving environment suffer differing degrees of boredom. On the basis of findings reported in the literature, it was supposed that the following would be more likely to suffer driver boredom: younger, male, and more experienced drivers; less neurotic and less conscientious drivers; those with a higher sense of time urgency; those more likely to suffer boredom in general; and those less enthusiastic about driving.

Research design

Given the expected prevalence of driver boredom and its likely negative implications for road safety, the low level of attention it had received seemed an important gap in the literature. The preliminary study was conducted to assess the value of a larger study. It aimed to explore the prevalence of driver boredom, in order to ascertain its potential importance in driver behaviour and in this respect determine whether it justified further research. It also aimed to explore whether some people are more likely than others to suffer driver boredom, in order to determine the importance of considering individual difference effects on driver boredom in further research. In addition, it aimed to explore relations between driver boredom and driver behaviour as related to road safety, in order to determine whether driver boredom is likely to compromise road safety and in this respect worthy of further research. The preliminary study was qualitative in nature. It comprised focus group discussions, thematic analysis of transcripts and frequency cross tabulations.

The main study was then conducted to test relationships between individual difference factors, driver boredom, and driver behaviour as related to road safety. It aimed to test whether and how individual differences relate to driver boredom, in order to determine which people are most likely to suffer driver boredom. It also aimed to test relations between driver boredom and driver behaviour as related to road safety, in order to test the idea of driver boredom being likely to compromise road safety. Last, the main study aimed to test whether driver boredom explains relations between individual differences and driver behaviour, to further understanding of why some people are more likely than others are to pose a threat to road safety. The main study was quantitative in nature. It comprised a self-report questionnaire, opportunity sampling, and multivariate analyses.

4.2 Limitations of this research

Sample representation of the population

The sample used in the quantitative study was gained using opportunity sampling. Sampling was directed to ensure that demographic quotas were satisfied. However, due to response bias the sample is over-representative of young drivers, especially young male drivers, and under-representative of older drivers.

Sample misrepresentation of the population under investigation could have biased findings. For example, if young males are less likely than young females and older males more likely than older females to suffer boredom whilst driving, a sample that is over representative of young people is more likely than a representative sample to find that males are less likely than females to suffer boredom whilst driving. In this context, sample misrepresentation of the population could be perceived as a study limitation.

To correct for the sample misrepresentation of the population data were weighted according to the demographic grouping of the participant and the extent to which their group was representative of the population (See Section 3.2.1). Weighted data were used in all analyses reported in Chapter 3. In this way, results pertaining to these analyses relate to a representative population and are applicable to the population under investigation.

Self-report data

This programme of research has tested relations between human factors, driver boredom, and driver behaviour as related to road safety using self-report data. Results thus relate to subjective rather than objective data. This is a potential research limitation. Data gathered using self-report measures of human factors, driver boredom, and driver behaviour as related to road safety are likely to be less valid than data gathered using objective measures of the same [if this were possible].

Many of the human constructs tested in this programme of research, including driver boredom, are difficult if not impossible to measure objectively. Age and sex can be measured objectively. So too can driving experience, conceivably. In contrast, objective measures of the five main personality traits, type A behaviour pattern, facets of boredom proneness, driver enthusiasm, and driver boredom are, arguably, impossible to measure objectively.

Further to the idea that human factors are difficult if not impossible to measure objectively, research has shown that self-report is a valid method of measuring human factors. McCrae and Costa (1987) tested relations between self-report on each of the five main personality traits and peer scores on the same. They found that self-report and peer scores on each dimension of personality correlated strongly[72]. Their results hence support the use of self-report human factor measures in this programme of research.

Likewise, self-report is understood to be a valid method of measuring driver behaviour. West et al. (1993) tested relations between self-report measures of driver behaviour and observed driving behaviour using data from a sample of 48 male and female drivers based in the UK. They found that those who reported driving faster were more likely to have been observed driving fast; that those who reported being calmer whilst driving were less likely to have exhibited indecision or stress; and that those who reported higher levels of deviance whilst driving were more likely to have exhibited inattention, carelessness, and dangerous driving[73]. The findings of West et al. (1993) hence indicate that self-report measures of driver behaviour are likely to be valid.

4.3 Prevalence of driver boredom

The qualitative study provided preliminary evidence that driver boredom might be prevalent. Results showed that discussions reflected driver boredom more than any other state of driver arousal [relaxation, optimal experience, anxiety, and excitement]. They also showed that discussions were more likely to reflect boredom when they also reflected the following: long journeys [versus journeys of an undefined length]; high levels of traffic [versus traffic of an undefined level]; and driving on motorways and urban roads [versus driving on rural roads]. These preliminary findings were confirmed in the larger quantitative study. Most participants in the quantitative study agreed with items designed to measure boredom when held up by traffic, driving on motorways, and driving for lengthy periods. For example, 83 percent of participants agreed with the item *Being stuck in a traffic jam is really boring*; 64 percent agreed with the item *I find slow traffic really boring*; 57 percent agreed with the item *I find that driving gets more*

[72] McCrae and Costa (1987) found that self-report and peer scores [obtained using adjective factors and the NEO personality inventory] correlated [with correlation coefficients as indicated in parentheses] on facets of: neuroticism [**.50**; **.42**]; extraversion [**.48**; **.47**]; openness [**.49**; **.57**]; agreeableness [**.49**; **.30**]; and conscientiousness [**.40**; **.43**].

[73] West et al. (1993) found that [with correlation coefficients as indicated in parentheses] self-reported speed correlated with observed average and maximum speeds on a first stretch of motorway [**.57**; **.55**] and a final stretch of motorway [**.62**; **.65**]; they found that self-reported calmness whilst driving correlated with observed indecision [**-.39**] and stress [**-.41**]; and they found that self-reported deviance whilst driving correlated with observed attentiveness [**-.29**], care [**-.38**], and safety [**-.28**].

boring as time passes; and 48 percent agreed with the item *I find driving on motorways dull*.

Results show that driver boredom is prevalent in situations offering particularly low levels of driver stimulation. Levels of driver stimulation are likely to be particularly low when driving in traffic jams or otherwise slow traffic because levels of driver stimulation are a function of speed (Fuller, 2005b). Levels of driver stimulation are likely to be low when driving for extended periods because levels of stimulation are understood to decline with increasing time-on-task (Fisher, 1993). Levels of driver stimulation are likely to be low when driving on motorways because, being designed for safety at high speeds, motorways are potentially one of the least stimulating road types.

Implications for theory and road safety

Results showing that driver boredom is likely to be prevalent in situations offering particularly low levels of driver stimulation support the idea of driver boredom being a state of under-arousal. People are logically more likely to suffer under-arousal when levels of stimulation are low. They also suggest that driver boredom is prevalent, because a lot of driving takes place in situations offering low levels of driver stimulation. For example, people drove 61 billion miles on the motorway network in Great Britain in 2010 (Department for Transport, 2011) and as argued the motorway network is likely to be one of the least stimulating driving environments. Results hence suggest that driver boredom is likely to be an important issue in road safety.

Guest et al. (1978) report finding that between 11 and 56 percent of British employees across organisational levels avowed to finding their entire job boring. They also report finding that between 79 and 87 percent of employees across organisational levels avowed to sometimes feeling bored at work. Furthermore, Fisher (1993) claims that complaints of feeling bored are common both on and off the job. Results showing that driver boredom is likely to be widespread are thus consistent with existing research suggesting that boredom is prolific at work.

4.4 Driver boredom effects on road safety

Driver boredom relates to driver distraction, error-proneness, speeding penalty history, and at-fault crash history. This research has shown that people suffering driver boredom are much more likely than those not suffering it to be distracted and to make mistakes, and marginally more likely to be penalised for speeding and cause crashes. Interestingly, results show that driver boredom does not relate to speed, except marginally on a stretch of motorway.

Implications for theory

The strong positive relation between driver boredom and driver distraction suggests that people are likely to cope with driver boredom by seeking additional stimulation elsewhere. This supports boredom theory as posed by Fisher (1993) indicating that people are likely to cope with boredom by adopting subsidiary behaviours. Furthermore, it supports findings reported by Nett et al. (2010) suggesting that people are likely to cope with boredom using avoidance strategies.

Positive relations between driver boredom and each of driver distraction, error-proneness, speeding penalty history, and at-fault crash history suggest that driver boredom is likely to compromise performance. Theories of optimal arousal and optimal experience posit that performance declines with increasing levels of boredom (Csikszentmihalyi, 2002; Hebb, 1955; Yerkes and Dodson, 1908). Findings are hence consistent with and support theories of optimal arousal and optimal experience.

Boredom theory (Fisher, 1993) and existing research (Nett et al., 2010) indicate, like theories of arousal, that people are likely to cope with driver boredom by seeking additional stimulation in the driving task. In view of positive relations between speed and levels of stimulation whilst driving (Fuller, 2005b) the seeking of additional stimulation in the driving task seems likely to manifest as driving at higher speeds. Results showing that driver boredom related positively to both motorway speed choice and speeding penalty history are consistent with this view. In other words, the findings also provide some evidence that people cope with driver boredom by seeking additional stimulation in the driving task [i.e. driving faster].

Given that no relationships were found between driver boredom and speed choice on urban or rural roads, the implication is that people do not cope with boredom on these road types by seeking additional stimulation in the task. People suffering driver boredom might be likely to seek additional stimulation in the driving task when driving on the motorway network but not when driving on urban or rural roads because the driving task on the motorway network is relatively simple. The motorway network comprises long, straight, wide stretches of road, where sight lines are good and levels of vehicle conflict are low. In contrast, on urban and rural road networks, roads are often narrow and with sharp bends, levels of vehicle conflict are often high, and sight lines are often poor.

The implication that drivers cope with boredom by seeking additional stimulation in the driving task [indicated by boredom being positively associated with both speed choice on motorways and speeding penalty history] or by seeking addition stimulation elsewhere [indicated by boredom being positively associated with driver distraction] is consistent with the work of Nett et al. (2010). These authors found, in relation to boredom in mathematics classes, that people cope using approach strategies [i.e. seeking additional stimulation from the task] or avoidance strategies [i.e. seeking additional stimulation from outside the task]. The findings of this programme of research thus indicate that boredom coping strategies as identified by Nett et al. (2010) apply in the context of driver behaviour.

Implications for road safety

Results showing that people more likely to suffer driver boredom are much more likely to be distracted from the driving task and much more likely to make mistakes therein suggest that driver boredom is likely to compromise road safety. Likewise, results showing that people more likely to suffer driver boredom are marginally more likely to be penalised for speeding and marginally more likely to cause a crash suggest that driver boredom is likely to compromise road safety. These results have important implications for road safety, given results showing that driver boredom is likely to be widespread.

Results showing that driver boredom is likely to compromise road safety suggest that road safety can be enhanced by reducing levels of driver boredom. However, reducing levels of driver boredom is likely to be extremely challenging. It would be very easy, in principle, to design road environments that increase the complexity of the driving task [e.g. introduce minimum speed limits; introduce additional vehicle conflict; reduce sight lines; narrow roads; and narrow the radii of bends]. However, while this might combat boredom through increased arousal it would almost certainly be detrimental to road safety (e.g. Lamm et al., 1999).

Therefore, alternative ways to combat driver boredom are needed. Possible solutions might be to deliver educational campaigns that raise drivers' awareness of the negative effects of driver boredom [in terms of road safety] and encourage them to engage in the driving task. Further research is needed to identify effective methods to reduce driver boredom that do not compromise road safety.

4.5 Individual difference effects on driver boredom

Results of this programme of research suggest that some people are more likely than others are to suffer driver boredom. Human factors considered explain 25 percent variance in driver boredom. Results show that driver enthusiasm, external boredom proneness, internal boredom proneness, age, type A behaviour pattern, conscientiousness, and sex relate to driver boredom in this order of decreasing strength. Those who reported being less enthusiastic about driving, more likely to suffer boredom in general, younger, with a type A behaviour pattern, less conscientious, and female are more likely to have reported suffering driver boredom.

Implications for theory

Results showing that human factors explain 25 percent variance in driver boredom are consistent with the writings of Conrad (1997). He claims that boredom is in the eye of the beholder, and that what may be boring to one person may be fascinating to another. Interestingly, results indicate that 75 percent variance in driver boredom remains unexplained by human factors considered here. Given the negative safety implications of driver boredom, other factors that might explain driver boredom deserve attention in further efforts to understand driver boredom.

The strong negative relationship between driver enthusiasm and driver boredom supports theory indicating that people are unlikely to suffer boredom when doing something they like doing, as argued by Dyer-Smith (1995). The relationship seems likely to be a function of those more enthusiastic about driving being more likely to engage in the driving task (Loukidou, 2009; Fisher, 1993). In support of this idea, results from the quantitative study suggest that those more enthusiastic about driving are less likely to be distracted from the driving task [i.e. more likely to be engaged in it][74]. In further support of this idea, results also suggest that more enthusiastic drivers are likely to drive at higher speeds on stretches of non-urban road. Higher speeds are likely to reflect higher skills (Csikszentmihalyi, 2002) and higher skills seem likely to reflect higher levels of engagement in the driving task.

Higher levels of engagement in the driving task are likely to manifest as knowledge and schemas pertaining to the task that are more complex (Loukidou, 2009; Fisher, 1993). In this context, those more enthusiastic about driving are likely to perceive higher levels of stimulation in the driving task, and thus less likely to suffer under-arousal. This explanation of why driver enthusiasm relates to driver boredom warrants testing in further research on the subject of driver boredom.

Results here show that those more likely to suffer boredom in general due to needs for high levels of variety are much more likely to suffer driver boredom. They also show that those more likely to suffer boredom in general due to a perceived inability to amuse themselves are slightly more likely to suffer driver boredom. According to Fuller (2005b), the driving task is a function of the position of the vehicle on the road and its trajectory as well as the speed of the vehicle, the vehicle itself, other road users, and the driving environment. In other words, according to Fuller (2005b) the driving task is a function of external stimulation, not internal. The fact that driver boredom relates more strongly to needs for high levels of variety than to a perceived inability to amuse oneself supports the notion of the driving task being a function of external stimulation.

Results suggest that people who are younger, less conscientious, and with a type A behaviour pattern are more likely to suffer driver boredom. Age effects are consistent

[74] Driver enthusiasm relates negatively to driver distraction as shown in the regression analysis summarised in Table 3.14 before driver boredom is added to the model [the fact that driver enthusiasm does not relate negatively to driver distraction when driver boredom is added to the model reflects the fact that driver boredom explains the relationship].

with evidence suggesting that younger people are more likely to need high levels of stimulation in general, due to adolescence (Arnett, 1995) and ageing (Martin et al., 2007). This of course predisposes younger people to suffer under-arousal whilst driving. Type A behaviour pattern effects are consistent with the definition of the trait as a struggle to obtain an unlimited number of things from any situation, in the shortest period of time (Friedman and Rosenman, 1986). In the context of driving, people with a type A behaviour pattern seem likely to strive to reach their destinations as quickly as possible. They hence seem likely to need high levels of stimulation from the driving task and consequently seem likely to suffer under-arousal. Last, conscientiousness effects are consistent with the definition of conscientious people as careful and their counterparts as careless. People who are more conscientious seem likely to perceive greater levels of complexity and stimulation in the driving task. In this context, they seem less likely to suffer under-arousal.

The effects of other main personality traits [neuroticism, extraversion, openness, and agreeableness] on driver boredom are either not significant or very weak. This is surprising considering the nature of personality traits as aspects of personality that underlie prevalent patterns of thinking and behaviour (Martin et al., 2007). It is also surprising considering the definitions of the traits themselves and their apparent logical links with susceptibility to boredom. For example, open people, described as being complex and daring (McCrae and Costa, 1987) seemed more likely to need high levels of stimulation from the driving task and hence more likely to suffer driver boredom than their reticent counterparts, described as being simple and unadventurous (ibid.).

Not significant and weak relationships between the main five personality traits and driver boredom might reflect the fact that this study used a short form measure of these traits (Gosling et al., 2003). It could also reflect the fact that the five main personality traits are too simple a representation of personality. It could be that had personality been measured using a more detailed breakdown of the five main traits [which are up to 30], stronger relationships between personality and driver boredom might have been observed. For example, had extraversion been measured according to its constituent facets [warmth, gregariousness, assertiveness, activity, excitement seeking, and positive emotions] using the Revised NEO Personality Inventory (Costa and McCrae, 1992) strong relationships between the constituent facets and driver boredom might have been observed. People scoring more highly on excitement seeking [a facet of extraversion] could be more likely to suffer driver boredom due to their needing higher levels of stimulation, for example. In this study, it was not practical to use the Revised NEO Personality Inventory due to its length and the associated time it takes to complete, but this measure could be used on the subject of driver boredom in furture research.

Results show that females are slightly more likely than males to suffer driver boredom. This finding is inconsistent with theory, existing research, and results elsewhere in this study. It is inconsistent with theory indicating that males are less sensitive to stimulation and more prone to tire of stable environmental surroundings (Ellis, 2011). It is inconsistent with existing research showing that males are more likely to suffer boredom in general due to needs for high levels of variety (Vodanovich et al., 2005; Vodanovich and Kass, 1990b). It is inconsistent with results of this study showing that males are much more likely than females to suffer boredom in general due to needs for high levels of variety [external boredom proneness]. Moreover, it is inconsistent with results of this study showing that both internal and external boredom proneness relate strongly and positively to driver boredom.

However, sex differences in driver enthusiasm seem likely to explain sex effects on driver boredom that are inconsistent with theory and previous research. Results of this programme of research show that males are likely to be much more enthusiastic about driving than females. Levels of task engagement, knowledge, schema complexity, and perceived levels of stimulation from the driving task are likely to explain enthusiasm effects on driver boredom as argued. Males hence seem less likely to suffer driver boredom, despite the likely need for higher levels of stimulation from the driving task, due to their likely higher levels of engagement in the driving task and thus higher levels of perceived stimulation therein. Findings of this study suggesting that males are likely to drive faster on rural roads and motorways are consistent with the notion of males being more likely to be engaged in the driving task. Higher speeds are likely to reflect higher levels of ability, which seem likely to reflect higher levels of engagement in the driving task.

Implications for road safety

While differences in demography and personality provide information on the types of drivers who are likely to suffer driver boredom, they provide limited insight into how to reduce driver boredom. However, knowing which types of drivers are more prone to suffering driver boredom does provide some information that can be used to target road safety interventions [e.g. educational messages designed to reduce driver boredom or make drivers aware of the risks]. Consistent with the results of this study, interventions should be targeted predominantly at the following drivers: those who are younger, less conscientious, with a type A behaviour pattern, who need higher levels of variety, and who are less enthusiastic about driving.

Although it is the case that individual differences (e.g. personality) generally provide little insight into how to reduce driver boredom, one exception is driver enthusiasm. Enthusiasm for driving is one of the human factors most strongly related to driver boredom. Those more enthusiastic about driving are much less likely to suffer it as boring. As discussed, those more enthusiastic about driving seem less likely to suffer driver boredom because they seem more likely to be engaged in the driving task as well as with complex knowledge and schemas pertaining to it (Loukidou et al., 2009; Fisher, 1993). In this way, they seem more likely to perceive high levels of stimulation in the driving task. This suggests that if people more likely to suffer driver boredom[75] could be educated such that they drive in a more engaged fashion and thus derive higher levels of stimulation from the task, driver boredom could be reduced and road safety enhanced. This idea warrants testing in further efforts to minimise driver boredom and enhance road safety.

The notion of those more enthusiastic about driving being much less likely to suffer driver boredom due to their perceiving higher levels of stimulation in the driving task raises a further potential solution to the driver boredom issue. Given that boredom, a state of under-arousal (after Mikulas and Vodanovich, 1993) is a function of perceived capability (Csikszentmihalyi, 2002; Hebb, 1955, Yerkes and Dodson, 1908) it seems likely that driver boredom could be reduced by educating people likely to suffer driver boredom such that they are with lower levels of self-efficacy[76]. As above, this idea also warrants testing in further efforts to minimise driver boredom and enhance road safety.

[75] See preceding footnote.
[76] Self-efficacy is the belief in one's own competences (Martin et al., 2007).

4.6 Mediation effects of driver boredom

Results show that driver boredom explains effects of age, sex, conscientiousness, type A behaviour pattern, external boredom proneness, and driver enthusiasm on measures of driver distraction and/or error-proneness. Specifically, results show that people who are younger, female, less conscientious, with a higher sense of time urgency, more likely to need high levels of variety, and less enthusiastic about driving are more likely to be distracted and/or make mistakes whilst driving because they are more likely to find it boring. The results therefore provide evidence that the effects of demography and individual differences on driver behaviour [specifically distraction and error-proneness] are at least partially explained by driver boredom, itself acting as a more proximal determinant of driver behaviour.

Implications for theory and road safety

Results showing that driver boredom mediates relations between human factors and both driver distraction and error-proneness corroborate findings relating to relations between human factors and driver boredom and relations between driver boredom and driver behaviour. In this sense, they corroborate implications for theory and road safety as discussed. The finding that driver boredom mediates the effects of individual differences on driver behaviour, more specifically behavioural errors and driver distraction, is particularly important because there is potential to combat driver boredom using interventions (Section 4.4) whereas demography and individual differences such as personality are not amenable to change using interventions (Section 4.5).

4.7 Further research

Corroboration of findings using objective measures

Findings of this programme of research warrant testing using objective measures of constructs where possible despite the validity of self-report data relating to human factors and driver behaviour (Section 4.6). An instrumented vehicle study could be used to corroborate findings of this programme of research.

Initially, participants could complete self-report measures of age, sex, driving experience, driver enthusiasm, the main five personality traits, boredom proneness, and type A behaviour pattern[77]. Participants could then drive an instrumented vehicle on a predetermined route. The route could include stretches of main and minor road in urban and rural settings. It could also include free-flow and congested stretches of road. Driver arousal could be measured using physiological indicators [e.g. heart rate; blood pressure; galvanic skin response]. Further to this, drivers could be asked to indicate at regular intervals whether they are bored, relaxed, anxious, or excited[78]. Driver behaviour [e.g. speed; off-task behaviour; mistakes] could also be measured using appropriate technologies [e.g. GPS; digital video]. Data could be coded where appropriate [e.g. state of arousal; engagement in off-task behaviour; mistakes]. Relations between task complexity, time-on-task, individual differences, driver boredom, and driver behaviour, could then be tested.

Testing of why driver enthusiasm relates negatively to driver boredom

The strong negative relationship between driver enthusiasm and driver boredom seems likely to be a function of those more enthusiastic about driving being more likely to be engaged in the driving task. In this way, those more enthusiastic about driving seem likely to have more complex knowledge and schemas pertaining to the driving task. They thus seem more likely to perceive high levels of stimulation in the driving task, and less likely to suffer under-arousal. The fact that an item capturing engagement in the driving task [*I really like feeling in control of the vehicle when driving*] loads highly on the driver enthusiasm scale certainly supports the idea of those more enthusiastic about driving being likely to be more engaged in the driving task.

Further research could be conducted in order to test why driver enthusiasm relates negatively to driver boredom. It is important to investigate why driver enthusiasm and driver boredom are negatively related in order to develop intervention measures which are likely to be effective in terms of moderating levels of driver boredom. Specifically, further research could test whether the above suppositions regarding the relationship between enthusiasm for driving and driver boredom are valid. Questionnaire scales could be developed to measure the degree to which people engage in the driving task as well as the extent to which they have a developed knowledge about the driving task,

[77] It is very difficult if not impossible to measure these constructs objectively.
[78] This is necessary because physiological indicators do not differentiate between states of boredom and relaxation, or likewise between states of anxiety and excitement.

including potential hazards and approaches to minimising risk. Participants could complete self-report measures of age, sex, driving experience, driver enthusiasm, the main five personality traits, boredom proneness, type A behaviour pattern, and driver boredom. They could also complete self-report measures designed to capture the extent to which they engage in the driving task and have a developed knowledge about the driving task.

The degree to which participants perceive stimulation in the driving task could be measured by placing participants in a pre-recorded driving scenario. Participants could be asked to imagine themselves as drivers and to provide a running commentary on all the hazards they perceive in the scenario. Participants' commentaries could be scored in terms of level of perceived stimulation. Relations between driver enthusiasm, driver engagement, perceived levels of stimulation in the driving task, and driver boredom could then be tested whilst controlling for confounding variables.

Investigation of other human factors explaining driver boredom

Human factors considered in this programme of research explain 25 percent variance in driver boredom. This raises the question of what might explain the remaining 75 percent variance in driver boredom. It is likely that the extents to which people engage in the driving task, have complex knowledge pertaining to it, and perceive stimulation in it all explain further variance in driver boredom as argued. Furthermore, self-efficacy in the context of the driving task seems likely to relate to driver boredom as argued. The extent to which these constructs explain additional variance in driver boredom could be tested in the study outlined above.

Testing of ways to mitigate driver boredom

If it can be shown that driver boredom is related to engagement in the driving task, knowledge about the task, perceived levels of stimulation in the task, and self-efficacy, approaches to minimising driver boredom could be developed and trialled. Assuming driver boredom relates negatively to engagement, knowledge, and perceived stimulation, further research could test whether driver boredom can be minimised by educating people such that they drive in a more engaged style; have more complex knowledge pertaining to the task; and perceive higher levels of stimulation in the task. Likewise, assuming driver boredom relates positively to self-efficacy in the driving context, further research could test whether driver boredom can be minimised by educating people such that they are less confident in their own driving skills.

A longitudinal study using an intervention programme could be developed and conducted. The intervention programme could be designed to educate people such that they drive in a more engaged style; have more complex knowledge relating to the driving task; perceive higher levels of stimulation in the driving task; and are more aware of their own limitations in respect to driving. Half the sample could be randomly assigned to a control group whilst the other half could be exposed to the intervention programme.

4.8 Conclusions

Results of this programme of research suggest that driver boredom, a state of under-arousal attributed to an inadequately stimulating driving task, is prevalent in situations offering low levels of stimulation [e.g. traffic jams]. Results further suggest that driver boredom is likely to compromise road safety due to disengagement from the driving task and the adoption of subsidiary thoughts and behaviours. Some evidence also, was found to suggest that people cope with driver boredom by increasing their speed, in particular on motorways, one of the most monotonous road types in the network. These findings indicate that driver boredom warrants attention in efforts to understand driver behaviour and further road safety.

This research has shown that some people are more likely than others are to suffer driver boredom. Specifically, people who are younger, female, less conscientious, with a type A behaviour pattern, less able to amuse themselves, in need of higher levels of variety, and less enthusiastic about driving all seem more likely to suffer driver boredom. Enthusiasm for driving is the human factor that has been found to relate most strongly to driver boredom. Results show that those more enthusiastic about driving are much less likely to suffer driver boredom. It is thought that this relationship is a function of those more enthusiastic about driving being more likely to engage in the driving task, having more complex knowledge and schemas pertaining to it, and thus perceiving higher levels of stimulation in the driving task.

In all, these results indicate that the solution to the problem of driver boredom lies in driver (re-)education. Given findings showing that those more enthusiastic about driving are much less likely to suffer driver boredom, further research should develop understanding of why this is the case. Given that engagement in the driving task, knowledge about the complexity of the task, and perceived levels of stimulation in the task, seem likely to mediate relations between driver enthusiasm and driver boredom, further research should test relations between these constructs. If it can be shown that those more enthusiastic about driving are less likely to suffer driver boredom due to their being more likely to engage in the driving task, intervention measures should be developed around the idea of promoting engagement in the driving task. Educating people likely to suffer driver boredom such that they are less susceptible to suffering it is likely to be the most viable solution to the threat driver boredom poses to road safety.

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