Behavioural Aspects of Safer Transport

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Summary

The study of transport behaviour is essential for health, safety and productivity. Human factors are widely acknowledged as major contributors in road traffic collision (RTC) involvement. However, despite extensive research on specific topics in certain areas of transport, there are still substantial gaps in our knowledge.

A systematic review of the literature related to human factors in the remit of car driving revealed that much of the empirical research studies factors in isolation, whereas it is clear a multivariate approach is essential. This thesis describes a series of well-powered cross-sectional studies, employing multivariate methods conducted to better understand the psychological underpinnings of the propensity to commit driving violations – this being a major risk factor in RTC occurrence.

Associations between human factors and their connection to RTCs, as well as their potential links with some of the established risk factors as outcome variables (driving behaviour, driver fatigue and risk-taking) were considered.

Hierarchical, logistic and multinomial regressions demonstrated a variety of novel predictors implicated in RTC involvement, such as job characteristics, when the driving was taking place (commuting/ leisure), high numbers of near-miss involvement and recent driver retraining course attendance. Cumulative effects analyses revealed a multiplicative impact of the significant predictors – for example a 16.73-fold increase in driver fatigue was detected for younger, single drivers who often drive in heavy traffic, on the motorway and in adverse weather, with stressful, noisy, pressurised jobs, lower in levels of respect (typical of the blue-collar worker). These effects were detected alongside the established risk factors, affording confidence in the novel predictors.

Overall, the research contained in this thesis contributes to expert knowledge in transport psychology – based on these findings, it is clearly important to use a holistic approach to improve transport behaviour in all domains and groups where research on transport behaviour is poorly developed.

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Publications in Thesis

Sections of Chapters 2, 4, 5, 6 and 7 have been presented in the following publications:

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Bowen, L., & Smith, A. (2019). Drive better, feel better: predicting well-being and driving behaviour in undergraduate psychology students. *Advances in Social Sciences Research Journal 6*(2), 302-318. https://doi.org/10.14738/assrj.62.6221

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Chapter One

1.1 General Introduction

Road transport is often representative of the greatest risk to which individuals are exposed. By way of illustration, there were a reported 29,795 seriously injured casualties on UK roads during 2022, of which 1,695 were fatalities (Department for Transport, 2023). As well as the obvious concerns surrounding injury and mortality, road traffic collisions (RTCs) cost the UK economy over £33 billion in unreported and reported accidents during 2019, with this figure comprising of vehicle and property damage, police costs, and insurance costs (GOV.UK, 2022). This equated to 1.5% of the UK's gross domestic product. There can be little doubt that the study of transport behaviour is of considerable importance to individuals, businesses and society as a whole.

1.1.2 A Brief History of Road Traffic Collisions

In 1896, Mrs Bridget Driscoll, of Croydon (UK) became the first motoring fatality in August 1896 when she was hit by a Roger-Benz car at Crystal Palace, London (UK). An employee of the Anglo-French Motor Company, Arthur Edsell was driving at 'tremendous speeds' of 4mph/6.44kph, when he struck Bridget, fracturing her skull in the process. Bridget died from her injuries minutes later (Radjou et al., 2022).

The first driver to die from injuries sustained from an RTC was Mr Henry Lindfield of Brighton (UK) when his electrical carriage overturned in February of 1898. According to an article published in Autocar in the spring of 1898, Henry had only driven the car a 'few times' and thus the incident was probably caused by high-speed driving (16 mph/25kph) which was declared a 'high speed for a novice to maintain'. Henry died of shock the day after his accident, triggered by the amputation of one of his legs (National Motor Museum, 2023).

The first crash to cause the death of a passenger in a car happened during February 1899 at Harrow (UK). Major James Stanley Richer was a passenger in a Daimler Wagonette

being demonstrated by a Mr Sewell. James died four days after the collision without ever regaining consciousness, whilst Mr Sewell was killed instantly – making him the first driver of a petrol car to die in an RTC (O'Neill & Mohan, 2019).

1.1.3 A Brief Introduction to the History of Road Traffic Safety

In the early 1900s, mobility was changing dramatically. Horse-drawn wagons, carts and omnibuses (the latter used to transport large numbers of people) were giving way to trams, buses and cars. The result was near chaos, with pedestrians dotted everywhere, stepping in front of and around trams, animals, cyclists, and cars. Traffic was quickly becoming significantly heavier and faster, subsequently, accidents became much more common and far more serious (Cooper & Orme, 2009).

This was quickly recognised by the automobile industry; the sector took action to create new laws, features, and infrastructure to make roads safer for all. Traffic signs and lights became commonplace in most cities, as well as the presence of traffic police, all of which helped to maintain a semblance of safety and enforce the law. In addition, mechanical indicators were added to cars to communicate a drivers' intentions more clearly than hand signals (the major flaw of which was that they could not be seen at night). During 1909, Germany introduced some of the world's first traffic laws, as well as a state driving test and licence. Despite these changes, serious incidents on roads continued to rise and so further changes were introduced – the UK introduced the first pedestrian crossings in the 1930's, in 1934, Germany introduced its first nationwide speed limit (37 mph/60kph) in urban areas. Without doubt however, one of the most important developments in road safety was that of the seatbelt. However, adoption of the seatbelt was surprisingly slow – vehicle manufacturers started to offer them as 'optional extras' during the 1950s, but consumer uptake was extremely low. It was two decades later, in the 1970s when Australia introduced the first compulsory seat belt law whilst mandatory seatbelt usage for all passengers did not occur until the 1980s in many European countries (Hakkert & Gittleman, 2014).

Another major factor in the development of road traffic safety was the implementation of drink driving laws. GOV.UK (2019) offers a comprehensive timeline of UK road traffic safety implementation. The UK introduced the Road Traffic Act in 1930, making it illegal to drive, attempt to drive or be in charge of a motor vehicle in a public place while being 'under the influence of a drink or a drug to such an extent as to be incapable of having proper control

of the vehicle'. Clearly, the definition of incapable lent itself to some degree of subjectivity, therefore, in 1965 a blood-alcohol limit (otherwise known as the drink-drive limit) was introduced for all drivers. It was a further two years before this was properly enforced, occasioned by the introduction of the roadside breathalyser. The legal limit was set at 80mg of alcohol per 100ml of blood. Legislation passed in 1967 made it an offence to fail to provide a breath specimen; similarly, the failure to provide an evidential blood or urine specimen test without reasonable excuse was also a criminal offence. The use of breathalysers, known as the 'Alcotest 80' – a reference to the limit it was designed to detect quickly began to reduce RTCs. In conjunction with a government-led advertising campaign, alcohol-related RTCs dropped from 25% to 15% in the first year alone. The impact was significant - there were 1,152 fewer recorded fatalities, 11,177 fewer serious injuries and a 28,130 reduction in traffic related minor injuries. Contemporaneously, drink-driving has become a socially unacceptable behaviour, this change aided by a number of high-profile advertising campaigns and an increase in awareness of the hazards of driving whilst intoxicated. A recent survey by road safety campaigners THINK! found that of 2,000 participants, 91% agreed that drink driving was 'unacceptable' and 92% would feel 'ashamed' if they were caught drink-driving (THINK! 2022). Clearly, unacceptable driving behaviours can be modified in the face of shifting societal attitudes.

1.2 Road Traffic Statistics – UK

1.2.1 Vehicle Type and Number

According to (GOV.UK, 2022), at the end of December 2022, there were 40.7 million licenced vehicles in the UK, representing a 1.0 per cent increase in comparison to the previous year, and a 10.3 per cent increase in comparison to 2020. Cars make up the majority of licenced vehicles. In the UK, 33.2 million cars (87.1%), 4.63 million LGVs (11.4%), 0.54 million HGVs (1.3%), 1.36 million motorcycles (3.3%), 0.15 million buses/coaches (0.4%) and 0.84 million other vehicles (2%).

1.2.2 RTC's

Car occupants account for the greatest number of casualties in road traffic collisions (RTCs) each year, making up 59% of total casualties, and around 44% of total fatalities during 2022 (RAC Foundation, 2023). Whilst it is acknowledged that injurious and fatal RTCs have decreased with the implementation of safety legislation (i.e., seat belt usage; drink

driving laws) there is little doubt that RTCs have plateaued at a level at which recent initiatives and innovations (e.g., driver safety courses; improved vehicle safety features) appear to make little difference. As a result, attention has turned toward the determination of causative factors related to human factors in order to reduce crash risk.

1.3 Human Factors and Driving

Undeniably, human factors play a major part in safe transport, and there exists a considerable body of research addressing specific topics in certain areas of transport (e.g., fatigue in long haul truck drivers; see Crizzle et al., 2017 for a review) but there are still considerable gaps in our knowledge to date. Specifically, what is missing is an understanding of the motivation underlying unsafe behaviour. The vast majority of the extant research focuses on factors in isolation, whereas it is clear that a multivariate approach is essential. Also, it is important to adjust for potential confounding variables which may influence both risk factors and outcomes (e.g., psychosocial factors, demographic variables, lifestyle, and job characteristics).

1.3.1 Driving: Errors and Violations

The Driver Behaviour Questionnaire (DBQ; Manstead et al., 1990) is widely used as a measurement of driving behaviour in a plethora of contexts. The tool offers empirical evidence that driving behaviour is governed by two psychologically distinct components: errors and violations. Errors reflect performance limits of the driver such as those related to attentional, perceptual and information processing abilities. As a result, the literature is replete with factors contributing to driver error, such as risk-taking, stress, and physical and mental illness, which in turn have been found to predict RTCs (e.g., Smith, 2016). Fatigue often emerges as the strongest predictor for RTCs and has thus received significant research attention (Bener, 2017). Violations, on the other hand, represent the style in which the driver *chooses* to drive, (referred to as driving behaviour) and includes actions such as indicating hostility to other drivers and speeding, often affected by driver mood. Also, drivers are exposed to hazards which perceivably exacerbate RTC risk, such as excessive motorway driving, and driving for prolonged periods (Smith). While driver error may be dealt with using retraining and improved designs of driver interface, it is becoming apparent that a more holistic picture is required in the remit of driving behaviour, which is arguably underpinned by attitudinal dynamics (Parker et al., 1995).

1.3.2 Driving and Well-being

There is an emerging body of literature exploring whether well-being, defined as a dynamic concept that includes subjective, social, and psychological dimensions, as well as health-related behaviours, has a bearing upon driving behaviour, typically from a negative perspective (i.e., lower levels of well-being equating to poorer driving; Hu et al., 2013). However, what has currently not been accounted for is the role of *driving itself* upon well-being. Given that well-being is known to be affected by other environments, such as the workplace, in which safety and productivity can be compromised (Bryson et al., 2017; de Cates et al., 2014; King & Jex 2014) it is reasonable to suggest that such effects may be observed in drivers. Indeed, it can be no coincidence that car manufacturers invest billions year on year into the improvement of driver interfaces to improve the driving 'environment' (Giust et al., 2018).

1.4 Research Aims

There are three major objectives and a number of research questions addressed in this thesis. The first objective was to undertake multivariate research to examine novel well-being/personality predictors and job characteristics whilst controlling for established predictors (such as fatigue) for their potential associations with unsafe driving practices. The second objective was to ascertain whether such factors are subject to a cumulative effect – that is, whether the chances of adverse outcomes increase exponentially when drivers possess more than one predictor of the risk factors. Finally, a longitudinal methodology was employed to assess causal links between both the established and novel predictors identified in the cross-sectional studies.

1.4.1 Thesis Structure

Prior to the undertaking of empirical work, it is imperative to examine the extent to which the subject has been investigated and any gaps that might exist. To this end, Chapter two presents a systematic literature review of the empirical literature surrounding UK car drivers.

Chapter three outlines the methodological considerations pertinent to this research. The thesis contains seven quantitative studies. This purpose of this chapter is to give a detailed account of the ethics, sampling structure, rationales for the various methodologies employed and the analytic strategy.

Chapters four through nine report the rationale, methodology and results of the empirical studies conducted. Each chapter also includes a detailed discussion of the findings and a brief chapter summary.

Chapter ten revisits the thesis aims and offers a brief general discussion around the novel findings in this thesis. Potential interventions, based on the key findings and future research directions are also considered.

1.5 Chapter Summary and Links to Chapter Two

This chapter provided context and a rationale for the research, as well as an overview of the research aims and thesis structure.

The next chapter presents a systematic review of the empirical literature surrounding non-professional car drivers.

Chapter Two

Systematic Literature Review

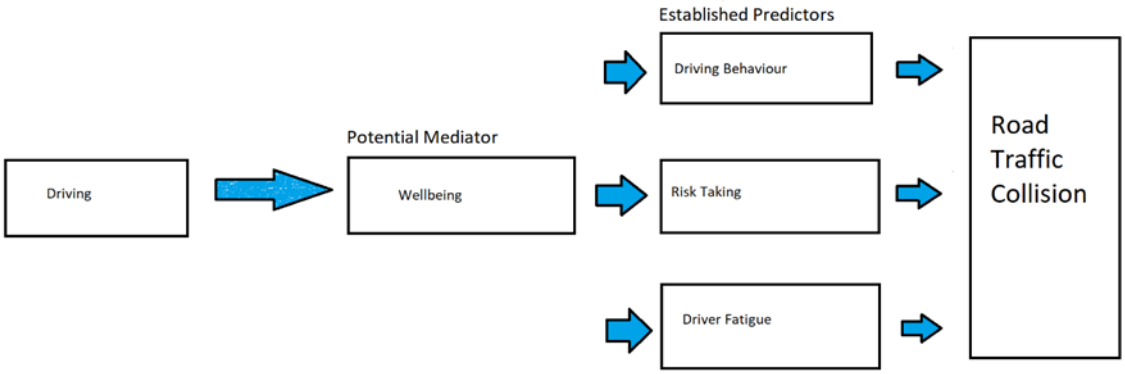
2.2 Introduction and Rationale

As detailed in Chapter one, attention has turned toward the determination of causative features related to human factors of drivers to better understand and potentially reduce crash risk.

One such avenue of interest is the well-being of drivers and its potential link to RTC involvement. Many studies have found associations between fatigue and crash risk (see Moradi et al., 2018 for a review) as well as individual differences such as risk-taking behaviour and driving behaviour (e.g., Smith, 2016). In the remit of well-being, defined as a dynamic concept that includes subjective, social, and psychological dimensions, there are a number of studies which examine factors such as mental health and driving, personality traits and the effect of commuting upon both driving behaviour and RTC occurrence. The literature is replete with studies examining various factors affecting the well-being of professional drivers, such as high rates of disease and stress attributed to the nature of the job (e.g., Lemke & Apostolopoulos, 2015). Indeed, there are multiple systematic and meta-analytic studies which synthesise psychological and physical factors underpinning well-being in professional drivers; by way of illustration, Tse et al., (2006) offered a review of fifty years of literature pertaining to bus driver well-being, this being revisited recently by Crizzle et al. (2017). In addition, there is a body of research aiming to systematically review interventions arising from the inquiry into such factors, such as the efficacy of interventions to reduce fatigue and sleepiness in professional drivers (Nazari et al., 2017). Less attention is focused on the impact of driving on the well-being of drivers using the roads (to use motor vehicle insurer parlance) for social, domestic, pleasure and commuting (SDP&C) purposes. Figure 2.1 shows the proposed relationship between driving, well-being and driving outcomes.

Figure 2.1

Proposed Direction of the Relationship Between Driving, Well-being and Driving Outcomes



The purpose of this chapter is to provide a systematic review of the literature surrounding the well-being and personality of SDP&C road users and its potential links to both poorer levels of driving behaviour (DB), and RTC involvement. Whilst there is a consensus that car drivers are at risk of injury and fatality on the roads and well-being is a causal factor, there has been no critical appraisal or synthesis (unlike that of professional drivers) of this literature to date. Specifically, the research questions are thus: 'What does the extant literature suggest are well-being and personality factors associated with driving behaviour, aggressive driving, risky driving and road traffic collision involvement?' and 'To what extent does the literature consider the impact of driving on the well-being of the driver?' Well-being, in the current context refers to factors involved in the well-being process

(Williams & Smith, 2018) and include: outcomes (anxiety/depression; happiness/negative affect), predictors (demands, control/support) appraisals (stress, satisfaction).

2.3 Method

2.3.1 Search Strategy

The present review included studies related to well-being, personality and driving. A search for relevant studies published in peer reviewed journals was conducted using the following databases: PsychINFO (PsychNET), Scopus (Elsevier), Web of Science (Social Sciences Index; WoS), ORCA (Online research at Cardiff University), Science Direct (Elsevier), Taylor and Francis Online, and PubMed. Grey literature was retrieved using the Transport Research Documentation Database (TRID) as well as conference proceedings from the Driving Assessment Conference and Human Factors and Ergonomics Society Annual Meeting (full-text articles only for quality appraisal). In parallel, an internet search of Google Scholar was undertaken. Eligible papers were those published in the English language, during the last decade; the latter to allow for a more contemporary appraisal of the literature.

2.3.2 Search Terms

The search strategies were undertaken between March 2019 and February 2020 and consisted of keywords and database specific subject headings for the main concepts of interest (i.e. the well-being process, mental health and driving outcomes) entered both singly and in combination for study retrieval. Search terms consisted of three levels and included both commuting and leisure drivers of all age ranges.

Professional driver literature was excluded, for the reasons already stated. Acronyms and Americanised spellings (e.g., behaviour) were used to ensure no relevant studies were excluded. The full list of search terms can be found in Table 2.1.

Table 2.1

Search Terms

1st level terms	(AND) 2nd level terms	(AND) 3rd level terms
Driving Motor vehicle driving	Mental Health Anxiety Well-being/wellbeing Positive affect Negative affect Life satisfaction Demands Control/support Personality Stress Happiness Individual differences	Influence RTC RTA Crash Relationship Accident Risk Human factors
OR	**OR**	**OR**
Driving Behaviour/Driving Behaviour	Well-being/wellbeing Positive affect Negative affect Life satisfaction	Relationship Influence RTC RTA

	Demands Control/support Personality Stress Happiness Mental health Anxiety Individual differences	Crash Accident Risk
OR	**OR**	**OR**
Commuting	Well-being/wellbeing Positive affect Negative affect Life satisfaction Demands Control/support Personality Stress Happiness Mental health Anxiety	Relationship Influence RTC RTA Crash Accident Risk

	Individual differences	
OR	**OR**	**OR**
Travel	Well-being/wellbeing Positive affect Negative affect Life satisfaction Demands Control/support Personality Stress Happiness Mental health Anxiety Individual differences	Influence RTC RTA Crash Relationship Accident Risk

***Note*. RTC= Road traffic collision; RTA = Road traffic accident**

2.3.3 Procedure

Citations retrieved from each database search were downloaded to EndNote, a reference management software program. In the first screening phase, titles and abstracts of 9,172 articles and 2,904 reports from the grey literature were screened to identify potentially relevant studies. The first one hundred abstracts were screened by two reviewers in order to ensure consistency in terms of the inclusion/exclusion criteria. There was a 94% level of agreement between the two, a decision rendered via consensus when any disagreement for article inclusion arose. The remaining articles were divided among the two reviewers and assessed independently. Five hundred and fifty duplicates were removed, as well as 253

papers not available in English. Of the remaining 11,273 papers, a further 8,221 were excluded as they examined professional drivers. Conference proceedings (offering abstracts only) were also excluded (n = 42). Papers in which mental health disorders, such as post-traumatic stress disorder (PTSD) on specific populations (i.e., service personnel) were also removed from the analysis as the current review considers mental health only in the remit of depression and anxiety on the general population (n = 346). Studies which only considered the validity of measurement instruments such as the DBQ were also removed from the process (n = 105). 'Driving' is a term often used in the psychological literature to describe phenomenon (e.g., 'Factors *driving* well-being') not relevant in the current context and were thus removed (n = 725). Research focusing on well-being following RTC involvement were excluded (n = 379) as the present purpose is to examine the literature surrounding potential *predictors* of RTC involvement - not the impact of such involvement. Three hundred and ninety papers were removed as the primary focus was one of the development of safety systems/automation in relation to driving, whilst 483 studies exploring the development/uptake/feasibility of vehicle automation, and those in which the central focus is one of the impact of mobile/cell phone use, passenger interaction and technology while driving (n = 257) were also removed.

The remaining 325 papers were evenly divided between the two researchers for the full-text screening process. A total of 40 papers were identified as relevant to the present review by consensus of the two reviewers (see Figure 2.2).

2.3.4 Methodological Quality Appraisal

All articles underwent methodological quality appraisal using the Mixed Methods Appraisal Tool (MMAT; Pluye et al., 2011). The MMAT was devised for the appraisal stage of complex systematic literature reviews which include qualitative, quantitative and mixed-methods studies. Validated in several studies testing its usability, content validity and inter-rater reliability (e.g., Hong et al., 2018; Pluye & Hong, 2014), the MMAT is an efficient tool for concomitantly appraising the most common types of empirical studies. For the present purpose, the sub-domains of qualitative and quantitative descriptive studies (incidence or prevalence studies which form a large part of the driving literature) were deemed appropriate to assess methodological rigor. Scores are based on meeting pre-determined criteria, of which a score of 1 is given for each criterion met (to a maximum of 4). Criteria which are not met,

or in cases whereby details are not supplied by the authors are given a score of 0. Twenty-four studies (60%) achieved a score of three, the remaining 16 (40%) a score of four.

Figure 2.2

Flow Diagram of the Screening Process using Preferred Reporting Items for Systematic Reviews and Meta Analyses Guidelines (PRISMA; Moher et al., 2009)

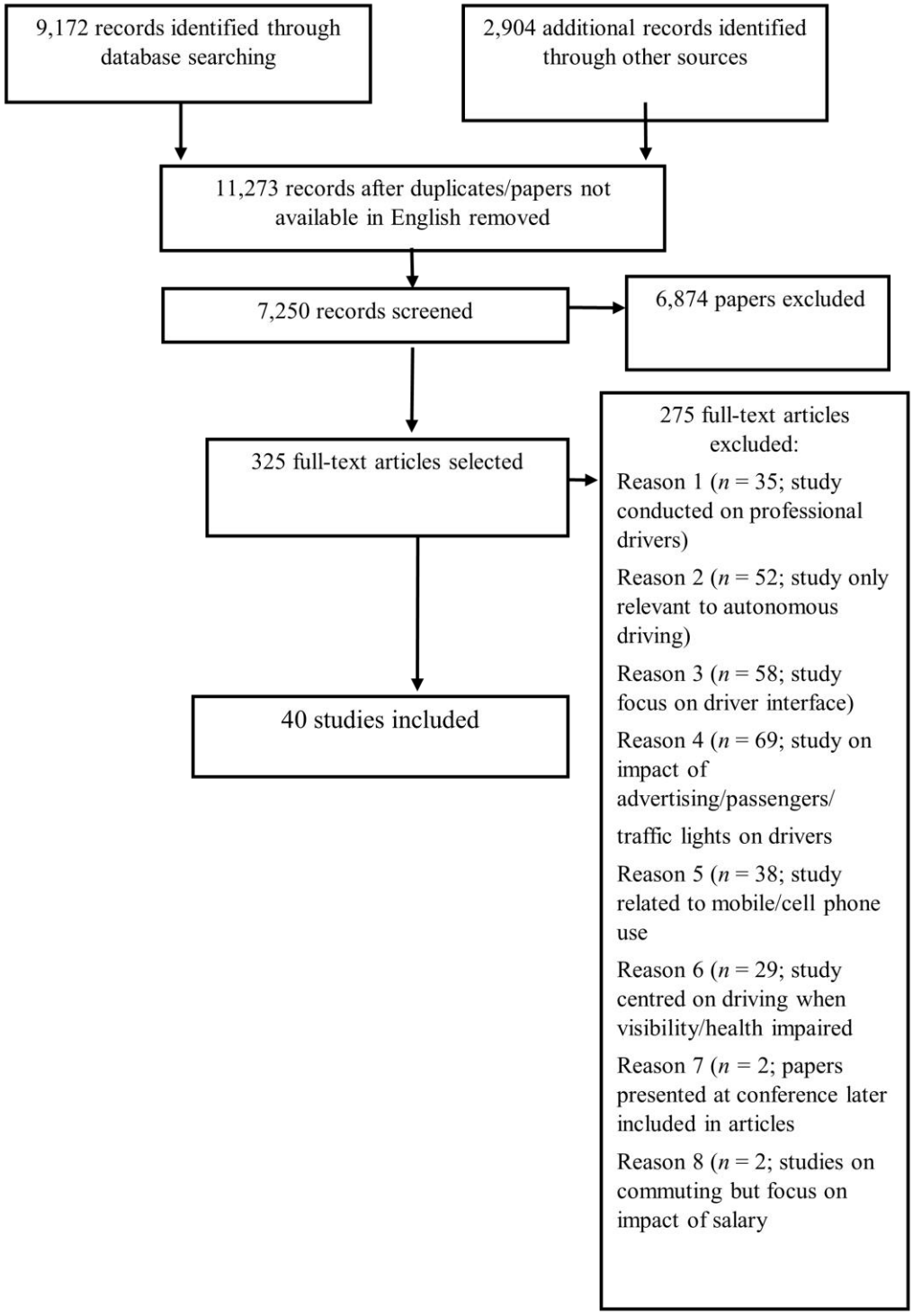


Table 2.2

MMAT Grading Criteria (Adapted from Pluye et al., 2011)

Type of Study	Methodological Quality Criteria
Screening questions (all studies)	Are there clear qualitative/quantitative research questions (or objectives) Do the collected data address the research question/objective? E.g., Consider whether the follow-up period is long enough for the outcome to occur (longitudinal studies) *Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Cannot tell' to one/ both screening questions*

Qualitative	1.1 Are the sources of qualitative data (archives/documents/informants/ observations) relevant to address the research question (objective)?
	1.2 Is the process for analysing qualitative data relevant to address the research question (objective)?
	1.3 Is appropriate consideration given to how findings relate to the context, e.g., the setting, in which the data were collected?
	1.4 Is appropriate consideration given to how findings relate to researchers' influence, e.g. through their interactions with participants?
Quantitative descriptive	4.1 Is the sampling strategy relevant to address the quantitative research question?
	4.2 Is the sample representative of the population under study?
	4.3 Are measurements appropriate (clear origin, or validity known, or standard instrument)?
	4.4 Is there an acceptable response rate (60% or above)?

2.4. Results

All studies used driving outcomes as the dependent variable (measured via DBQ, Dula dangerous driving index and/or other appropriate measure; see Table 2.3 for a summary). Of the 40 studies, 9 were studies on anxiety, and/or stress and driving (one study qualitative in nature) with the number of participants ranging from 38 to 2743. Seven studies used survey data, one of which was longitudinal in nature, another combined galvanic skin response sensor data with a stress survey. One study combined experimental tasks (*n*-back/PGNG) (see Table 2.4). Nine studies on personality and driving were included, with the number of participants ranging from 88 to 2856, all of which used questionnaire/survey data, one coupling this with GPS data (see Table 2.5). Fourteen studies explored the effect of emotion on driving, with the number of participants ranging from 15 - 1400. Six driving and emotion studies were simulator coupled with emotion induction, one of which included a physiological measure. One used experimental video clips as a means to induce emotion, the remaining seven studies used questionnaires/surveys (see Table 2.6). Six studies investigated the impact of commuting and driving on well-being, the number of participants ranging from 11 to 502. Five used surveys, one observation/catch probe descriptive experience (see Table 2.7). Job characteristics and their potential impact on driving featured in two studies, one of which was an online survey, the second a naturalistic survey, using driving application data (*n* = 2586/50 respectively; see Table 2.8).

Table 2.3

Summary of Methodology and Measures

Driving and Personality

Methodology	Driving measures used	Number of studies
Survey/Questionnaire	Driver behaviour questionnaire (DBQ; Reason et al., 1990)	3

	Driving anger scale (DAS; Deffenbacher et al., 1994)	1
	Driving anger expression (DAX; Deffenbacher et al., 1994)	
	Dula dangerous driving index (DDDI; Dula, 2003)	1
	Multidimensional driving style inventory	1
	Short form driving	1
	Risky driving behaviour/Risk taking & attitudes to driving scale	2

Driving and Emotion

Methodology	Driving measures used	Number of studies
Survey/Questionnaire	Reactions under anger-provoking situations	1
	Driving anger scale (DAS; Deffenbacher et al., 1994)	2
	Dula dangerous driving index (DDDI; Dula, 2003)	2
	Dickman impulsivity inventory/driving background	1
	NASA TLX (Hart et al., 2006)	1
	Risky driving behaviour/driving risk attitude scale/driving risk perception	1
	Driver behaviour questionnaire (DBQ; Reason et al., 1990)	2
	Satisfaction with travel (STS; Ettma et al., 2011)	1

Simulator study		3

Commuting/Job Characteristics & Driving

Methodology	Driving measures used	Number of studies
Survey/Questionnaire	Driver behaviour questionnaire (DBQ; Reason et al., 1990)	4
	Satisfaction with travel (STS; Friman et al., 2003)	1
	Driving violation history	1
Observation/Naturalistic survey	Risky driving behaviour/driving risk attitude scale/driving risk perception. Green Road app (Greenroad, 2017).	2

2.4.1 Driving and Stress/Anxiety

2.4.1.1 Demographics

Average driver age was reported in all nine studies, ranging from 17 to 70 years. Gender was also reported in all studies, with female drivers comprising the majority of the samples. Two studies reported participants' years of driving experience, one of which also recorded both the average age licence was received, and attempts to complete driving exam (see Table 2.4).

2.4.1.2 Driving Stress

Four studies were sourced which examined the *direct* impact of driving on the stress levels of drivers (Dogan et al., 2019; Dorantes-Argandar et al., 2016; Rowden et al., 2011; Scott-Parker et al., 2018).

Dogan et al. (2019) used a combination of physiological and questionnaire data to measure the stress responses of participants. Results from the galvanic skin response measure correlated strongly with the questionnaire data (total accuracy 87.5%), capturing driving stressors across six groups, participants required to select answers from choices such as 'I will drive normally' (non-stressed response) to 'It is too stressful. I would not want to drive under this condition' (high-stressed response). Findings indicate a higher overall stress response in females. Inexperienced drivers (those with less than two years driving experience) were shown to be most stressed in instances whereby the road is unknown and/ or driving after stressful work. Frequency of driving is also a factor, with the least stressed drivers with regard to driving on unknown roads being those who drive daily, in comparison to those who drive weekly who were more stressed. Along a similar vein, Dorantes-Argandar et al. (2016) also looked to pinpoint the elements of the environment which stress individuals while operating a motor vehicle. Key findings pointed to road infrastructure not being the principal stressor of car drivers, rather, the predominant stressors were socially interactive in nature. The most stressful element in the context of driving was *'people that drive violently'* closely followed by *'not respecting social rules'*. The authors suggest that drivers are to some extent aware of the factors which endanger their well-being – the subsequent stress response being a reaction to a threat posed by others' behaviour. In contrast to Dogan et al. (2019), there were no differences in stressors found between sex or age groups. Seemingly one will

be stressed by socially interactive events in the driving environment regardless whether they be male or female, younger or older.

In an investigation into the relative impact of various sources of stress (life stress, work stress, environment stress) on driving outcomes, Rowden et al. (2011) demonstrated that extraneous stress factors were associated with three classes of violations, as measured by the DBQ. General mental health and daily hassles were significantly positively correlated with the DBQ violations, lapses and errors. Also positively correlated (albeit weaker, *rs* = <.2) with the three DBQ criteria was work stress. Multivariate analyses were used to further elucidate the links between variables, in which the DSI factors 'negative affect' and 'risk-taking' strongly positively correlated with high levels of extraneous stress. The question was posed as to the potential 'overspill' of stress from other sources into the driving environment. Bivariate analyses revealed work stress, hassles and mental health symptoms correlated in the region of .2-.3 with DSI factors, although it should be noted that driver stress may be reciprocally related to stress in other contexts, such as home and work life.

Finally, Scott-Parker et al. (2018) used focus groups to uncover 'hidden' information through interactions between the experts in the subject matter (i.e. the participants) and between the participants and the interviewer. In contrast to the findings of Dorantes-Argandar et al. (2016), road infrastructure emerged as a theme; roadworks, roundabouts, traffic lights and posted speed limits cited as sources of driving stress. However, the behaviour of other road users was also prominent in discussions; discourtesy/dangerous behaviour shown by other drivers (tailgating, speeding, territoriality and disobeying signage) a frequent cause of stress. Further, such incidences gave rise to an emotional response (often anger) leading to risky driving behaviour, such as deliberately driving in an intimidating manner. Clearly, driving can be a stressful experience, which impacts not only an individuals' well-being, but also has a knock-on effect in terms of their own driving.

2.4.1.3 Driving Anxiety

Five papers explored the impact of anxiety on driving (Clapp et al., 2011; Dula et al., 2010; Hempel et al., 2017; Shahar, 2010; Wong & Titchener, 2015).

Clapp et al. (2011) explicate contributory factors of anxious driving behaviour. Whilst associations with objective accident severity and distress were examined - which does not form part of the present review, findings also point to the unique associations between higher levels of self-reported life stress (such as death of friend/family, this experienced by 46.4% of participants) and three domains of driving anxiety. The first domain, exaggerated safety/caution behaviour revealed a sex effect, in that females reported more frequent caution/safety behaviour than their male counterparts (sr^2 =.046). A direct relationship between accident distress and safety behaviour was manifest specifically in individuals with greater life stress history (sr^2 = .029), whereas there was no association observed between safety behaviour and distress in those reporting fewer life stressors. The second domain, anxiety-based performance deficits also revealed females reporting higher frequencies of performance errors than men (sr^2 = .019) and those with higher levels of life stress also demonstrating a direct relationship between accidents and performance deficits (sr^2 = .018). The final domain, aggressive/hostile behaviour, in contrast to the other domains evidenced no sex association, although akin to the other domains, did indicate a direct relationship between life stress history and hostile/aggressive driving behaviour (sr^2 = .035), aggressive/hostile behaviour not apparent in those reporting fewer life stressors. Dula et al. (2010), in an online survey of 1121 students (M_{age} = 21.3, SD = 5.6) found that higher levels of anxiety were associated with greater propensity toward dangerous driving (as measured by the DDDI). Changing focus from younger to older drivers, Hempel et al. (2017) investigated the impact of driving anxiety on young-older adults (55-70 years). Driving anxiety was found to be associated with poorer mental, and physical health and quality of life. Whilst the researchers did not investigate whether these relationships are indicative of premature cessation of driving in such individuals, this is undeniably an important area for consideration, given the impact of such cessation upon overall well-being (loss of independence etc.). Shahar (2010) focused upon self-reported driving behaviour as a function of anxiety in males aged between 22 and 50. Riskier driving behaviour was identified in individuals high in trait anxiety, the explanation offered for this being cognitive overload in the highly anxious leading to unintentional violations, lapses and errors while driving. In similar research, Wong et al. (2015), using a combination of experimental measures (e.g. n – back task; PGNG), measures of state and trait anxiety and the driver behaviour questionnaire also found trait anxiety as predictive of poor driving behaviour.

2.4.2 Driving and Personality

2.4.2.1 Demographics

All studies reported average age, ranging from 17-87. Gender was reported in all studies, with a roughly equal split between male and female participants. Two studies gave an average mileage and mean number of accidents across the sample, as well as an average frequency of driving. One study used data obtained from an in-vehicle data recorder (captured over a 12-month period drawn from a larger longitudinal study) coupled with questionnaire data. Along similar lines, another study coupled GPS data obtained over 4 weeks with questionnaire data (see Table 2.5).

2.4.2.2 Driving and Personality

Individual differences such as personality feature reasonably heavily in the extant literature as being associated with poor driving practice. By way of illustration, so called 'Dark Triad' personality traits (machiavellianism, narcissism and psychopathy) and attitudes towards risky driving behaviour were examined in a group of learner drivers (Endriulaitienė et al., 2018). The results revealed that dark personality is significantly related to riskier attitudes toward speeding, drunk driving and violating traffic rules for both males *and* females.

Changing focus, Bowen & Smith (2019) examined the role of personality on driving behaviour and risk-taking. Driving behaviour was measured using a factor analysed version of the DBQ, comprising factors such as speeding and indicating hostility to other drivers, arguably indicative of violations, rather than errors. Findings revealed that poorer driving behaviour was associated with low levels of agreeableness ($\beta = 1.67$) and conscientiousness ($\beta = 1.77$), and high levels of neuroticism ($\beta = 1.59$). Risk-taking was associated with high levels of openness ($\beta = 1.08$) and extraversion ($\beta= 1.24$). No associations were found directly between any of the personality traits and road traffic collision involvement. These findings broadly align with those of Sarma et al. (2013), who uncovered an association between higher levels of speeding and high levels of extraversion ($\beta = 0.09$). In addition, personality traits were also not found to be directly associated with RTC involvement - those who had been involved in an RTC reported greater levels of speeding and violations. This view is borne out

by Dahlen et al. (2012) who found partial SEM support for a model in which the Big Five personality factors, coupled with driving anger predicted aggressive driving, which, in turn, predicted road traffic collisions. Indeed, contrary to expectations, personality variables accounted for 36% of the variance in aggressive driving behaviours. On the other hand, Sârbescu & Maricuţoiu (2019) did not report any associations between any of the Big 5 personality traits and violations (as measured by the DBQ), although, excepting agreeableness, all personality factors were related to at least one dangerous driving behaviour - particularly that of extraversion and aggressive driving. This may be due, in part to the separate measure used to explicitly measure driving anger (DAZ; Deffenbacher et al., 2002) which may have been more sensitive to anger-based violations. The error dimension of the DBQ was linked with personality, specifically, a negative association between errors and trait openness.

Ge et al. (2014) used personality scales acknowledged as being related to driving safety in China, namely anger, sensation seeking, altruism, and normlessness with the Dula Dangerous Driving Index (DDDI). The DDDI encompasses four sub-categories, negative/cognitive emotional driving (NCED), aggressive driving (AD), risky driving (RD), and drunk driving (DD). Sensation seeking was a significant predictor of all sub- categories of the DDDI, as well as the scale overall. Anger was a significant predictor of NCED (β = 0.281), AD (β = 0.235), RD (β = 0.145) and the scale overall (β = 0.249). Those high in altruism, on the other hand were less likely to engage with AD (β = -0.178) and DD (β = -0.167). Likewise, Shen et al. (2018) measured the influence of both positive and negative personality traits on aggressive driving behaviour using the prosocial and aggressive driving inventory. Congruent with the findings of Ge et al. individuals high in altruism exhibited more pro-social driving behaviours (β = .451), whilst those high in sensation seeking presented more aggressive driving behaviours (β = .311). Poó and Ledesma (2013) revealed positive correlations between the impulsive sensation seeking trait and dissociative driving styles, and Lucidi et al. (2014) who found a direct effect of sensation seeking on violations (β = .023). In line with other findings, positive correlations were observed by Poó and Ledesma between the aggression- hostility personality trait and risky, angry driving styles, as well as positive correlations between neurotic-angry personality and anxious and dissociative driving styles. Hostility was also found to predict both lapses and errors, as measured by the DBQ

(Lucidi et al.). Similarly, Wang et al. (2018) found that risky style, angry- high-velocity style, and anxious style were all positively associated with dangerous driving behaviours. In addition, Wang et al. found that three styles of driving, namely risky style, angry- high-velocity style, and anxious style were all positively associated with dangerous driving behaviours. Meanwhile, careful style was positively associated with positive driving behaviours and negatively correlated with dangerous driving behaviours. In addition, the same three driving styles correlated positively with the personality traits previously acknowledged as having negative effects on driving, such as neuroticism and extraversion. Conversely, the three styles were negatively correlated with conscientiousness and agreeableness in general.

Finally, two studies focused directly on speeding behaviour and personality. Campbell et al. (2013) found that, in line with the broader literature, younger, male drivers were more likely (by around 3-4 times) to speed than their older, female counterparts. Interestingly, however, when factors such as poor driving skill, opportunity/temptation to speed, being less influenced by disapproval of speeding by others were covaried, they were better predictors of propensity to speed than either age or sex. Conversely, Griffin and Cass (2010) report lower levels of conformity to the expectations of others led to greater compliance with the speed limit.

2.4.3 Emotion and Driving

2.4.3.1 Demographics

Ten studies reported age range, which was between 16 and 80 years, whilst the remaining four gave a mean age. Gender was reported in all studies, with male drivers comprising the majority of the sample. Seven studies gave mean years of driving experience/number of years licence held, whilst another three reported annual mileage (see Table 2.6).

2.4.3.2 Emotion and Driving

Emotion and driving research appears to use more simulator/experimental methodology than other driving research, perceivably due to the need to induce real-time emotions for the

purposes of measurement. Seven of the included studies used simulator methodology to examine the role of affective states in driving. Jeon et al. (2014), identified specific affective effects (anger, fear, happiness or neutral) on three different road conditions (easy, highway driving without any turn; medium, included a tunnel, obstacles and lane changes and hard, which included reduced visibility, fog and snow). Induced anger showed negative effects on subjective safety level and led to degraded driving performance in comparison to neutral and fear. Relaxing positive affect, arousing positive affect, negative affect and neutral affect on risk-taking behaviour was examined by Ehrenfreund-Hager et al. (2017). Arousing positive affect and negative affect led to increased risky driving, whereas relaxed arousing affect moderated risk-taking. Similar to the aforementioned personality research, higher levels of self-esteem and sensation seeking were also related with higher levels of risk-taking in the simulated driving. Steinhauser et al. (2018) investigated how positive and negative emotions impact driving behaviour, and which of these effects is related to emotional effects on attention. States of anger, happiness and calm were induced by way of a combination of autobiographical imagination and music in a driving simulator. Congruent with other research, emotions were found to be changed directly – for example, anger promoting aggressive driving, speed being higher in the angry condition (M = 1.00km/hr, SE = 0.02km/hr) than in the calm condition (M = 0.87 km/hr, SE = 0.02km/hr). In addition, driving behaviour was changed indirectly by altering attentional effects on driving (similar to the cognitive overload effect found in the highly anxious driver). Abdu et al. (2012) empirically examined situational anger and driving choices. Participants drove twice in a simulator following one of two emotion inductions, angry and neutral. Anger induction led to drivers crossing more yellow traffic lights (n^2 = .43) and tended to drive faster, although, unlike the findings of Steinhauser, speed was not significantly impacted by anger. Driving skill, as measured by the ability to avoid a collision when faced with a car cutting in, or a pedestrian stepping into the road was also not affected by situational anger. Stephens and Groeger (2011) used physiological (heart rate) and subjective ratings of anger with driving simulation. Anger was induced by way of enforced following, in which drivers are forced to follow a lead vehicle in which firstly, the driver maintained inconsistent, slower driving speeds and lane positioning, secondly, the lead driver replicated speed and lane position of the participant, and finally, the lead driver drives consistently below the speed limit. Time pressure was induced using a dash-board mounted stopwatch counting down the time

participants were told the drive should take to complete. Participants then completed a second 'general drive' in which three types of hazard (familiar, as in used in the first simulation, and unfamiliar, such as oncoming vehicle events and jaywalking pedestrians). The general drive was used to examine any 'spillover' impact of anger on driving behaviour. Results demonstrated a negative relationship between anger, mood and driving behaviour, in that higher anger led to degraded mood and driving practice, such as increased speed and aberrant lane position. From a physiological perspective, heart rate monitoring revealed increased arousal rates during the impediment task, as well as a cumulative effect of time pressure across the conditions. Interestingly, these effects carried over into the subsequent drive – even to driving situations which bore no resemblance to the situations in which the provocation occurred, drivers previously impeded attempting more dangerous overtaking manoeuvres and approaching hazards with less caution and recording higher arousal rates as measured by heart rate. A more recent simulator study conducted by Roidl et al. (2014) found similar effects in terms of emotion 'spillover' with anger leading to stronger acceleration ($\beta = 0.22$) and elevated speed ($\beta = 0.31$) some 2km beyond the emotion-eliciting event. Two states of affect - emotion and mood were explored in relation to driving in an experimental study using a combination of video clips and questionnaires (Hu et al., 2013). Participants watched one of four video clips (traffic related negative, traffic-unrelated negative, positive and neutral) and different emotions were induced. Negative emotion significantly elevated drivers' risk perception, but such perception failed to develop an appropriate attitude for drivers. A more favourable risk attitude resulted in increased reports of speeding. Mood states invoked similar reactions, with negative mood affecting drivers' risk driving behaviour through risk perception as well as risk attitude.

The questionnaire data is largely similar to the simulator data; of the eight studies included in the current review, all associated negative emotions (such as anger) with negative driving outcomes (such as aggressive driving). Nesbit and Conger (2012) used a sample of participants self-reporting either high or low levels of overall driving aggression. Perhaps predictably, more individuals in the higher aggression group disclosed an issue with anger whilst driving, based on odds ratios, 2.88 times higher than those reporting lower levels of aggressive driving. In terms of aggressive acts themselves, 94.7% of the high aggression group reported arguing with a passenger when driving, 73.7% reported arguing with another

driver, 63.6% has injured someone else in the vehicle whilst involved in an act of driving aggression, 56.6% purposefully damaged another vehicle, 54.3% had injured themselves when engaging in an act of aggression, and 54.3% had physically aggressed toward another driver. These self-reported behaviours map onto driving outcomes, 63.2% had received at least one speeding ticket, and 72.2% had been involved in at least one vehicle collision. The difference in driving outcomes was statistically significant between the two groups ($\chi^2(1) = 10.84$, $p = .001$). Further, group membership (high aggression vs low aggression) was evaluated using discriminant function analysis and predictors from the scales used (see Table 5) in addition with driving frequency, as the two groups differed in terms of their driving frequency (high aggression, nearly every day; low aggression 2-3 times per week). Group membership was found to be significantly predicted by the model, which explained 97% of the variance in high versus low driver aggression. Staying with aggression, negative affect was found to be significantly associated with aggressive driving in younger drivers ($M = 19$ years; Ellwanger & Pratt, 2012), whilst Bernstien et al. (2019) report greater symptoms of emotional distress (as measured by the HADS scale; see Table 2.5) were associated with greater aberrant driving behaviours in older adults ($M = 62.6$ years) (as measured by the DBQ; see Table 2.5). Specifically, individuals reporting greater suicidality and changes in appetite reported higher tendencies toward errors whilst driving, whilst those with higher levels of ill-temper and appetite loss reported higher propensities toward driving violations. Anger, hostility, nervousness and upset were associated with aggressive driving in a survey of Slovak and Czech drivers. The researchers also investigated trait 'forgiveness', finding it inversely related to aggressive driving during situations of frustration and provocation, although those lower in trait forgiveness also demonstrated higher propensity toward aggressive driving.

Wu et al. (2018) surveyed the reactions of Chinese drivers when encountering anger-provoking situations, such as congestion, pedestrians crossing the street illegally, being flashed by the high beams of cars travelling in the opposite direction and being impeded by the car in front driving slowly. Participants reported being 'angry but tolerant' in the face of aberrant overtaking, 71% did not become angry when pedestrians crossed the street illegally, however being flashed by high beams was an anger inducing event for 51.3%, 34.1% of whom turn on their own high beams to 'fight back' (this being reminiscent of Scott-Parker et

al.'s (2018) qualitative research, in which participants describe deliberately driving in an intimidating manner as a result of others' perceived driving discourtesy). Indeed, 53% of participants reported honking or flashing lights to prompt drivers who moved off too slowly following a green light or drive too slowly. Ellwanger and Pratt (2012) Negative affect was found to be significantly associated with aggressive driving (Ellwanger & Pratt, 2012; Kovácsová et al., 2016). Friman et al. (2017) investigated the impact of travel on emotional well-being and life satisfaction. Active modes of travel (cycling and walking) were found to have a more positive effect than passive modes (driving or public transport) on life satisfaction, emotional well-being and overall satisfaction with daily travel, although travel by car was more satisfying than travel by public transport; the latter effect explained in the context of public transport infrastructure in Sweden. Finally, emotional intelligence, understood as recognition and expression of emotion was assessed in the remit of risky driving behaviour (as measured by the BDDS and DDDI; see Table 2.5). Regression analyses indicated a positive relationship between risky driving and greater emotion recognition and expression, as well as younger age (R^2 = 7.3%), although the effect size was relatively small. That said, such findings point to the import of including a measure of emotional intelligence when examining risky driving behaviour, particularly in younger drivers.

2.4.4 Commuting and Driving Itself on Well-being

2.4.4.1 Demographics

All studies reported either average or mean ages (18-65) and gender split, which was predominantly female. One study described the licence status of participants, as well as the number of unwanted driving incidences, two the number of years licence held (see Table 3.7).

2.4.4.2 Commuting, Driving and Well-being

Three studies explored the impact of driving itself on well-being. The first (Ettema et al., 2013) measured satisfaction with travel in car drivers on specific routes in The Netherlands. Regression analyses carried out with three dimensions of the satisfaction with travel scale (STS; Ettema et al.) suggest that a variety of factors impact STS in drivers. Namely, positive activation during travel is positively affected by lower trip frequency, experienced traffic safety, not being annoyed by other road users, and the trip being less

tiring. In terms of sex differences, males were found to have higher levels of positive de-activation than females. The second study measured life-satisfaction, well-being and safe driving behaviour in undergraduate students (Isler & Newland, 2017). Results indicate that high levels of happiness relating to well-being and life satisfaction enable pro-social and adaptive behaviour, seemingly safeguarding drivers against engaging in deliberate traffic violations. Third, Bowen and Smith (2019) also examined well-being and driving in undergraduate students. Hierarchical multiple regressions revealed that poor driving behaviour (as measured by the DBQ; see Table 6) predicted negative appraisal, whereas more pro-social driving behaviour was predictive of positive well-being and appraisal. These effects remained significant even when established predictors of well-being were co-varied. Three investigated the effects of the daily commute by car and driving. The first two (Burdett et al., 2016; 2018) explored the potential impact of 'mind wandering' during the daily commute. Given the perceived familiarity of this type of driving in terms of timing and route, it would be reasonable to anticipate some form of combination of conscious and unconscious processes. In the first study, self-reported mind wandering was examined according to driver demographics, cognitive traits, the state of the driver (e.g. feeling stressed or fatigued), route familiarity and scores on the DBQ (see Table 6). Mind wandering was found to be most likely when the route was familiar, or the driver was fatigued. In addition, more driving lapses and violations were reported by those whose mind wandered more frequently. In terms of demographics, mind wandering was more prevalent in younger drivers. The second study used a catch-probe descriptive experience sampling procedure, thought samples were compiled in terms of whether they related to the driving being undertaken or not. Mind wandering was found to be a reasonably wide-spread phenomenon, with 63% of participants reporting mind wandering. That said, in instances whereby the driving task required effortful attention, mind wandering is immediately interrupted. Finally, psychological stressors created in a work environment were examined for their impact on drivers during the daily commute (Turgeman-Lupo & Biron, 2017). Issues with work-life balance and so called 'abusive supervision' (categorised as subordinates' perceptions of hostility in supervisors' verbal and non-verbal behaviours) were found to be positively associated with unsafe commuting behaviour.

2.4.5 Job Characteristics and Driving

2.4.5.1. Demographics

Both studies reported either mean age or age ranges. One study gave details of the length of the post-work commute (see Table 3.8).

2.4.5.2 Job characteristics and driving

Calderwood and Ackerman (2019) addressed the knowledge gap in terms of validated methodology to connect subjective self-report variables to objective driving performance in a naturalistic driving environment. Samples of daily experiences and objective recordings were collected and a multilevel methodology applied to evaluate a model in which daily hindering and challenging components of work stress, psychological distress and negative affect experienced at the end of the working day influenced objectively monitored unsafe driving behaviours during the commute. Findings demonstrated a lowered propensity toward unsafe driving during the post-work commute in individuals who had encountered more challenge stressors during the working day (odds ratio = .63). Conversely, employees exposed to heightened negative affective spill over were more likely to drive unsafely during their post-work commute (odds ratio = 1.96). Using survey methodology, Bowen & Smith (2019) assessed the potential impact of job characteristics and appraisals (the former using the Demands, Resources and Individual Effects Model; DRIVE, Mark & Smith, 2008) and driving outcomes, namely fatigue, risk-taking, driving behaviour and road traffic collision involvement. The results of logistic regression modelling indicate that job characteristics played a part in all outcomes. Increased numbers of road traffic collisions were associated with job with high levels of noise and pressure, with long working hours and lower levels of respect. Degraded levels of driving behaviour were associated jobs in which perceived stress levels (β =.218) and working hours (β = .118) are high, employees have less control over decision making (β = .199) who experience high work/life balance problems (β = .384) Risk-taking was associated with those earning higher salaries (β = .508), with demanding (β = .288), stressful (β = .339) jobs with long working hours (β = .256) who have higher levels of choice (β = .134) and decision making (β = .364) at work. Driver fatigue was predicted by high levels of stress (β = .265) and pressure (β = .256) in the workplace, exposure to high noise levels (β = .214) and lower levels of overall job satisfaction (β = 698).

Table 2.4

Studies on Stress/Anxiety and Driving (in alphabetical order of first author surname)

Authors (year), Title, Location	**Sample**	**Methods**	**Measures**	**Results**	**MMAT Score/Dimension not met (if applicable)**
Clapp et al. (2011) Factors contributing to anxious driving behaviour: The role of stress history and accident severity. USA	317 undergraduate drivers involved in at least 1 RTC. 52.4% male; Mean age = 19.5 Mean attempts to complete driving exam = 1.2 Mean number of collisions = 1.8	Questionnaires	Accident severity: Modified interview developed by Blanchard and Hickling (2004) Life Events Checklist (LEC; Blake et al., 1990) DBS	Unique associations found between accident distress and anxious behaviour (across three domains) only in those reporting more severe life stress.	3 Unrepresentative Sample

Dogan et al. (2019) Evaluation of driver stress level with survey, galvanic skin response sensor data, and force-sensing data. Turkey	38 randomly selected drivers; 50% female; Age range 20-25 (52,6%) 34.2% with 2-5 years' driving experience	Questionnaire and physiological (galvanic skin response) in prototype electric car to collect data during differing driving experiences	Questionnaire: 24 questions categorized into 6 groups of stress questions (e.g. driving while feeling upset due to reasons that are not related to driving) Group 1 = stress of driving on unknown road Group 2 = stress level of a long drive and driving disturbance Group 3 = stress level of driving on a road that requires attention and uncomfortable driving status Group 4 = stress level of sleepy driving and driving with a negative lighting factor Group 5 = stress level of fragile goods transport and driving after stressful work	Females overall more stressed than males, drivers with <2 yrs driving experience most stressed drivers, whereas those with ~10-15 yrs experience the least stressed. Frequency of driving also a factor; daily drivers < stressed, once a week drivers > stressed.	3 Unrepresentative Sample

			Group 6 = stress level of driving at a lower speed with respect to the legal limit. Galvanic skin response sensor (GSR)		
Dorantes-Argandar et al. (2016) Measuring situations that stress Mexicans when driving. Mexico	103 drivers; 52.4% female; Mean age = 33.6 ± 12.3	Survey	Questionnaire: Inventory of stressful situations in traffic	Violent drivers and a lack of respect for social rules are the most stressful elements of the context in which drivers are immersed. No differences in stress levels across sex or age groups were found.	4
Dula et al. (2010) Examining relationships between anxiety and dangerous driving.	1121 students; 67.4% female; Mean age = 21.3 ± 5.6 Age range 17-55	Online Survey	Questionnaires: Beck anxiety inventory	Higher levels of anxiety associated with greater levels of dangerous driving (independent of sex)	3 Unrepresentative Sample

USA			Propensity for angry driving scale DDI		
Hempel et al. (2017) Scared behind the wheel: what impact does driving anxiety have on the health and well-being of young older adults? New Zealand	Equal probability sampling & random selection to select two nationally representative subsamples (general population & exclusively Maōri population; 2743 participants; Age range = 55-70	Longitudinal Surveys	Questionnaires: New Zealand population census. Medical outcomes study. Short form driving anxiety (x1 question)	HMR's revealed driving anxiety associated with poorer mental and physical health, as well as lower quality of life. Women more likely	4

				to experience driving anxiety than men.	
Shahar (2010) Self- reported driving behaviours as a function of trait anxiety. Israel	120 male participants; Mean age = 32.21 ±7.02; Age range = 22-50	Driving Surveys	Questionnaires: State trait anxiety inventory DBQ	Riskier driving behaviour among highly anxious individuals potentially due to cognitive overload	3 Sample characteristics
Scott-Parker et al. (2018) A qualitative exploration of driving stress and driving discourtesy. Australia	38 drivers; 20 female; Age range = 26-40	Focus groups	Semi-structured interviews	Three themes were extracted via content analysis: driving context, other road users, and the self as a road user.	3 Potential researcher influence via interactions with participants

Rowden et al. (2011) The relative impact of work-related stress, life stress and driving environment stress on driving outcomes. Australia	247 participants; Mean age 45.7; Age range = 22 – 69 77.7% male	Questionnaires	Job-Related Tension Scale (JRTS; Khan et al., 1964) Driver Stress Inventory (DSI; Matthews et al., 1997) DBQ General Health Questionnaire – 12 (GHQ - 12; Goldberg & Blackwell, 1970)	Stress, mental health and daily hassles correlated with DBQ.SEM indicated that driver stress negative affect factor influenced both lapses *and* errors, whereas driver stress risk-taking was the strongest influence on violations.	3 Response rate 28.6%
Wong et al. (2015) Driven by distraction: investigating the effects of anxiety on driving performance using the attentional control theory.	75 drivers; 53 female; Mean age = 24.45 ± 7.8;	Questionnaires / experiments	Questionnaires: State-trait anxiety inventory	Trait anxiety found to predict poor DB.	3 Unrepresentative Sample

	Age range = 17-47			
			DBQ	
			Experimental measures:	
			PGNG	
Australia				
			n-back task	

Note. HMRs = Hierarchical multiple regression; SEM = Structural equation modelling

Table 2.5

Studies on Driving and Personality (In Alphabetical Order Of First Author Surname)

Authors (year), Title, Location	Sample	Methods	Measures	Results	MMAT Score/Dimension not met (if applicable)
Atombou et al. (2017) Personality, socioeconomic status, attitude, intention and risky driving behaviour. Ghana	278 licensed drivers; 78.5% male; Annual mean mileage = 11,936 km ± 8,937km; Mean number of accidents= 2.26 ± 2.22	Surveys	Questionnaires: International personality item pool Attitude and intention Risky driving behaviour Socioeconomic status	Structural equation modelling suggested that personality variables significantly and positively influence intention and attitude toward speeding, with normlessness directly and positively influencing risky driving. Mediation analyses show that intention mediated the effects of personality variables on risky driving.	4

Bowen & Smith (2019) Associations between job characteristics, mental health and driving: A secondary analysis UK	2856 clients of an insurance company; 68% female; Mean age = 34; Age range = 18-74	Online Survey	Job characteristics/appraisal International Personality Item Pool (IPIP; Goldberg, 1999) Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) Risk-taking and RTC involvement DBQ	Logistic regression models indicate low levels of conscientiousness and agreeableness and high levels of neuroticism associated with poor driving behaviour. High levels of openness and extraversion, low levels of conscientiousness were associated with risk-taking behaviour.	4

Campbell et al. (2013) Not so fast! An investigation of the real-world speeding behaviours and underlying attitudes USA	88 drivers; 42 female; Age range 18-55	GPS data Questionnaires	GPS comparing driver speed with legal speed limit DBQ Theory of Planned Behaviour Risky Driving Questionnaire (DeJoy, 1992)	Male drivers more likely to speed than female drivers. Younger drivers more likely to speed than older drivers. However, factors such as poor driving skill, speeding when the temptation/opportunity to speed, being less influenced by the disapproval of others toward speeding were strongly associated with speeding behaviour and were in the main better predictors of speeding than either age or sex.	3 Unrepresentative Sample

Dahlen et al. (2012) Taking a look behind the wheel: An investigation into the personality predictors of aggressive driving. Australia	308 drivers whilst visiting the Office of Motor Vehicles (OMV); Mean age = 37.89 ± 14.47; 178 females; Average number of years driving = 21.08 ± 14.32	Surveys	Driving Anger Scale (DAS; Deffenbacher et al., 1994) IPIP Driving Anger Expression Inventory (DAX; Deffenbacher et al., 2002) Driving Outcomes (Arthur & Doverspike, 1992)	Partial support was evidenced for driving anger and personality traits as predictive of aggressive driving. Further, SEM results show agreeableness and driving anger as contributory to aggressive driving. Overall, personality variables accounted for 36% of the variance in aggressive driving behaviours.	4
Endriulaitienė et al. (2018) Attitudes toward risky driving and Dark Triad personality	Convenience sample of 475 driving licence candidates; 187 male; Mean age = 23.8 ±	Online survey	Questionnaires: Scale of risk-taking attitudes to driving	Dark personality traits (Machiavellianism, narcissism and psychopathy) are significantly related to riskier driving attitudes (drunk	4

traits in a group of learner drivers. Lithuania	8.06 years Age range = 17-58 years		Short dark triad scale	driving, joyriding, violations of road rules).	
Ge et al. (2014) The effect of stress and personality on dangerous driving behaviour among Chinese drivers. China	242 drivers recruited from local communities, train stations, the Commodity Wholesale Market Center and the Institute of Psychology, Chinese Academy of sciences. Mean age = 35.75 ± 8.08 years	Surveys	DDDI Perceived Stress Scale Personality Scale derived from the International Personality Item Pool (IPIP) adapted to reflect driving safety in China	Perceived stress and sensation seeking were significantly correlated with four subcategories of dangerous driving behaviour; anger was positively correlated with negative cognitive/emotional driving, aggressive driving, and risky driving, whereas altruism negatively correlated with aggressive and drunk driving. HMRs revealed anger mediated the relationship between stress and dangerous driving behaviour.	3 Unrepresentative Sample

Griffin & Cass (2010) An exploration of personality and speed limit compliance Australia	558 participants; Age range 18-67; 66% female	Surveys	Social Responsibility Scale (SRS; Berkowitz & Lutterman, 1968) Internal-External Control Scale (O'Cass, 2004) Consideration of Future Consequences (Strathman et al., 1994) Consumer Susceptibility to Interpersonal Influence (CSII; Bearden et al. (1989) Risk-Aversion (Dählback, 1990) Social issue involvement (Mittal, 1995)	Forty percent of participants reported travelling over the speed limit 'most of the time'. Speed limit compliance was not connected with perceived control, nor susceptibility to normative influence, however risk aversion and consideration of future consequences were positively connected with speed limit compliance. Lower concern to conforming to the expectations of others led to greater propensity to comply with the speed limit.	3 Unrepresentative Sample

Lucidi et al. (2014) Personality and attitudes as predictors of risky driving among older adults. Italy	485 convenience sample drivers; Older and active – Age range 60-90 Mean age = 68.1 ± 6.2; 61.2% male; Mean years holding a drivers' licence = 48.3 ± 8.8 60.2% drive daily 7.5% involved in at least 1 RTC in the last year; 27.3% received at least 1 ticket in the last year	Surveys	Neo-Personality Inventory-Revised (Costa & McCrae, 1992) Attitudes toward traffic safety (Iversen & Rundmo, 2004) DBQ Crash involvement and traffic law violations	SEM analysis of latent variables showed more positive attitudes toward traffic rules were predicted by higher levels of anxiety, low levels of hostility and normlessness. Positive attitudes negatively related to violations, lapses and errors. Direct effects of personality were apparent, with sensation seeking predicting violations, and hostility predicting both lapses and errors. Anxiety covaried positively with hostility and altruism, and negatively with sensation seeking.	4

Poó & Ledesma (2013) A study on the relationship between personality and driving styles. Argentina	Nonprobablistic sample of 908 drivers from the general population; 57% male;	Surveys	Questionnaires : Multidimensional driving style inventory	Positive correlations between impulsive, sensation seeking personality and risky, angry and dissociative positively correlated with conscientiousness and agreeableness.	4

Table 2.6

*Studies on Driving and Emotion (In Alphabetical Order **o**f First Author Surname)*

Authors (year), Title, Location	**Sample**	**Methods**	**Measures**	**Results**	**MMAT Score/Dimension not met (if applicable)**
Abdu et al. (2012) Situational (state) anger and driving. Israel	15 male drivers; Age range = 22-27; 4-9 years driving experience	Simulator Mood induction	Mood check Simulator data; average speed, number of collisions, number of pedestrians hit, number of yellow light crossing (risky driving behaviour)	Following anger induction, drivers crossed more yellow traffic lights and tended to drive faster (although the latter effect was not statistically significant) Performance on emergency measures unaffected by anger.	3 Unrepresentative Sample

Bernstein et al. (2019) Associations between emotional symptoms and self-reported aberrant driving behaviours in older adults. USA	341 older adults; Mean age = 62.6 ± 4.8; 66.6% female; age range 55-80	Survey	DBQ Inventory of Depression and Anxiety Symptoms (IDAS II; Watson et al., 2012)	Multiple regression analyses showed that greater symptoms of emotional distress were associated with greater aberrant driving behaviours. Emotional well-being not associated with aberrant driving behaviours. Follow up regressions indicate greater suicidality, appetite gain/loss, panic and ill-temper significantly associated with aberrant driving.	3 Unrepresentative Sample

				Greater suicidality and appetite loss was apparent in errors; high levels of ill-temper and appetite loss was apparent in violations.	
Eherenfreund-Hager et al. (2017) The effect of positive and negative emotions on young drivers: A simulator study. Israel	80 drivers; 40 male; Mean age = 19.2 ± 0.75 Age range = 18-21	Simulator study	Simulator tasks: Driving simulator STISIM drive Affect priming Questionnaires:	Exposure to words arousing positive or negative affect led to more risky driving, while exposure to words arousing relaxing positive affect reduced risk-taking on the road.	3 Unrepresentative Sample

			Relevance of driving to self-esteem Sensation seeking scale Driving history questionnaire		
Ellwanger & Pratt (2014) Self-control, negative affect, and young driver aggression: An assessment of competing theoretical claims. USA	Stratified probability sample of drivers; *N* = 365; 156 males; Mean age = 19 Age range = 16-24 years	Survey	Questionnaires: Driving practices scale Self-control Strain measure Driving questionnaire	Self-control and negative affect exert significant direct effects on driving aggression.	4

Friman et al. (2017) How does travel affect emotional well-being and life satisfaction? Sweden	367 drivers; 62.7% female; Mean age = 41.0 ± 12.0; 28.1% use car as main mode of transport	Survey	Emotional well-being (Västfjäll et al., 2002) Satisfaction with Travel (STS; Ettema et al., 2011) Satisfaction with Life Scale (SWLS; Deiner et al., 1985)	Direct and indirect effects of travel satisfaction on life satisfaction and emotional well-being as analysed with PLS-SEM revealed that satisfaction with daily travel directly impacts emotional well-being and both directly and indirectly, life satisfaction. Driving and active modes (e.g. cycling) have more positive effects than public transport.	3 Response rate (9%)

Hayley et al. (2017) Emotional intelligence and risky driving behaviour in adults. Australia	179 drivers; 55% male; Mean age = 29.85 ± 11.46; Age range = 18-64	Online survey	Brief distracted driving scale (BDDS; Eastman, 2013) DDDI Swinbourne University Emotional Intelligence Test (SUEIT; Palmer & Stough, 2001)	Regression analyses revealed that risky driving was associated with greater levels of emotional recognition and expression, and lower age. The negative emotions subscale of the DDDI was significantly predicted by emotional control and age. Mediation modelling demonstrated a significant indirect effect of age through emotional control.	4

Hu et al. (2013) Negative or positive? The effect of emotion and mood on risky driving. China	218 drivers; 93.6% male; Mean age = 34 ± 7.70 years Age range = 20-56 Mean years driving experience = 7.33 ± 5.46	Experimental; Video clips Negative/positive emotion induction	Emotion Risky driving behaviour Driving risk attitude scale Driving risk perception	Negative emotion significantly elevated drivers' risk perception but such perception failed to develop an appropriate attitude for drivers.	4

Jeon et al. (2014) Effects of specific emotions on subjective judgement, driving performance, and perceived workload. USA	70 undergraduate psychology students; 33 male; Mean age = 20.3 ± 2.2 Mean years of driving experience = 4.7 ± 2.4	Simulator study	Simulator road conditions with induced affective states: anger, fear, happiness, neutral. NASA TLX (Hart et al., 2006) measuring perceived workload for the overall driving task while under an induced affective state. Subjective judgement of: driving confidence, risk perception and affect safety level Driving errors: lane keeping, traffic rules, aggressive driving, collision when driving.	Induced anger showed negative effects on subjective safety level and led to degraded driving performance in comparison to neutral and fear. Fear yielded no significant effect on driving performance. Happiness also showed degraded performance in comparison to neutral and fear.	3 Unrepresentative Sample

Kovácsová et al. (2016) Aggression on the road: Relationships between dysfunctional impulsivity, forgiveness, negative emotions, and aggressive driving. Slovakia	578 drivers; 37.2% female; Mean age = 32.8 ± 11.4 Annual mileage = 18,598 km Driving licence held (in years) = 13.2 ± 10.2	Online survey	Scenarios portraying examples of aggressive driving Questionnaires: Dickman impulsivity inventory Forgiveness scale Driving background	Negative affect (anger, hostility, nervousness and upset) was associated with aggressive driving.	4
Nesbit & Conger (2012) Predicting aggressive driving behaviour from anger and negative cognitions.	One hundred and thirty undergraduate psychology students; selected based on responses to the Driving anger scale.Higher aggression group *n* = 57, lower aggression group *n* = 73. Mean age = 18.85 ± .99 Mean years driving = 3.64 years ± 1.02	Survey	Driver aggression subscale of the Driving Anger Scale (Deffenbacher et al. 1994) Number of RTCs and speeding tickets	Drivers higher in aggression demonstrate differing patterns of affective experience, problematic cognitive tendencies and negative outcomes than those with lower levels of aggression.	3 Unrepresentative Sample

USA	68% female; 45% in the higher aggression group	Trait Anger Scale (TAS; Speilberger, 1999) Anger Expression Scale (AXEX; Speilberger, 1983) Driving Angry Thoughts Questionnaire (DATQ; Deffenbacher et al., 2000) Hostile Angry Thoughts scale (HAT; Snyder et al., 1997) Modified Dysfunctional Attitudes Scale (DYS; Calhoon, 1996)

Roidl et al. (2014) Emotional states of drivers and the impact of speed, acceleration and traffic violations – A simulator study Germany	Seventy-nine drivers; 61% female; Mean age = 23.54 ± 4.21; Age range = 18-43; Average mileage = 7130 km/year ± 8870	Simulation	Simulation of differing driving scenarios DAS State Trait Anxiety Inventory Driving behaviour in simulator: mean speed, acceleration and braking; speeding behaviour and potential driving violation.	Anger leads to stronger acceleration and higher speeds even 2km after the emotion inducing event. Anxiety and contempt demonstrated similar but weaker effects, however the pattern in terms of negative and dangerous driving was the same as that of anger. Fright correlated with lower speeds (directly following a critical event) and stronger braking momentum	4
Steinhauser et al. (2018) Effects of emotions on driving behaviour.	73 drivers; 46 female; Mean age = 42.6 ± 12.8	Simulator study	Emotion induction, combining autobiographical imagination and affective music.	Emotions were found to change behaviour in two ways: directly, by promoting aggressive driving or indirectly, by altering attentional effects on	3 Unrepresentative Sample

	Age range = 18-65		Driving simulation	driving.	
Germany					
Stephens & Groeger (2011) Anger-congruent behaviour transfers across driving situations UK	Ninety-six drivers; 48 males; Mean age = 22.44 ± 5.41; Age range = 18-65 Mean years licence held = 4.47± 4.76; Mean mileage = 4,956 miles/year ± 5,511	Simulator, physiological & questionnaire	Heart rate Driving simulator – measuring driving events as they occur in real time. Driver position, heading, speed and velocity, as well as other car-traffic interactions. Small web camera recorded verbal responses during driving task. Pre and post-drive Assessment of wellness questionnaire	Anger increased following simulated driving in which the driver was required to drive slower than usual (impediments such as slow moving vehicle introduced into the simulation). Mood and driving behaviour deteriorated in comparison with controls not subjected to the manipulation. These behavioural differences carried over into the subsequent drive in which no provocation was introduced. Drivers previously impeded later approached hazards with less caution and attempted more	4

			dangerous overtaking maneuvers.	
		DAS		
		Skill questionnaire		
		General Causality Orientation Scale (GCOS; Deci & Ryan, 1985)		
		State and Trait Anxiety Inventory (STAI; Speilberger et al., 1983)		
Wu et al. (2018) A questionnaire survey on road rage and anger-provoking	1400 drivers; 64.86% male; Age range = 18-60+; 38.71% >6 years driving experience	Online survey Reactions under anger-provoking situations	When encountering aberrant overtaking, 61.3% driver 'angry but tolerant'. Being flashed by high beams by driver in the opposite direction provoked an enraged	3 Limited information with regard to origin/validity of the measures used

situations in China	Measures to prevent road rage	response in 51.3% of drivers, 34.1% of whom turned on their own high beams to 'fight back'. 61.4% of participants were dissatisfied when the car ahead drives slowly, or fails to move when a traffic light turns green, 53% of whom honk or flash their lights to prompt the driver ahead. Novice drivers displayed a higher tolerance to such events than their more experienced counterparts.
China		71.5% of participants chose 'improve public transportation' as a means to reduce road rage.

Table 2.7

Studies Examining the Impact of Commuting and Driving on Well-Being (In Alphabetical Order Of First Author Surname)

Author (year), Title, Location	Sample	Methods	Measures	Results	MMAT Score/Dimension not met (if applicable
Bowen & Smith (2019) Drive better, feel better: Examining associations between well-being and driving behaviour in students. UK	224 undergraduate psychology students; Age range 18-24; 82.1% female	Survey	Student Well-being Questionnaire (WPQ; Williams et al., 2017) DBQ	HMRs revealed poor driving behaviour predicted negative well-being and appraisal, whereas more pro-social driving behaviour was predictive of positive well-being and appraisal. These effects remained significant when established predictors of well-being were covaried.	3 Unrepresentative Sample

Burdett et al. (2018) Inside the commuting driver's wandering mind. New Zealand	*N* = 11; 100% female; Age range = 28-48; Mean age = 40.6 ± 5.9 years.	Observation/probe-catch descriptive experience Questionnaire	Mindful attention scale Study specific questionnaire capturing pre and post-drive questions Observer probe questions	Drivers reported mind wandering on 63% of reports; actively focused on the driving task between 15-20% of samples. Mind wandering more common in familiar, undemanding situations, however this quickly changes when the driving task requires effortful attention.	3 Unrepresentative Sample

Burdett et al. (2016) Not all minds wander equally: The influence of traits, states and road environment factors on self-reported mind wandering during everyday driving New Zealand	502 participants; Mean age = 44.4 ± 14.0; Mean years licence held = 23.1 ± 15.3; 112 male	Questionnaire	Mindful Attention and Awareness Scale Cognitive Failures Questionnaires (CFQ; Broadbent et al., 1982) DBQ Mind wandering questions	Mind wandering most likely on familiar, rather than unfamiliar roads and when drivers were tired. Increased mind wandering associated with younger drivers, who reported less mindful attention in daily life, more cognitive failures and more violations and lapses.	3 Unrepresentative Sample

Ettema et al. (2013) The road to happiness: Measuring Dutch car drivers' satisfaction with travel. Sweden	256 drivers on specific highways in the Netherlands; 65.8% male; Age range = 18-65	Questionnaires	Questionnaires: Trip characteristics: duration/frequency of the trip, company during the trip, activities such as music, talking and whether a rest stop was undertaken Subjective evaluation of road condition Satisfaction with travel scale	Regression analyses suggest car drivers' satisfaction with travel was influenced by experienced traffic safety, annoyance with other road users, the journey being tiring, distraction by billboards and lack of freedom to choose speed and lane.	4
Isler & Newland (2017) Life satisfaction, well- being and safe driving behaviour in	160 undergraduate psychology students; Mean age = 25.1 ± 7.4; Age range = 18-63;95 females	Survey	Questionnaires: Driving history	Happiness orientations of meaning and engagement correlated negatively	3 Unrepresentative Sample

Table 2.8

Studies Examining the Impact of Job Characteristics on Driving (In Alphabetical Order of First Author Surname)

Bowen & Smith (2019) Associations between job characteristics, mental health and driving: A secondary analysis UK	2856 clients of an insurance company; 68% female; Mean age = 34; Age range = 18-74	Online Survey	Job characteristics/ appraisals (DRIVE; Mark & Smith, 2008) IPIP Hospital Anxiety and Depression Scale	Logistic regressions revealed associations between poor levels of driving behaviour and high levels of perceived job stress, long work hours, issues of work-life-balance and jobs which require high levels of	4

	(HADS; Zigmond & Snaith, 1983)	decision making.
	Risk-taking and RTC involvement	
	DBQ	
	Driver fatigue	

Calderwood & Ackerman (2019) Modeling intraindividual variation in unsafe driving in a naturalistic driving environment. US	50 participants; 76.2% female; average postwork commute = 32.96 min ± 29.66 min	Naturalistic Survey	Daily work stressors Abbreviated Perceived Stress Scale Positive and Negative Affect Schedule Expanded Form Unsafe driving; Green-road app (Greenroad 2017) used to quantify frequency of engagement in five categories of behaviour deemed	Employees less likely to drive unsafely during the postwork commute on days in which they encountered more challenge stressors at work. However, employees who experienced heightened negative affective spillover were more likely to drive unsafely during the postwork commute.	3 Unrepresentative Sample

	indicative of unsafe driving

2.5 Discussion

The present purpose was to provide a systematic review of the literature surrounding the well-being of SDP&C road users, given that no synthesis or critical appraisal of this research has been undertaken to date. The research questions guided the search terms used and papers included in the analyses, such that it would be possible to appraise to what extent the literature suggests well-being factors are associated with driving behaviour, aggressive driving, risky driving and road traffic collision involvement. In addition, the literature was analysed to gain an appreciation as to how far current research considers the impact of driving on the well-being of the SDP&C road user. All studies were assessed for methodological quality using the MMAT (Pluye et al., 2011) producing pleasing results, with all scoring highly using the pre-determined scale. This affords confidence in the methodological robustness of the research included.

Remaining with methodology, the vast majority of driving research is survey/questionnaire based, with researchers using a variety of scales with which to measure driving outcomes. The current review found that just over 33% of studies used the driver behaviour questionnaire (DBQ; Reason et al., 1990); with other scales, such as the Dula dangerous driving index (DDDI; Dula, 2003) only being used around 10% of the time. One reason for this may be that the DBQ offers empirical evidence that driving behaviour is governed by two psychologically distinct components: errors and violations. Errors reflect performance limits of the driver such as those related to attentional, perceptual and information processing abilities. Violations, on the other hand, represent the style in which the driver chooses to drive (referred to as driving behaviour) and includes actions such as indicating hostility to other drivers and speeding, often affected by driver mood. The DBQ is a well-researched measurement instrument used widely to assess aspects of driver behaviour that reflect human error, lapses, and deliberate risky actions. The DBQ has been used in a range of cultural settings and is sometimes used as one of many outcome measures in road safety interventions. The scale exhibits high levels of internal consistency and test-retest reliabilities between r=.65 and r=.75. Those papers which include consistency statistics largely agree, with alpha levels being between .7 and .8.

Results indicate that driving has a direct impact on stress levels of the driver; mainly due to drivers' heightened awareness of the dangers posed by poor driving by others (e.g.

aggressive driving). This was found to be of greater consequence than other factors such as road infrastructure and thus the predominant stressors were socially interactive in nature. Whilst it has often been acknowledged that younger, male drivers are typically proponents of anti-social driving practices (e.g. Starkey & Isler, 2016), interestingly, the socially interactive stressors were apparent regardless of sex or age (Dorantes-Argandar et al., 2016). The qualitative inquiry into driving stress gave rise to an alarming theme – that of driving discourtesy by others giving rise to a 'knee-jerk' reaction in drivers leading to engagement in risky behaviours, such as deliberately driving in an intimidating manner (Scott-Parker et al., 2018), this supported by the findings of Wu et al. (2018), whereby angry drivers reported turning on their own high beams in retaliation to vehicles with high beams travelling in the opposite direction. Potentially, the reaction of the driver in relation to perceived discourtesy works in the same way whether the reaction elicited is stress or anger. Experience and frequency of driving also play a part in the stress response of drivers, inexperienced drivers/those who drive infrequently displaying higher subjective stress responses, as well as higher physiological stress responses (as measured by galvanic skin response; Dogan et al., 2019). Moving from purely driving stress to extraneous stress and driving outcomes, Rowden et al. (2011) demonstrated that life stress and work stress are also of import in a driving context – poorer mental health and greater levels of daily hassles were implicated in driving errors, lapses and violations. In addition, work stress was also found to correlate with the three driving outcomes, suggestive of an 'overspill' effect of stress experienced in other contexts impacting driving behaviour.

Driving and personality has been reasonably extensively researched, with the included literature differing in terms of the conceptualisation of personality (e.g. some measure by way of attitudes and intentions, others the Big 5 International Personality Item Pool) and the driving outcomes, which vary from the propensity to speed, to aggressively drive, to driving behaviour as measured by the DBQ in terms of lapses, errors and violations. That said, the picture painted by the research is one of negative traits, behaviours and intentions translating to poorer driving outcomes, whether that be more aggressively driving, taking higher risks, speeding or higher levels of errors, lapses and violations. Put simply, negative personality traits tend toward negative driving behaviours/outcomes. Perhaps unsurprisingly, the more negative personality traits, such as those of the dark triad (Endriulaitienė et al., 2018) map onto riskier attitudes toward drunk driving, speeding and the violation of traffic rules.

Conversely, individuals high in altruistic personality traits, as well as the more conscientious driver correlate with more positive road safety behaviour (Bowen & Smith, 2019; Wang et al., 2018; Zhang, 2018). Two of the included studies focused on personality and speeding whilst driving, results suggesting that younger males are more likely to speed than older drivers, however, when other factors were covaried (such as opportunity/temptation to speed) the effect of age and gender was diminished (Campbell et al., 2013).

Certainly, trait sensation seeking appears to play a key role in driving behaviour, in that those with higher levels of sensation seeking appearing to engage more regularly with negative driving practice (Ge et al., 2014; Lucidi et al., 2014; Poó & Ledesma) Interestingly, findings are indicative of personality not being directly causal of collision involvement, rather, they are implicated with engagement in riskier driving practice (Bowen & Smith; Dahlen et al., 2012). This was recently highlighted in a meta-analysis conducted by Wåhlberg et al. (2017). The authors concluded that tests of personality are weak predictors of RTCs in comparison to other outcome variables, although findings in the current synthesis suggest that personality is still of importance when considering factors which give rise to collisions.

This review found that emotions are heavily implicated in driving behaviour, particularly that of anger, which was found across the board to induce poor decisions behind the wheel. The survey/questionnaire data is largely conclusive with driving simulator data, bringing together the subjective and the objective. Findings revealed a 'carryover' effect of anger, in that driving behaviour was altered in the angry individual even during different driving events, or several miles after the anger-inducing event (Roidl et al., 2014; Stephens & Groeger, 2011). Startlingly, drivers high in aggression report a multitude of negative behaviours when driving, such as physically aggressing toward another driver, and injuring a passenger when involved in an act of driving aggression (Wu et al., 2018). Furthermore, these behaviours map directly onto involvement in road traffic collisions. Along a similar vein, well-being was also found to be implicated in driving behaviour, perhaps most enlighteningly in that drivers higher in levels of well-being, displayed greater levels of pro-social driving (Bowen & Smith, 2019; Isler & Newland, 2017). Put simply, happier drivers engage less with driving violations, although caution should be used when interpreting these findings, given both were samples of undergraduate university students, who arguably do not represent the population as a whole.

An important part of any employees' day is that of the commute to and from work. Given the familiarity of the route, it would be reasonable to suggest that one's mind may wander when conscious attention to the road is not necessary. Burdett et al. (2016; 2018) explored the phenomenon of mind wandering whilst driving and found that as anticipated, most individuals report some form of this during the daily commute. Importantly, this was not found to influence safety behaviour, in that mind wandering was swiftly interrupted when the driving task required effortful attention. Similarly, employees spend a significant amount of time in the work environment, and thus it may be reasonable to consider the impact of the work environment on driving. Only two studies were sourced which considered job characteristics and their potential impact on driving behaviour. Bowen and Smith (2019) uncovered direct links between negative job characteristics/appraisals and subsequent driving behaviour, suggestive of the work environment playing a key part in the ways in which we drive. That said, Calderwood and Ackerman (2019), revealed that individuals who encountered high levels of challenge stressors during the working day were more likely to engage in safer driving practice – lending more support to the notion that challenging components of work stress may very well lead to positive employee outcomes (eustress, rather than distress).

The current review revealed a dearth of research based on UK drivers, this being problematic in terms of generalising findings to UK road users. Indeed, UK road infrastructure differs to that of Australia/The Netherlands (for example) and research on UK drivers is required to examine whether the effects discussed here are also observed in this population. The literature examining the impact of commuting, job characteristics/appraisals and driving itself on well-being is also scant. Given that most individuals who commute for employment spend a significant amount of time in the work environment, it is surprising that relatively little research explores the impact of this environment on driving. The research sourced during this review is suggestive of associations between the work environment and driving behaviour and, given that many road traffic collisions occur during the daily commute, it would be of distinct utility to examine these effects in further detail.

Whilst the research reviewed affords some insight into the research questions posed, it is useful to note the limitations of the studies discussed, as well as some limitations of the current systematic review, both of which form the basis of recommendations for future

research. In terms of the studies analysed, the findings are mainly consistent, however, it is important to bear in mind that a large proportion were self-report surveys, which can be problematic for a number of reasons. First, there is a possibility that the positive relationship between driving outcome scores and higher anxiety scores reflects the higher levels of self-criticism acknowledged as a facet of anxiety (Iancu et al., 2015). Second, self-report relies upon the ability of the individual to use insight, something not everyone is able to do well. Lastly, there is a risk of social desirability bias, which, although evidentially low on the DBQ (see Sullman & Taylor, 2010) there is still a possibility that responses do not match actual driving behaviour. Presumably, the use of driving simulator methodology may address this, although this is not always practical. It is suggested that as a minimum, survey-based studies ought to include a measurement of social desirability bias. Furthermore, many of the studies analysed did not adopt a multivariate approach to the research in order to ascertain whether the more novel variables, such as workplace environment were still present when established predictors of RTC involvement (such as fatigue) were considered. In this way, a more holistic picture of the predictors may emerge – after all, humans are complex and likely to possess a multitude of the factors currently discussed in the literature. Only one study was longitudinal, the rest being cross-sectional, which makes attribution of causality problematic.

In the present review, a limitation applies to the exclusion criteria used; only papers published in English were assessed, potentially discounting valuable research. In addition, the review of abstracts for inclusion (prior to full-text reading) may also be limiting – it is acknowledged that some journals allow only certain information to be included in the abstract and as such, some studies may have been unnecessarily rejected. It is suggested that future reviews of this nature are reviewed by multiple reviewers, and checks undertaken for abstracts written in English, such that a decision can be made as to whether they should be translated for potential inclusion. Furthermore, generalisability of the included studies may be an issue – much of the research used relatively homogenous samples.

In conclusion, the extant literature reveals a multitude of associations between well-being, personality and driving – all *human factors*, which may provide key insights into the ways in which drivers may be supported to achieve more positive safety behaviour on the

road. Specifically, what is needed is a longitudinal, multivariate approach to driving and well-being which controls for established predictors as well as introducing the variables discussed to ascertain in a rounded fashion what factors (both in combination and isolation) contribute to unsafe driving behaviour. In this way, it may be possible to continue the reduction of potentially fatal or life-threatening incidents achieved so far by safety improvements and driving legislation.

2.5.1 Concluding Summary

The present review yielded empirical literature connected to five themes, namely: driving and emotion, personality, job characteristics, commuting, and mental health.

Emotion, particularly anger is heavily implicated in poor driving outcomes, this effect 'carrying over' to other driving environments. Negative personality traits were found to map onto poor driving behaviour, although more positive traits and leanings toward altruism had a protective effect in terms of risky driving engagement. The way we feel about our employment also has a bearing on the way in which we drive, with negative job characteristics predicting risk taking and poor driving behaviour, although some research is suggestive of a challenge element in the workplace relating to safer driving behaviour. Mind wandering is a phenomenon occurring often during the commute to and from work, however attention is quickly diverted back to the driving task when required. Mental health, specifically anxiety and stress undeniably impact the driving experience. High levels of anxiety translate to higher road traffic collision incidence and riskier driving practice, whereas stress encountered in the driving environment, typically precipitated by discourtesy of others potentially leads to retaliatory behaviour. Finally, there appears to be a dearth of research examining when RTCs occur and whether there are any unique predictors for collisions depending on the type of driving being undertaken (e.g. commuting, leisure time etc).

2.6 Chapter Summary and Links to Chapter Three

The purpose of this chapter was to report a systematic review of the literature related to the personality and well-being of social, domestic, pleasure and commuting (SDP&C) car drivers.

The following databases were searched: PsychINFO (PsychNET), Scopus (Elsevier), Web of Science (Social Sciences Index; WoS), ORCA (Online research at Cardiff University), Science Direct (Elsevier), Taylor and Francis Online, and PubMed. Grey literature was sourced using the Transport Research International Database (TRID) as well as conference proceedings of the Human Factors and Ergonomics Society and Driver Assessment. In parallel, an internet search of Google Scholar was undertaken. Two researchers reviewed papers suitable for inclusion. Eligible papers were those published in the English language, during the last decade; the latter to allow for a more contemporary appraisal of the literature. The search yielded thirty peer reviewed articles and ten reports relevant to the personality and well-being of SDP&C road users.

The findings show that anxiety, stress and depression were predictive of unfavourable driving outcomes (e.g. risk-taking, aggression, poor driving behaviour.) Further, driving discourtesy by others was found to not only induce stress reactions in drivers, but also led to riskier driving practice, such as deliberately engaging in intimidating driving behaviour. Negative personality traits were related with negative driving behaviours, whilst higher levels of well-being and life satisfaction appear to safeguard drivers against deliberate driving violations. There was a dearth of literature focusing on UK drivers, research examining the impact of driving itself on the well-being of the driver as well as an understanding as to whether there are unique predictors for RTC involvement depending upon when the incident occurred.

Further longitudinal, multivariate research is required to examine all well-being/personality predictors, whilst controlling for established predictors (such as fatigue) such that the factors underpinning unsafe driving behaviour (in isolation and in combination) may be revealed. The following chapter details the methodological considerations addressed in the studies contained in this thesis undertaken to achieve this aim.

Chapter Three

Methodological Considerations

3.1 Overview of Chapter

As described in chapter one and two, there are three major objectives and a number of research questions addressed in this thesis. The first objective was to undertake multivariate research to examine novel well-being/personality predictors and job characteristics whilst controlling for established predictors (such as fatigue) for their potential associations with unsafe driving practices. The second objective was to ascertain whether such factors are subject to a cumulative effect – that is, whether the chances of adverse outcomes increase exponentially when drivers possess more than one predictor of the risk factors. Finally, a longitudinal methodology was employed to assess causal links between both the established and novel predictors identified in the cross-sectional studies.

Chapter three describes the methodology employed to achieve these objectives. The chapter also offers a detailed description of the research design, sample selection, the research procedure and ethical considerations. The measures and variables used in each study are best described in the requisite chapters in the interests of sufficient context and narrative flow, although they are summarised here in tabular form (Table 3.1). Also included is an overview of the data analysis procedures undertaken throughout the thesis.

3.2 Research Design

The research undertaken for the purpose of this thesis consisted of five studies which used a cross-sectional design, mainly informed by the systematic literature review detailed in Chapter two. It is acknowledged that causality between antecedent variables and outcomes can only be regarded as tentative in such designs, and therefore a longitudinal design was employed for study five. Online survey methodology was used to collect data on the study variables in all cases except study four, which was a postal questionnaire. The variables of interest identified across the studies were used in the final, longitudinal study to afford a focused, holistic purview of the driving variables and any associations with the outcomes, with minimal redundancy in terms of the length of survey instrument. Study two was undertaken to address a common critique of driving behaviour research methodology, namely participant sample size and low annual mileage. All questions in the surveys were

counterbalanced, achieved by randomisation within the survey software to alleviate any potential order effects.

3.3 Sample and Sample Selection

3.3.1 Ethics in Psychological Research

Ethics in the current context refers to the correct rules of conduct necessary when carrying out research. Researchers have a moral responsibility to protect research participants from harm — the purpose of which is to protect participants, the reputation of psychology, and arguably, psychologists themselves (British Psychological Society, 2018). All studies undertaken in this thesis have been subject to rigorous ethical consideration and approval by Cardiff University's ethics committee, the details of which are contained in each chapter.

3.3.2. Sampling Restrictions

Whilst a stringent representative sample would require the use of a probability sampling technique to acquire a random sample of drivers, this technique was not feasible nor practical in the present research due to several factors, including (but not limited to), resource restrictions, time constraints and challenges in accessing information needed for such methods. Consequently, non-probability (i.e., convenience) samples of UK drivers were used, including students. Nonetheless, despite the sampling restrictions, the researcher purposefully sampled drivers from a wide cross-section of the UK, such that drivers from a variety of backgrounds and geographical locations were represented.

3.3.3 Inclusion Criteria

A reasonably broad inclusion criteria was used, with all studies requiring participants to be over the age of eighteen, with normal or corrected-to-normal vision. In study 1, both car drivers and non-car drivers were recruited in order to obtain a comparison of well-being outcomes between the two groups. Of the studies assessing job characteristics, participants were required to be in either part of full-time employment.

3.3.4 Sample Size

Empirical studies must consider statistical power when utilising significance testing to make conclusions surrounding the generalisablilty of sample results. To calculate power, or

rather the sample size necessary to reach a certain level of power, it is necessary to set the size of the effect likely to be true for the population of interest (Jones et al., 2003). One way in which to achieve this is to appraise the previous studies in the area of the current research and derive a mean or typical effect (Schäfer & Schwarz, 2019). However, as identified in the systematic literature review, there is a dearth of research in this area which incorporates all of the areas of interest and so this approach was not practicable for the present purpose. In addition, the studies used a multitude of variables, analysed using regression techniques and therefore a major limitation of sample size calculation with packages such as G* Power (Faul et al., 2007) is that there are multiple independent variables in multiple regression analyses and no separate sample size can be calculated for each (Yenipinar et al., 2019). Therefore, a-priori power analyses were deemed to be of little practical use in the current research. Instead, the researcher sought to recruit as many participants as practicable to explore any potential relationships between the variables. Sample sizes and participant characteristics are reported in each study chapter.

3.4 Rationale for Self-Report Data, Short-Item Scales, and Single-Item Measures

All studies described in this thesis utilise self-report, short-item scales, as well as some single-item measures.

As outlined in Chapter two, driving research typically uses self-report, with a small number combining simulator or observational type research with self-report measures. A major criticism levelled at self-report data is one of the risk of social desirability bias (SDB); more minor critique surrounding self-report, particularly for research undertaken online is one of responder carelessness – whereby the participant pays little attention to the questions being asked and simply 'ticks boxes' (discussed in detail by Bowling & Huang, 2018). That said, self-report is undeniably a quick and easy way to administer, is relatively inexpensive to use and can be one of the most efficient ways of capturing the subjective experiences of human participants. Moreover, measures surrounding driving behaviour, including outcomes such as RTCs appear to be largely unaffected by SDB, as demonstrated by Sullman and Taylor (2010). However, to counteract the potential for SDB and responder carelessness, the researcher embedded a SDB scale, as well as questions to screen for carelessness into the surveys from study three onward. In addition, average timings for survey completion were

considered across the studies to ensure no outliers in terms of surveys being completed so quickly that due consideration would have been unlikely. These are described in more detail within the study chapters.

The studies described in this thesis involved the development of a multi-measure questionnaire to assess the variables of interest. Multiple factors, such as well-being, personality, and job characteristics are of interest, however incorporating several multi-item scales results in an unwieldy questionnaire length which can have practical implications related to response time, burden and frustration (Sauro, 2018). Indeed, the additional demands placed on participants potentially leads to lower response rates and increased attrition (Fisher et al., 2016) impacting both generalisation of findings and validity of responses. Certainly, attrition is of consequence when undertaking longitudinal enquiry, with high attrition rates posing a significant ubiquitous threat to the validity of inferences drawn from such research. Understandably, higher attrition rates are found among lengthier surveys (Kocar, 2020). Great care was taken to ensure that single-item measures were effectively measuring the variable of interest and to this end, study one used a factor analysis with varimax rotation to pinpoint which driving variables loaded onto specific factors (this is discussed in detail later in this chapter). Study five examined the potential for using a single-item measure for driver fatigue, as opposed to the three questions used in earlier studies (the findings of which are reported in Chapter eight). Validated short-item scales /single item measures were used to examine constructs such as personality, SDB, hostility and impulsivity. Despite the care taken, it is acknowledged that single-item measures have some drawbacks, mainly centred on the statistical robustness of this approach. Three major concerns are expressed when using single-item scales. First, content validity, which refers to how well the content of the items in the questionnaire address the topic is considered to be low as it can be problematic to adequately address the construct using only one item. Indeed, McIver and Carmines (1981) stress that single items are unlikely to fully represent complex theoretical constructs, nor any specific attribute. Second, single items are limited in their capability to provide enough points of discrimination, leading to issues of sensitivity. For example, a single Likert question has between five and ten points to discriminate. In contrast, a ten-item five-point scale has forty points of discrimination. Third, reliability, most commonly measured using Cronbach's alpha to ascertain internal consistency (i.e., how

respondents consistently answer items) requires at least two items to compute, this not being possible for single items (Fisher et al., 2016). Conversely, multi-item measures also have limitations. By way of illustration, each additional similarly worded item can significantly inflate alpha scores, simultaneously reducing the quality of responses whilst adding little or no improvement on informational value (Drolet & Morrison, 2001). On the whole however, the extant literature on single-item measures suggests they are a practical alternative to multi-item measures in settings where cost and burden are of concern, as well as in cases where multiple constructs are of interest (Williams & Smith, 2012).

Table 3.1

Summary of Study Variables and Measures

Study 1	**Variables**	**Measure (s)**
Demographics	Gender, age, annual mileage, driving in last 12 months	
Driving behaviour (DB)	Use mobile when driving, lapses of concentration, hostility to others, speeding	Questions related to driving (adapted from Smith, 2016)
Driving hazards (DH)	Drive in heavy traffic, drive on motorway, drive when tired, drive with a cold, drive late at night, drive long periods, drive after prolonged work, listen to radio when driving, conversations with passengers, drive in bad weather, annual mileage	Questions related to driving (adapted from Smith, 2016)
Driver skill (DS)	Self-rate driving skill, others' ratings of driver skill	Questions related to driving (adapted from Smith, 2016)
Well-being	Positive affect, life satisfaction, happiness, high self-efficacy, self-esteem, optimism, anxiety, depression, perceived stress,	Student WPQ (Williams et al., 2017)

	conscientiousness, coping, stressors, social support, positive personality, positive appraisal, negative appraisal, life satisfaction	
Study 2 & 5		
Demographics	Gender, age, mileage	
Driver fatigue (DF)[a]/ Driver fatigue short-item[b]	Drive tired, drive ill, drive late/early, drive long periods, drive after prolonged work	[a]DBQ (adapted from Smith, 2016), 5 items; single item measure encompassing the 5 items[b]
Well-being	Positive personality, healthy lifestyle, course demands, academic control/support	Student short SWELL (Smith & Smith, 2017)
Personality	Extraversion, openness, neuroticism, agreeableness, conscientiousness	Ten-Item Personality Scale (TIPI; Gosling et al., 2003)
Impulsivity	Impulsivity, cynicism, anger and aggression	Short item scale developed for study (4 items)
Social desirability bias	Social desirability	Brief Social Desirability Scale (BSDS; Haghihgat, 2007)

Study 3	**Variables**	**Measure (s)**
Demographics	Gender, age, annual mileage, education, salary, marital status, employment status, job type	

Driving behaviour (DB)	Use mobile when driving, lapses of concentration, hostility to others, speeding	Questions related to driving (adapted from Smith, 2016)
Driver fatigue (DF)	Drive in heavy traffic, drive on motorway, drive when tired, drive with a cold, drive late at night, drive long periods, drive after prolonged work, listen to radio when driving, conversations with passengers, drive in bad weather, annual mileage	Questions related to driving (adapted from Smith, 2016)
Driver skill (DS)	Others' ratings of driver skill	Questions related to driving (adapted from Smith, 2016)
Road Traffic Collison (RTC)	Traffic incidents with injury, traffic incidents without injury	Questions related to driving (adapted from Smith, 2016)
Risk-taking	Take risks at work, take risks outside work	Two items designed to ascertain propensity toward risk-taking
Mental health	Anxiety, depression	Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983)
Personality	Extraversion, openness, agreeableness, conscientiousness, neuroticism	International Personality Item Pool (IPIP; Goldberg, 1992)
Job characteristics[a]/Appraisals[b]	Choice, support, respect, reward, demand, pressure[a] Working hours, workplace noise, job satisfaction, work/life balance, perceived job stress	Demands – Resources – Individual Effects (DRIVE) model (Williams et al., 2017)

Accidents and cognitive failures	Workplace accidents, memory problems at work	Number of accidents at work requiring medical intervention, frequency of memory problems, inattention or action at work
Study 4		
Demographics	Gender, age, mileage, salary, marital status, job role	
Risk-taking	Take risks at work, take risks outside work	Two items designed to ascertain propensity toward risk-taking
Road Traffic Collison (RTC)	Number of road traffic collisions	Road traffic collisions where participant was the driver
RTC occurrence	On way to/home from work, travelling outside workplace as part of your job, travelling within your workplace, other	Bristol Stress and Health study (Smith, 2000)
Fatigue/perceived stress/mental health	Life stress, work stress, fatigue, anxiety, depression	Bristol Stress and Health Study (Smith, 2000)
Accidents/Cognitive failures/RTC	Accidents outside work (minor injury), accidents at work, cognitive failures at/outside work, high levels of RTCs (as the driver)	Bristol Stress and Health Study (Smith, 2000); HSE pro forma
Work/life balance	Family reducing time for work, family obligations reducing time to relax/sleep, frequent socialising with friends/colleagues	Bristol Stress and Health Study (Smith, 2000)

Job appraisal	Bullying stress, satisfaction with conditions, satisfaction with prospects/pay, satisfaction with use of abilities, satisfaction with colleagues	Bristol Stress and Health Study (Smith, 2000)
Job characteristics	Long, unsociable hours, high levels of fumes, unpredictable hours, frequently on call, handling harmful substances, high noise at work, night work	Bristol Stress and Health Study (Smith, 2000)
Study 5[a]		
Demographics	Gender, age, marital status, salary, employment	
Personal characteristics	Healthy lifestyle, happiness, positive personality, depression/anxiety, life satisfaction, stress challenge, life stress, stress threat	
Job characteristics/appraisals	Demand, pressure, engagement, control, support, thriving at work, perceived job stress, shift work, job satisfaction, frequently on-call, fatigue at work, happiness at work, illness caused by work efficiency, depressed because of work, noise at work, frequent bullying by management/colleagues	All study 6 measures developed for study using identified predictors, as well as the addition of novel predictors (67 items) – Driving safety predictors survey (Bowen & Smith, 2020)
Personality	Extraversion, agreeableness, openness, neuroticism, conscientiousness	
Accidents/cognitive failures	Workplace accidents, memory problems at work	

Driving	Frequent driving in heavy traffic, others' rating of driver, frequent motorway driving, poor driving behaviour, frequent driving in bad weather, driver fatigue, RTC occurrence/number, annual mileage, near miss, driver retraining	
Risk Taking	Risk taking at/outside work	
Absenteeism/Presenteeism	Days sick leave, attending work when unwell	
Study 5[b]		
Pandemic changes	Frequency of driving during and after lockdown, mileage during lockdown, during lockdown relaxation, after lockdown, employment changes due to pandemic	Developed for the study (eight questions)
Job characteristics/appraisals	Engagement, shift work, frequently on call, demands, perceived stress at work, control, support, fatigue at work, presenteeism, work/life balance, happy/depressed at work, noise at work, bullying by boss/colleagues	Adapted SWELL (Smith & Smith, 2017)
Stress	Stress challenge, stress threat	Developed for the study (2 questions)
Well-being/mental health	Positive personality, life satisfaction, happiness, anxiety, depression	Driving safety predictors survey (Bowen & Smith, 2020)
Social desirability bias	Social desirability	Brief Social Desirability Scale

		(BSDS; Haghihgat, 2007)
Risk-taking	Risk-taking at/outside work	Two items designed to ascertain propensity toward risk-taking
Accidents/Cognitive failures	Workplace accidents, memory problems at work	Number of accidents at work requiring medical intervention, frequency of memory problems, inattention or action at work
Driving	Frequent driving in heavy traffic, others' rating of driver, frequent motorway driving, poor driving behaviour, frequent driving in bad weather, driver fatigue, RTC occurrence/number, annual mileage, driving domain, near misses, familiarity	

Note. Study 5^{a} and 5^{b} refer to part 1 and 2 of the longitudinal study

3.5 Analytic Strategy

All studies were quantitative and analysed using the Statistical Package for Social Sciences (SPSS) computer program, Version 23.0. A number of statistical procedures were performed on the data, namely: descriptive analysis, factor analysis, univariate analysis, correlation analysis, regressions and combined effects. An overview of these procedures and rationale is detailed in the following sections.

3.5.1 Descriptive Data Analysis

The sample characteristics were outlined using means and standard deviations or frequency tables. Variables were dichotomised at median split, producing categorial data which was then interrogated to identify variables of interest using chi-square tests.

3.5.2 Univariate and Correlation Analyses

Arguably the simplest form of analysing data, univariate, or cross-tabular analyses, were initially used on the dichotomised variables (categorised as 'high' and 'low' for ease of comparison) was used to initially identify variables of interest using frequency tables. These variables were then entered into logistic regression models.

Pearson Product Moment tests were used to ascertain whether single-item measures held as much predictive validity as multi-item measures in study five, as well as to examine whether there was any statistically significant relationship between constructs such as social desirability bias and the reporting of negative driving outcomes. In study one, correlations were used to compare the well-being of drivers and non-drivers.

3.5.3 Data Reduction (Factor Analysis)

Factor analysis is a data reduction technique, allowing for the capturing of variance in variables. Commonly, there is some confusion between factor analysis and principal component analysis (PCA). PCA creates one or more index variables from a larger set of measured variables, achieving this by way of a linear combination of a set of variables (the created index variables are called components). Factor analysis is a measurement of a latent variable which cannot be measured with a single variable. Whilst the techniques are related (the process and output appear similar), it is important to consider the fundamental mathematical differences between the two methods. Specifically, PCA does not impose testable restrictions on the parameterization of the covariance matrix, instead computing the decomposition of any real symmetric matrix eigenvalues and eigenvectors. On the other hand, factor analysis computes the covariance matrix, loading the factors as squares as cross products. Factor analysis therefore imposes parameter restrictions on the covariance matrix which can be tested in a statistical manner. As such, unlike PCA, not every covariance matrix can be represented by the factor analysis model (Hatcher, 2013). To this end, PCA was used in study one and three to identify the extent to which there was measurement overlap between the driving variables, creating a more parsimonious model of variables for the subsequent analyses.

Following the extraction of variables, the next step is to clarify the relationship among the factors, using a 'rotation'. Two techniques are discussed in the literature, depending upon the assumptions about the underlying constructs. Varimax rotation is used for uncorrelated factors (orthogonal), whilst oblimin is used for correlated factors (oblique). Although it is suggested that uncorrelated factors in social science research are rare, and accurate interpretations of and the resultant identification of underlying themes can be problematic to determine using an orthogonal approach, this view tends to be associated with studies examining behavioural states associated with states of emotion or motivational factors. As such, any attribution of specific emotions with behaviours becomes figurative guesswork (Dilbeck, 2018). For the present purpose, the objective was to identify which data belong to which factor, rather than the identification of underlying themes, more associated with orthogonality in contrast to oblique rotations. As such a varimax rotations of the data were undertaken in this thesis. The results of the PCA with varimax rotation (eigenvalues, variance explained etc) are described in detail in Chapters two and five.

3.5.4 Regression Models

Regression analyses are undertaken to test multivariate effects of a number of predictor variables on one continuous predictor variable. Hierarchical regressions are used to enter sets of variables in steps or 'blocks', with each subsequently entered variable assessed based upon what it uniquely adds to the prediction of the dependent variable. In addition to ascertaining the relative contribution of each block of variables, the independent contribution of each variable is seen in the final model, and enables the statistical 'control' for certain variables to observe whether adding variables improves a model's ability to predict outcomes (Osbourne, 2017). Similarly, logistic regression adopts the same process but is used to predict categorical outcomes. Binary logistic regression estimates a relationship between one or more explanatory variables and a single output binary variable. In general, the probability of the two alternatives is modelled, as opposed to simply outputting a single variable, as in a linear regression (Collett, 2003). All three approaches suited the analytic requirements of the current research due to the necessity to control for established predictors and examine the contribution of the novel variables for categorical, continuous and binary outcome data.

3.5.5 Combined Effects

Combined effects, often used in meta-analytic studies to synthesise the knowledge base on a given topic (Tang et al., 2013) can also be a valuable tool when assessing the additive effects of risk factors. Following the multivariate regressions detailed above, combined effects of the risk factors identified were then examined in another set of logistic regressions by adding the score from median splits to obtain risk 'groups', in line with the work of Smith (2016). The results of these analyses are detailed and discussed in the requisite chapters.

3.6 Chapter Summary and Links to Chapter Four

This chapter presented a discussion of relevant considerations that informed the methods applied in the studies detailed in this thesis. In particular, research design, sample selection, study variable measurement and analytic strategies were expounded. The following chapter addresses the first research aim of the thesis.

Chapter Four

Study One

4.1 Chapter Overview, Aims and Hypotheses

The purpose of the present study is to examine well-being and driving behaviour in a student population, using driving behaviour measures derived from recent research by Smith (2016) and the Student WPQ (Williams et al., 2017) . Although it is noteworthy at this juncture that the cross-sectional study design does not allow claims of causality, it may afford an insight into key variables which may be of use in further longitudinal enquiry.

The well-being of university students has received considerable research attention (e.g. Cameron, 1999; Lee & Yuen Loke, 2005) and more recently, high levels of anxiety, stress and depression have been reported in undergraduate students (Bayram & Bilgel, 2008), alongside the core well-being characteristics of coping style, demand, skill, resources and personality identified by the Well-being Process Questionnaire (WPQ; Williams & Smith, 2012). The WPQ arose from the identification of a gap in the measurement of well-being, given that well-being is a multi-faceted construct which necessitates the inclusion of both positive and negative outcomes (e.g. anxiety and depression, and happiness), positive and negative appraisal (e.g. perceived stress) and individual differences (e.g. self-efficacy, optimism, self-esteem and positive personality). Contemporary research by Williams et al. (2017), led to the development of the Student Well-being Process Questionnaire (Student WPQ) affording more focused well-being research on this population, with single item questions offering the same predictive validity as multi-item scales. The questionnaire examines predictors of positive well-being, negative mental health and cognitive function. The core variables attributed to the well-being outcomes are similar to those of the WPQ (discussed in detail elsewhere, e.g. Williams & Smith, 2012), however student related circumstances, such as long hours of study, lack of social support, fear of failing, time pressures, challenges to development and social mistreatment are also taken into account. Further, non-direct coping styles, including hostility and wishful thinking, known to impact levels of distress in this population (Tully, 2004) add to this diverse approach to the measurement of student well-being. Also, the model is flexible in that it allows for the incorporation of new predictors and outcomes, such that it is possible to utilise the 'core'

well-being variables as covariates, allowing one to determine whether any new effects are independent or related to the core variables.

As uncovered in chapter two, there is a paucity of empirical investigation into driving behaviour and well-being. Notably, however, a recent study conducted by Isler and Newland (2017) on undergraduate psychology students found that high levels of life satisfaction and well-being were related to lower levels of driving violations. Since there has been a clear link established between the self-reported tendency to commit violations and RTC involvement (Parker et al., 1995), such an insight warrants more detailed exploration.

As driving behaviour has not been extensively studied in the context of well-being, one needs to assess whether the aforementioned core variables established in the literature are demonstrated in the current sample, affording confidence in any effects detected in the novel addition of driving behaviour. First, it was hypothesised (in line with the findings of Williams et al., 2017) that positive well-being (positive affect, life satisfaction and happiness) would be predicted by positive personality (high self-efficacy, self-esteem and optimism) low stressors and negative coping and high levels of social support, whereas negative outcomes (anxiety, depression and perceived stress) would be predicted by high conscientiousness, coping and stressor scores and low social support and positive personality scores. Negative appraisals would be predicted by fatigue and perceived stress and positive appraisal by life satisfaction. Second, the study investigated whether well-being (positive or negative), affected driving behaviour, or conversely, whether driving itself impacted on well-being, using a multivariate approach, in which the established well-being variables were held constant and any new effects examined.

4.2 Method

4.2.1 Participants

The study was approved by the Ethics Committee, School of Psychology, Cardiff University, before the recruitment of participants (EC.19.03.12.560G). Data were collected from 224 undergraduate psychology students at Cardiff University (82.1% female, 4% other; age range 18-24) recruited via the School's Experiment Management System, (EMS) in return for course credit. There was no similar research that would have aided us to calculate a sample size based on effect sizes. As a result, a relatively large sample size that would allow detection of moderate size effects was recruited. The rationale being that should the study fail

to reveal any significant relationship between well-being and driving behaviour, one may infer that should such a relationship exist, it would be unlikely to hold any practical significance. Of the sample, 131 participants reported having driven a motor vehicle in the last 12 months.

4.2.2. Measures and Design

The materials used in this study and the research design are described in detail in chapter three.

4.2.3 Procedure

A detailed information sheet outlining the aims and procedure of the study for participants to give informed consent to take part was provided at study sign up. Participants received the following instructions for completion of the well-being measurement:

'The following questions contain a number of single-item measures of aspects of your life as a student and feelings about yourself. Many of these questions will contain examples of what thoughts/behaviours the question is referring to which are important for understanding the focus of the question but should be regarded as guidance rather than strict criteria. Please try to be as accurate as possible but avoid thinking too much about your answers- your first instinct is usually the best'

With regard to student life, they were presented with the following instructions:

'Please consider the following elements of student life and indicate overall to what extent they have been a part of your life over the past six months. Remember to use the examples as guidance rather than trying to consider each of them specifically'.

Participants who had driven in the last twelve months completed the driving behaviour measure, with the following instructions:

'The following questions relate to your driving behaviour. Please answer as accurately as possible'.

At the end of the survey the participants were thanked for their time, shown a debrief statement and awarded course credits for their participation.

4.3 Results

4.3.1 Established Well-being Predictors and Outcomes

Multiple linear regression analyses were computed for each of the predictors (stressors, positive personality, negative coping, conscientiousness and social support) with outcomes as the dependent variable (positive outcomes, negative outcomes, negative appraisal, positive appraisal and cognitive problems).

Negative well-being was predicted by high stressors, conscientiousness and negative coping scores and low positive personality and social support scores. The multiple regression revealed that these established predictors contributed significantly to the regression model, F (5, 210) = 73.05, p = .001, accounting for 63.2% of the variance in negative well-being. Positive well-being was predicted by low stressors, high positive personality and social support, and low conscientiousness scores, and also contributed significantly to the regression model, F (5, 210) = 64.99, p = .001, accounting for 60.4% of the variance in positive well-being.

Negative appraisals (e.g. perceived stress) were predicted by high negative coping, stressors and conscientiousness and low positive personality and social support scores. Overall, all five predictors produced a significant regression model, F, (5, 209) = 84.29, p = .001, with the predictors accounting for 66.6% of the variance in negative appraisals and outcomes. Positive appraisals (e.g. life satisfaction) were predicted by low stressor and high positive personality and social support scores, with all predictors yielding a significant regression model, F (5, 210) = 72.26, p = .001, accounting for 62.9% of the variance in positive appraisals. Finally, cognitive problems were predicted by high stressor and negative coping scores and low positive personality and conscientiousness scores, with all predictors giving a significant regression model, F (5, 213) = 19.17, p = .001, accounting for 29.9% of the variance in cognitive problems. These results follow the pattern of the established well-being predictors and outcomes and afford confidence in the novel analyses to follow.

4.3.2 Well-Being Outcomes and Driving

Analyses compared the well-being outcome scores of drivers and non-drivers. No significant differences were found.

4.3.3 Factor Analyses of Driving Behaviour, Driving Hazards and Self-Reported Driving Skill

Factor analysis (with a varimax rotation) of the driving questions showed that these variables loaded on three separate factors (see Table 4.1). The factor scores were used in the analyses of well-being outcomes in all instances except that of driving hazards, driving behaviour and annual mileage, which utilises total scores for ease of interpretation.

Before conducting a hierarchical multiple regression (HMR), the relevant assumptions of this statistical analysis were tested. First, a sample size of 131 was deemed adequate given the six independent variables (IVs) in the analysis (Tabachnick & Fidell, 2013). The dependent variable was normally distributed. Collinearity statistics (Tolerance and VIF) were all within accepted limits, meeting the assumption of multicollinearity (Turkson & Otchey, 2015). Finally, residual and scatter plots indicated assumptions of normality, linearity and homoscedasticity were satisfied (Pallant, 2010).

A two-stage HMR was conducted with each of the well-being outcomes as the dependent variable. The established predictor variables were entered at stage one of the regression to control for the established effects on the outcome. Driving behaviour was entered at stage two. The regression statistics can be found in Table 4.2.

Table 4.1

Factor Analysis of Driving Behaviour (DB), Driving Hazards (DH) and Self-Reported Driving Skill (DS). Loadings <.4 are not shown

	DB factor: **Eigenvalue = 1.45** **% variance = 24.14**	**DH factor:** **Eigenvalue = 4.47** **% variance = 40.67**	**DS factor:** **Eigenvalue = 1.76** **% variance= 29.27**
Use mobile when driving	.646		
Lapses of concentration	.525		
Hostility to others	.574		
Miss warning signs	.578		
Self-rate driving skill			.911
Others rate driving skill			.822
Drive in heavy traffic		.681	
Drive on motorway		.640	
Drive when tired		.694	
Drive with a cold		.642	
Drive late at night		.681	

Drive long periods		.726	
Drive after prolonged work		.665	
Listen to radio when driving		.611	
Conversations with passengers		.522	
Drive in bad weather		.716	

4.3.4 Predicting Well-being Outcomes and Driving Behaviour

For positive well-being, the HMR revealed that at Step 1, the established predictors contributed significantly to the regression model, F (5, 130) = 36.46, p < .001. The addition of driving behaviour at Step 2 also yielded a significant regression model, F (6, 130) = 30.43, p< .001. Together, the three IVs accounted for 57% of the variance in positive well-being, indicating that when established predictors are held constant, driving behaviour also predicts positive well-being outcomes. For negative well-being, the established predictors contributed significantly to the model, F (5, 130) = 39.44, p = <.001, and the addition of driving behaviour at Step 2 also returned a significant regression, F (6, 130) = 34.60, p = <.001. The five IVs contributed to 62% of the variance in negative well-being, indicating that driving behaviour is predictive of negative outcomes.

For negative appraisals, the HMR yielded a significant contribution of the established predictors at Step 1, F (5, 130) = 44.24, p = <.001, and at Step 2, the inclusion of driving behaviour also returned a significant regression model: F (6, 130) = 38.53, p <.001. Combined, the six IVs contributed to 63.4% of the variance in negative appraisals, demonstrating that driving behaviour predicts negative appraisal, in that the higher the driving behaviour score (more negative driving) the higher the negative appraisal score. For positive appraisals, there was a significant contribution to the model at Step 1, F (5, 130) = 41.43, p <.001, as well as at Step 2: F (6, 130) = 34.65, p <.001, indicating that lower driving behaviour scores are predictive of positive outcomes. Finally, for cognitive problems, there

was a significant regression model at Step 1, F (5, 130) = 10.26, p = <.001, as well as at Step 2, F (6, 130) = 9.06, p <.001, although driving behaviour did not contribute significantly to the model. Overall, the HMRs indicate that driving behaviour is associated with well-being.

4.3.5 Well-Being and Driving Hazards

A Pearson product-moment correlation coefficient was computed to assess the relationship between well-being outcomes and driving hazards. No statistically significant relationship was found between the variables.

4.3.6 Well-Being and Driving Skill

To assess any relationship between well-being outcomes and driving skill, a further Pearson product-moment correlation coefficient was undertaken. There was a statistically significant positive relationship found for both positive outcome and positive appraisal. HMRs were conducted for positive appraisal and well-being to ascertain whether driving skill remained a predictor when the established well-being predictors were held constant. Results are summarised in Table 4.3.

For both positive outcome and appraisal, the HMR yielded a significant contribution of the established predictors at Step 1, F (5, 130) = 36.46, p <.001; F (5, 130) = 41.43, p <.001, and at Step 2, the inclusion of driving skill also returned a significant regression model for both outcomes: F (6, 130) = 32.06, p = <.001; F (6, 130) 36.17, p <.001. Combined, the five IVs contributed to 59% of the variance in positive outcomes, demonstrating that driving skill predicts positive well-being in that the higher the driving skill score (higher driving skill rating) the higher the positive well-being score. For positive appraisals, the five IVs together contributed to 62% of the variance in positive appraisal, again demonstrating that those who rate their driving skills highly also enjoy higher positive appraisal.

4.3.7 Driving Behaviour, Driving Hazards and Annual Mileage

Driving behaviour and annual mileage were compared to investigate whether there was any association between annual mileage, self-reported driving behaviour and exposure to driving hazards. Mean annual mileage was 7734.05 (SD = 3275.32), while mean driving behaviour and driving hazard scores were 10.60 (SD = 5.25) and 26.24 (SD = 12.24) respectively.

Pearson's *r* correlations revealed significant moderate positive correlations between annual mileage and higher levels of reported driving violations, explaining 42.3% of the variance ($r = .65$, $n = 131$, $p < .001$). A similar correlation was observed between annual mileage and exposure to driving hazards ($r = .55$, $n = 131$, $p < .001$; 30.3% of variance explained) suggesting an association between higher annual mileage, exposure to driving hazards and propensity to commit driving violations.

Table 4.2

HMRs Showing Predictors for the Five Outcomes. (a) Positive Outcomes (b) Negative Outcomes (c) Negative Appraisal (d) Positive Appraisal (e) Cognitive Problems

(a)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	-.324	.120	-.161	-.2.70
Positive personality	1.73	.184	.648	9.39***
Negative coping	.293	.178	.0.99	1.64
Social support	.605	.144	.265	4.19***
Conscientiousness	-.974	.453	-.2.15	-2.15*
Step 2 Stressors	-.321	.120	-.159	-2.67
Positive personality	1.73	.184	.649	9.39***
Negative coping	.282	.179	.095	1.58
Social support	.608	.145	.267	4.20***

Conscientiousness	-.984	.454	-.142	-2.17*
Driving behaviour	616	.733	.048	.841*

Note. Adjusted *R2* = .55 for Step 1; adjusted *R2* for Step 2 = .57; ΔR2 =.02. *p<.05, **p <.01, ***p <.001.

(b)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	.478	.108	.258	4.43***
Positive personality	-1.30	.164	-.538	-7.89
Negative coping	.572	.157	.215	3.65***
Social support	-.456	.132	-.214	-3.47**
Conscientiousness	.145	.398	.233	3.64***
Step 2 Stressors	.480	.106	.259	4.52***
Positive personality	-1.30	.161	-.539	-8.04
Negative coping	.596	.154	.224	3.87***
Social support	-.472	.129	-.222	-3.65***
Conscientiousness	1.45	.391	.233	3.71***
Driving behaviour	1.52	.653	.127	2.32*

Note. Adjusted *R2*= .59 for Step 1; adjusted *R2* for Step 2 =. 62; ΔR2 =.03 *p<.05, **p <.01, ***p <.001.

(c)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	.747	.129	.328	5.80
Positive personality	-1.15	.195	-.513	-7.73
Negative coping	.884	.186	.271	4.76***
Social support	-.408	.162	-.151	-2.51**
Conscientiousness	2.05	.473	.268	4.33***
Step 2 Stressors	.752	.127	.330	5.91***
Positive personality	-1.52	.192	-.154	7.77***
Negative coping	.910	.184	.279	4.95***
Social support	-.415	.160	-.154	-2.59**
Conscientiousness	2.04	.467	.268	4.38***
Driving behaviour	1.61	.782	.110	2.06

Note. Adjusted *R2*= .59 for Step 1; adjusted *R2* for Step 2 = .63; ΔR2 = .04 *p<.05, **p <.01, ***p <.001.

(d)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	-3.53	.126	-.160	-2.79*
Positive personality	1.91	.194	.652	9.81***
Negative coping	.297	.188	.091	1.58
Social support	.702	.152	.281	4.61***
Conscientiousness	-.924	.478	-.122	-1.93
Step 2 Stressors	-.350	.127	-.158	-.2.76*
Positive personality	1.91	.194	.653	9.82***
Negative coping	.285	.188	.088	1.51
Social support	.706	.153	.282	4.63***
Conscientiousness	-.936	.478	-.123	-1.96
Driving behaviour	.733	.773	.052	.949

Note. Adjusted *R2*= .57 for Step 1; adjusted *R2* for Step 2 = .60; ΔR2 =.03 *p<.05, **p <.01, ***p <.001

(e)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*

Step 1 Stressors	.105	.035	.233	2.30*
Positive personality	-.104	.054	-.174	-1.91
Negative coping	.152	.051	.233	2.96*
Social support	-0.16	.042	-.032	-.386
Conscientiousness	-.241	.132	-.158	-1.83
Step 2 Stressors	.106	.035	.235	3.04*
Positive personality	-.102	.054	-.171	-1.88
Negative coping	.147	.051	.225	2.87**
Social support	-.014	.042	-.028	-.339
Conscientiousness	-.936	.478	-.123	-1.96
Driving behaviour	.329	.214	.114	1.53

Note. Adjusted *R2*= .26 for Step 1; adjusted *R2* for Step 2 = .27; ΔR2 = .013 *p<.05, **p <.01, ***p <.001.

Table 4.3

HMRS Showing Predictors for (a) Positive Outcomes and (b) Positive Appraisal

(a)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	-.324	.120	-.144	-.244*
Positive personality	1.73	1.84	.648	9.39**
Negative coping	.293	.178	.099	1.64
Social support	.605	.144	.265	4.19**
Conscientiousness	-.974	.453	-.141	-2.15*
Step 2 Stressors	-.290	.119	-.144	-2.44*
Positive personality	1.75	.182	.656	9.62***
Negative coping	.285	.175	.096	1.62
Social support	.561	.144	.246	3.90***
Conscientiousness	-1.03	.447	-.149	2.31*
Driving skill	1.68	.775	.125	2.17*

Note. Adjusted *R2*= .61 for Step 1; adjusted *R2* for Step 2 = .62; ΔR2 = .013 *p<.05, **p <.01, ***p <.001.

(b)

	Unstandardised Coefficients	Standardised Coefficients		
Predictors	B	SE b	β	*t*
Step 1 Stressors	-.353	.126	-.160	- 2.79*
Positive personality	1.91	.194	.652	9.81***
Negative coping	.297	.188	.091	1.58
Social support	.702	.152	.281	4.61***
Conscientiousness	-.924	.478	-.122	-1.93
Step 2 Stressors	-.319	.126	-.144	-2.53*
Positive personality	1.92	.192	.658	10.03***
Negative coping	.289	.185	.0.89	1.56
Social support	.657	.152	.263	4.32***
Conscientiousness	-.984	.472	-.129	2.08*
Driving skill	1.71	.819	.116	2.08*

Note. Adjusted *R2*= .61 for Step 1; adjusted *R2* for Step 2 = .62; ΔR2 = .013 **p*<.05, ***p* <.01, ****p* <.001.

4.4 Discussion

The first analyses confirmed that the established well-being predictors in a student population were present in the current sample, affording more confidence in the addition of the novel driving behaviour, hazard and skill variables. The second analyses demonstrated that more positive driving behaviour (engaging in fewer violations, such as indicating hostility to other drivers and missing warning signs) was associated with higher levels of positive well-being and appraisal, whereas those with higher levels of negative well-being and appraisal reported more violations. Also, drivers with higher levels of positive well-being and appraisal also reported higher levels of driving skill, with these findings being broadly in line with the recent work of Isler and Newland (2017). Unsurprisingly, increased annual mileage was associated with an increased risk of exposure to driving hazards, as well as increased levels of poor driving behaviour; although notably, this data was correlational, and thus cannot be taken as implying causality. That said, the identification of such an association lends itself to further investigation. In terms of RTC involvement, the present sample reported so few incidences (< 4 in the entire sample) that it was not possible to analyse this data in a statistically meaningful way in terms of its relation to the driving variables. It is suggested that the reasonably low reported annual mileages of the participants might provide a partial explanation, although an eyeball examination of the data revealed those who reported RTCs also scored highly in both negative well-being and reported more negative driving behaviour.

Behaviour associated with negative well-being, such as low positive personality, social support and coping scores starkly contrasts with adaptive, proactive and positive behaviour that has been linked with pro-social traits (Huppert, 2009) and therefore, in a driving context, it is conceivable that drivers who score highly on negative well-being are less inclined to drive in adaptive or pro-social ways. Conversely, behaviours associated with positive well-being, predicted by positive affect (high optimism, self-efficacy and self-esteem) low stressors, negative coping and high social support scores have a strong relationship with pro-social behaviours, in that behaving in a pro-social manner *increases* positive well-being (Khanna et al., 2017) and so it is possible that driving in a pro-social fashion aids positive well-being. Research supportive of this view undertaken by Taubman-Ben-Ari (2012)

revealed that when using priming procedures, positive affect translated into lower levels of willingness to drive in a recklessly in younger drivers. Positive appraisal, reflecting higher levels of life satisfaction (Schueller & Seligman, 2010) has also been strongly linked to positive, proactive and adaptive behaviours, as well as optimal mental health, the latter being connected in the literature as consistent with better driving behaviour (Goudie et al., 2014). Negative appraisal reflects fatigue and perceived stress which are both factors known to predict poor driving behaviour and RTCs (Smith, 2016).

Clear associations between driving behaviour (the propensity to commit driving violations) and RTC involvement have been reported in other studies (e.g. Jafarpour & Rahimi-Movaghar, 2014). The current findings show that levels of well-being are associated with driving behaviour which could help to explain the underpinning motivation to drive in an anti-social fashion. This all points toward the necessity of an appreciation of driving in a more social context, as suggested by Parker et al. (1995) and more recently by Isler and Newland (2017). In this way, measurements of well-being may be used to predict future driving behaviours, as well as interventions developed for drivers which may increase levels of well-being and, by extension, increase driver safety.

While careful consideration was given to the methodology employed in this research, some limitations must be acknowledged, such as the sample being drawn from a psychology student population, with older drivers and males being under-represented and the sample size being somewhat small. As the survey was cross-sectional in design, confidence in causality is problematic. The study was based on self- report data which may have been biased to some extent with social desirability issues and respondent carelessness a possibility (discussed in detail by Bowling & Huang, 2018) although encouragingly, Sullman and Taylor (2010) found that self-reports of driver behaviour were largely unbiased. That said, the multi-variate approach undertaken in the present study, whereby known predictors of well-being were accounted for, and the novel predictors added to the regression model at step two, has addressed a previous gap in the literature, potentially heralding the beginnings of a more holistic approach to driver behaviour research.

The present study has identified links between well-being and driving behaviour and as such, provides an opportunity to consider ways in which drivers may be supported to achieve more positive safety behaviour while on the road. One way in which this may be realised is to

use mindfulness, a term used to describe a particular way of paying attention to the present moment, characterised by a receptive and non-judgemental attitude (Kabat-Zinn, 1994) which has garnered increasing research attention in recent years. In its broadest sense, mindfulness can be defined as the extent to which one attends to the present moment, rather than being preoccupied (Sauer et al., 2012). In this way, mindfulness may be understood as an attribute of consciousness empirically shown to promote positive well-being (Brown & Ryan, 2003) which, considering the current findings, may prove a beneficial feature of driver training, such that well-being may mediate improved driving behaviour. Without a doubt, road safety is of key importance to individuals, businesses and society as a whole. Therefore, the identification of the underpinnings of poor driving behaviour and ways in which this may be improved should be investigated.

4.5 Chapter Summary and Links to Chapter Five

This chapter presents results from a study conducted on psychology students to ascertain whether a) established predictors of driving outcomes are evident and b) whether more novel predictors are of any utility. Findings confirm the presence of the established predictors, affording confidence in the addition of new predictors. The next chapter reports a study in which other variables, such as job, personality and mental health characteristics are implicated in driving outcomes among a general population, as identified in the systematic literature review detailed in chapter two.

Chapter Five

Study Two

5.1 Introduction, Rationale and Hypotheses

Factors such as personality, stress, fatigue, risk-taking, gender, age and marital status (to name but a few) have been studied extensively in the remit of their potential impact upon collision causality. Moreover, contemporarily emerging in the literature is the link between collisions and driving behaviour, as measured by the Driver Behaviour Questionnaire (Reason et al., 1990), which has a three-factor structure, consisting of errors, lapses and violations, and crash involvement (de Winter & Dodou, 2010).

Demographic risk factors have also been identified, with age and gender repeatedly being associated with RTC risk. Younger, male drivers are acknowledged as being significantly more at risk than their older, female counterparts, and this increase in risk has been attributed to driving inexperience and propensity for risky driving behaviours (Blows et al., 2005; Lemieux et al., 2008). That said, the nature of such research requires that drivers disclose behaviours which are illegal, and as such, there is a potential for socially desirable responding which may lead to an underestimation of the magnitude of association between risky driving behaviours and RTC involvement. Similarly, differences in the measurement of risky driving make comparison between studies problematic. Marital status has also been found to have a bearing on the risk of driver injury; single drivers are estimated to be twice as likely to be involved in a RTC as their married counterparts. This again is thought to be associated with risk-taking behaviour, with single drivers adopting a 'nothing to lose' attitude to driving (Barraclough et al., 2016). Moreover, risk-taking has also been related to unsafe road traffic behaviour, the assumption being that risk-taking attitudes correlate with risk-taking behaviour (Nabi et al., 2007). Whilst the connection between marital status and RTC involvement has been made, most studies do not factor in how much time participants spend behind the wheel; it must be acknowledged that exposure to the road also plays a role in the frequency of collisions, and this in turn may impact the observed variance. Perhaps unsurprisingly, fatigue has often been identified as causal of RTCs; a recent meta-analysis found a significant statistical association between driver fatigue and collision involvement

Moradi et al., 2018). Shift workers and those working long hours, younger drivers, commercial drivers and those with undiagnosed sleep disorders such as obstructive sleep apnoea, (Garcia-Borreguero et al., 2003) as well as frequent business travellers who may be prone to jet lag, spend too long driving and get too little sleep are at higher risk of RTCs due to fatigue.

There exists a considerable literature spanning many decades on the influence of personality on road traffic safety; the rationale being that facets of personality are associated with greater risk. Personality is a multifarious phenomenon, typically defined as the stable behavioural tendencies of individuals over time, or the psychological traits which create such behaviours (Allport, 1937). Whilst many systems of personality measurement have been utilised over the years, there is now general agreement that personality and driving-related outcomes and behaviour can be measured according to the Five Factor Model (FFM): Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness, which translate well onto other systems (Dahlen & White, 2006). In terms of the theoretical framework for personality and its association with road traffic safety, individuals high in extraversion tend toward risk-taking and poor diligence and, as a result, this trait has been associated with RTCs, traffic violations, traffic fatalities, and drink driving Attombo et al., 2017; Brown et al., 2017; Renner & Anderle, 2000; Shen et al., 2018). Those high in neuroticism are said to be reactive to stress, easily distracted, and display a lower propensity to take control of the immediate environment. Thus, a dislike of driving, RTCs, aggressive driving and traffic fatalities have been associated with this trait (Alavi et al., 2017; Kirkcaldy & Furnham, 2000; Lajunen & Summala, 1995). Lower levels of agreeableness relate to higher levels of aggression both from an emotional and behavioural perspective, which is thought to be causal of RTCs by increasing aggressive driving (Benfield et al., 2006). Higher levels of openness are associated with improvisation and experimentation, neither behaviour conducive with the necessity for adherence to routine and rules when driving (Wåhlberg et al., 2017). Finally, conscientiousness has been found to be inversely related to RTCs overall, as well as ‘at fault’ RTCs Arthur & Doverspike, 2001). As personality is a complex construct, it is worth noting that studies examining the links between the traits and driving have reported divergent findings; for example, conscientiousness has been found to be both negatively and positively significantly related to RTCs. This may be due in part to differences in the measurement

instruments used, or, as suggested by some researchers (e.g., Arther & Doverspike) the overrepresentation of younger, male drivers in many such studies.

The association between mental health and RTCs has been studied, most typically from the perspective of RTC involvement giving rise to psychological disorders such as post-traumatic stress disorder (PTSD) and acute stress disorder (ASD) (Dai et al., 2018). What is less frequently studied is the causal impact of mental health issues such as anxiety and depression on driving and RTC involvement. In a recent systematic review, only sixteen studies concerning mental health disorders, such as depression and anxiety, and fitness to drive were sourced - this literature being somewhat disjointed due to small sample sizes and differing methodology (Unsworth et al., 2017). Given the prevalence of depression and anxiety in the general population, with 19.7% of UK adults reporting symptoms of anxiety or depression in 2014 (Mental Health Foundation), an evaluation of the potential impact of such disorders on driving would be extremely useful. Similarly, job characteristics, such as job demands and pressure, working hours and exposure to noise have not been extensively studied in the arena of the general public and driving. The literature is replete with factors associated with RTCs among professional drivers, the most emergent being fatigue caused by shift work/long working hours and the dangers of health issues brought about by the sedentary nature of driving for a profession (Zhang & Chan, 2014). However, given that the average worker spends much of their working life in the work environment, with many commuting to and from work by driving, it is reasonable to suggest that job characteristics may contribute to how an individual may drive and, by extension, to RTC causality. Recently, research addressed the issue of work-life balance and psychological work stressors on commuting behaviour, finding that over two time-points, work-family conflict and negative job characteristics (termed 'abusive supervision') were both positively related to unsafe driving during commuting (Turgeman-Lupo & Biron, 2017). Such insights afford fruitful lines of further inquiry, although the study authors acknowledge the necessity to examine the psychometric properties of the scale used to measure commuting norms in future research. While it is widely acknowledged that stressful job characteristics are implicated in stress-related physical and psychological issues, many of the current stress models by which this phenomenon is measured are either too broad and complex (e.g., Cognitive- Relational model; Lazarus & Folkman, 1984) resulting in a lack of predictive validity. Other models are too narrow in scope (e.g., the Effort-Reward Imbalance model (Seigrist, 1996), and fail to

account for individual differences. In recognition of this shortcoming, the Demands, Resources, and Individual Effects model (DRIVE) combines many of the features of existing stress models, by including work and individual demands and resources (Mark & Smith, 2008). The model proposes that individual differences, work demands and resources have main effect relationships on health outcomes, such as anxiety and depression. Research suggests that these effects may be mediated through perceived stress and job satisfaction although the evidence for moderating effects is weak. The model is flexible in that it allows for the inclusion of new variables. This may provide more information on the relative importance of different variables in the prediction of outcomes and, perhaps more importantly, provide key information about the independence of different factors.

Staying with the impact of the work environment on driving and RTCs, accidents at work, as well as failures of cognition (defined as failures in perception, memory and motor functioning) (Allahyari et al., 2008) have previously been associated with crash involvement. Links were identified between cognitive failures and susceptibility to driving errors, the latter acknowledged as causal to RTCs. Similarly, associations were uncovered between minor accidents at work and cognitive failures; with cognitive failures being linked with both injuries in the workplace and fatigue, (Wadsworth et al., 2003). Nonetheless, given the connections already made, it was of interest to examine whether cognitive failures and accidents at work are associated with RTCs or poor driving behaviour, particularly considering the ways in which driving error and behaviour are predictive of RTC involvement.

The purpose of the present study, using secondary data analysis from the recent work of Smith (Smith, 2016) in which poor driving behaviour, driver fatigue and risk-taking were found to predict RTCs, is to further analyse associations between job characteristics, mental health, personality, fatigue and driving behaviour, and their potential connection to RTCs, as well as their potential links with some of the risk factors (driving behaviour [DB], driver fatigue [DF] and risk-taking [RT]) as outcome variables. Using the aforementioned DRIVE model (Mark & Smith, 2008) positive and negative job characteristics will be micro-analysed to ascertain which specific factors contribute to unsafe driving behaviour, driver fatigue, risk-taking and RTCs. For example, the parent study by Smith identified work hours and excessive noise at work together to be significant in RTC involvement and driver fatigue,

whereas the proceeding analysis seeks to tease apart the variables to discover whether one factor over another is predictive of the outcome variables mentioned. It is acknowledged that the cross-sectional nature of the data makes attribution of causality problematic, however, it is suggested that finding preliminary associations may pave the way for further, longitudinal enquiry. Specifically, the research hypothesis is: the established predictors of RTC, DB, RT and DF will be evident, and can be statistically controlled for, which thus affords confidence in the novel analyses of mental health (anxiety and depression) and the DRIVE model variables (choice, reward, respect pressure and decision making) in addition to work-life balance, work hours and noise, as well as accidents and cognitive failures at work.

5.2 Method

5.2.1 Participants

Clients of an insurance company (opportunity sample; Admiral.co.uk) who were in current employment and had previously agreed to receive correspondence from the company were sent details about the study. Individuals who expressed an interest in participating were sent an online link to the study. Of the 3,000 participants sent links, 2856 (95.2%) completed the survey. The participants comprised 68% females, with an age range of 18-74 years (M = 34). Further demographics of the final sample are detailed in Table 5.1. Ethical permission to undertake the research was granted by Cardiff University's Research Ethics Committee (EC.18.02.13.5228).

Table 5.1

Final Sample Demographics

Married/Living with Partner	61.2%
Education	55.5% Degree/Professional Qualification 24.5 % A-Level 20.4% GCSE
Salary	19.6% > £40,000 per annum

	29.6% £25 – 40,000 per annum 38.8% £10 – 25,000 per annum 10.6% < £10,000 per annum
Full-time Employment Permanent Employment Employment Type:	87.9% 89.3% Self-employed: 8% Management: 23.3% Supervisor: 10.4% Employee: 58.3%

5.2.2 Materials and Measures

Materials and measures in relation to driving, risk taking, and fatigue are detailed in chapter three, however, the measurement of job characteristics/appraisals, mental health and personality is further explicated here. The full survey can be found in Appendix A.

5.2.2.1 Job characteristics/appraisals

Questions in this section pertained to the nature of the participant's job, using the DRIVE model (Mark & Smith, 2008). The model conceptualises workplace and individual characteristics in terms of work demands and resources, as well as working hours and noise levels in the workplace. The questionnaire possesses acceptable reliability, with the average alpha reliability of the multi-item measures reported by the authors as $\alpha = .81$ (Mark & Smith). Using single-item measurements, participants were asked to rate their employment (0 = never; 5 = very often) in terms of positive characteristics such as choice ('do you have a choice in what or how you do your job?'), decision making ('do you have a great deal of say in decisions at work?'), support ('do you have a lot of support at work?'), respect ('do you

receive the respect you deserve from superiors and colleagues?'), reward ('do you feel your efforts and achievements at work are appropriately rewarded?') and negative characteristics, such as demand ('do you have a demanding job ('have to work fast, intensively etc.?'), and pressure ('do you have constant pressure due to a heavy workload?').

Job appraisals were assessed by way of the participants' subjective feelings about their job and encompass working hours ('do you work long or unsociable hours?'), noise in the workplace ('how often are you exposed to noise at work?'), job satisfaction ('are you satisfied with your job?), and work/life balance ('does your job interfere with family life or other activities outside work?' /'do family matters (and other things outside work) interfere with your work?'). Perceived job stress was measured on a five-point Likert scale (0 = not at all stressful; 5 = very stressful). Accidents and cognitive failures in the workplace were assessed by single items. Participants were asked to indicate the number of accidents whilst at work that required medical attention in the last twelve months (none - more than six) and frequency of memory problems, attention, or action at work (0 = not at all; 4 = very frequently).

5.2.2.2 Mental health

Mental health was measured using the hospital anxiety and depression scale (HADS) [33]. The fourteen item scale measures self-reported depression and anxiety. Originally developed for use in clinical settings, it also demonstrates appropriate validity in other populations [34]. Cronbach's alpha for the anxiety subscale (HADS-A) was .83, and the depression subscale (HADS-D) .82. Participants were asked to rate on a four-point Likert scale the extent to which they have been feeling fourteen mood-related descriptions (seven for anxiety, seven for depression) with responses ranging from 'not at all' to 'most of the time' (a score of 0 to 3, respectively). Scores are summed from items for the two sub-factors and range from 0-21.

5.2.2.3 Personality

Personality traits were assessed using the International Personality Item Pool (IPIP) Goldberg, 2018), an instrument widely acknowledged to show good convergent and discriminant validity (Lim & Ployhart, 2006). Each factor is assessed by 8 items rated from 0 (never) to 4 (very often) as to how accurately it describes the respondent. The first factor,

extraversion (α =.88) assesses an individuals' active and social traits (e.g., am the life of the party). Conscientiousness (α =.78) is designed to assess one's traits of dependability and conscientiousness (e.g., I am always prepared). Agreeableness (α = .71) consists of items connected to one's warmth and interest toward others (e.g., I have a good word for everyone). Openness (α = .76), otherwise known as intellect, relates to traits of sophistication and creativity (e.g., I believe in the importance of art). Finally, neuroticism (α = .70) assesses an individuals' sensitivity to fluctuations in emotional experience and stress (e.g., I often feel blue).

5.2.3 Design

This cross-sectional study was presented as an online survey, administered using Survey Tracker software. Potential order-effects were alleviated by way of counterbalancing, using randomisation within the software. Median splits (high/low) were used for all variables to allow like for like comparison. Cross-tabular analyses were used to initially examine any associations among RTCs, RT, DF and DB. Binary logistic regressions were then carried out with demographics, job characteristics, job appraisals, personality, mental health and driving as covariates. Dose-response was examined by combining the effects of the risk factors identified in a further series of logistic regressions, achieved by way of adding the scores from the median splits and then splitting the combined scores into quartiles.

5.2.4 Procedure

An information sheet outlining the aims and procedure of the study for participants to give informed consent to participate was provided prior to study commencement. Participants received the following information:

'Please read each question carefully and mark the response that BEST reflects your knowledge or feelings. Do not spend a lot of time on each one; your FIRST answer is usually the best. Please make sure you mark all answers in the space provided. If there are any questions you do not want to answer you may omit them'.

Participants who were in employment completed the job characteristics/appraisal measure, with the following instructions: 'We would like to ask you some questions about you and work. If you are not working, go to the next section'.

Regarding mental health, they were presented with the following instructions:

'Please read each item and then tick the box next to the reply that comes closest to how you have been feeling in the past week. Try to give your first reaction. This will probably be more accurate than spending a long time thinking about an answer. Please answer all questions, and tick only ONE BOX per question'.

The personality scale contained the instruction:

'Please use the rating scale to assess how accurately the statement describes you'.

At the end of the survey participants were thanked for their time and shown a debrief statement.

5.3 Results

5.3.1 Factor Analyses of Driving Questions

In line with the work of Smith (2016) and as described in chapter three, a factor analysis (with varimax rotation) of the driving questions revealed that these variables loaded on three separate factors, driving behaviour (DB), driver fatigue (DF) and risk-taking (RT) (see Table 5.2). Cumulative variance was 56.28%. The Cronbach αs for the factors were .75, .78 and .72 respectively.

Table 5.2

Factor Analysis of Driving Questions

	DB factor:	**DF factor:**	**RT factor:**
	Eigenvalue = 1.50	**Eigenvalue = 3.36**	**Eigenvalue = 1.34**
	% variance = 13.62	**% variance = 30.52**	**% variance = 12.14**
Drive long periods		.734	
Drive after prolonged work		.774	
Drive late at night/post lunch		.774	
Drive when tired		.638	
Drive with a cold		.470	
Lapses of concentration	.794		
Speeding	.747		
Miss warning signs	.687		
Indicate hostility to others	.454		
Take risks at work			.865
Take risks outside work			.860

Note. Loadings <.04 not shown

5.3.2 Derived scores

The factor scores detailed above were dichotomised at median split, whereas the job characteristics/appraisal, personality, mental health and driving variables were dichotomised at the scale score median split. All variables were categorised into ‘high/low', except for others' rating of driving, categorised into ‘good/bad' for ease of interpretation.

5.3.3 Analyses

As outlined in chapter three, in order to initially examine potential associations between the variables, cross-tabular analyses were conducted, with the outcome variables as RTCs, DB, DF and RT and demographic, personality, mental health, job characteristics, job appraisal, driving behaviour, driver fatigue and risk-taking as predictor variables. Marital status was dichotomised into ‘Married/separated/ divorced' versus ‘Single' as chi-squares yielded significant effects between these groups for each of the outcome variables (p =.05).

Logistic regression analyses (using the ENTER method) were performed with RTCs, driving behaviour, driver fatigue and risk-taking as the dependent variables, and demographics (marital status, age, gender, education and salary), job characteristics (demand, pressure, choice, decision making, support, reward and respect), job appraisals (work-life balance problems, job satisfaction, job stress, work hours, noise levels), personality (conscientiousness, agreeableness, extraversion, neuroticism and openness), mental health (depression/anxiety) and driving variables (driving in bad weather, motorway driving, driving in heavy traffic, driver fatigue, driving behaviour and others’ ratings of the drivers’ ability) as predictor variables. Marital status and age were entered into the regression as single (risk group; 2) and married (control; 1), younger (risk group; 2) older (1; control group). A total of 2856 cases were analysed.

5.3.4 Road Traffic Collisions

The univariate analyses showed that the following were risk factors for RTC involvement (see Table 5.3):

- Being single

- Being younger
- Having pressure at work
- Having low respect at work
- High stress at work
- Working long hours
- Having an accident at work
- High cognitive failures at work
- Being rated by others as a bad driver
- High frequency of driving when fatigued
- Inappropriate driving behaviour
- Frequently taking risks

Table 5.3

Percentage of Participants in the RTC, Poor Driver Behaviour, Frequently Driving While Fatigued and High-Risk Taking Groups

Demographics	**RTC**	**DB**	**DF**	**RT**
Married/Separated/Divorced	9.9%	10.7%	46.4%	45.2
Single	14.7%	17.9%	52.2%	58.8
Male				
Female				

Older driver		9.3%	47.4%	46.3%	
Younger driver		13.5%	52.1%	53.0%	
Salary	High				58.4%
	Low				48.6%
Job Characteristics					
Demand	High				55.4%
	Low				44.5%
Pressure	High	12.3%			
	Low	10.8%			
Choice	High			57.6%	57.9%
	Low			44.0%	44.0%
Decision making	High		45.3%		56.7%
	Low		56.2%		43.7%
Support	High				
	Low				
Reward	High				
	Low				
Respect	High	10.4%			
	Low	12.7%			
Job Appraisal					

Job satisfaction	High			36.5%	
	Low			45.7%	
Job stress	High	12.6%	52.5%	55.8%	55.3%
	Low	9.7%	46.3%	41.5%	42.2%
Work hours	High	13.3%	50.8.%		55.5%
	Low	10.3%	48.7%		46.6%
Noise Levels	High	47.8%	51.3%	56.0%	
	Low	35.9%	49.2%	46.0%	
Work/Life balance problems	High		55.2%		52.7%
	Low		44.6%		47.3%
Accidents at work	High	24.1%	39.9%	73.0%	58.4%
	Low	10.8%	30.6%	48.7%	49.3%
Cognitive failures at work	High	13.6%	67.3%	55.2%	56.5%
	Low	10.5%	41.8%	48.0%	46.9%
Personality					
Openness	High				50.5%
	Low				49.5%
Conscientiousness	High		41.2%		52.7%
	Low		59.7%		52.7%
Extraversion	High				52.6%

	Low				47.3%
Neuroticism	High		60.4%		58.9%
	Low		40.0%		51.0%
Agreeableness	High		41.8%		45.7%
	Low		58.2%		54.3%
Mental Health					
Anxiety	High		40.5%		52.1%
	Low		59.8%		47.9%
Depression	High				51.0%
	Low				49.1%
Driving					
Driving in heavy traffic	High			68.2%	
	Low			30.8%	
Motorway driving	High			71.0%	
	Low			34.3%	
Driving in bad weather	High			80.5%	54.5%
	Low			38.8%	47.8%
Others' rating of driving	Bad	14.1%	60.5%		
	Good	9.7%	42.3%		
Driver fatigue	High	13.9%	66.6%	-	49.9%

	Low	9.0%	51.9%	-	50.1%
Driving behaviour	High	13.4%	-		53.2%
	Low	9.5%	-		46.8%
Risk taking	High	14.7%	53.6.%		-
	Low	10.5%	48.5%		-

Note. Outcome variable data is displayed at 'high' level

A logistic regression was then conducted (Appendix 1). The full model significantly predicted RTCs (omnibus $\chi 2 = 84.88$, $df = 33$, $p = .001$). The model accounted for between 34% and 68% of the variance in RTCs. The Hosmer and Lemeshow test indicated a good model fit: $p = .803$. Analysis of the demographic, job, personality, mental health and driving variables revealed that the following were risk factors for RTCs:

- Being single
- Being a younger driver
- Having a job with high levels of noise
- Working long hours
- Low levels of respect at work
- Having pressure at work
- Having an accident at work
- Frequently driving when fatigued
- Inappropriate driving behaviour
- Higher levels of risk taking
- Being rated by others as a bad driver

Table 5.4 contains the co-efficient, Wald statistics and probability values for each of the predictor variables.

Table 5.4

Logistic Regression: RTCs

	β	Std. Error	Wald Stat	Exp (β)	95 % Confidence Interval for Exp (β)	
					Lower	Upper
Demographics						
Being Single	.358*	.139	6.66	1.43	1.09	1.88
Being Younger	.392*	.145	7.31	1.48	1.11	1.97
Education	-.327	.137	.569	.721	.551	.943
Salary	.231	.147	2.47	1.26	.945	1.68
Gender	.010	.155	.004	1.01	.745	1.37
Job Characteristics						
Low Choice	-.177	.095	1.25	.921	.765	1.16
High Demand	-.126	.158	.629	.882	.647	1.20
High Pressure	.010*	.156	4.00	1.20	1.02	1.41
Less Control Over Decision Making	-.029	.153	.037	.971	.719	1.31
Low Support	.037	.151	.061	1.04	.771	1.40

High Reward	.170	.155	1.19	1.91	.874	1.61
Low Respect	.290*	.163	3.94	1.41	1.39	1.03
Long Work Hours	.291*	.144	4.06	1.34	1.01	1.77
High Noise Levels	.304*	.152	3.99	1.36	1.01	1.83
Job Appraisal						
Low Job Satisfaction	-.018	.157	.014	.982	.722	1.34
High Job Stress	.168*	.143	4.37	1.03	1.18	1.39
High Work/Life Balance Problems	-.058	.147	.155	.944	.708	1.26
Accidents/Cog Failures						
Having an Accident at Work	.840***	.241	12.16	2.32	1.45	3.71
Cognitive Failures at Work	.250	.145	2.97	1.28	.966	1.71
Personality						
High Openness	-.012	.129	.009	.988	.768	1.27
Low Conscientiousness	.071	.137	.265	1.07	.820	1.40
High Extraversion	.219	.137	2.55	1.25	.952	1.63
Low Agreeableness	-.025	.135	.035	1.03	.787	1.34
High Neuroticism	.069	.152	.204	1.07	.795	1.44
Mental Health						
High Anxiety	-.263	.151	3.01	.769	.571	1.04
High Depression	.084	.146	.319	1.09	.812	1.46

Driving/Risk Taking						
Driving in heavy traffic	.025	.149	.028	1.03	.765	1.37
Motorway driving	.012	.145	.006	1.01	.755	1.36
Driving in bad weather	.020	.156	.016	1.02	.751	1.39
Others' rating of driving (negative)	.448***	.132	11.57	1.59	1.23	2.04
Frequent driving when fatigued	.337*	.149	5.08	1.40	1.05	1.89
Poor driving behaviour	.356*	.138	6.68	1.43	1.09	1.87
High risk-taking	.233*	.132	4.13	1.26	1.15	1.64

Note. $N = 2751$; *$p = 0.05$, ***$p = 0.01$

5.3.5 Driving Behaviour

The univariate analyses indicated that poor driving behaviour was associated with:

- Being single
- Being younger
- Higher levels of stress at work
- High noise exposure at work
- Work-life-balance problems
- Cognitive failures at work
- Having an accident at work
- Low levels of conscientiousness
- High levels of neuroticism
- Low levels of agreeableness

- Low levels of anxiety
- Lower control over decision making at work
- Frequently working long hours
- Higher levels of risk taking
- Lower levels of driving skill ratings (by others)

When these risk factors were entered into a logistic regression (Appendix 2), the full model significantly predicted driving behaviour (omnibus $\chi 2 = 348.00$, $df = 32$, $p < .001$) and accounted for between 15% and 21% of the variance in driving behaviour, with lower levels of poor driving behaviour correctly predicted in 66% of cases; higher levels of poor driving behaviour correctly predicted in 67.8% of cases, giving an overall percentage of 66.9% – a 10% increase on the intercept model. The Hosmer and Lemeshow test indicated a good overall fit for the model, $p = .752$. Table 5.5 details the coefficient, Wald statistics and probability values for each predictor variable. Poor driving behaviour was found to be associated with:

- Younger drivers
- Less control over decision making at work
- High work/life balance problems
- High perceived stress at work
- Long working hours
- Higher levels of cognitive failure at work
- Low levels of conscientiousness and agreeableness
- High levels of neuroticism
- Low levels of anxiety

- Higher levels of risk taking
- Frequently driving whilst fatigued
- Others' rating the driver badly

Table 5.5

Logistic Regression – Driving Behaviour

	β	Std. Error	Wald Stat	Exp (β)	95 % Confidence Interval for Exp (β)	
					Lower	Upper
Demographics						
Being Single	.024	.096	.064	1.03	.849	1.24
Being Younger	-.016*	.940	4.03	1.43	1.20	1.68
Education	-.0.74	.092	.653	.928	.775	1.12
High Salary	-.080	.099	.664	.923	.761	1.12
Gender	-.471	.110	1.50	.624	.504	.774
Job Characteristics						
High Demand	-.045	.106	.180	.956	.776	1.18
High Pressure	-.1.44	.106	1.84	.866	.704	1.07
Low Choice	-.044	.093	.220	.957	.798	1.15
Less control over decision making	.199*	.100	4.00	1.22	1.00	1.48

Low Support	-.060	.098	.372	.942	.777	1.14
Low Reward	.018	.099	.031	.983	.809	1.19
Low Respect	.134	.105	.015	.987	.803	1.21
Long Work Hours	.118*	.098	4.98	1.23	1.05	1.36
High Noise Levels	-.020	.095	.043	.981	.815	1.18
Job Appraisal						
Low Job satisfaction	-.049	.109	.217	.952	.775	1.17
High Job Stress	.218*	.107	5.13	1.24	1.02	1.51
High Work/Life Balance Problems	.384***	.086	19.97	1.47	1.24	1.74
Accidents/Cog Failures						
Having an Accident at Work	-.817	.100	.732	.818	.836	3.01
Cognitive Failures at Work	.206*	.451	4.67	1.26	1.05	1.33
Personality						
High Openness	.046	.090	2.10	.879	.775	1.17
Low Conscientiousness	-.570***	.089	40.09	1.77	1.48	2.11
High Extraversion	.124	.094	1.30	.901	.753	1.08
Low Agreeableness	-.518***	.089	33.53	1.67	1.41	1.99
High Neuroticism	.286*	.099	8.27	1.59	1.23	2.04
Mental Health						

Low Anxiety	.347*	.098	12.49	1.46	1.24	1.69
High Depression	-.024	.101	.057	.976	.702	1.03
Driving						
Driving in heavy traffic	-.065	.100	.418	.937	.770	1.14
Motorway driving	-.139	.101	1.91	.870	.714	1.06
Driving in bad weather	.356	.101	2.44	.943	1.17	1.74
Others' Rating of Driving (Bad)	.188***	.088	56.51	1.94	1.63	2.31
High risk- taking	663***	.068	19.99	1.48	1.25	1.76
Frequent driving when fatigued	.394***	.100	43.51	1.21	991	1.47

Note. $N = 2751$; *$p = 0.05$, ***$p = 0.01$

5.3.6 Driver Fatigue

The univariate analyses indicated that frequent driving when fatigued was associated with:

- Being single
- Being a younger driver
- Having pressure at work
- High stress at work
- Exposure to high noise levels
- Lower levels of job satisfaction

- High incidences of accidents and cognitive failures at work
- More frequent driving in heavy traffic
- Frequent motorway driving
- Frequent driving in bad weather

The variables were entered into a logistic regression (Appendix 3; Table 5.6). The full model significantly predicted driver fatigue (omnibus $\chi 2 = 820.68$, $df = 32$, $p < .001$), and accounted for between 28% and 38% of the variance in driving fatigue, with lower levels of driver fatigue correctly predicted in 76.5% of cases; higher levels of driver fatigue correctly predicted in 71% of cases, giving an overall percentage of 70.2% – a 20.2% increase on the model without predictors. The Hosmer Lemeshow test yielded $p = .733$, suggesting a good model fit. The regression revealed that the risk factors significantly associated with driver fatigue are:

- Being single
- Being a younger driver
- High levels of pressure in the workplace
- Lower levels of job satisfaction
- High levels of stress at work
- Exposure to high noise levels at work
- Higher levels of reported failures of cognition and accidents in the workplace
- Frequently driving in heavy traffic
- Frequently driving on the motorway
- Frequently driving in adverse weather conditions

Table 5.6

Logistic Regression – Driver Fatigue

	β	Std. Error	Wald Stat	Exp (β)	95 % Confidence Interval for Exp (β)	
					Lower	Upper
Demographics						
Being Single	.298*	.107	7.79	1.27	1.03	1.55
Being Younger	.344***	.101	11.57	1.41	1.16	1.72
Education	.094	.099	.889	1.10	.904	1.33
Salary	.131	.101	1.67	1.14	.934	1.39
Gender	-.323*	.114	7.97	1.72	1.58	1.91
Job Characteristics						
High Demand	-.064	.118	.297	.938	.745	1.18
High Pressure	.256***	.087	8.72	1.29	1.09	1.53
Low Choice	.106	.104	1.05	1.11	.907	1.36
Less Control Over Decisions	.003	.112	.001	1.00	.805	1.25
Low Support	.001	.111	.325	1.00	.804	1.24
Low Reward	.190	.113	2.80	1.21	.968	.887
Low Respect	-.188	.121	2.43	.828	.654	1.05
Long Work Hours	.190	.113	2.84	1.25	1.01	1.45
High Noise Levels	.214***	.085	11.47	1.33	1.13	1.58

Job Appraisal						
Lower Job Satisfaction	.698***	.093	56.36	2.01	1.68	2.41
High Job Stress	.265*	.112	5.63	1.21	1.09	1.47
High Work/Life Balance Problems	-.095	.096	.996	.909	.754	1.10
Accidents/Cog Failures						
Having an Accident at Work	.561*	.247	5.14	1.19	1.06	1.29
Cognitive Failures at Work	.235*	.109	4.61	1.34	1.18	1.44
Personality						
High Openness	-.123	.093	1.74	.884	.737	1.06
Low Conscientiousness	0.44	.098	.205	1.05	.863	1.27
High Extraversion	.123	.095	1.56	1.13	.933	1.37
Low Agreeableness	.032	.096	.114	1.03	.856	1.25
High Neuroticism	.134	.109	1.51	1.14	.923	1.42
Mental Health						
High Anxiety	.047	.107	.195	1.05	.850	1.29
High Depression	.114	.127	1.13	1.12	.908	1.38
Driving						
Driving in heavy traffic	1.01***	.099	103.82	2.74	2.26	3.32
Motorway driving	.987***	.101	95.76	2.68	2.20	3.27

Driving in bad weather	1.39***	.116	142.76	3.99	3.18	5.01
Others rating of driving (bad)	.079	.095	.698	1.08	.899	1.30
Poor driving behaviour	.073	.100	.536	1.06	.885	1.31
Risk-Taking	.055	.104	.277	.947	.773	1.16

5.3.7 Risk-Taking

The univariate analyses showed that more frequent risk-taking was associated with:

- Being single
- Having a higher salary
- High job demands
- High control over decision making
- High levels of choice at work
- Higher job stress
- Long working hours
- More work-life-balance problems
- More accidents and cognitive failures at work
- Greater openness, neuroticism and extraversion
- Lower conscientiousness and agreeableness
- Higher anxiety and depression
- More likely to drive in bad weather
- Less frequent driving when fatigued

- Higher levels of poor driving behaviour

The full logistic regression model (Appendix 4) significantly predicted risk-taking (omnibus $\chi 2 = 158.25$, $df = 32$, $p < .001$) and accounted for between 58% and 77% of the variance in risk-taking, with lower levels of risk taking correctly predicted in 65.5% of cases; higher levels of risk-taking correctly predicted in 61.7% of cases, giving an overall percentage of 63.6% – a 6.1% increase on the model without predictors. The Hosmer and Lemeshow test indicated a good fit for the overall model - $p = .656$. Risk-taking was found to be significantly associated with:

- Being single
- Earning a higher salary
- High levels of demand at work
- High job stress
- Long working hours
- Higher reports of accidents and cognitive failures at work
- Higher levels of choice and decision-making at work
- High levels of openness and extraversion
- Lower conscientiousness and agreeableness
- Frequently driving in bad weather
- Less frequently driving while fatigued
- High levels of poor driving behaviour

Table 5.7 gives the coefficient, Wald statistic and probability values for each predictor.

Table 5.7

Logistic Regression – Risk-Taking

	β	Std. Error	Wald Stat	Exp (β)	95 % Confidence Interval for Exp (β)	
					Lower	Upper
Demographics						
Being Single	.206*	.091	5.11	1.23	1.03	1.47
Being Younger	.162	.088	3.39	1.18	.990	1.40
Education	.083	.086	.932	1.09	.918	1.29
Higher Salary	.508***	.088	32.97	1.66	1.39	1.98
Gender	.077	.093	.680	1.08	.899	1.29
Job Characteristics						
High Levels of Demand	.288*	.085	4.98	1.33	1.13	1.58
High Pressure	-.056	.103	.299	.945	.772	1.16
High Levels of Choice	.134***	.091	12.16	1.30	1.11	1.56
High Levels of Decision Making	.364***	.098	13.89	1.20	1.07	1.46
Low Support						
Low Reward	.297	.100	3.35	.695	.578	.581
Low Respect	-.104	.106	.968	.901	.732	1.11
Long Work Hours	.256*	.081	9.99	1.29	1.10	1.51
High Noise Levels	-.060	0.92	.426	.942	.786	1.13

	-.121	.094	1.65	.886	.647	1.20
Job Appraisal						
Job Satisfaction	-.012	.103	.015	.988	.807	1.21
High Job Stress	.339***	.097	12.14	1.40	1.21	1.72
High Work/Life Balance Problems	.132	.083	2.51	1.14	.969	1.34
Accidents/Cog Failures						
Having an Accident at Work	.121*	.202	13.60	1.19	1.05	1.68
Cognitive Failures at Work	.279*	.095	8.56	1.32	1.10	1.60
Personality						
High Openness	0.72*	.081	4.79	1.08	1.02	1.26
High Conscientiousness	-.261*	.089	8.58	1.30	1.09	1.55
High Extraversion	.267*	.086	9.08	1.24	1.05	1.47
High Agreeableness	-.401***	.087	21.46	1.49	1.26	1.77
High Neuroticism	-.167	.095	3.05	.847	.702	1.02
Mental Health						
High Anxiety	.137	.094	2.10	1.15	.953	1.38
High Depression	.034	.093	.104	1.06	.859	1.24
Driving						
Driving in heavy traffic	.024	.097	.063	1.03	.847	1.24

Motorway driving	-.099	.098	1.03	.906	.748	1.10
Driving in bad weather	.234*	.098	5.724	1.26	1.04	1.53
Others rating of driving (negative)	.009	.087	.011	1.01	.852	1.20
Less driving when fatigued	.420***	.098	18.54	1.52	1.26	1.84
Poor driving behaviour	.392***	.088	19.79	1.48	1.25	1.76

Note. $N = 2751$; *$p = 0.05$, ***$p = 0.01$

5.3.8 Combined effects

As described in chapter two, a combined effects approach was employed to examine the impact of individual risk factors in combination with other risks. To achieve this, the risk factors identified in the analysis were combined and then split into quartiles. Logistic regressions were used to achieve the cumulative odds ratios.

5.3.8.1 RTCs

The combined effects analysis (Appendix 5) revealed that younger, single drivers working long hours in high pressured, noisy environments with low levels of respect, reporting a high level of accidents in the workplace who often drive when fatigued, exhibit higher levels risk-taking and poor driving behaviour and rated as a bad driver by others were cumulatively 2.90 times more likely to be involved in an RTC. The quartile values are presented in Table 5.8.

Table 5.8

Quartiles Displaying Cumulative Odds Ratios for RTCs

	β	**Std Error**	**Wald Statistic**	**Exp (β)**	**95% Confidence Interval for EXP(β)**	
					Lower	**Upper**

Quartile 1	.572***	.168	11.59	1.77	1.28	2.46
Quartile 2	.785***	.173	20.46	2.19	1.56	3.08
Quartile 3	1.07***	.175	37.24	2.90	2.06	4.09

Note. *N = 2751 *p <.001*

5.3.8.2 Driving behaviour

Combined effects (Appendix 6) revealed that for the risk factors identified - being younger, high levels of work/life balance problems, high perceived stress at work, long working hours and high incidences of cognitive failures at work and less control over decision making at work, coupled with high levels of neuroticism, low levels of conscientiousness agreeableness and anxiety, higher propensity toward risk taking, more frequently driving whilst fatigued and others' rating the driver badly were 1.42 times more likely to engage in poor driving behaviour. The quartile values are displayed in Table 5.9.

Table 5.9

Quartiles Displaying Cumulative Odds Ratios for Poor Driving Behaviour

	β	**Std Error**	**Wald**	**Exp(β)**	**95% Confidence Interval for EXP (β)**	
					Lower	**Upper**
Quartile 1	.222*	.113	3.87	1.25	1.00	1.56
Quartile 2	.132	.112	11.38	1.14	.916	1.42
Quartile 3	.535*	.101	12.09	1.42	1.16	1.73

Note. *N = 2751 *p = 0.05*

5.3.8.3 Driver fatigue

The combined risk factors for driver fatigue, namely being single, a younger driver, in a job with high levels of stress, pressure, noise and higher levels of reported cognitive failures and accidents in the workplace, as well as frequently driving in heavy traffic on the motorway and inn adverse weather conditions yielded a 16.73-fold increase in driver fatigue (Appendix7). The quartile values are presented in Table 5.10.

Table 5.10

Quartiles Displaying Cumulative Odds Ratios for Driver Fatigue

	β	Std Error	Wald Statistic	Exp (β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Quartile 1	1.20*	.141	72.53	3.33	2.52	4.40
Quartile 2	1.89*	.159	142.81	6.59	4.83	8.98
Quartile 3	2.82*	.156	332.37	16.73	12.36	22.65

Note. *N = 2751 *p = 0.05*

5.3.8.4 Risk-taking

The additive effects of risk-taking; being single, earning a higher salary in a demanding job, with high levels of stress, long working hours with higher levels of choice and decision making and high incidences of cognitive failures and accidents at work, with low levels of conscientiousness and agreeableness but higher levels of extraversion and openness, coupled with less frequently driving when fatigued, frequently driving in bad weather and engaging with higher levels of poor driving behaviour result in a 2.06-fold increase in risk-taking behaviours (Appendix 8). The quartile values are presented in Table 5.11.

Table 5.11

Quartiles Displaying Cumulative Odds Ratios for Risk-Taking

	β	Std Error	Wald Statistic	Exp(β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Quartile 1	.269*	.125	4.59	1.31	1.02	1.67
Quartile2	.631**	.101	38.97	1.88	1.54	2.29
Quartile 3	.724**	.110	43.55	2.06	1.66	2.56

Note. *N = 2751; *p = .0.05 **p<.001*

5.4 Discussion

The aim of this study was to examine potential associations between RTCs, driving behaviour, driving fatigue and risk-taking with demographics, mental health, personality, job characteristics and accident/cognitive failures at work.

In line with the research hypothesis, the established predictors were evident, affording greater confidence in the novel variables examined. Given that humans are complex and likely to possess multiple variations of the predictors (such as personality traits and job characteristics) it is of utility to appraise how the predictors in combination increase the chances of RTCs, poor driving behaviour, driver fatigue and risk-taking. To address this, a combined-effects approach was used, whereby the additive effects of the significant predictors reveal cumulative odds ratios of the outcome variables. This revealed a staggering 16.73-fold increase of driver fatigue when drivers are single, younger, drive often in heavy traffic, on the motorway and in adverse weather conditions and engage in employment which is low in job satisfaction but higher in stress, pressure and noise, and report more incidences cognitive failures and accidents during working hours. Arguably, such conditions may be typical of many blue-collar roles. In addition, the outcome variables were included as predictor variables in a series of analyses, such that the potential mechanisms underpinning unsafe driving may be unpicked. For example, much of the extant literature points to

personality traits such as extraversion (Brown et al., 2017) neuroticism, (Alavi et al., 2017) agreeableness, (Benfield et al., 2006) openness (Wåhlberg et al., 2017) and conscientiousness (Arthur & Doverspike, 2001) as being predictive of RTCs; whereas the present analysis found that such traits do not directly influence RTCs, but rather, they impact driving behaviour and risk-taking - both predictors of RTCs. Such insights afford valuable information on potential causality, enabling more tailored interventions for drivers. By way of illustration, if certain personality traits are involved in risk-taking and poor driving behaviour, the identification of such traits in the learner driver, or drivers attending National Driver Offender Retraining courses could stimulate educational instruction designed to mitigate poor driving and risk-taking behaviour.

Demographics feature heavily in the literature in terms of the connection between age and marital status and RTC causation (Barraclough et al., 2016). The current analysis bears this out, as well as identifying that both demographics are associated with driver fatigue. Surprisingly, an association between salary and risk-taking emerged, in that the higher the salary, the higher the propensity to engage in risk-taking behaviour. This is somewhat demonstrated in studies of entrepreneurs who tend toward higher earnings (Macko & Tyszka, 2011) (although this is not exclusive), notably due to the risk-taking nature of owning one's own business. More research into this finding would be of interest to ascertain whether this association might be explained by entrepreneurship as is suggested here, or whether there are certain forms of employment which, as well as attracting higher salaries, also have characteristics which lend themselves to risk-taking behaviours.

Of the driving variables examined, consistent with the existing literature, RTCs were found to be associated with fatigue and poor driving behaviour, whilst poor driving behaviour was linked with risk-taking behaviour. Both RTCs and poor driving behaviour were related with the subjective measure of others' rating of the driver. Put simply, if other people believe you to be a poor driver, then you probably are. Both driver fatigue and risk-taking were associated with driving in poor weather; driver fatigue, perhaps understandably also linked to motorway driving, driving in heavy traffic and in adverse weather—endeavours acknowledged as both mentally and physically taxing (Lyu et al., 2017). Mental health, specifically anxiety and depression have not been studied extensively with regard to RTC, driving behaviour, driver fatigue or risk-taking. The current study did not find associations in

this remit, except for anxiety and driving behaviour, which were found to be negatively associated. This may be explained by anxiety causing an individual to drive more carefully due to anxieties surrounding mortality as well as heightened states of vigilance – often features of the disorder (Iverach et al., 2014).

Changing focus, the present analysis sought to further analyse the potential impact of accidents and cognitive failures at work. Previously, these have been found to be strongly predictive of driving errors, with such errors being acknowledged as causal of RTCs. Here, we identified that cognitive failure is also predictive of poor driving behaviour. Considering this, it is tentatively suggested that the development of a driving-oriented cognitive failure scale - possibly an amalgam of the DBQ (Reason et al., 1990) and a cognitive scale such as the Cognitive Failures Questionnaire (Broadbent et al., 1982) may be of use in the identification of drivers prone to errors and violations before RTC involvement occurs.

Remaining with the impact of employment upon driving, perhaps the most enlightening findings in the current study are those connected with job characteristics and appraisals. Whilst there is a dearth of research focusing on the public and the impact of work environment on driving, issues with work-life balance, as well as a negative work environment have been implicated in unsafe commuting behaviour (Turgeman-Lipo & Biron, 2017). The present study found that just as with professional drivers, long work hours and high noise levels, as well as lower levels of choice and respect in the workplace and high levels of pressure (typically indicative of the blue-collar type employment) were associated with RTCs. Driver fatigue was predicted by jobs with high levels of pressure, low levels of job satisfaction, high levels of perceived job stress as well as high levels of noise and incidences of accidents and cognitive failures in the workplace. Previous studies, such as that of Smith (2016) uncovered an association between long work hours and noise in combination as being predictive of driver fatigue - here we have teased apart the variables and found that, perhaps counter-intuitively, high levels of noise in the workplace predict fatigue, as opposed to long working hours. Perhaps most interesting are the findings connected to job appraisals/characteristics and driving behaviour. Driving behaviour is defined as the way a person chooses to drive, with this perceivably underpinned by attitudinal dynamics (Reason et al., 1990). The current findings bear this notion out. High levels of decision making (also referred to as job control), perceived job stress, issues of work-life balance and long working

hours were significant predictors of poor driving behaviour. It is proposed that high levels of decision making at work may lend themselves toward a more blasé attitude toward following the 'rules of the road' and thus contribute to the types of poor driving behaviour, such as indicating hostility to other drivers and speeding. Similarly, working long hours may create a sense of frustration and urgency in drivers to reach their destination, leading to similar violations on the roads. Of the appraisals, perceived job stress and work-life balance appear to be associated with poor driving behaviour. Taken together, it may be argued that these predictors change the attitudinal dynamics of drivers, supportive of the assertions of Reason et al. If this is the case, just as with professional drivers, in-depth, longitudinal inquiry into the impact of work environment on driving behaviour is warranted.

It should be noted that the present study has several methodological and analytical limitations. The first limitation is the cross-sectional nature of the research, which makes attribution of causality problematic. Secondly, the analysis did not consider the effect of interactions between the variables, interpreting the models as additive rather than potentially multiplicative. Third, criticisms have been levelled at self-report questionnaires as measures of driving behaviour in relation to possible issues with external validity and reliability, due to this method of data collection being vulnerable to social desirability bias in comparison to other methods - such as behavioural observation (West et al., 1993). Finally, the participants were recruited based on an opportunity sample, with females overrepresented (68% of sample). Whilst the sample size was reasonably large, it would be of benefit to observe how the current findings may differ from those of a sample drawn randomly from the entire population. These limitations form the basis for suggested future directions; future studies should be longitudinal in nature, using random sampling (if practicable) with logistic regression models tested for interactive effects. In addition, the incorporation of a 'lie scale' relevant to driving, such as the Driver Social Desirability Scale (Lajunen et al., 2017) ought to address issues surrounding social desirability bias and self-report measures of driving behaviour

5.5 Chapter Summary and Links to Chapter Six

The current study has found evidence of the established predictors of RTCs, driving behaviour, risk-taking and driver fatigue, as well as identified novel factors which may lead to a greater appreciation of the complex machinations underpinning RTC involvement.

Notably, the findings relating to job characteristics/appraisals and driving behaviour are of particular interest and should form the basis of further research. Given the findings in relation to the impact of the workplace on driving, the following chapter investigates whether driving outcomes may differ depending on when driving is taking place – for example, as part of a commute or during leisure time.

Chapter Six

Study Three

6.1 Introduction and Rationale

Given the associations found thus far, this research aims to further explore the underpinnings of RTC involvement – just as other situations can be predicted by different

factors dependent on the setting, the analyses examined whether there were different predictors depending on whether the driver was driving as part of the commute to and from work, when travelling as part of their job (during the working day) or when driving during leisure time. The impact of such insights could be far reaching, enabling employers and policy makers to design tailored interventions supportive of road users achieving more positive safety behaviour.

The predictors examined have been chosen as they have previously been associated with either RTC involvement or risk-taking behaviour (detailed in Table 6.1). The study hypothesis was that different predictors will emerge as significant depending on when the RTC took place: driving to work, driving home from work, driving as part of a job (class 1 in insurer parlance), or driving during leisure time. This information was available from a study investigating risk factors for health and safety (Smith, et al., 2000a, b) and secondary analyses addressing the current hypothesis are reported here.

Table 6.1

Variables of Interest

Variables of interest – RTC/risk-taking			
Demographics	**Fatigue/perceived stress/mental health**	**Accidents/cognitive failures/RTC**	**Work/life balance**
Age	Life stress	Accidents outside work (minor injury)	Family reducing time for work
Gender	Work stress	Accidents at work	Family obligations reducing time to relax
Salary	Fatigue	Cognitive failures at work	Family obligations reducing time to sleep
Marital status	Anxiety	Cognitive failures outside work	Frequent socialising with friends outside work
Job role	Depression	High levels of RTCs (as the driver)	Frequent socialising with work colleagues
Job appraisal		**Job characteristics**	
Bullying stress	Satisfaction with conditions	Long, unsociable hours	High levels of fumes
Satisfaction with prospects/pay	Satisfaction with running of organisation	Unpredictable hours/frequently on call	Handling harmful substances

Satisfaction with use of abilities	Satisfaction with work colleagues	High noise at work	Night work

6.2 Method

6.2.1 Participants

Eight accident and emergency units participated in the research. They were selected to be representative of cities and similar towns in different geographical locations. These were: The University of Wales Hospital, Cardiff; Prince Philip Hospital, Llanelli; Glan Clwyd Hospital, Rhyl; Wrexham Maelor Hospital, Wrexham; Royal Gwent Hospital, Newport; Morriston Hospital, Swansea; West Wales General Hospital, Carmarthen and Princess of Wales Hospital, Bridgend. The final sample size was 2488, of which 1229 were female (49.4%).

The Accident and Emergency Study was approved by the Multi-Research Ethics Committee for Wales. In addition, approval was obtained from all the relevant Local Research Ethics Committees, and from all the relevant NHS Research and Development Committees.

6.2.2 Design and Procedure

Each unit was asked to select: 1000 individuals aged between 18 and 40 years who had attended following an accident at work in the previous six months; 1000 individuals aged between 18 and 40 years who had attended following a road traffic, sports, or home accident in the previous six months; and 500 individuals aged between 18 and 40 years who had attended for a non-trauma (a medical) reason. They selected the most recent attendees who fitted the criteria, up to a maximum of 2500, and they never went beyond the six-month cut off. Two of the smaller accident and emergency units were unable to reach the required numbers, so they sent as many as possible before the six-month cut off.

Upon receipt of all relevant ethical approval each individual selected was sent one copy of the questionnaire, a covering letter and a freepost return envelope. There was no

reminder or follow-up questionnaire, and it was requested that all respondents kept their anonymity.

6.2.3 Measures

The study was an anonymous postal questionnaire survey. No identifiers were attached to the questionnaires, and no identifying details were requested. There was, therefore, no reminder or follow-up questionnaire.

The questionnaire and covering letter were based on those used in the Bristol Stress and Health Study (Smith, 2000), with additional sections on accidents at work (based on the HSE proforma). RTC involvement was measured by asking participants to indicate whether they had been involved in any traffic collisions in the last twelve months (responses ranging from 0-6+) and if so, whether they were the driver at the time of the collision. RTC occurrence was measured by asking the participant to indicate when the collision occurred (on your way to work; on your way home from work; travelling outside your workplace as part of your job; travelling within your workplace; other).

6.3 Results

6.3.1 Derived Scores

All variables were dichotomised using a median split and categorised into 'high or low'. When the RTC occurred was split into commuting, travelling as part of work and travelling in leisure time to examine whether RTC occurrence is predicted by different variables, dependent on the reason for the journey.

6.3.2 Logistic Regression – Risk-Taking

A logistic regression (using the ENTER) method was conducted with risk-taking as the dependent variable (Appendix 9). The full model significantly predicted RTCs (omnibus $\chi 2 = 241.57$, $df = 28$, $p = .001$). The Hosmer and Lemeshow test indicated a good model fit: $p = .827$. The model accounted for between 13% and 21% of the variance in risk-taking. Table 6.2 gives the coefficient, Wald statistics and probability values for each of the significant predictor variables. Overall, 94.3% of predictions were accurate, an 11.3% increase on the intercept model.

Analysis of the demographic, job (characteristics and appraisal), mental health, fatigue, stress, accidents, cognitive failures (both in and outside work) and RTCs revealed the following significant factors in risk-taking:

- Being male
- Being stressed by bullying at work
- Earning a higher salary
- Low satisfaction with job prospects
- Family life reducing time for work
- Being younger
- High levels of life stress
- Frequently working at night
- High levels of anxiety
- Having a minor injury outside work
- Being the driver in an RTC
- Frequently socialising with friends

Table 6.2

Logistic Regression – Risk-Taking

	β	**Std. error**	**Wald statistic**	**Exp (β)**	**95% confidence interval for EXP(β)**	
					Lower	**Upper**
Demographics						
Younger driver	.676**	.154	19.32	1.97	1.45	2.66
Male	.904**	.175	26.80	2.47	1.92	3.32
Higher salary	.439*	.181	5.87	1.55	1.09	2.21
Fatigue/perceived stress						

Life stress	.730**	.222	10.79	2.08	1.34	3.21
Accidents/cognitive failures						
Accidents outside Work (minor injury)	.617**	.145	18.10	1.85	1.39	2.46
High levels of RTCs (as the driver)	.244*	.228	11.14	1.28	.816	1.99
Mental health						
High anxiety	.467*	.161	8.48	1.60	1.17	2.19
Job characteristics						
Night work	.340*	.160	4.51	1.40	1.03	1.92
Job appraisal						
Bullying stress	.541*	.260	4.32	1.72	1.03	2.87
Low satisfaction with pay/prospects	.371*	.183	4.12	1.45	1.01	2.07
Work/life balance						
Family reducing time for work	.395*	.163	5.88	1.49	1.08	2.04
Frequently socialising with friends outside work	.492*	.178	7.63	1.64	1.15	2.32

Note. * = $p<.05$; ** = $p<.001$

6.3.3 Multinomial Logistic Regression – RTC Occurrence

All variables were entered into the regression (Appendix 9) to examine whether there were unique predictors depending on when the RTC took place (commuting to and from work; travelling as part of work; travelling in leisure time). Only cases where the participant was the driver (as opposed to a passenger, pedestrian, or cyclist) were analysed. The

reference variable was 'No RTC'. Additions to a model containing only the intercept significantly improved the fit between the model and data, omnibus $\chi 2$ (df = 270, n = 2488) = 383.41, Nagelkerke R^2 = .23, p <.05. As illustrated in Table 6.3, significant unique contributions were made for RTCs occurring on the way to work by job stress, having a minor injury at work and being in a job with high levels of noise (resulting in a ringing in the ears); RTCs occurring on the way home from work were predicted by high levels of family distractions (reducing time for work), bullying at work and being female; RTCs during leisure time were predicted by failures of cognition outside work, low levels of satisfaction with the running of the organisation in which they are employed, harassment at work, high levels of risk-taking and frequently socialising with friends; RTCs occurring when travelling as part of the job were predicted by failures of cognition outside work, low levels of satisfaction with ability, being younger, harassment at work and working long, unsociable hours, frequently on-call (see Table 6.4). Goodness of fit was ascertained by conducting Hosmer Lemeshow tests, which were not statistically significant.

Table 6.3

Multinomial Regressions of RTCs Occurring During Commute/Leisure Time

RTC Occurrence:							
Commuting to work[a]							
	Predictors	**β**	**Std. error**	**Wald statistic**	**Odds ratio EXP (β)**	**95% confidence interval for EXP (β)**	
						Lower	**Upper**
Perceived stress:	Job stress	.904**	.365	6.13	2.47	1.21	5.05
Accidents:	At work	.249*	.498	12.50	1.28	.483	3.41
Job	High noise	.042**	.502	10.07	1.04	.390	2.79

characteristics:	Ringing in ears	1.20*	.569	4.42	3.31	1.09	10.08
Commuting from work[b]							
Demographics	Gender: female	.724**	.426	13.76	2.33	.894	4.76
Job appraisals	Bullying stress	.839**	.612	11.88	2.31	.698	7.68
Work/life balance	Reduced time for work	.246**	.431	13.25	1.28	.549	2.98
Leisure driving[c]							
Cognitive failures:	Outside work	.678*	.331	4.20	1.97	1.03	3.77
Job appraisals:	Harassment	.163*	.694	10.55	1.18	.302	4.59
Low satisfaction with:	Running of organisation	.019*	.610	10.01	1.02	.308	3.37
Frequent socialising	With friends	.454**	.252	13.24	1.58	.960	2.58
High risk-taking	Outside work	.705*	.272	6.72	2.02	1.19	3.45

Note. [a] = $N = 51$; [b] = $N = 40$; [c] = $N = 127$; * = $p < .05$; ** = $p < .001$

Table 6.4

Multinomial Regressions of RTCs Occurring Whilst Driving as Part of a Job

RTC Occurrence: Travelling as part of job[d]	Predictors	β	Std. error	Wald statistic	Odds ratio EXP (β)	95% confidence interval for EXP (β)	
						Lower	Upper
Age	Younger driver	.272**	.582	12.18	1.76	.243	2.39
Cognitive failures	Outside work	1.05**	.748	11.97	2.86	.660	12.39
Work patterns	Frequently on-call	1.11**	.582	13.61	3.02	.966	9.46
Hours	Long, unsociable	1.76*	.737	5.72	5.82	1.37	24.67
Job appraisals	Harassment	.222*	.288	5.95	1.25	.710	2.20
Low satisfaction with							
	Use of abilities	.453*	.654	4.80	1.57	.437	5.66
Work/life balance:	Reduced time for work	.246**	.431	13.25	1.28	.549	2.98

Note. [d] = N =51; * = p <.05

6.4 Discussion

The aim of this study was to examine whether there were differing predictors of RTCs, depending upon when the driving takes place. First, an analysis was done of the variables in

relation to risk-taking (a known predictor of RTCs) to establish whether predictors previously found to be implicated, such as demographics, life stress, job characteristics or appraisals, issues of work/life balance and mental health (Bowen & Smith, 2019b) were present in the current sample, affording confidence in the more novel approach of analysing the predictors of when the RTC occurred. This was found to be the case. Certainly, the current findings provide some support for the hypothesis that RTCs are predicated by factors which differ according to when the collision occurs.

Commuting to and from work is perceivably when one ruminates over the day and as such, high levels of job stress and bullying at work may lead to a distracted, or even an aggressive style of driving, in which driving errors and violations are committed. Interestingly, harassment at work also features for those involved in collisions during leisure driving, suggesting that the impact of bullying and harassment at work lasts over a longer period. High levels of risk-taking were associated with collisions during leisure time as was frequent socialising with friends; it is possible this may be linked with personality traits previously found to be connected to extraverted individuals and driving (Bowen & Smith, 2019b).

Perhaps the most enlightening findings were those connected with driving as part of a job. Here, the predictors paint a picture of a highly pressurised environment, with individuals working long, unsociable hours, frequently on-call. Indeed, issues of work/life balance, specifically family issues reducing time for work, were significant predictors of collisions when driving as part of a job and when commuting home, again suggesting that effects of this pressure last over a longer period. Lack of satisfaction with the use of abilities at work, a factor for those driving as part of the job, also appeared to carry over into leisure time in the form of dissatisfaction with the running of the organisation within which the individual was employed.

The present findings call for an information campaign designed to make individuals and organisations more aware of the carry over effects of the job. Similarly, for those who drive as part of their employment, whether this is driving from site to site, or wider distances (such as the case with sales representatives or home carers) consideration ought to be given to

the levels of pressure under which these individuals are exposed. In terms of interventions, it is possible that for those instances where rumination may be a factor, mindfulness, a term used to describe a particular way of paying attention to the current moment, characterised by a receptive and non-judgemental attitude (Kabat-Zinn, 1994) may be of utility. The approach has received considerable empirical support in recent years and is potentially particularly suitable in the remit of driving, when one is encouraged to attend to the present moment, rather than being preoccupied (Sauer et al., 2012).

Whilst careful consideration was given to the methodology employed in this research, some limitations must be acknowledged, and these form the basis for recommended future directions. Firstly, the study was cross-sectional, and as such, causality is problematic. Along a similar vein, the data was based upon self-report which may have been biased to some extent with social desirability issues and respondent carelessness a possibility (discussed in depth by Bowling & Huang, 2018). Whilst encouragingly, self-reports focusing on driver behaviour have been found to be largely unbiased (Sullman & Taylor, 2010), methodological robustness would be improved by the inclusion of a social desirability scale in such research. In addition, longitudinal research would allow for an examination of causality. Sample size in the current study is reasonably small, this being perhaps an inevitable by-product of breaking overall RTC involvement into the different driving contexts. Finally, it would be beneficial to also examine the driving behaviour, annual mileage and driver fatigue variables used in other research (for example Bowen & Smith, 2019a,b) in order to fully examine the underpinnings of RTC involvement: for example, does bullying at work translate to higher propensity to commit driving violations, such as indicating hostility to other drivers and/or speeding, or does the psychological weight of rumination distract such as to lead to the driver making errors whilst driving, or becoming particularly fatigued? Further studies, exploring these variables, with larger sample sizes may hold the key to a more holistic approach in this regard.

6.5 Chapter Summary and Links to Chapter Seven

The present data has supported the notion that there are different predictors for RTCs, depending on the context of the driving – the Sunday afternoon leisure driver differs to the Monday morning commuter and this insight affords pause for thought for employers,

policymakers and drivers alike. The next chapter addresses some of the limitations outlined in the previous studies - such as sample size, survey length and social desirability bias to better understand how to measure driving outcomes in an optimal manner.

Chapter Seven

Study Four

7.1 Introduction and Rationale

In previous chapters it has been argued that issues of sample size, social desirability bias, and lengthy survey instruments may hamper or skew utility of research findings.

The systematic review in chapter two identified other variables associated with predictors of road safety. Anxiety, stress and depression were predictive of unfavourable driving (e.g., risk-taking, aggression, poor driving behaviour.) Driving discourtesy was found to not only induce stress reactions in drivers, but also led to riskier driving practice, such as deliberately engaging in intimidating driving behaviour. Negative personality traits were related to negative driving behaviours, with higher levels of well-being and life satisfaction appearing to safeguard drivers against deliberate driving violations. The review also revealed that most studies examine only a few predictors. Indeed, large epidemiological databases are required to identify the small effects of some predictors.

As detailed in chapter two, previous research often used commercial drivers with a high annual mileage. The present study aimed to test a model of driver safety that could be used

with a small sample of university students whose driving habits led to a low annual mileage (there are obvious challenges to sourcing student participants with high annual mileage). A sample of students were recruited and although they might be considered low risk because of their low mileage, insurance claims show they have a high risk of having an RTC. The key feature of the research was to examine whether a combined driver fatigue/poor driving behaviour/risk taking variable would predict driver safety in this sample. Other predictors, such as personality and measures from the wellbeing process (see below), were considered in studies one and two and were also included here to determine whether they could add to the model. The 'wellbeing process model' is a holistic approach to wellbeing and provides a theoretical framework that led to the development of a measuring instrument that would be useful in practice and policy. The initial approach was based on the Demands-Resources-Individual Effects (DRIVE) model which was developed for use in occupational stress research (Mark & Smith, 2008). This model included work characteristics, perceived stress, personal characteristics such as coping styles and negative outcomes (e.g., anxiety and depression). The next versions of the model (Smith, et al., 2010; Wadsworth, et al., 2009) also included positive factors such as psychological capital (self-esteem, self-efficacy and optimism), positive appraisals (e.g., job satisfaction) and outcomes (e.g., positive affect and happiness).

Previous research has identified a problem in using the wellbeing process model, in that it requires measurement of many variables and the use of long scales led to a questionnaire that was very lengthy and not very acceptable to the respondents. To remove this problem, short scales were developed, and these were found to be significantly correlated with the longer scales from which they were derived. The Wellbeing Process Questionnaire (WPQ - Williams & Smith; Williams et al., 2017) was developed using this approach. The questionnaires have been modified for use in research with students and a short form has been developed (the Smith Short Wellbeing questionnaire; Smith & Smith, 2017) which has also been used with students (Nor & Smith, 2019; Alharbi & Smith, 2019; Alheneidi & Smith, 2020). The main differences between the WPQ for workers and students reflect the type of stressors the two groups are exposed to.

Other features of the present approach included the use of a more sensitive measure of driver safety than RTC occurrence. This new outcome included incidents which involved

collisions requiring medical treatment, collisions requiring no medical treatment and near misses. The dynamics of near-miss involvement and its subsequent impact on driving are mixed in the literature to date, with some researchers pointing to an increase in caution, whilst others report a boost in confidence in one's ability, referred to as 'near-miss bias' (Terum & Svartdal, 2019). A second feature of the approach is the use of short measures so that a lot of different concepts could be investigated without producing a long questionnaire that would have a negative effect on engagement and compliance. Another feature was the addition of concepts that were identified as important in the literature review, but which had not been combined with the present model. Impulsivity and hostility were identified as having a significant effect on driving outcomes, and, as such, the present study included short-item measurements of these constructs.

Finally, a key limitation in research using self-report is that of the potential influence of Social Desirability Bias (SDB) defined as participants' propensity to provide 'desirable' answers to questionnaires to appear more socially acceptable, which may impact reliability and external validity of the data. Several studies have assessed this issue in the remit of driving behaviour (for example, Sullman & Taylor, 2010), finding that the DBQ is not particularly vulnerable to socially desirable responding. However, SDB has not yet been explored in the context of risk-taking, driver fatigue, near-misses, driver retraining and RTC involvement. Therefore, the present purpose is to assess whether these measures are subject to SDB.

7.2 Method

7.2.1 Participants

The study was approved by the Ethics Committee, School of Psychology, Cardiff University (EC.19.10.12.5809) prior to the recruitment of participants. Data were collected from 103 (85.4% female; age range 18-40, M_{age} = 20) undergraduate psychology students, all of whom had driven a motor vehicle in the last twelve months (Mean annual mileage = 5413; *SD* = 4259). The sample were recruited via the School's Experimental Management System (EMS) in return for partial course credit.

7.2.2 Materials

The 67 - item questionnaire comprised five sections, briefly detailed below.

Section 1: Student short SWELL, consisting of four established predictors of well-being: positive personality (high self-efficacy; self-esteem; optimism); healthy lifestyle; course demands; and academic control/support. The outcome measures are negative and positive well-being. Responses are recorded on a 10-point Likert scale (1= not at all; 10 = very much so).

Section 2: Ten-item personality scale (TIPI) measuring extraversion, opennness, neuroticism, agreeableness and conscientiousness. Responses are recorded on a 7-point Likert scale (1 = disagree strongly; 7 agree strongly).

Section 3: Impulsivity- short item scale measuring impulsivity, cynicism, anger and aggression. Responses are recorded on a 10-point Likert scale (1= not at all; 10= very much so). The scale returned satisfactory Cronbach Alpha reliability in the present study: $\alpha = .710$.

Section 4: Social desirability bias (SDB) was measured using the Brief Social Desirability Scale (BSDS; Haghighat, 2007). Comprising four questions, each item requires a yes/no response, of which only one is considered socially desirable. The scale has acceptable validity and reliability ($\alpha = .6$) and is free of gender specificity. Used for its brevity and practicality, the cut-off score can be set depending on the import of gleaning transparent responses from participants (> 1 socially desirable response to > 2 socially desirable responses).

Section 5: Questions relating to driving (Smith, 2016) measured via a 5-point Likert scale (1= never, 5= very often).

7.2.3 Design

Delivered via survey platform Qualtrics, this cross-sectional study was presented as an online survey. All questions were counterbalanced (achieved by way of randomisation within the software) to alleviate any potential order effects. The predictor variables were initially explored for associations with the outcome variables using univariate analyses, those returning significant chi-squares were then combined and entered logistic regressions to

assess cumulative effects. The reliability of the short items was assessed using correlations and Cronbach Alpha analyses.

7.2.4 Procedure

A detailed information sheet outlining the aims and procedure of the study for participants to give informed consent to take part was provided at study sign up. At the end of the survey the participants were thanked for their time, shown a debrief statement and awarded course credits for their participation.

7.3 Results

7.3.1 Short-Item: TIPI

A Cronbach Alpha analysis of the TIPI in the present study returned low reliability for trait conscientiousness ($\alpha = .653$), and moderate-to-strong reliability for extraversion ($\alpha = .819$); agreeableness ($\alpha = .829$); neuroticism ($\alpha = .701$); and openness ($\alpha = .753$).

7.3.2 Short-Item: Driver Fatigue

A correlation between the five individual items (frequency of driving when tired; with a minor illness such as a cold; after prolonged work; for long periods; late at night, in the early morning or post-lunch period) and one item (encompassing all items) revealed moderate to strong positive correlations between the individual items and the short item (see Table 7.2). This suggests that the use of a single item for the measurement of driver fatigue in future research offers satisfactory reliability and validity.

Table 7.2

Correlations of Single Items and Short Item for Driver Fatigue

	1	2	3	4	5
1 Drive tired	-				

2 Drive when ill	.612**	-			
3 Drive late/early	.597**	.578**	-		
4 Drive long periods	.534**	.370**	.485**	-	
5 Drive after prolonged work	.472**	.532**	.641**	.398**	-
6 Driver fatigue short item	**.679****	**.510****	**.719****	**.488****	**.585****

Note. *N = 103;* **Correlation is significant at the 0.01 level (2-tailed)

7.3.3 Social desirability

To assess the potential of social desirability bias in participants' self-report of driving behaviour, driver safety and risk-taking, scores on the social desirability scale were correlated with the outcomes. Scores on the social desirability scale were dichotomised into 'low' and high' at median split (*M* = 2.00). The correlations revealed no statistically significant association between low levels of poor driving behaviour, driver safety, high levels of risk-taking and high levels of social desirability bias. Therefore, the data were analysed as one group. The correlation coefficients can be found in Table 7.3.

Table 7.3

Correlation Co-Efficients: Social Desirability Bias

	1	2	3	4
1 Social desirability bias	1			
2 Driver safety	**.041**	1		
3 Driving behaviour	**.054**	.282**	1	
4 Risk-taking	**.091**	.306**	.374**	1

Note. *N = 103*; ** = Correlation is significant at the 0.01 level (2-tailed)

7.3.4 Univariate analyses

Cross-tabular analyses were performed to initially examine associations between the predictor and outcome variables. These effects can be found in in Table 7.4.

Table 7.4

Percentage of Participants in the Driver Safety (DS), Poor Driving Behaviour (DB), Driver Fatigue (DF) and High Risk-Taking (RT) Groups

		DF	RT	DB	DS
Well-being					
Healthy Lifestyle	High	-	-	-	-
	Low	-	-	-	-
Positive Personality	High	-	-	-	-
	Low	-	-	-	-
Life Satisfaction	High	-	-	-	-
	Low	-	-	-	-
Life Stress	High	-	-	-	-

	Low	-	-	-	-
Happiness	High	-	-	-	-
	Low	-	-	-	-
Anxiety/Depression	High	-	-	-	-
	Low	-	-	-	-
Worthwhile	High	-	-	-	-
	Low	-	-	-	-
Academic Characteristics					
Course Demands	High	-	46.0%	-	-
	Low	-	69.2%	-	-
Control/Support	High	-	-	-	-
	Low	-	-	-	-
Stress at university	High	-	-	-	-
	Low	-	-	-	-
Course satisfaction	High	-	-	-	-
	Low	-	-	-	-
Physical/mental tiredness	High	-	-	36.1%	-
	Low	-	-	59.7%	-
Efficiency	High	-	41.9%	-	-
	Low	-	69.5%	-	-

Presenteeism	High	-	-	-	-
	Low	-	-	-	-
Illness caused by university work	High	-	74.3%	-	-
	Low	-	48.5%	-	-
Anxiety/depression (due to academic work)	High	-	-	-	-
	Low	-	-	-	-
Issues of work/life balance	High	-	-	-	-
	Low	-	-	-	-
Happy at university	High	-	-	-	-
	Low	-	-	-	-
Impulsivity/Hostility/Risk-taking					
Impulsivity	High	-	69.5%	73.6%	-
	Low	-	37.2%	38.0%	-
Hostility	High	-	-	66.0%	-
	Low	-	-	32.0%	-
Risk-taking	High	57.9%	-	67.8%	54.2%
	Low	35.7%	-	30.2%	23.3%
Personality					
Extraversion	High	-	-	-	-
	Low	-	-	-	-

Conscientiousness	High	-	-	37.8%	-
	Low	-	-	62.1%	-
Openness	High	-	-	-	-
	Low	-	-	-	-
Agreeableness	High	-	-	38.8%	-
	Low	-	-	64.2%	-
Neuroticism	High	-	-	-	-
	Low	-	-	-	-
Driving					
Motorway driving	Frequent	65.5%	67.3%	66.1%	-
	Infrequent	24.4%	42.5%	32.6%	-
Driving in heavy traffic	Frequent	83.9%	-	68.8%	-
	Infrequent	31.9%	-	43.7%	-
Driving in poor weather	Frequent	63.9%	-	60.8%	-
	Infrequent	7.4%	-	25.0%	-
Others' rating of the driver	Poor	32.3%	-	-	-
	Good	73.7%	-	-	-
Poor driving behaviour	High	64.4%	75.5%	-	67.4%
	Low	29.2%	38.8%	-	32.6%
Driver fatigue	High	-	68.8%	70.8%	54.2%

	Low	-	47.1%	34.6%	30.8%
Driver retraining course	Yes	85.7%	-	-	-
	No	45.2%	-	-	-
Driver safety	Low	61.9%	76.2%	67.4%	-
	High	37.9%	45.0%	40.0%	-

Note. Outcome variable data is displayed at 'high' level; Percentages shown are those with significant effects between the groups, chi-square $p < .05$; $N = 103$

Driver fatigue was predicted by:

- High levels of risk-taking
- Frequent driving on the motorway, in heavy traffic and in poor weather
- Others' rating the driver as a good driver
- Poor driving behaviour
- Driver training course attendance
- Low levels of driver safety

Risk-taking was predicted by:

- Low levels of course demands
- Engaging with academic work less efficiently
- High levels of illness caused or made worse by university work
- High levels of impulsivity
- Frequently driving on the motorway

- Poor driving behaviour
- High levels of driver fatigue
- Low levels of driver safety

Poor driving behaviour was predicted by:

- Lower levels of physical and/or mental tiredness (at university)
- High levels of impulsivity, hostility and risk-taking
- Lower levels of conscientiousness and agreeableness
- Frequently driving on the motorway, in heavy traffic and in poor weather
- High levels of driver fatigue
- Low levels of driver safety

Driver safety (low safety = high RTC/near-misses) was predicted by:

- High levels of risk-taking
- Driver fatigue
- Poor driving behaviour

7.3.4 Logistic Regression

Binary logistic regressions were performed on each outcome variable (driver fatigue; risk-taking; driving behaviour, and driver safety (achieved by combining RTC occurrence with/without the necessity for medical assistance and near-misses). The predictor variables in each model comprised of those identified as significantly associated with each outcome in the univariate analyses (detailed above). Combined effects (in the context of odds ratios; OR) were calculated by combining and then splitting the predictors into tertiles to achieve cumulative odds ratios for each of the outcomes. The Hosmer and Lemeshow statistics were not statistically significant for any of the models, suggesting satisfactory model fits. The tertile values for each outcome can be found in Table 7.5.

7.3.4.1 Driver fatigue

The full model significantly predicted driver fatigue (omnibus $\chi 2 = 11.75$, $df = 2$, $p = .003$), accounting for between 11 and 14 percent of the variance in driver fatigue. Sixty-four percent of predictions were accurate, an increase of 13.5% on the intercept model. The combined impact of risk-taking, frequent driving on the motorway, in poor weather, reporting poor driving behaviour, being rated by others as a below average driver levels of driver safety and attendance on a driver retraining course yielded a 7.20 times increase in driver fatigue.

7.3.4.2 Risk-taking

The full logistic regression significantly predicted risk-taking (omnibus $\chi 2 = 16.71$, $df = 2$, $p = .001$). The model accounted for between 16 and 12 percent of the variance in risk-taking, with 70% of predictions accurate – a 12.4% increase on the intercept. The combined effects of low course demands, efficiency, high levels of illness caused by academic work, impulsivity, frequent driver fatigue, motorway driving, and low levels of driver safety resulted in a 7.20 times increase in risk-taking.

7.3.4.3 Driving behaviour

The full model significantly predicted driving behaviour (omnibus $\chi 2 = 9.04$, $df = 2$, $p = .01$); variance explained = 9 -12%. Sixty-two percent of predictions were accurate, an increase of 8.9% on the intercept. The combined effects of physical and mental illness precipitated by university work, high levels of impulsivity, hostility and risk-taking, low levels of conscientiousness and agreeableness, together with frequent driving on the motorway, in heavy traffic and in poor weather and driver fatigue and low levels of driver safety reveal a 4.00 times increase in poor driving behaviour.

7.4.3.5 Driver safety

The full model significantly predicted driver safety (omnibus $\chi 2 = 15.81$; $df = 2$, $p = .001$). The model accounted for between 15 and 20 percent of the variance in driver safety. Overall, 70% of predictions were accurate, a 14.4% increase on the intercept model. The combined effects of poor driving behaviour, high risk-taking and frequent driver fatigue revealed a 9.00 times increase in the occurrence of lower driver safety (RTC/near-misses).

Table 7.5

Tertiles Displaying Cumulative Odds Ratios for Driver Fatigue, Risk-Taking, Driver Behaviour and Driver Safety

	β	Std.Error	Wald Statistic	Odds Ratio Exp (β)	95% Confidence Interval for Exp (β)	
					Lower	Upper
Driver fatigue						
Tertile 1[a]			10.05			
Tertile 2	.547*	.484	1.27	1.73	.669	4.46
Tertile 3	1.97*	.626	9.94	7.20	2.11	24.56
Risk-taking						
Tertile 1[a]			14.81			
Tertile 2	1.07*	.586	3.34	2.92	.925	9.21
Tertile 3	1.97**	.517	14.58	7.20	2.61	19.82
Driving behaviour						
Tertile 1[a]			8.35			
Tertile 2	.526	.515	1.04	1.69	.617	4.64
Tertile 3	1.51*	.525	8.25	4.51	1.61	12.62

Driver safety	1.40***	.436	10.33	4.06	1.73	9.56
Tertile 1[a]			13.72			
Tertile 2	.492	.594	.688	1.64	.511	5.24
Tertile 3	2.20***	.676	10.56	9.00	2.39	33.87

Note. *N = 103; * p = <.05; *** p = .001;* [a]= reference

7.4 Discussion

This research explored the utility of short-item measurements, the potential presence of social desirability bias and the impact of newer variables. The following discussion provides a summary of the findings in respect of the study aims, as well as a consideration of the similarities and differences of findings relative to the student study described in chapter four. Finally, study limitations, a chapter summary and links to the next chapter will be outlined.

As described in the chapter introduction, survey length can negatively impact the quality of responses and as such, researchers ought to carefully consider the use of short-item measures where practicable. The results of the present study point to the validity of a one item measure for driver fatigue, as opposed to the five items used previously. In addition, the TIPI was found to possess satisfactory reliability for the present purpose, rather than the longer International Personality Item Pool (IPIP; Goldberg, 1992). With the necessity for brevity in mind, short-item measures have been utilised when adding items, such as social desirability bias, impulsivity and hostility and driving measures. In doing so, the length of the survey has been considerably reduced.

In line with findings of previous studies (for example, Lajunen & Summala, 2003; Sullman & Taylor, 2010), the present research is supportive of the notion that the DBQ is relatively immune to socially desirable responding. The present study aimed to extend this research by examining the potential presence of socially desirable responding in relation to the other outcomes, such as risk-taking, driver fatigue and driver safety (operationalised as a combination of RTCs and near-misses). Findings suggest that social desirability had little or no effect on self-report of these measures, affording confidence in the quality of the data collected.

As described in the introduction, impulsivity and hostility have been previously associated with driving outcomes and thus it was considered of utility to include such measures in this multivariate inquiry. Findings reveal that impulsivity is associated with higher levels of risk-taking, which, at face value, may be one and the same. However, research undertaken over a number of decades has recognised that the two can be dissociated, in that one does not *automatically* lead to the other (see Isles et al., 2018 for a review). This is of interest in the present context due to the importance of risk-taking in both driving behaviour and RTC occurrence. Supportive of the wider literature, impulsivity and hostility were predictive of poor driving behaviour in the present study, suggesting such traits are valuable measures when considering the underpinnings of driving behaviour. Indeed, despite the traits being considered as dissociated from other traits, - such as personality, the present study also found support for lower levels of conscientiousness and agreeableness and driving behaviour. That said, much of the extant literature also points to impulsivity as being a trait of the younger driver (for example, Lazuras et al., 2019) which may explain the present finding, given the demographics of then sample (M_{age} = 20). Moving forward, it would be of interest to examine this association in older drivers.

When assessing driver safety, previous studies have used RTC involvement as the sole outcome, whereas it has become apparent that near misses may also be a useful gauge as to the overall profile of the driver. The present study combines RTCs requiring medical assistance and those not requiring medical assistance with near-miss involvement to afford a more holistic picture. This is of pertinence given the age of the drivers studied - exposure to driving in some cases being in its infancy and therefore, near-misses are a more appropriate measurement of driver ability overall. Lower levels of driver safety were associated with each of the outcomes: risk-taking, driver fatigue and poor driving behaviour.

The findings of the present study are broadly in line with those of the previous studies described in this thesis. The established predictors are present in the current analysis, affording confidence in the newer findings. Interestingly, lower levels of physical and mental tiredness brought about by university pursuits and lower levels of efficiency in the completion of academic work were implicated in increases in risk-taking and poor driving behaviour. One possible explanation is a feeling of boredom or disengagement giving rise to engagement with such behaviours.

The present study is not without limitations – the most significant being the demographics of the sample. There is an overrepresentation of females (84.5%) and the mean annual mileage is somewhat low (M = 5413). That said, the overarching aim of the research was to assess the validity of the shorter items and introduce newer variables – this has been achieved. Arguably, a major challenge is that of sample size (N = 103), however, this has been somewhat assuaged by using dose-response (or cumulative effects) to examine the risk-factors in relation to the outcomes, supportive of the idea that diminutive samples can be of utility in driving research.

7.5 Chapter Summary and Links to Next Chapter

This chapter has described a small-scale, cross-sectional survey-based study intended to assess the validity of short-item measurements, the impact of newer variables and the presence of social desirability bias. Findings from this study will be used to inform the development of a general driving population, multivariate, longitudinal study, intended to be of sufficient brevity to minimise insufficient effort responding.

Chapter Eight

Study Five (a)

8.1 Introduction

In chapter four it was argued that much of the extant literature represents an over simplified picture of factors contributing to RTC involvement, typically by interpreting variables (such as personality) to be directly causal, whereas study two (chapter five) demonstrated such factors to be predictive of other outcomes, such as risk-taking and poor driving behaviour. In addition, the systematic literature review presented in chapter two identified a variety of gaps in the literature, such as the potential impact of job characteristics on driving outcomes, a dearth of studies conducted on UK drivers and the absence of multivariate, longitudinal inquiry.

The research carried out so far, as well as research previously conducted in the literature have informed the development of the empirically informed survey devised for this flagship study. Put simply, only those predictors found to be implicated in each of the driving outcomes are included in the current study, allowing focused inquiry, with the potential for inference of causality (following part 2) whilst affording minimal redundancy.

The present research represents the first part of a multivariate, longitudinal study, intended to address the aforementioned lacunas in the literature. Limitations of the previous studies, such as the issue of potential social desirability bias, and the necessity to identify what types of driving participants are undertaking (i.e. commuting/leisure/for work) have been included in the current survey. Along a similar vein, stress has been implicated in driving outcomes and so it was considered of benefit to more holistically examine stress, not only in the way of measuring an individuals perceived stress levels, but also how an individual deals with stressors. As a result, two further measures were added to assess whether the individual views stress as a challenge (positive) or a threat (negative). Previous studies indicate that individuals who perceive stressful situations as threatening are more likely to engage in angry, confrontational behaviour, whereas those who perceive stress as a challenge to be overcome are more likely to deal with stressors in a problem-solving manner (Li et al., 2017). Given the findings of the systematic review in chapter two, in which anger and confrontational behaviour were found to be implicated in negative driving behaviours, it is of interest to examine whether there is an association between coping strategies and the

resultant driving outcomes here. Of the driving measures, it became apparent across the studies that solely measuring recent RTC involvement was potentially not sufficient to gain a complete picture of an individuals' driving, and thus two further questions were added, the first measuring 'near-miss' involvement; the second whether the participant had attended a driver retraining course to avoid prosecution for speeding. The dynamics of near-miss involvement and its subsequent impact on driving are mixed in the literature to date, with some researchers pointing to an increase in caution, whilst others report a boost in confidence in one's ability, referred to as 'near-miss bias' (Terum & Svartdal, 2019). Driver retraining courses, otherwise known as 'speed awareness courses' are offered by police authorities in the UK in lieu of traditional penalties as an educational alternative for drivers caught speeding within a specified range (currently over limit between 10% of limit + 2mph). The aim of the courses is to increase awareness of the dangers of speeding, provide guidance as to how to determine the speed limits on different roads, as well as the dangers of hazardous driving overall. There has been some academic interest in the efficacy of speed awareness courses, although this has been predominantly focused on methods of evaluating the courses and theoretical frameworks (Ward et al., 2012). Consequently, an appraisal of the continued impact of this intervention on driver behaviour is somewhat limited, as it relies on drivers volunteering a follow-up response, typically in the first three months after course attendance which a) does not allow for an examination of the long term effects and b) does not afford a comparison between those who have and those who have not attended a course and their resultant driving behaviour.

Finally, job characteristics have been demonstrably implicated in driving outcomes and until very recently, absenteeism, defined as the failure to report for scheduled work was deemed the most accurate predictor of decreased productivity and even poorer mental health outcomes (Quazi, 2013). Contemporary researchers have uncovered a phenomena of 'presenteeism', defined as attending work even when ill, this being arguably more prevalent than absenteeism (Deery et al., 2014). Presenteeism has been associated with reduced productivity and higher stress levels; those suffering with the highest level of stress are among those who attend work despite their illness (Ruhle et al., 2020). This is of import in the current context due to the links between stress and driving behaviour, as well as the potential for those commuting to work by driving whilst unwell being more susceptible to negative driving outcomes. Bullying at work by management and/or colleagues was

identified as predictive in study three with respect to risk-taking and when the collision occurred, and, as such, will now be investigated as a potential predictor for each of the outcomes (RTC involvement, driving behaviour, driver fatigue, risk-taking, RTC occurrence).

8.2 Hypotheses

The following hypotheses are based on the proposed relationships between the variables uncovered in the studies featured in chapter three, four and five, as well as the literature surrounding the novel additions.

Hypothesis one:

Road traffic collision involvement will be predicted by demographics (age, marital status), job characteristics (pressure, stress, long hours, high noise levels), accidents and cognitive failures, frequent risk-taking, high frequency of driving when fatigued, poor driving behaviour and being rated by others as a bad driver.

Hypothesis two:

Poor driving behaviour will be significantly associated with younger drivers, low levels of anxiety, job characteristics (issues of work/life balance, high perceived stress, long working hours, low control and support at work, high demand and pressure), personality (low conscientiousness, high agreeableness and neuroticism), risk-taking, being rated by others as a bad driver, frequent driver fatigue and RTC involvement. Higher levels of well- being, as measured by the Smith Well-being Questionnaire; Short-SWELL (Smith & Smith, 2017) will be protective of engagement with poor driving behaviour (measured by an appraisal of lower levels of well-being and driving behaviour).

Hypothesis three:

Driver fatigue will be predicted by job characteristics (low job satisfaction, high job stress and pressure, exposure to high noise levels, frequent shift work), accidents and cognitive failures, demographics (age, marital status), frequently driving in heavy traffic, on the motorway, in bad weather.

Hypothesis four:

Risk-Taking will be significantly associated with personality (greater openness, neuroticism and extraversion; lower conscientiousness and agreeableness), personal characteristics (higher anxiety, depression and life stress), demographics (age, salary), high levels of accidents and cognitive failures, job characteristics (high pressure, decision making, stress, working hours, work/life balance, bullying at work) and driving variables (lower levels of driver fatigue, high levels of poor driving behaviour, frequently driving in bad weather, being the driver in a road traffic collision).

Hypothesis five:

Bullying by management and/or colleagues will be significantly associated with negative driving outcomes.

Hypothesis six:

Presenteeism and near-miss involvement will be significantly associated with the driving outcomes, whilst driver retraining course attendance will produce more favourable driving behaviour scores.

Hypothesis seven:

There will be unique predictors depending upon when the road traffic collision took place (commuting to and from work; travelling as part of work; travelling in leisure time).

Hypothesis eight:

Stress threat will be associated with poor driving outcomes, whereas stress challenge will be associated with positive driving outcomes.

8.3 Method

8.3.1 Participants

The study was conducted with the approval of the ethics committee, School of Psychology, Cardiff University (E.C.19.11.12.5806R) and the informed consent of participants. A G* Power Analysis (Erdfelder et al.,1996) returned an optimum sample size of 2000 in order to detect the effects of the risk factors after adjustment of covariates.

Participants were recruited via social media (Facebook; Twitter) and the survey platform Prolific. Those recruited via social media were offered entry into a prize draw for up to £150 in Amazon vouchers, whilst those recruited via the Prolific were paid £1.05 immediately following participation, this deemed appropriate recompense due to the length of the survey. The final sample comprised 2070 participants (20% social media; 80% Prolific). Participants were required to be over the age of 18, resident in the UK, with a full UK driving licence. The latter criteria was necessary to gain an appreciation of factors impacting UK drivers. No other exclusion criteria were applied. As this study forms part of a longitudinal inquiry, participants completing the survey via social media were asked whether they would be amenable to being contacted by the research team after a six-month period to complete a second, shorter survey. Four hundred and twenty participants indicated they would be happy to be contacted (59.9%). For those participants completing the study via Prolific (n = 1,369), participants gave consent to be contacted after 6-months during study sign-up using a unique identifier in the software, at which point they would be invited to complete the second survey, again for a nominal fee. The participants comprised 72.3% females, 4% other, with an age range of 18-82 years (M = 37; SD = 36.7). Further characteristics of the sample are detailed in Table 8.1.

Table 8.1

Characteristics of the Final Sample

Marital status	36.9% Married; .9% Widowed; 5.7% Divorced; 2.3% Separated; 55.2% Never married
Salary	<10,000 = 16.6%; 10,000-25,000 = 24.9%; 25,000-40,000 = 11.7% 40,000 + = 36.4%; Prefer not to answer = 10.4%
Employment	Full/Part-time = 67.8%; Self-employed = 7.3%; Unemployed = 8.1%; Student = 10.9%; Retired = 4.8%; 1.1% Prefer not to answer
Road traffic collision involvement	16.7% report at least 1 RTC
Near-miss involvement	64.7% report at least 1 near-miss
Driver re-train course attendance	10.8% report attending driver re-training in the last three years

Driving domain	74.3% drive to and from work; 96.9% drive during leisure time; 45.7% drive as part of a job
Annual mileage	Mean annual mileage = 8942 (*SD* = 9041)

8.3.1 Materials

The survey used in this study comprised of several sections, utilising the knowledge gleaned from the previous three studies to include only factors found to be relevant to the driving outcomes, outlined in detail in previous chapters (see Table 8.2). In an attempt to reduce participant carelessness or potential 'bot' responses (automated online responders who target online surveys for the rewards offered), participants were asked to select a number from a list, sporadically throughout the survey, for example, 'If you are reading this, please choose 4', this being effective as it eliminates automated responses by requiring a pre-defined response.

Novel additions to the survey included measures of absenteeism/presenteeism, stress threat and challenge, near-miss involvement, recent participation in a driver re-training course and a brief measure of social desirability bias. These new measures are detailed below.

8.3.1.1 Absenteeism/Presenteeism

Absenteeism and presenteeism were assessed using two questions: absenteeism by asking the participant to state how many days sick leave they had in the last twelve months; presenteeism by asking participants 'Do you ever come to work when you are feeling ill and knowing you can't do your job as well as you would like to?', this requiring a yes/no response.

8.3.1.2 Driving Near-miss/Retraining/Driving domain

Near-misses whilst driving were measured by asking participants ‘Thinking about the last 12 months, how many 'near-misses' (where an accident may have occurred, but did not) have you been involved in whilst driving?’ The response ranged from ‘none’ to /more than 6’. Driver re-training course participation was ascertained by asking ‘Have you attended any driver retraining courses in the last three years (such as those offered to avoid speeding points)?’ requiring a yes/no response. Driver domain was gleaned by asking participants to indicate what type of driving they engage with: driving to and from work/driving for leisure/driving as part of a job

8.3.1.3 Social desirability bias

Social desirability bias (SDB), defined as participants’ propensity to provide ‘desirable’ answers to questionnaires in order to appear more socially acceptable was measured using the Brief Social Desirability Scale (BSDS; Haghighat, 2007). Comprising four questions, each item requires a yes/no response, of which only one is considered socially desirable. The scale has acceptable validity and reliability ($\alpha = .6$) and is free of gender specificity. Used for its brevity and practicality, the cut-off score can be set depending on the import of gleaning transparent responses from participants (> 1 socially desirable response to > 2 socially desirable responses). The present purpose of the scale was to ascertain whether participants more prone to SDB were also more likely to report fewer driving violations. To this end, a median score of SDB from the sample was computed; $M = 1.79$. Therefore, those scoring <2 categorised as low SDB, >2, high SDB. High SDB was then correlated with low scores on the driving behaviour measure. Results indicated there was no statistically significant correlation between high levels of SDB and lower levels of reported driving violations ($r = .006$, $n = 2070$, $p = .796$). Therefore, the data were analysed as one group.

Table 8.2

Measures from Previous Studies Used in this Study

Demographics	
	Age
	Salary
	Marital status
	Gender
Personal characteristics	
	Happiness
	Depression/anxiety
	Stress challenge
	Stress threat
	Healthy lifestyle
	Positive personality
	Life satisfaction
	Life stress
Job Characteristics/Appraisals	
	Job engagement
	Thriving at work

	Shift work
	Demand/pressure
	Control/support
	Perceived job stress
	Job satisfaction
	Fatigue at work
	Illness caused by work
	Depressed due to work
	Frequent bullying by co-workers
	Frequently being on-call
	Happiness at work
	Efficiency
	Noise at work
Personality	
	Extraversion
	Agreeableness
	Openness
	Conscientiousness
	Scale α = .7**

Risk-taking (at/outside work)	
	Risk-taking*
Accidents/cognitive failures	
	High incidence of accidents
	High incidence of cognitive failures
Driving	
	Frequent driving in heavy traffic
	Others' rating of driver (as below average)
	Frequent motorway driving
	Poor driving behaviour*
	Frequent driving in bad weather
	Driver fatigue*
	When collision occurred
	Road traffic collisions*
	Annual mileage

Note. *denotes variable as both a predictor and outcome variable; ** alpha reliability coefficient of scale obtained in present study

8.3.2 Design

This cross-sectional study was presented as an online survey, administered using survey platform Qualtrics. Potential order effects were alleviated by counterbalancing, achieved by using randomisation within the software. Median splits 'high/low' were used for all variables (except for when the collision happened and marital status) to allow like for like comparisons. Cross-tabular analyses were used to initially examine any associations between

RTCs, when the collision happened, risk-taking, driver fatigue and driving behaviour. Binary logistic regressions were then carried out with the demographics, job characteristics/appraisals, personal characteristics, personality, risk-taking, cognitive failures/accidents and driving variables as covariates, whilst multinomial logistic regressions were performed to examine predictors potentially linked to when the collision happened (driving to/from work; leisure driving; driving as part of a job). Interactions in the models were examined by combining the significant variables and observing whether they significantly interacted and were therefore multiplicative, as well as whether any interaction significantly altered the overall model performance. Finally, dose-response was achieved by combining the effects of the risk factors identified in a further series of logistic regressions, calculated by adding the scores from the median splits and then further splitting the combined scores into quartiles.

8.3.3 Procedure

An information sheet outlining the aims and procedure of the study for participants to give informed consent was provided prior to study commencement. Once informed consent was obtained, participants were asked to minimise any distractions by switching off electronic apparatus, such as televisions/radios/mobile phones whilst participating.

Participants were then asked whether they would like to be included in the prize draw, and also whether they would be happy to take part in the second part of the study in the following ways: 'We appreciate that your time is precious, and as such, there is a prize draw for Amazon vouchers (1st prize £150; 2nd £100; 3rd £50) as a thank you for your participation. If you wish to be included in the prize draw, please provide an email address here:' 'Alternatively, if you DO NOT wish to be included in the prize draw, please indicate here'; 'We would love to hear your views again after a six-month period, whereby you will be invited to complete a shorter survey. If you are happy for the research team to contact you about further research participation, please provide an email address below. Should you participate, you will be given the opportunity to enter a second prize draw. Please be aware that your initial survey responses will not be personally identifiable to you.

They were then given the following information/instruction: 'The questionnaire contains sections on driving, your job, and your health, lifestyle and personal characteristics.

The information you provide is strictly anonymous. We are only interested in groups of people and therefore no individual will be identified in connection with any of the research findings. Your identity and responses to the questionnaire will be completely protected.

Please read each question carefully and mark the response that BEST reflects your knowledge or feelings. Do not spend a lot of time on each one; your FIRST answer is usually the best. Please make sure you mark all answers in the space provided. If there are any questions you do not want to answer you may omit them'.

The personality scale contained the instruction 'Here are a number of personality traits that may or may not apply to you. Please indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other. Use the following scale to rate each of the pairs of adjectives'

About driving, the instruction was: 'Now we would like to ask you some questions about your driving experiences. Please answer as honestly as possible. The survey is nearly over, and we thank you for your time'.

At the end of the survey participants were thanked for their time and shown a debrief statement.

8.4 Results

8.4.1 Derived Scores

Scores were dichotomised at the scale score median split, and categorised into 'high/low', with the exception of others' rating of the driver, which was categorised as good/poor' for ease of interpretation, and marital status, dichotomised into'married/separated/divorced/widowed' versus 'never married/single' as chi-squares yielded significant effects between these groups for each of the outcome variables (p = .03).

8.4.2 Univariate Analyses

To initially examine potential associations between the variables, cross-tabular analyses were conducted with the outcome variables as road traffic collisions, driving behaviour, driver fatigue and risk-taking, and demographic, personal characteristics, job characteristics and appraisals, personality, risk-taking, accidents and cognitive failures and driving as

predictor variables. Each of the outcome variables was included in the other analyses (i.e., driving behaviour as a predictor of driving fatigue) given the previously acknowledged links between these factors. A tabulated illustration of these effects is located in appendix A. For each outcome, the hypotheses supported, new effects detected and predicted effects not supported in the present analysis are detailed.

8.4.3 Driving Behaviour

The univariates for driving behaviour in the context of predicted and new effects are detailed in Table 8.3.

Table 8.3

Predicted and New Effects: Driving Behaviour

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics	Younger driver		
Personal characteristics	Low levels of positive personality (SWELL)		Low anxiety
Job characteristics/Appraisals	High demand and pressure; presenteeism*; high stress	Unhappy at work	Issues of WLB; long hours; high stress; control and support
Personality	High agreeableness		Low conscientiousness; high neuroticism
Risk-taking	High risk-taking		

Driving	Driver fatigue; high number of near-misses*; RTCs	Motorway driving; driving in poor weather	Others' ratings; participation in driver retraining*

Note. * Denotes novel variables

8.4.4 Driver Fatigue

Table 8.4 details the predicted and new effects yielded by the univariate analysis for driver fatigue.

Table 8.4

Predicted and New Effects: Driver Fatigue

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics	Marital status		Age
Personal characteristics		Low life satisfaction	
Job characteristics/Appraisals	High presenteeism *; frequent shift work	Frequent bullying at work; issues of WLB; frequently on- call	High exposure to noise
Accidents/Cognitive failures			High accidents; high cognitive failures
Driving	Driving in heavy traffic; high near-misses*; frequent motorway driving; frequent driving in bad weather	High RTC incidence; poor driving behaviour	

Note. **Denotes novel variable*

8.4.5 Risk-Taking

Table 8.5 illustrates the predicted effects supported, those not supported and new effects in the univariate analysis of risk-taking.

Table 8.5

Predictions and New Effects: Risk-Taking

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics	Being younger; high salary		
Personal characteristics			Anxiety/depression/life stress
Job characteristics/Appraisals	High demand; bullying by management; issues of WLB; high stress	High job engagement; high noise levels	Long working hours
Personality	High openness		High Neuroticism & extraversion; Low agreeableness & conscientiousness
Accidents/Cognitive failures	High cognitive failures		High accidents
Driving	RTC occurrence; poor driving behaviour; driving in bad weather	Frequent motorway driving; others' rating of the driver as poor	

Note. * Denotes novel variable

8.4.6 Road Traffic Collisions

Table 8.6 gives the univariate predicted and new effects for RTCs

Table 8.6

Predicted and New Effects: RTCs

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics	Being younger; being single		
Personal characteristics		Low positive personality; high life stress	
Job characteristics/Appraisals	Bullying by management; frequent long hours; low control and support; high noise levels	Frequently working on-call; fatigue caused by work; being unhappy/ depressed because of work	High pressure/stress
Personality			
Accidents/Cognitive failures	Accidents & cognitive failures		
Risk-taking	High risk-taking		
Driving	Frequent driver fatigue; being rated as a poor driver by others; poor driving behaviour; high	Frequent motorway driving	

	levels of near-misses*		

Note. *Denotes novel variable

8.5 Logistic Regressions

Logistic regression analyses (ENTER method) were performed using the significant predictors identified in the univariates.

8.5.1 Driving Behaviour

The full logistic regression model significantly predicted driving behaviour (omnibus $\chi 2 = 272.57$; $df = 36$, $p = .001$). The model accounted for between 23% and 36% of the variance in driving behaviour. Overall, 79.3% of predictions were accurate, a 10.2% increase on the intercept model. The Hosmer and Lemeshow test indicated a good model fit: $p = .863$. Table 8.7 details predictors supported in the current analysis and the new effects detected.

Table 8.7

Predicted and New Effects: Driving Behaviour

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics			Younger driver
Personal characteristics	Low levels of positive personality (SWELL)		Low anxiety
Job characteristics/Appraisals	High demand and pressure; presenteeism*; high stress	Unhappy at work	Issues of WLB; long hours; high stress; control and support
Personality	High agreeableness		Low conscientiousness; high neuroticism

Risk-taking	High risk-taking		
Driving	Driver fatigue; high number of near-misses*; RTCs	Motorway driving; driving in poor weather	Others' ratings; participation in driver retraining*

Note. * Denotes novel variable

Table 8.8 (Appendix 10) reports the logistic regression, Wald statistics and probability values for each of the significant predictor variables.

Table 8.8

Logistic Regression of Driver Behaviour

	β	Std.Error	Wald Statistic	Odds Ratio EXP (β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Personal characteristics						
Low positive personality	.079***	.134	13.45	1.08	.832	1.41
Job Characteristics/Appraisals						
High demand	.393*	.174	5.08	1.48	1.05	2.09
High presenteeism	.425**	.137	9.61	1.53	1.17	2.00
Unhappy at work	.290***	.233	11.56	1.34	.847	2.11
Personality						
High agreeableness	.542*	.193	7.91	1.72	1.18	2.51

Risk-Taking						
High risk-taking	.837***	.229	13.31	2.31	1.47	3.62
Driving						
Frequent driving in heavy traffic	.288***	.151	13.63	1.33	.992	1.79
Frequent motorway driving	.501***	.133	14.12	1.65	1.27	2.14
Frequent driving in bad weather	.577***	.154	14.01	1.78	1.32	2.41
Frequent driver fatigue	.777***	.178	19.16	2.18	1.54	3.08
High numbers of near-misses	.677***	.113	35.96	1.97	1.58	2.46
Recent driver retraining course participation	.639***	.211	9.18	1.90	1.25	2.87
High RTC incidence	.235***	.154	12.32	1.27	.935	1.71

The full model was tested with the inclusion of interaction terms for the significant variables. The model remained significant (omnibus $\chi 2 = 234.53$, $df = 41$, $p = .001$), although the number of interactions present may be representative of chance effects.

8.5.2 Driver Fatigue

The full logistic regression model significantly predicted driver fatigue (omnibus $\chi 2 = 227.57$; $df = 36$, $p = .001$). The model accounted for between 11% and 23% of the variance in driver fatigue. Overall, 71.6% of predictions were accurate, an 8.9% increase on the intercept model. The Hosmer and Lemeshow test indicated a good model fit: $p = .959$. Table 8.9 details the significant predictors for driver fatigue. Table 8.10 (Appendix 11) contains the coefficient, Wald statistics and probability values for each of the significant predictor variables.

Table 8.9

Predicted and New Effects: Driver Fatigue

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Personal characteristics		Low life satisfaction	
Job characteristics/Appraisals	High presenteeism*; frequent shift work	Frequent bullying at work; issues of WLB; frequently on-call	
Driving	Driving in heavy traffic; high near-misses*	High RTC incidence; poor driving behaviour	Frequent motorway/driving in bad weather

Note. * Denotes novel variable

Table 8.10

Logistic Regression: Driver Fatigue

	β	Std.Error	Wald Statistic	95% Confidence Interval for EXP (β)	
				Lower	Upper

Personal characteristics						
Low life satisfaction	-.468*	.241	5.78	1.60	.996	2.56
Job Characteristics/Appraisals						
High presenteeism	.551*	.212	6.79	1.74	1.15	2.63
Shift work	.457***	.269	12.89	1.58	.932	2.68
Frequently on-call	.356***	.314	11.29	1.43	.772	2.64
Issues of work/life balance	.490*	.227	4.67	1.63	1.05	2.55
Frequent bullying by management	.510*	.158	10.46	1.67	1.22	2.27
Driving						
Frequent driving in heavy traffic	.966***	.213	20.50	2.63	1.73	3.99
High numbers of near- misses	.845***	.177	22.70	2.33	1.65	3.30
High RTC incidence	.337*	.226	12.22	1.71	.458	1.11
Poor driving behaviour	.784***	.178	19.40	2.19	1.55	3.10

8.5.3 Risk-Taking

The full logistic regression model significantly predicted risk-taking (omnibus $\chi 2 = 262.67$; $df = 36$, $p = .001$). The model accounted for between 12% and 34% of the variance in risk-taking. Overall, 94.3% of predictions were accurate, an 11.3% increase on the intercept model. The Hosmer and Lemeshow test indicated a good model fit: $p = .665$. Table 8.11(Appendix 12) details the predictions supported/not supported in the current analysis, as

well as the new effects detected. The coefficient, Wald statistics and probability values for each of the significant variables are displayed in Table 8.12.

Table 8.11

Predicted and New Effects: Risk-Taking

	Predicted effects supported in current analysis	**New effects**	**Predicted effects not supported in current analysis**
Personality	High openness		
Accidents/Cognitive failures	High levels of cognitive failures		
Driving	RTC occurrence Poor driving behaviour	Frequent motorway driving Others' rating the drivers' driving skill as poor	Frequent driving in bad weather

Table 8.12

Logistic Regression: Risk Taking

	β	Std.Error	Wald Statistic	EXP (β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Demographics						
Being younger	.697**	.268	6.76	2.01	1.19	3.40
High salary	.060*	.242	10.62	1.06	1.03	1.81
Job Characteristics/Appraisals						

High job engagement	.678*	.377	4.24	1.97	.941	4.12
High noise at work	.875*	.278	9.92	2.40	1.39	4.14
Frequent bullying by management	.448*	.193	5.39	1.57	1.07	2.28
Personality						
High openness	1.47**	.445	10.90	4.34	1.87	2.39
Accidents/Cognitive Failures (at/outside work)						
High incidence of cognitive failures	2.41*	.283	7.53	1.13	6.39	1.97
Driving						
Frequent motorway driving	.808**	.316	6.53	2.24	1.21	4.17
Poor driving behaviour	.937***	.245	14.61	2.55	1.58	4.13
Others' rating of driver (as poor)	1.22**	.309	15.39	3.36	1.83	6.16
High RTC incidence	.507**	.409	11.54	1.66	.745	3.70

8.5.4 RTCs

The full model significantly predicted RTCs (omnibus $\chi 2 = 125.60$; $df = 36$, $p = .001$). The model accounted for between 31% and 66% of the variance in RTCs. Overall, 90.3% of predictions were accurate, a 12.1% increase on the intercept model. The Hosmer and Lemeshow test indicated a good model fit: $p = .915$. Table 8.13 contains the predicted effects supported and new effects detected.

Table 8.13

Predictions and New Effects: RTCs

	Predicted effects supported in present analysis	**New effects**	**Predicted effects not supported in present analysis**
Demographics	Being single		Being younger
Personal characteristics		Low positive personality High life stress	
Job characteristics/Appraisals	Bullying by management; frequent long hours	Frequently working on-call Fatigue caused by work Being unhappy/ depressed because of work	High noise levels
Accidents/Cognitive failures	Accidents & cognitive failures		
Risk-taking	High risk-taking		
Driving	Frequent driver fatigue Being rated as a poor driver by others Poor driving behaviour High levels of near-misses*	Frequent motorway driving	

Note. *Denotes novel variable

The coefficient, Wald statistics and probability values for each of the significant predictor variables are given in Table 8.14 (Appendix 13).

Table 8.14

Logistic Regression: RTCs

	β	Std.Error	Wald Statistic	Odds Ratio EXP(β)	95% Confidence interval for EXP (β)	
					Lower	Upper
Demographics						
Being single	.300*	.139	4.69	1.35	1.03	1.77
Personal characteristics						
Low positive personality	.419*	.150	7.83	1.52	1.13	2.04
High life stress	.010*	.136	10.05	1.01	.773	1.32
Low happiness	.420*	.196	4.59	1.52	1.04	2.24
Job Characteristics/Appraisals						
Low control/support	.381*	.179	5.53	1.47	1.03	2.08
High fatigue at work	.175*	.191	8.39	1.19	.819	1.73
Shift work	.140***	.175	16.44	1.86	.617	1.22

Frequently on-call	.607*	.220	7.59	1.83	1.19	2.82
Unhappy at work	.542*	.250	4.69	1.72	1.05	2.81
Depressed at work	.370*	.166	4.98	1.45	1.05	2.00
Frequent bullying by management	.515***	.121	17.99	1.67	1.32	2.12
Risk-Taking						
High risk-taking	.633**	.394	12.59	1.63	.394	2.59
				3		
Accidents/Cognitive Failures (at/outside work)						
High incidence of accidents	.541*	.228	5.61	1.72	1.09	2.69
High incidence of cognitive failures	.474*	.281	12.84	1.61	.925	2.79
Driving						
Frequent motorway driving	.342**	.156	4.79	1.41	1.04	1.91
Frequent driver fatigue	.355**	.219	12.64	1.70	.457	1.08
Others' rating of driver (as below average)	.490*	.279	13.08	1.71	.355	1.06
High numbers of near-misses	.245*	.138	13.18	1.28	.976	1.67
Poor driving behaviour	1.23*	.839	11.79	1.23	.839	1.79

Note. *N = 2070; *p = 0.05, **p = 0.01*

8.6 Road Traffic Collision Occurrence – Univariate analysis

The outcome variable RTC occurrence comprised five groups: commuting (to and from work), travelling as part of job, travelling during leisure time, and no RTC. Only cases where

the participant was the driver (as opposed to a passenger, pedestrian, or cyclist) were analysed. The univariate analysis showed that bullying at work and high levels of fatigue were risk factors for RTC occurrence when travelling home from work; high levels of life stress, low levels of job control and support from colleagues, feeling threatened by stressful situations, high levels of job engagement, issues of work/life balance and a tendency toward poor driving behaviour were risk-factors for accidents when driving to work; being on-call and older were risk factors for RTCs occurring when driving as part of the job; high levels of bullying at work was a risk factor for RTCs during leisure time.

8.7 Multinomial Logistic Regression – RTC Occurrence

All variables were entered into the regression to examine whether there were unique predictors depending on when the RTC took place (commuting to and from work; travelling as part of work; travelling in leisure time). Only cases where the participant was the driver (as opposed to a passenger, pedestrian, or cyclist) were analysed. The reference variable was 'No RTC'. Additions to a model containing only the intercept significantly improved the fit between the model and data, omnibus $\chi 2$ (976, n = 2070) = 889, Nagelkerke R^2 = .16, p = .001.

As illustrated in Table 8.15, significant unique contributions were made by differing predictors, depending on accident context – as stated in hypothesis seven. Specifically, RTCs occurring on the way to work by low levels of positive personality, low job satisfaction, high presenteeism, and feeling depressed at work, high incidence of accidents and frequently driving in heavy traffic. RTCs occurring on the way home from work were predicted by high levels of depression/anxiety, gender (female), high incidence of minor accidents, being unhappy at work, low levels of positive personality, working in a job high in demand and pressure with high levels of thriving, frequently being on-call and experiencing frequent bullying by both co- workers and management. RTCs during leisure time were predicted by gender (male), low positive personality and high levels of depression/anxiety, feeling threatened by stressful situations as well as high levels of presenteeism, bullying by management and fatigue at work.

RTCs occurring when travelling as part of the job were predicted by low positive personality, life satisfaction and an unhealthy lifestyle, being challenged by stressful

situations, low job satisfaction, frequent bullying by management and often driving in bad weather.

Goodness of fit was ascertained by conducting Hosmer Lemeshow tests which were not statistically significant.

Table 8.15

Multinomial Regression: RTC Occurrence

RTC Occurrence:						
Commuting to work[a]						
	β	Std.Error	Wald Statistic	Odds Ratio	95% Confidence Interval for EXP β	
					Lower	Upper
Personal characteristics						
Low positive personality	.955	0.36	6.89	2.60	1.27	5.30
Job Characteristics/Appraisals						
Low job satisfaction	.103	0.53	10.04	1.90	1.32	2.56
High presenteeism	.825	0.38	4.83	2.28	1.09	4.76
Depressed at work	.890	0.39	5.32	0.41	1.19	1.88
Accidents/Cognitive Failures (at/outside work)						

High incidence of accidents	.599	.697	17.39	1.82	.464	7.13
Driving						
Frequent driving in heavy traffic	.287	0.41	10.49	1.33	0.60	2.98
RTC Occurrence:						
Commuting from work[b]						
Demographics						
Gender	1.11	0.54	4.21	0.33	1.15	1.95
Personal characteristics						
Low positive personality	1.30	0.56	5.39	3.67	1.22	10.99
High depression/anxiety	-1.30	0.52	6.26	0.27	1.10	1.76
Job Characteristics/Appraisals						
High demand/pressure	1.04	0.77	11.71	2.73	0.61	12.26
High thriving at work	1.34	0.69	13.79	0.26	0.07	1.01
Frequently on-call	1.17	0.62	13.58	3.23	0.96	10.88
Unhappy at work	2.15	0.92	5.42	0.12	1.02	1.71
Frequent bullying by co-workers	1.13	0.76	10.21	0.84	1.57	2.65
Accidents/Cognitive Failures (at/outside work)						
High incidence of accidents	2.22	0.77	8.34	9.25	2.04	41.81

RTC Occurrence:						
Travelling as part of a job[c]						
Personal characteristics						
Low healthy lifestyle	2.07	0.99	4.37	7.93	1.14	5.29
Low positive personality	4.47	1.44	9.61	7.47	5.18	1.47
Low life satisfaction	3.94	1.56	6.43	0.02	1.63	6.72
High stress challenge	3.43	1.25	7.46	30.73	2.63	8.79
Job Characteristics/Appraisals						
Low job satisfaction	3.26	1.73	13.56	.038	.001	1.13
Frequent bullying by management	4.40	1.94	5.15	1.01	0.44	0.55
Driving						
Frequent driving in bad weather	4.81	1.42	11.48	1.57	2.01	1.96
RTC Occurrence:						
Leisure driving[d]						
Demographics						
Gender	-1.04	0.42	6.02	0.36	1.55	1.81
Personal characteristics						

Low positive personality	.837	.379	4.88	2.31	1.10	4.85
High depression/anxiety	-.769	.354	4.73	.463	.231	.927
High stress threat	.721	.366	13.88	2.06	1.00	4.22
Job Characteristics/Appraisals						
High fatigue at work	1.24	0.50	6.08	0.29	0.11	0.78
High presenteeism	.791	0.40	13.88	2.21	1.00	4.85
Frequent bullying by management	.185	0.36	10.27	1.16	1.60	2.42

Note. [a] = *N* = 231; [b] = *N = 47*; [c] = *N* = 17; [d] = *N* = 168

8.8 Combined Effects Analyses

A combined effects analysis was used to examine the impact of individual risk factors in combination. The statistically significant risk factors identified in the logistic regressions were combined and then split into quartiles to achieve cumulative odds ratios for each of the outcomes.

8.8.1 RTCs

The combined effects analysis revealed that single drivers, lower in happiness and positive personality with high life stress who work in jobs with low control/support, frequently on call and working shifts who are bullied by management and experience high levels of accidents and cognitive failures as well as frequently taking risks, driving on the motorway when fatigued, engage in poor driving behaviour, with frequent near-misses and whose driving is rated as below average by others are cumulatively 3.09 times more likely to be involved in an RTC. The quartile values are presented in Table 8.16.

Table 8.16

Quartiles Displaying Cumulative Odds Ratios for RTCs

	β	Std.Error	Wald Statistic	Odds Ratio EXP (β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Quartile 1[a]			11.01			
Quartile 2	.447*	.162	8.05	1.64	1.11	1.91
Quartile 3	.516	.178	8.91	1.77	1.23	2.32
Quartile 4	.758*	.191	9.87	2.76	1.92	3.09

Note*p* = 0.05, ***p* = 0.01; ****p* = 0.001, [a] = reference

8.8.2 Driving Behaviour

Combined effects revealed that those with lower levels of positive personality and high levels of personality trait agreeableness, working in a job high in demand and pressure, in which they are unhappy, with a high degree of presenteeism who frequently drive on the motorway, in poor weather, often fatigued, have a high incidence of near-misses, recent participation in a driver retraining course with frequent RTC occurrence are cumulatively 3.19 times more likely to engage with poor driving behaviour. The quartile values are presented in Table 8.17.

Table 8.17

Quartiles Displaying Cumulative Odds Ratios for Driving Behaviour

	β	Std.Error	Wald Statistic	Odds Ratio EXP (β)	95% Confidence Interval for EXP (β)	
					Lower	Upper
Quartile 1[a]			6.45			
Quartile 2	.338***	.127	7.08	1.40	1.09	1.80
Quartile 3	.482**	.166	8.55	1.62	1.17	2.25
Quartile 4	.885***	.141	39.45	2.42	1.84	3.19

Note. *p = 0.05, **p = 0.01; ***p = 0.001, [a] = reference

8.8.2 Driver Fatigue

Cumulatively, drivers with low life satisfaction, frequently working shifts and on-call, with high presenteeism and issues of work/life balance who experience frequently bullying at work by superiors, who frequently drive on the motorway, have a high numbers of near-misses, more RTCs and poorer driving behaviour are 7.04 times more likely to experience driver fatigue (Table 8.18).

Table 8.18

Quartiles Displaying Cumulative Odds Ratios for Driver Fatigue

	β	Std. Error	Wald Statistic	Odds Ratio EXP β	95% Confidence Interval for EXP β	
					Lower	Upper
Quartile 1[a]			7.82			
Quartile 2	.547**	.183	8.94	1.73	1.21	2.47
Quartile 3	919**	.248	13.75	2.51	1.54	4.07
Quartile 4	1.49**	.237	39.50	4.43	2.78	7.04

Note. *p = 0.05, **p = 0.01; ***p = 0.001, [a] = reference

8.8.3 Risk-Taking

Combined effects revealed a 3.70 fold increase in risk-taking for younger drivers, high in personality trait openness, who earn a higher salary, with higher levels of noise in the workplace who are highly engaged in their work but are frequently exposed to bullying by management and experience high levels of cognitive failures who frequently drive on the motorway, engage in poor driving behaviour, have higher incidences of RTCs and are rated by others as a 'below average' in terms of driving competence. The quartile values are displayed in Table 8.19.

Table 8.19

Quartiles Displaying Cumulative Odds Ratios for Risk-Taking

	β	Std. Error	Wald Statistic	Odds Ratio EXP β	95% Confidence Interval for EXP β	
					Lower	Upper
Quartile 1[a]			1.01			
Quartile 2	.246	.242	1.51	1.28	.795	2.06
Quartile 3	.324*	.252	1.66	1.38	.844	2.26
Quartile 4	.688**	.316	4.74	1.99	1.07	3.70

Note*p* = 0.05, ***p* = 0.01; ****p* = 0.001, [a] = reference

8.9 Discussion

The rationale of the present study was to draw together significant predictors identified in the previous studies, address some of the limitations discussed (for example, social desirability bias) as well as provide baseline data for the longitudinal element, following which causality may be implied. The following discussion will address the findings in relation to the study hypotheses presented in the introduction, and examine similarities and differences between the current findings, and those of the previous studies for each of the outcomes. Findings in the context of the newly added variables will be considered and study limitations discussed. The presence of potential interactions in the regression models will be considered and cumulative effects described. Finally, the chapter will be summarised and links to the next chapter outlined.

Hypotheses one suggested that road traffic collision involvement would be predicted by demographics (age, marital status), job characteristics (pressure, stress, long hours, high noise levels), accidents and cognitive failures, frequent risk-taking, high frequency of driving when fatigued, poor driving behaviour and being rated by others as a bad driver. The current findings are broadly in-line with this, although age and high noise levels at work did not emerge as significant predictors. In relation to the previous studies, the results presented here are largely congruent and introduce further predictors implicated in road traffic collision involvement. Specifically, personal characteristics, such as high life stress and low levels of positive personality, coupled with similar work issues, such as fatigue at work, unhappiness and depression caused by work and being bullied by management emerge as factors.

Hypothesis two predicted that poor driving behaviour would be significantly associated with younger drivers, low levels of anxiety, job characteristics (issues of work/life balance, high perceived stress, long working hours, low control and support at work), personality (low conscientiousness and agreeableness, high neuroticism), risk-taking, being rated by others as a bad driver and frequent driver fatigue. Additionally, higher levels of well- being would be protective of engagement with poor driving behaviour. The current findings are supportive of this hypothesis, although personality did not emerge as heavily as suggested, with only lower

levels of agreeableness featuring. Lower levels of positive personality, and higher levels of unhappiness being implicated in poor driving behaviour is supportive of the notion that positive well-being reduces poor driving behaviour. In terms of similarities and differences, negative job characteristics, such as higher levels of demand and pressure at work were present here as they were in the previous studies, although issues of work/life balance did not feature. In the current data, driving variables, such as motorway driving and driving in poor weather conditions, as well as driver fatigue and previous road traffic collision involvement appeared to have a bearing on driving behaviour, whereas previously, only risk-taking and others' rating of the driver were implicated.

Hypothesis three suggested that driver fatigue would be predicted by job characteristics (low job satisfaction, high job stress and pressure, exposure to high noise levels), accidents and cognitive failures, demographics (age, marital status) and frequently driving in heavy traffic, on the motorway, in poor weather. Demographics did not feature as significant in the current study, however, job characteristics, such as frequently working long hours and being on-call, as well as issues of work/life balance were present. Of the driving variables, motorway driving, as per the hypothesis was found to be predictive of driver fatigue, as was poor driving behaviour, although driving in heavy traffic and in poor weather were not significant predictors. In terms of the previous studies, the current findings are similar, and paint a picture of driver fatigue being largely determined by factors such as exposure to the road and the necessity to work long hours.

Hypothesis four predicted that high levels of risk-taking would be significantly associated with personality (greater openness, neuroticism and extraversion; lower conscientiousness and agreeableness), personal characteristics (higher anxiety, depression and life stress), demographics (age, salary), high levels of accidents and cognitive failures, job characteristics (high pressure, decision making, stress, working hours, work/life balance, bullying at work) and driving variables (lower levels of driver fatigue, high levels of poor driving behaviour, frequently driving in bad weather, being the driver in a road traffic collision). Again, the current findings are largely supportive of this hypothesis, as in the clusters of factors (such as personality, job characteristics, personal characteristics etcetera) are present, although the specific predictors may be slightly different. By way of illustration, the study hypothesis states that personality would be a predictor, and the current findings bear

that out, although the significant predictor here is greater openness, rather than the several traits suggested. Congruent with the other studies, the model of risk-taking in this analysis points to higher levels of risk-taking as being centred around those earning higher salaries, in jobs with higher levels of engagement. Unlike the previous analyses, whereby noise was implicated with poor driving behaviour and road traffic collision involvement, the current findings demonstrate high noise levels in the workplace as indicative of the propensity to take more risks.

Hypothesis five was connected with the variables associated with bullying in the workplace, either by colleagues or management. Previously, this had only been examined for risk-taking and road traffic collision occurrence. The hypothesis predicted that bullying in the workplace would be significantly associated with the driving outcomes. This is certainly the case, with bullying by management being predictive of greater risk-taking, higher road traffic collision incidence, and increased driver fatigue. Perhaps the most illuminating finding is with regard to RTC occurrence, whereby bullying by management and/or colleagues was predictive of road traffic collision occurring during the commute home, whilst travelling as part of a job and during leisure time. It appears that the impact of workplace conflict is consequential even when we are not at work. These findings are wholly congruent with those of study three.

Turning to the newly added variables, using the established literature and the findings from previous studies, hypothesis six suggested that presenteeism and near-miss involvement will be significantly associated with the driving outcomes, whilst driver retraining course attendance will produce more favourable driving behaviour scores.

Presenteeism or attending work despite illness is acknowledged in the literature as being problematic in terms of productivity levels at work and stress levels (Ruhle et al., 2020), however this has not previously been evaluated in the context of driving. The current analysis demonstrates the negative impact of presenteeism; those who continue to present at work despite illness display poorer driving behaviour and high levels of driver fatigue. Interestingly, but perhaps intuitively, driving to work when unwell is predictive of road traffic collision involvement, this effect carrying over into leisure time. Given the link between driving behaviour and presenteeism found here and the associations with stress and poorer driving behaviour found in the previous analyses, it appears reasonable to point to

presenteeism translating to higher stress levels as the literature suggests. Whether this is due to the illness itself, or the stress felt by the individual because they feel obliged to attend work, either due to personal values or organisational pressure would be an avenue of interest for future human resource-based research.

Near-miss involvement and the resultant impact on driving is intriguing, with the current literature arguing either for such involvement to be protective of drivers, with near-misses creating a sense of future caution, or conversely, precipitating 'near-miss bias', whereby drivers feel overconfident in their driving ability (Terum & Svartdal, 2019). This study found near-miss involvement as indicative of the latter. Those reporting high numbers of near-misses also report poorer levels of driving behaviour and higher levels of driver fatigue. Road traffic collision occurrence was also predicted by near-miss involvement, although driving skill rated as below average by others was also a feature. One explanation for this is that individuals are aware of being rated as a poor driver by others *because* they have been involved in an incident, and so this effect, rather than cause. In addition, near-miss involvement was not predictive of risk-taking behaviour overall, rather, more directly implicated in driving itself.

Driver retraining, or speed awareness courses are thought to promote safer driving behaviours in offenders (Ward et al., 2012). Attendance of such courses was found to be detrimental to driving behaviour in the current study; those who had attended a course in the last three years reported poorer driving behaviour than their counterparts. This warrants further inquiry- it may be the case that such individuals are unaffected by the training given and attend purely to avoid penalties and the resultant increases in insurance costs associated with penalty points being present on the driving licence. Currently, drivers are not required to inform insurers of speed awareness course attendance; this is the focus of much debate among drivers and insurers alike (RAC, 2019), as this makes evaluating an individual's behaviour behind the wheel problematic. Consequently, drivers may exhibit a laissez-faire attitude to their driving – feeling that the odds of being caught again are smaller, and even if they are prosecuted, some of the impact is negated as they have previously avoided penalty points.

Study hypothesis seven stated that there will be unique predictors depending upon when the road traffic collision took place (commuting to and from work; travelling as part of

work; travelling in leisure time). This hypothesis has been supported; predictors of RTCs differ depending on the purpose of the driving. As previously found, job characteristics play in integral part in driving to and from work, with issues of job satisfaction, demand, and pressure, being unhappy at, or depressed at work all factors in RTCs occurring at these times. Similarly, those who drive as part of their job (from site to site, for example) are also negatively impacted by lower levels of job satisfaction. Indeed, job characteristics emerge as predictors even during leisure time, with fatigue caused by work and higher levels of presenteeism appearing to have a 'carry-over' effect. Personal characteristics, specifically lower levels of personality were present whatever the reason for driving, suggesting well-being is a key factor overall. Indeed, unhealthy lifestyle, a key component of well-being was predictive of RTCs occurring when driving as part of a job. As previously discussed, bullying in the workplace was found to be impactful on driving, this being demonstrated in study three.

The final study hypothesis predicted that stress threat would be associated with negative driving outcomes, whereas stress challenge would be associated with positive outcomes. This has not been wholly supported in the present data; stress threat was present in the univariate analyses for both RTC involvement and poor driving behaviour, however this did not feature as significant in the logistic regression models. That said, stress threat was a predictor of RTCs during leisure driving, potentially indicative of the driver being overwhelmed by a circumstance beyond the scope of their experience; stress challenge, on the other hand was predictive of RTCs occurring when driving as part of a job. An explanation of the latter finding is that those who drive as part of a job have more exposure to the road and as a result, greater confidence in their ability to overcome adversity on the road (for example, undertaking to avoid queues or using more treacherous routes to save time).

Social desirability bias (SDB) is frequently cited as an impediment in research which requires participants to respond to self-report questions centered on actions or behaviours deemed to be 'socially unacceptable' or stigmatised. Whilst there has been an acknowledgement in the literature that the DBQ is not overly susceptible to SDB (see Sullman & Taylor, 2010), until now, no research has examined the potential for this effect in driving research which factors in RTC involvement. The current study featured a measure of

SDB (described in detail in *Methods*; 8.3.1.3), intended to identify whether the sample were prone to SDB, resulting in compromised data. It is worthy of note that a correlational analysis did not find any statistically significant association between higher levels of SDB and poorer driving outcomes, suggesting that this form of inquiry is not blighted by the phenomenon.

Each logistic regression model was tested for the presence of interactions among the significant variables which would have a multiplicative, rather than an additive effect. The interactions demonstrated are intuitive, in that in RTC involvement, depression and unhappiness were significant, high job demands and presenteeism significantly interacted in driving behaviour, and presenteeism and issues of work/life balance in driver fatigue. That said, none of the interactions increased the predictive validity of the models and ought to be interpreted with caution due to the potential for any effects detected being a product of chance.

As has been previously stated, it is possible for individuals to possess more than one of the risk factors identified in the driving outcomes. As a result, it is of importance to consider the cumulative impact of the predictors. This makes for sobering reading – the cumulative effects of the risk factors equate to a 3.09 fold increase in RTC occurrence; a 3.70 fold increase in risk-taking; a 3.19 fold increase in poor driving behaviour engagement and a staggering 7.04 fold increase in driver fatigue. These statistics demonstrate the necessity to examine the factors together, rather than singularly to fully understand unsafe driving.

The present study design has several strengths in terms of the consideration given to limitations acknowledged both in the literature and the previous studies, some limitations prevail. Firstly, this study is cross-sectional, and thus causality cannot be attributed. Second, the average annual mileage reported by participants is reasonably low (8942 miles per annum), it would be of interest to examine the effects discussed on those with more exposure to the road. Third, the majority of participants were female (> 70%); a more balanced gender split may afford greater insights. Lastly, most participants were recruited using a survey platform in exchange for a small fee. These participants form a pool who regularly complete

on-line surveys and therefore may be more prone to completing surveys for financial gain and as such, not pay appropriate attention to the questions posed. That said, an examination of the average response time (~ 10 minutes) suggests this may not be the case. In addition, social desirability bias was not found to be present – higher levels of social desirability bias did not translate to more favourable driving behaviour scores.

8.10 Chapter Summary and Links to Chapter Nine

The present chapter describes a cross-sectional survey of UK drivers with the predictors previously found to be implicated in the driving outcomes, as well as some newer variables. Chapter nine reports the longitudinal element (i.e., time two data) of this study, the data having been captured several months later.

Chapter Nine

Study Five (b)

9.1 Introduction

Chapter eight detailed the first part of a multivariate, longitudinal study intended to examine the predictors implicated in the previous studies. The following chapter describes the second part of this study undertaken several months later, during October 2020.

9.1.1 COVID-19 Pandemic – Research Impact

The first case of severe acute respiratory syndrome (SARS-CoV2), causal of coronavirus disease 2019 (COVID-19) was reported in December 2019. The World Health Organisation (WHO) declared it a global pandemic on March 11, 2020 (WHO, 2020). The virus has wreaked havoc world-wide, leading to around 80 million cases of COVID-19 and over six million deaths (WHO, 2023). In addition to the very real health consequences, the pandemic had a devastating socio-economic impact. As detailed in a variety of editorials, commentaries, and journal articles (e.g., Weiner, 2020; Börgeson, 2021; Suart et al., 2021) the COVID-19 pandemic posed significant challenges for researchers worldwide in a multitude of disciplines; in mere weeks, almost all research was paused to prevent further spread of the disease (Servick et al., 2020). The impact was unprecedented – research laboratories have been subject to closure following natural disasters such as hurricanes and floods (Dalton, 2005; Rodriguez et al., 2018), however the COVID-19 pandemic was different in that the impact was global, as opposed to geographically limited and its longevity was unclear – many researchers had no idea when they would be able to return to pre-pandemic operating capacity.

The present research was no exception in terms of the disruption faced during the pandemic and beyond.

The UK (United Kingdom) announced its first nationwide lockdown on 23rd March 2020 - lasting until June 2020. Measures began to relax – to an extent, in the following months, referred to as ‘relaxation of lockdown,’ although specific restrictions for certain local areas were also used to ‘firebreak’ spikes in infections.

A raft of legislation was put in place known as ‘lockdown laws,’ which refer specifically to the restriction of movement, gatherings, and high street business operations. An almost total ban on social gatherings was imposed, along with severe restrictions on movement – individuals were prohibited from leaving their home without a ‘reasonable excuse.’ Laws also prevented people from travelling outside their local area and there was a complete ban on leaving the UK (UK Parliament, 2020).

9.1.1.2 COVID-19 and Employment

The beginning of the pandemic along with the first coronavirus lockdown in March 2020 had a dramatic effect on employment. There was a large drop in employment, while unemployment and economic inactivity (individuals not in work and not looking for work) both rose. The number of people in work fell by over 800,000 people between January-March 2020 and October-December 2020, while unemployment rose by around 400,000. Redundancies reached record highs while UK working hours dropped to the lowest since 1994.The number of people claiming unemployment benefits doubled between March and May 2020.

During early 2021, employment and unemployment levels started to improve. However, economic inactivity continued to grow, peaking in December 2021-February 2022 at 8.89 million, nearly 450,000 more than in January-March 2020. Two years after the start of the pandemic, employment levels were still around 350,000 lower than they had been before it began.

9.1.1.3 Pandemic impact on the current research

Unsurprisingly, restrictions completely changed the picture of car vehicle driving in the UK, the well-being of individuals and the job characteristics of the many whose employment was disrupted by the pandemic and, even for those whose employment did not. These factors were the intended focus of the follow-up research – the first data having been captured during February 2020. he second part of the research was launched in October 2020, however as feared, the profile of the respondents had changed so extensively, any comparison between time 1 data and time 2 data would be fruitless in gaining any causal inferences. As such, the following results section solely details the descriptive changes in driving and employment.

9.1.2 Study 5b: Changes in Response to the Pandemic

In response to the expected change in driving frequency, well-being and job characteristics, a number of additional measures were added to the survey used in study 5a (see chapter 8 for a detailed account of recruitment criteria and procedure). The new measures are detailed in Table 9.1.

Table 9.1

Additional Measures

Measure	Response choice (s)
Thinking about how much driving you have done during lockdown, (March-June) have you driven:	Less than usual About the same More than usual
Thinking about how much driving you have done during relaxing of lockdown (July - September), have you driven:	Less than usual About the same More than usual
Thinking about how much driving you have done during this period (September onward), have you driven:	Less than usual About the same More than usual

How many miles have you driven during lockdown?	Numeric response
How many miles have you driven during relaxation of lockdown?	Numeric response
Has your employment changed since the start of the pandemic?	Yes, my job has changed completely No, I have continued to attend my place of work Yes, I have been made redundant/become unemployed I am not employed I am a student
Did the risk of the illness made you stressed? - During national lockdown (March - June)	1 = Not at all - 12 = Very much so
Did the risk of the illness made you stressed? - During relaxing of restrictions (July - September)	1 = Not at all - 12 = Very much so
Did social isolation make you stressed: - During national lockdown (March - June)	1 = Not at all - 12 = Very much so
Did social isolation make you stressed: - During relaxing of restrictions (July - September)	1 = Not at all - 12 = Very much so
Please describe your state of well-being: - During national lockdown (March - June)	1 = Very negative (stressed, anxious, depressed) - Very positive (happy, satisfied with life, having a positive mood)

Please describe your state of well-being: - During relaxation of restrictions (July - September)	1 = Very negative (stressed, anxious, depressed) - Very positive (happy, satisfied with life, having a positive mood)

9.2 Results

9.2.1 Participants

The survey was distributed to the four hundred and twenty individuals from social media who had indicated they would be happy to be contacted for a follow up during time 1, as well as to the 1369 Prolific participants. The response rate was pleasing (77%), with 1383 individuals completing the time 2 data. Seventy-two percent of the participants derived from Prolific, the remaining twenty-eight percent social media. Participants comprised 65.6% females, 2% other, with an age range of 27-72 (M = 42 SD = 38.6). As with study 5a, Prolific participants were remunerated with a nominal fee in return for their participation, whilst respondents from social media were entered into a prize draw (as detailed in chapter 8).

9.2.2 Changes to Driving Frequency

Unsurprisingly, the ability to drive any distance was majorly impacted by COVID-19 restrictions. The initial sample (pre-COVID-19) reported a mean annual mileage of 8942. Participants' annual mileage in this study was largely similar to that of the wider sample in study 5a and as such it is reasonable to expect that is representative of the initial sample. Figure 9.2 illustrates the mean mileage of participants pre-COVID-19, whilst in lockdown and during relaxation of lockdown. As can be clearly seen, the amount of driving plummeted during the pandemic and, as working from home where practicable has become far more acceptable, it is unlikely to reach pre-pandemic levels in the near future.

To gauge how driving may be recovering following relaxation of lockdown – i.e., in the period following September 2020 (numeric mileage estimates would not be useful for this purpose given the brief time frame for the latter measure), participants were asked to rate comparatively how much driving they did during each period. The data indicates that the amount of driving is typically less than usual, with the exception of during relaxation of lockdown (see Figure 9.3). Perceivably, this may be explained by the 'novelty' effect of being able to do something one was previously prohibited from doing, as well as the

possibility that some individuals and businesses may have taken the decision to pursue more site-based working to assuage loneliness and encourage team working. One thing is clear – driving frequency changed for every participant as a result of the pandemic.

Figure 9.2

Graph Depicting Particpants' Mileage Pre-COVID, During Lockdown, and During Relaxation of Lockdown

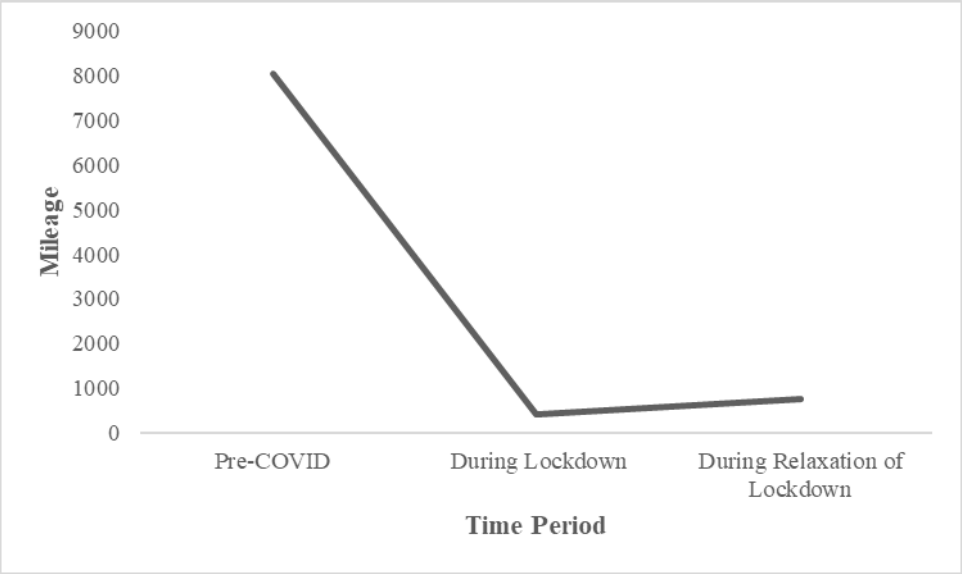
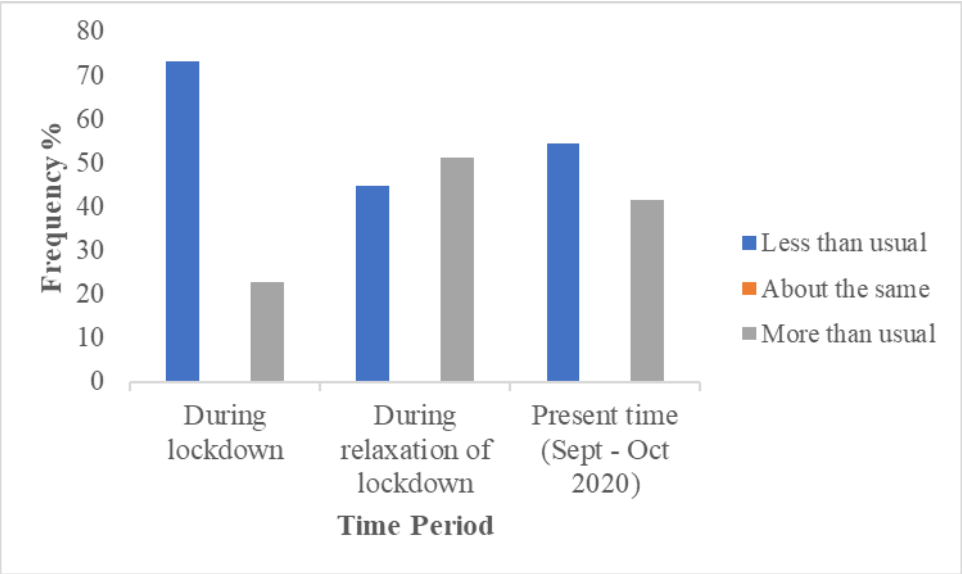


Figure 9.3

Percentage of Driving in Comparison to Pre-COVID-19 During Lockdown, Relaxation and Post-lockdown

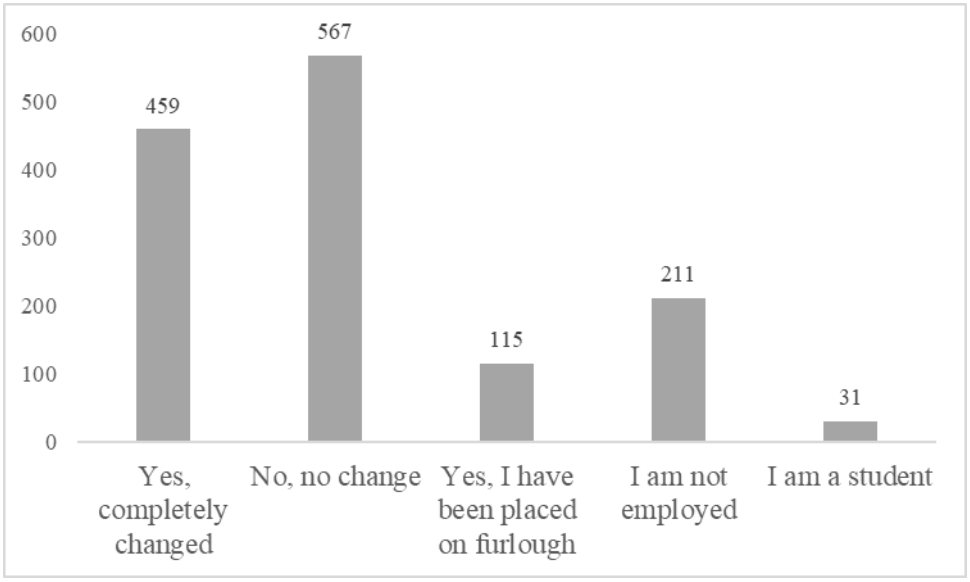


9.2.3 Changes to Employment

As previously detailed, the labour market in the UK changed substantially during the pandemic. Figure 9.3 illustrates this change in the current sample.

Figure 9.3

Changes in Employment as a Result of the COVID-19 Pandemic



Note. Figures denote number of participants in each group

9.*2.4 Well-Being During the Pandemic*

The pandemic significantly impacted individuals' levels of well-being, particularly in the remit of feeling anxious about the risk of illness and stressed about being socially isolated. Participants were also asked about their general state of well-being during the lockdown and relaxation of lockdown.

As can be seen in Figures 9.4, 9.5 and 9.6, anxiety and stress levels were high during the pandemic. This further illustrates how any measurement of comparative well-being between the time points would not be appropriate.

Figure 9.4

Percentages of Participants Feeling Anxious about the Risk of Illness During the COVID-19 Pandemic

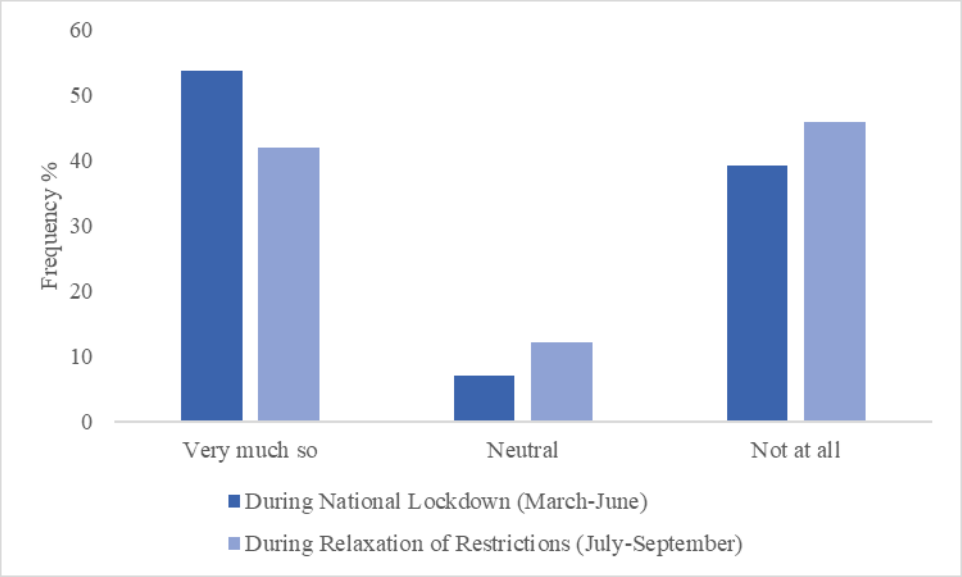


Figure 9.5

Percentages of Participants Feeling Stressed Due to Social Isolation During the COVID-19 Pandemic

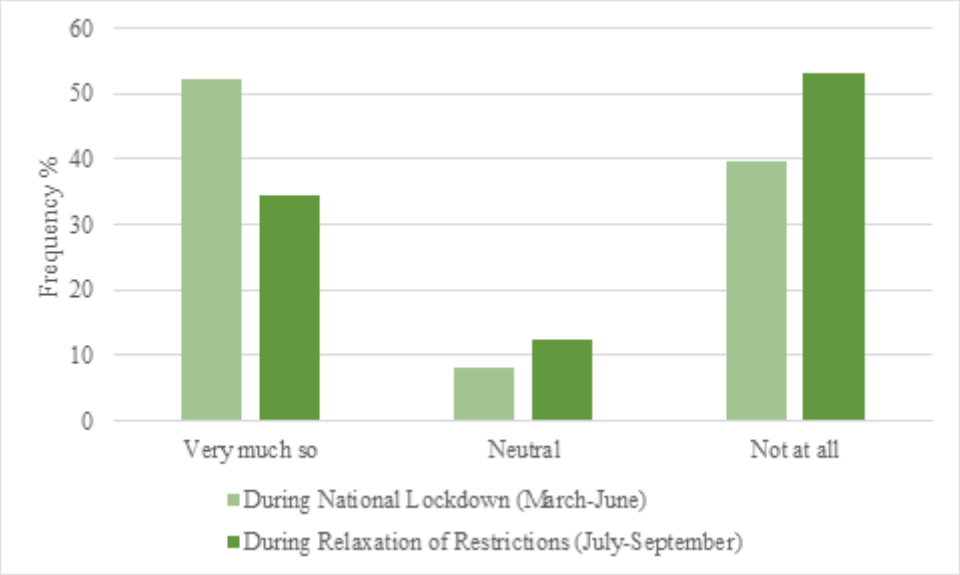
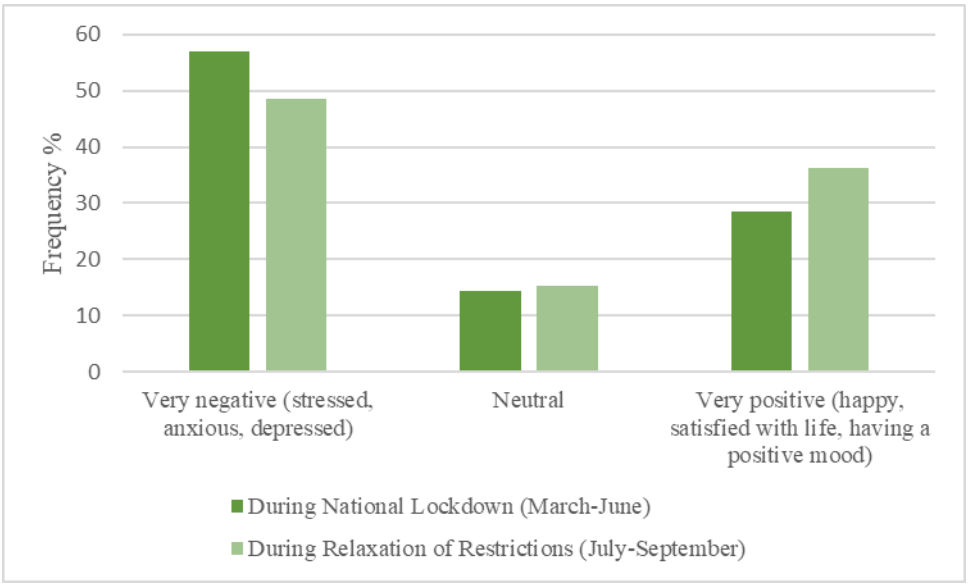


Figure 9.6

Well-being of Participants During the COVID-19 Pandemic



9.3 Summary and Links to Next Chapter

The aim of study 5b was to collect longitudinal data in the remit of the driving variables, job characteristics and well-being with a view to ascertaining causal links to the driving outcomes (RTCs, risk-taking, driving behaviour and fatigue) previously not accounted for in the other five studies.

Unfortunately, this was not possible – the two data sets could not be compared in any meaningful fashion due to the considerable changes brought about by the pandemic. Chapter 10 draws the findings from all the studies contained in this thesis to offer conclusions, as well as limitations and future directions are discussed.

Chapter Ten

10. General Discussion

The overarching aim of this thesis was to gain a holistic appreciation of the UK car driver and potential factors which may underpin the propensity to engage with unsafe driving behaviour. The driving environment was considered through the lens of being an extension of the individual behind the wheel, and so human factors – such as well-being, personality, mental health, job characteristics and how and when we drive were examined for potential links to risk-taking, driver fatigue, driving behaviour and RTC involvement.

Using a blend of exploratory and confirmatory research, established risk factors for unsafe driving were combined with more novel factors to build upon previous research in the field. This combination of established and novel risk factors serves three main purposes – 1) the existence of the established risk factors in the samples affords greater confidence in the findings surrounding the novel risk factors, 2) established risk factors can be controlled for to ascertain the impact of novel predictors and 3) examining the established and novel factors using multivariate and cumulative analytic methods addresses a gap in the extant literature surrounding driving behaviour identified in chapter two. Chapter two consisted of a systematic literature review which, in addition to identifying the absence of a multivariate approach, also uncovered a scarcity of empirical research focusing on UK drivers, or any appreciation as to whether there are unique predictors for poorer driving outcomes depending on when the incident occurred.

Each thesis chapter has provided a unique contribution to the literature in the field of driving behaviour. Limitations specific to each piece of research are discussed in detail within the requisite chapter. A potential overarching limitation of this body of research is the absence of behavioural or 'real-world' data to investigate driving behaviour. Driving simulators are commonly used to examine complex behaviours in a controlled environment that may not otherwise be safe, practical or ethical (Pawar et al., 2022). Arguably, it would be of utility to reinforce some of the survey-based findings with 'real-world' data, although a very real challenge is obtaining sufficient participant numbers to draw comparisons, given the

time required to undertake this type of research – this exacerbated by the COVID-19 pandemic, during which in-person experiments were prohibited. That said, despite their frequent use, a recent systematic review by Wynne et al. (2019) of over forty driving simulator studies found relatively little evidence confirming their validity and reliability. Further, inconsistencies were found in the types of simulator used and the operationalisation of 'real-world' driving in validations. It would appear then that there is no 'optimal' way in which driving behaviour can be examined. The present research has developed – across several studies, a survey tool (see Appendix B for a copy) consisting of established predictors of adverse driving outcomes, as well as newer predictors, all of which have been tested to assess their utility. Predictors not achieving statistical significance in earlier studies were excluded from the final survey tool such that over time, a 'model' of factors contributing to negative driving behaviour may emerge. Moreover, a methodology for research using small samples has also been developed – this being of utility to researchers with access to limited participant numbers.

This final chapter contains a brief summary of the research undertaken and the findings contained in each chapter, followed by a discussion of findings in relation to the wider literature reported in the systematic review (chapter 2). Finally, implications of the findings for future research, policies and interventions will be offered although it should be noted that such suggestions are tentative, given the absence of longitudinal data (as discussed in chapter nine) required to assess causality.

Chapter four examined well-being and driving behaviour in a student population, the findings of which demonstrated that poor driving behaviour predicted negative well-being and appraisal; whereas more pro-social driving behaviour was predictive of positive well-being and appraisal. These effects remained statistically significant when established predictors of driving outcomes were co-varied. These findings map well onto the extant literature; higher levels of satisfaction with travel (not being annoyed by other drivers, the trip not being too tiring) was found to promote positive well-being in drivers (Ettema et al., 2013). Examining effects from another perspective, high levels of happiness in relation to well-being and life satisfaction was identified as a driver for increased adaptive and pro-

social behaviour behind the wheel, perceivably reducing the propensity to engage in traffic violations (Isler & Newland, 2017).

Chapter five described a study in which associations between human factors, such as personality, job characteristics, mental health, fatigue and driving behaviour were assessed for potential links to RTC involvement. In addition, some of the risk factors, namely driving behaviour, risk-taking and driver fatigue were also analysed as outcome variables to better understand the dynamics of the established risk factors. This approach was productive, in that whilst much of the literature in the field points to personality traits as directly causal of RTCs, they actually impact risk-taking and driving behaviour. The use of a combined effects methodology was also of benefit; driver fatigue increased over 16-fold for those in blue collar employment. Considering the predictors from a combined perspective attends to the notion of gaining a holistic purview of drivers as individuals who may possess more than one of the predictor variables.

Chapter six delved into the impact of the work environment further, given the associations uncovered in the previous study. Analyses examined whether there were unique predictors of negative driving outcomes depending upon what type of driving the road user was engaging with: commuting, driving as part of a job, or during leisure time. Findings were enlightening and further strengthened the idea that the work environment carries over into the driving environment. For instance, collisions occurring during the commute to work were predicted by high job stress, high incidences of accidents in the workplace and noisy workplaces. Collisions occurring during the commute home were associated with females, with issues of work/life balance, who reported experiencing bullying and/or harassment at work. The impact of the work environment on driving behaviour is evident in the wider literature; employees exposed to heightened negative affect during the working day were more likely to drive unsafely during their post-work commute (Calderwood & Ackerman, 2019). Similarly, Rowden et al. (2011) demonstrated that work stress was positively correlated with driving violations. Clearly, work stress ‘overspills’ into the driving environment during the commute.

Chapter seven reports a study in which two new variables are added; impulsivity and hostility, these emerging in the literature as implicated in driving outcomes. The findings in this thesis bear that out – impulsivity was positively associated with both risk-taking and poor driving behaviour, hostility positively associated solely with poor driving behaviour. These findings have been replicated and extended by other researchers, for example, Memarian et al., (2023) examined the mediatory role of regulatory processes in the relationship between impulsive processes and risky driving. Congruent with the findings reported in chapter seven, impulsivity and hostility were implicated in poor driving behaviour – although attitudes toward driving safety significantly mediated this relationship, supportive of the importance of driver safety education.

In addition, the focus of chapter seven turned toward two methodological factors: survey length and socially desirable responding. Both factors can negatively impact data quality and so a facet of this research was to explore whether some factors may be reduced to a one-item measurement. Findings revealed that driver fatigue, previously measured using five-items could be reduced to one item, offering satisfactory reliability and validity. Short-item scales were used for the measurement of social desirability, personality and impulsivity. Findings demonstrate the instruments to be sufficient in terms of reliability, suggesting that brevity does not always equate to a decrease in the reliability of the data. In addition, the instrument was not subject to socially desirable responding, lending support to the existing stance that driving behaviour research is not substantially impacted by stigmas which may hamper other investigations.

Chapter eight contains the first part of a flagship, longitudinal study, comprising the statistically significant predictors found in the previous study. One new variable in this well-powered study was that of ‘near-misses’, in which participants were asked how many near-misses they had experienced in the past 12 months. Interestingly, near-misses were found to be predictive of both poor driving behaviour and RTC involvement. Given that 64.4% of the sample reported at least one near-miss, further investigation into near-misses is warranted.

Perhaps the most enlightening – not to mention counter intuitive finding relates to recent driver retraining course attendance. Drivers who had attended such courses reported

poorer driving behaviour than their counterparts. This is extremely interesting given the emphasis placed on this psychoeducational intervention as a way of reducing driver violations.

10.1 Future Directions, Policies and Interventions

In terms of future directions, the most obvious recommendation is to undertake longitudinal enquiry, using the survey tool developed over the course of this thesis to ascertain causality. In addition, the use of multivariate and cumulative effect methodology appears to yield holistic insights into driving behaviour and the human factors at play in the driving environment. It is suggested that future research adopts this practice, to gain a more rounded appreciation of driver safety.

Given that much of the findings contained in this thesis point to job characteristics as being heavily implicated in driving outcomes – particularly bullying and harassment in the workplace, it would be of benefit for employers to consider this when formulating occupational health interventions for employees. Clearly, the impact of the working day does not end when one leaves their place of work. Along a similar vein, it would be of interest to investigate how traumatic events in the workplace impact those who witness them (such as police, firefighters etc) during the commute.

Personality has been found to play a part in driving behaviour, often giving rise to risk-taking, a well-known predictor of RTC involvement. It may be of utility to screen learner drivers for problematic personality traits, such that those individuals high in personality traits predictive of risk-taking are offered more tailored driver safety training. Of course, it may be perceived as impractical or unethical to undertake such screening on a blanket basis – perhaps it could be offered as an optional service for learner drivers who wish to receive more detailed driver training. Currently in the UK, learner drivers are given instruction purely regarding the practical technique of driving a motor vehicle, not emotion regulation or behaviour management – perhaps techniques in self-regulation would be of benefit. There is growing research evidence for relaxation and cognitive behavioural interventions which may help to reduce anger, stress and aggressive driving (Haustein et al., 2021; Stephens et al., 2022).

As suggested in the requisite chapters, a variety of interventions, such as greater employer awareness surrounding the impact of the work environment on the driving environment, the practice of mindfulness as a way to improve levels of wellbeing, and closer examination of the effects of driver retraining on drivers following course attendance ought to be considered.

Overall, the research contained in this thesis has contributed to expert knowledge in the field of transport psychology. It is hoped that future research will build upon this newly acquired knowledge, such that further advances can be made toward safer driving.

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Appendices

Appendix A: Survey – Job Characteristics, Mental Health and Driving

Driving Survey

Section 1. Driving

1.1 How often do you drive in heavy traffic ?

Never	Rarely	Some- times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.2 How often do you drive on the motorway ?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.3 How often do you have to drive when you are tired?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.4 How often do you drive when you have a minor illness like a cold ?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.5 How often do you have to drive late at night, in the early morning or the post-lunch period?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.6 How often do you have to drive for long periods?

Never	Rarely	Some-times	Often	Very often

☐0	☐1	☐2	☐3	☐4

1.7 How often do you have to drive after prolonged work?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.8 How often do you feel you are distracted when you drive?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.9 How often do you listen to the radio or other forms of in-car entertainment when you drive?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.10 How often do you have conversations with passengers when you drive?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.11 How do you rate your driving skills?

Not very good	Below average	Average	Above average	Very good
☐0	☐1	☐2	☐3	☐4

1.12 How do others rate your driving skills?

Not very good	Below average	Average	Above average	Very good
☐0	☐1	☐2	☐3	☐4

1.13 How often do you have to drive in bad weather conditions?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.14 How often do you drive over the speed limit?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.15 How often do you indicate hostility to other drivers?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

1.16 How often do you have lapses of concentration when driving?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

1.17 How often do you use your mobile phone when driving?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

Section 2. Your Job

We would like to ask you some questions about you and work. If you are not working go to the next section.

2.1 a) What is your job title?

b) Is the job full-time or part-time? (Full-time: 30 hours per week or more, Part time: up to 30 hours per week)

Please tick one box.

Full-time □0
Part-time □1

c) Is your job permanent, temporary/casual, or fixed contract? Please tick one box.

Permanent □0
Temporary/casual □1
Fixed contract □2

d) Which one of the following best describes your current position at work.

Please tick one box.

Self-employed (25+ employees*)	□0	Manager (25+ employees*)	□3
Self-employed (less than 25 employees*)	□1	Manager (less than 25 employees*)	□4
Self-employed (no employees*)	□2	Supervisor	□5
		Employee	□6

(Total number in Company, not just those of whom you are in charge)*

e) In this job, how many hours per week do you work on average?

f) What is your work pattern?

Fixed hours □0
Flexi-time □1
Shift work □2

Shift Workers <u>Only</u>

g) What is the length of your current shift?

6hrs □0

8hrs □1
12hrs □2
Other

The following questions are designed to give a quick overview of your job characteristics. Please tick the appropriate box.

2.2 Do you work long or unsociable hours (shiftwork, at night, on call, unpredictable hours)?

Never	Rarely	Some- times	Often	Very often
□0	□1	□2	□3	□4

2.3 How often are you exposed to noise at work?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.4 Do you have a demanding job (have to work fast, intensively etc)?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.5 Do you have a choice in what you do or how you do your job?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.6 Do you have a great deal of say in decisions at work?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.7 Do you have a lot of support at work (from colleagues and superiors)?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.8 Do you have constant pressure due to a heavy workload?

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.9 Work rarely lets me go, it is still on my mind when I go home

Never	Rarely	Some-times	Often	Very often
□0	□1	□2	□3	□4

2.10 Do you receive the respect you deserve from superiors and colleagues?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

2.11 Do you feel your efforts and achievements at work are appropriately rewarded?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

2.12 Are you satisfied with your job?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

2.13 Do family matters (and other things outside work) interfere with your work?

Never	Rarely	Some-times	Often	Very often
☐0	☐1	☐2	☐3	☐4

2.14 Does your job interfere with family life or other activities outside work?

Never	Rarely	Some- times	Often	Very often
☐0	☐1	☐2	☐3	☐4

2.15 In general, how do you find your job?

Not at all stressful	Mildly stressful	Moderately stressful	Very stressful	Extremely stressful
☐0	☐1	☐2	☐3	☐4

Section 3. Your General Well-being

Please read each item and then tick the box next to the reply that comes closest to how you have been feeling in the past week. Try to give your first reaction. This will probably be more accurate than spending a long time thinking about an answer. Please answer all questions, and tick only ONE BOX per question.

a) I feel tense or wound up

Most of the time	☐0
A lot of the time	☐1
From time to time, occasionally	☐2
Not at all	☐3

b) I feel as if I am slowed down

Nearly all the time	☐0
Very often	☐1
Sometimes	☐2
Not at all	☐3

c) I still enjoy the things I used to enjoy

Definitely as much	☐0
Not quite so much	☐1
Only a little	☐2

d) I get a sort of frightened feeling like "butterflies" in the stomach

Not at all	☐0
Occasionally	☐1
Quite often	☐2

Hardly at all □3

Very often □3

e) I get a sort of frightened feeling as if something awful is about to happen

Definitely □0

Very definitely and quite badly □0

Yes, but not too badly □1

A little, but it doesn't worry me □2

Not at all □3

f) I have lost interest in my appearance

I don't take as much care □1

as I should

I may not take quite as much care □2

I take just as much care as ever □3

g) I can laugh and see the funny side of things

As much as I always could □0

Not quite so much now □1

Definitely not so much now □2

Not at all □3

h) I feel restless as if I have to be on the move

Very much indeed □0

Quite a lot □1

Not very much □2

Not at all □3

i) Worrying thoughts go through my head

A great deal of the time □0

A lot of the time □1

From time to time but not too often □2

Only occasionally □3

j) I look forward with enjoyment to things

As much as I ever did □0

Rather less than I used to □1

Definitely less than I used to □2

Hardly at all □3

k) I feel cheerful

Not at all □0

Not often □1

Sometimes □2

Most of the time □3

l) I get sudden feelings of panic

Very often indeed □0

Quite often □1

Not very often □2

Not at all □3

m) I can sit at ease and feel relaxed

Definitely □0

Usually □1

Not often □2

Not at all □3

n) I can enjoy a good book or radio or TV programme

Often □0

Sometimes □1

Not often □2

Very seldom □3

3.2 Over the past 12 months, how would you say your health in general has been?

Very good	Good	Fair	Bad	Very bad
□0	□1	□2	□3	□4

3.3 How do you find life in general? Please tick one box only.

Not at all stressful	Mildly stressful	Moderately stressful	Very stressful	Extremely stressful
□0	□1	□2	□3	□4

SECTION 4. ACCIDENTS AND INJURIES

4.1 Thinking about the last 12 months, have you had any accidents while you were working that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)?

None	1	2	3	4	5	6	More than 6
☐0	☐1	☐2	☐3	☐4	☐5	☐6	☐7
							Please specify

4.2 How many accidents requiring medical attention have you had outside work in the last 12 months?

None	1	2	3	4	5	6	More than 6
☐0	☐1	☐2	☐3	☐4	☐5	☐6	☐7
							Please specify

4.3 In the last 12 months how frequently have you had minor injuries that did not require medical attention?

a. at work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
☐0	☐1	☐2	☐3	☐4

b. outside of work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
☐0	☐1	☐2	☐3	☐4

4.4 How frequently do you find that you have problems of memory (e.g. forgetting where you put things), attention (e.g. failures of concentration), or action (e.g. doing the wrong thing)?

a. at work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
☐0	☐1	☐2	☐3	☐4

b. Outside of work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
☐0	☐1	☐2	☐3	☐4

4.5 Thinking about the last 12 months, have you been involved in any traffic accidents resulting in injuries that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)?

None	1	2	3	4	5	6	More than 6
☐0	☐1	☐2	☐3	☐4	☐5	☐6	☐7

4.6 Thinking about the last 12 months, have you been involved in any traffic accidents not involving injuries?

None	1	2	3	4	5	6	More than 6
☐0	☐1	☐2	☐3	☐4	☐5	☐6	☐7

Appendix B: Full Driving Survey

GENERAL INSTRUCTIONS

We are conducting research into driving behaviour and factors associated with this. There is a prize draw for Amazon Vouchers (1st prize £150; 2nd £100; 3rd £50) as a thank you for your participation. If you wish to be included in the prize draw, please provide an email address here:

Email:

Alternatively, if you DO NOT wish to be included in the prize draw, please indicate here:

I DO NOT wish to be included in the prize draw.

The questionnaire contains sections on driving, your job, your health, lifestyle and personal characteristics. The information you provide is strictly anonymous. We are only interested in groups of people and therefore no individual will be identified in connection with any of the research findings. Your identity and responses to the questionnaire will be completely protected.

Please read each question carefully and mark the response that BEST reflects your knowledge or feelings. Do not spend a lot of time on each one; your FIRST answer is usually the best. Please make sure you mark all answers in the space provided. If there are any questions you do not want to answer you may omit them.

Please do not hesitate to contact the research team if you would like more information about the study.

Louise Bowen E-mail: bowenl7@cardiff.ac.uk

Demographics

Gender

Are you:

Male

Female

Other

Age

How old are you? _____

Marital status

What is your marital status? Please tick ONE only

Single

Married/Divorced/Widowed/Co-habiting/Civil Partnership

Salary

What is the total current yearly amount you receive from your wage, pension, benefit allowance or annual salary (before tax is deducted)? Remember your responses are confidential. Please indicate one category.

Less than £2,500	**£2,500-£4,999**	**£5,000-£9,999**
£10,000-£15,999	**£16,000-£19,999**	**£20,000-£24,999**
£25,000-£29,999	**£30,000-39,999**	**£40,000-49,999**
£50,000 or more		

SWELL- Job characteristics/Appraisals

Health-related behaviours

A healthy lifestyle involves taking exercise, eating a balanced diet, not smoking, not drinking excessive amounts of alcohol, and not being overweight. To what extent do you have a healthy life style?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

Personality

People often describe themselves as being positive ("seeing" the glass as half full) or negative ("seeing the glass as half empty"). How would you describe yourself?

Very negative **Very positive**

1 2 3 4 5 6 7 8 9 10

Thinking about the last 6 months:

Life satisfaction

How satisfied are you with life in general?

Not at all **Very much so**

1. **2 3 4 5 6 7 8 9 10**

If you are reading this, choose 7

1 2 3 4 5 6 7 8 9 10

Life stress

How much stress have you had in your life in general?

Very little **A great deal**

1. **2 3 4 5 6 7 8 9 10**

Happiness

Would you say you are generally happy?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

Anxious/Depressed

Would you say that you generally feel anxious or depressed?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

Noise

Are you exposed to noise at work?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

Shift work/Night work

Do you work shifts or work at night?

Yes/No

Job demands

How demanding do you find your job (e.g. do you have constant pressure, have to work fast, have to put in great effort)?

Not at all demanding **Very demanding**

1 2 3 4 5 6 7 8 9 10

Job control and support

Do you feel you have control over your job and support from fellow workers?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

If you are reading this, choose 4

1 2 3 4 5 6 7 8 9 10

Perceived stress at work

How much stress do you have at work?

Very little **A great deal**

1 2 3 4 5 6 7 8 9 10

Job satisfaction

Are you satisfied with your job?

Not at all **Very much so**

1 2 3 4 5 6 7 8 9 10

Physical and mental fatigue

How physically or mentally tired do you get at work?

Not at all tired **Very tired**

1 2 3 4 5 6 7 8 9 10

Illness caused or made worse by work

Have you had an illness (either physical or mental) which you believe was caused or made worse by work?

Yes **No**

Presenteeism

Do you ever come to work when you are feeling ill and knowing you can't do your job as well as you would like to?

Yes **No**

Efficiency at work

How efficiently do you carry out your work?

Not very efficiently **Very efficiently**

1 2 3 4 5 6 7 8 9 10

Work-life balance

Do you find your job interferes with your life outside work or your life outside of work interferes with your job?

Never **Very often**

1 2 3 4 5 6 7 8 9 10

Happy at Work

Are you happy at work?

Never **Very often**

1 2 3 4 5 6 7 8 9 10

Anxious/Depressed because of work

Are you anxious or depressed because of work?

Never **Very often**

1 2 3 4 5 6 7 8 9 10

Absenteeism

Approximately how many days sick leave have you had in the last 12 months?

_____Days

Do you have any conflict with your direct boss/supervisor?

Never Sometimes Often Always

Do you have any conflict with your colleagues?

Never Sometimes Often Always

Personality

Please use the following rating scales to assess how accurately the statement describes you. Please try to be as accurate as possible, but avoid thinking too much about your answers - your first instinct is usually the best.

I see myself as:

Extraversion

Extraverted, enthusiastic

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Agreeableness (R)

Critical, quarrelsome

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Conscientiousness

Dependable, self-disciplined

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Neuroticism

Anxious, easily upset

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Openness

Open to new experiences, complex

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

30. Extraversion (R)

Reserved, quiet

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

If you are reading this, choose 6

1 2 3 4 5 6 7 8 9 10

Agreeableness

Sympathetic, warm

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Conscientiousness (R)

Disorganised, careless

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Neuroticism (R)

Calm, emotionally stable

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Openness (R)

Conventional, uncreative

1. Disagree strongly 2. Disagree moderately 3. Disagree a little 4. Neither agree nor disagree

5. Agree a little 6. Agree moderately 7. Agree strongly

Social Desirability Scale

35. Do you always practice what you preach to people?

Yes No

If you say to people you will do something, do you always keep your promise no matter how inconvenient it may be?

Yes **No**

Would you smile at people every time you meet them?

Yes **No**

Would you ever lie to people?

Yes **No**

<u>Risk-Taking</u>

How frequently do you take risks?

a) at work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently	Not applicable

b) outside work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently	Not applicable

Accidents and Injuries

Accidents at Work

Thinking about the last 12 months, have you had any accidents WHILE YOU WERE WORKING that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)? *Please do not include traffic accidents here, as they are covered in a later question.*

None	1	2	3	4	5	6	More than 6

RTCs

Thinking about the last 12 months, have you been involved in any traffic accidents resulting in injuries that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)?

None	1	2	3	4	5	6	More than 6

Were you:

The driver	A passenger	On foot	Other

When did the accident happen? :

a. **On your way to work**

b. **Travelling as part of your job**

c. **On your way home from work**

d. **Travelling during leisure time**

If you are reading this, choose 2

1 2 3 4 5 6 7 8 9 10

Accidents Outside Work

Thinking about the last 12 months, have you had any accidents OUTSIDE WORK that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)?

Please do not include traffic accidents covered in the previous questions.

None 1 2 3 4 5 6 More than 6 Not applicable

Cognitive Failures

How frequently do you find that you have problems of memory (e.g. forgetting where you put things), attention (e.g. failures of concentration), or action (e.g. doing the wrong thing)?

a. **at work**

Not at all **Rarely** **Occasionally** **Quite frequently** **Very frequently**

b. **outside of work**

Not at all **Rarely** **Occasionally** **Quite frequently** **Very frequently**

Driving

Have you driven a motor vehicle in the last 12 months (e.g. car, van etc.)?

Yes **No**

DRIVERS ONLY

Drive Heavy Traffic

How often do you drive in heavy traffic?

Never **Rarely** **Sometimes** **Often** **Very often**

Motorway Driving

How often do you drive on the motorway?

Never Rarely Sometimes Often Very often

Mileage

What is your annual mileage? (please enter a *numeric* value, e.g. 10,000)

_____ miles per year

RTC Incidence

Thinking about the last twelve months, have you been involved in any 'near misses' on the road, in car parks etc?

None 1 2 3 4 5 6 or more

Driving Skill (as rated by others)

How do others rate your driving skills?

Not very good Below average Average Above average Very good

Drive in Poor Weather

How often do you have to drive in bad weather conditions?

Never Rarely Sometimes Often Very often

Driving Behaviour

How often do you miss warning signs?

Never Rarely Sometimes Often Very often

How often do you indicate hostility to other drivers?

Never Rarely Sometimes Often Very often

How often do you drive above the speed limit?

Never Rarely Sometimes Often Very often

If you are reading this, choose 3

1 2 3 4 5 6 7 8 9 10

Driver Training

Have you attended any driver retraining courses in the last three years (such as those offered to avoid speeding points)?

Yes No

Driver Fatigue

60. How often do you have to drive when you are tired? (for example, after prolonged work, with a minor illness like a cold, over long periods, late at night, in the early morning or post-lunch period)

Never Rarely Sometimes Often Very often

Invitation to second survey.

We would love to hear your views again after a three-month period, whereby you will be invited to complete a shorter survey. If you are happy for the research team to contact you about further research participation, please provide an email address below.

Email address: _____