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Factors underpinning unsafe driving: A systematic literature review of car drivers.

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Abstract

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

Methods: 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.

Results: 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, as well as research examining the impact of driving itself on the well-being of the driver.

Conclusions: 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.

Keywords:

Social, domestic and pleasure drivers; Well-being; Personality; Risk-taking; Road traffic collision;

Mental health.

1. Introduction

The Global status report on road safety 2018 (World Health Organisation; WHO, 2018) highlights that the number of deaths on the world's roads is unacceptably high, with an estimated 1.35 million people dying each year. Whilst it is acknowledged that injurious and fatal road traffic collisions (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.

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, Nazari & Rahmani, 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. Also of concern is the effect of driving *itself* upon the well-being of the driver. 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, Flynn and Meyers (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, Moradi, & Rahmadi, 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. 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, Forth & Stokes, 2017) 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). Figure 1. shows the proposed relationship between driving, well-being, and driving outcomes.

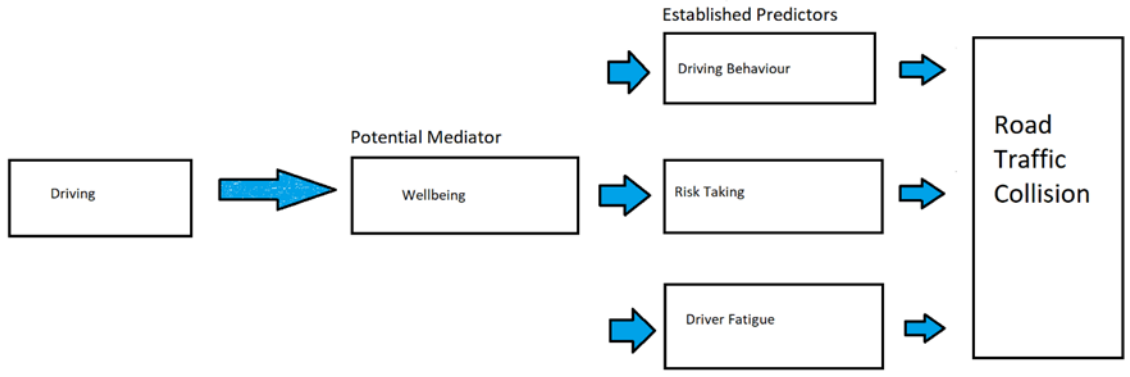

Figure 1. Proposed direction of the relationship between driving, well-being and driving outcomes

The purpose of this paper 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. Method

2.1 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.

Search Terms

The search strategies, developed by a health sciences librarian in consultation with the researcher, were undertaken between March 2019 and February 2020 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. behavior) were used to ensure no relevant studies were excluded. The full list of search terms can be found in Table 1.

Table 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	Influence RTC RTA Crash Relationship Accident Risk Human factors

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

2.2 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 below).

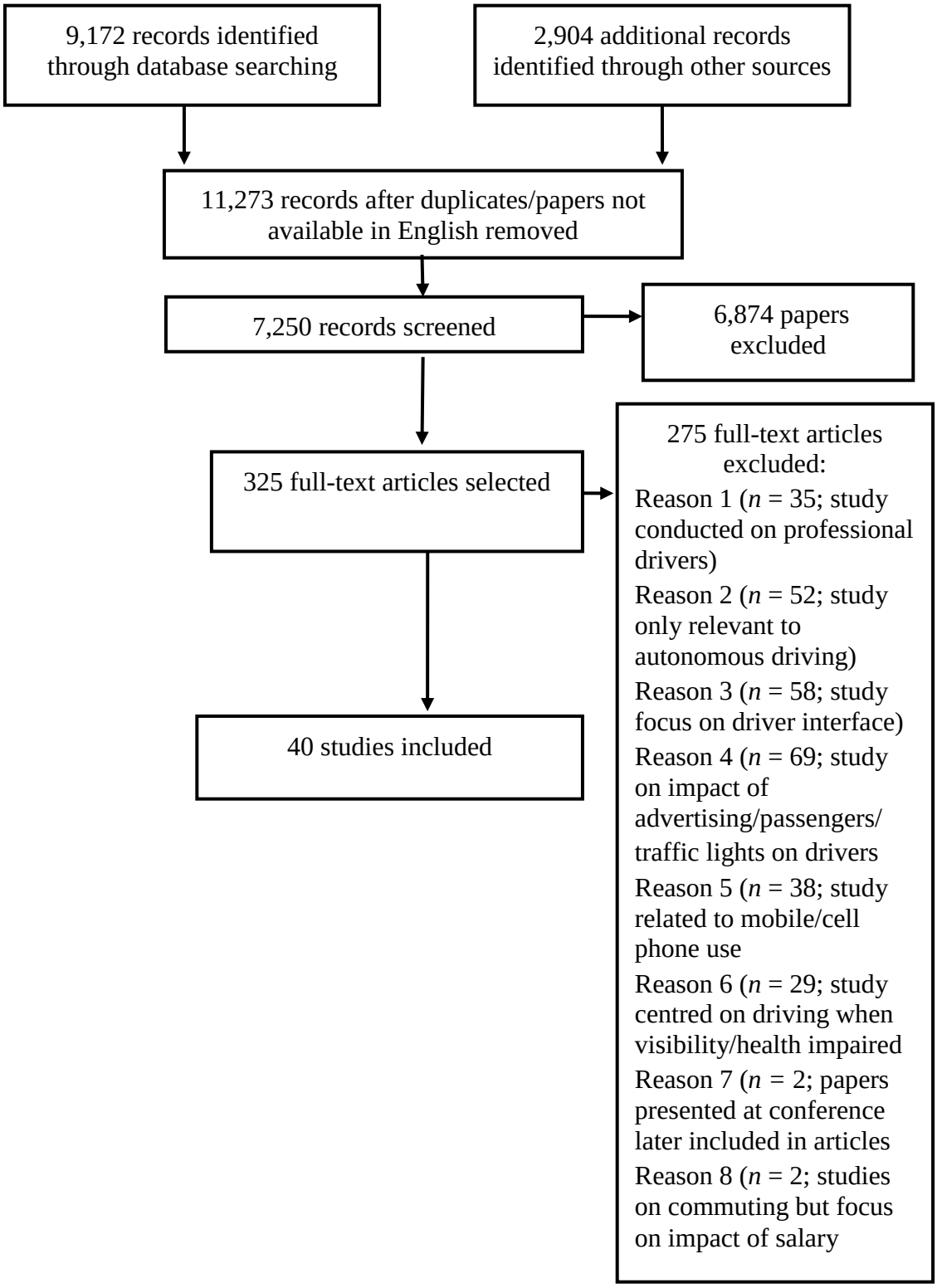

Figure 2. Flow Diagram of the Screening Process using Preferred Reporting Items for Systematic Reviews and Meta analyses guidelines (PRISMA; Moher et al., 2009).

2.3 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, Gonzalez-Reyes & Pluye, 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 rigour. 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.

Table 2.

MMAT grading criteria (adapted from Pluye et al., 2011; see tutorial for definitions and examples)

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)?

3. Results

All studies used driving outcomes as the dependent variable (measured via DBQ, Dula dangerous driving index and/or other appropriate measure; see Table 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 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 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 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 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 8).

Table 3.

Summary of methodology and measures used

Driving and stress/anxiety

Methodology	Driving measures used	Number of studies
Survey/Questionnaire	Driver behaviour questionnaire (DBQ; Reason et al., 1990)	4
	Driver behaviour survey (DBS; Clapp et al., 2011)	1
	Dula dangerous driving index (DDDI; Dula 2003)	1
	Inventory of stressful situations in traffic	1
	Short form driving	1
Focus groups		1

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)/Driving anger expression (DAX; Deffenbacher et al., 1994)	1
	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 and 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

3.1 Driving and stress/anxiety

3.1.1 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 the both the average age licence was received and attempts to complete driving exam (see Table 4).

3.1.2 Driving stress

Four studies were sourced which examined the *direct* impact of driving on the stress levels of drivers (Dogan, Bogosyan, & Acarman, 2019; Dorantes-Argandar, Gil & Berlanga, 2016; Rowden, Matthews, Watson & Biggs, 2011; Scott-Parker, Jones, Rune & Tucker, 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, 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, Gil and Berlanga (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.

3.1.3 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 behavior. 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 behavior revealed a sex effect, in that females reported more frequent caution/safety behavior than their male counterparts (sr^2 =.046). A direct relationship between

accident distress and safety behavior was manifest specifically in individuals with greater life stress history (sr^2 = .029), whereas there was no association observed between safety behavior 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 behavior, 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 behavior (sr^2 = .035), aggressive/hostile behavior 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.

3.2 Driving and Personality

3.2.1 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 5).

3.2.2 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, Šeibokaite, Žardeckaitė-Matulaitienė, Markšaitytė & Slavinskienė, 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 ($\beta = 0.281$), AD ($\beta = 0.235$), RD ($\beta = 0.145$) and the scale overall ($\beta = 0.249$). Those high in altruism, on the other hand were less likely to engage with AD ($\beta = -0.178$) and DD ($\beta = - 0.167$). Likewise, Shen, Ge, Qu Sun and Zhang (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 ($\beta = .451$), whilst those high in sensation seeking presented more aggressive driving behaviours ($\beta = .311$). Poó and Ledesma (2013) revealed positive correlations between the impulsive sensation seeking trait and dissociative driving styles, and Lucidi, Mallia, Lazuras and Violani (2014) who found a direct effect of sensation seeking on violations ($\beta = .023$). 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, Qu, Ge, Sun and Zhang (2018) found that risky style, angry- high-velocity style, and anxious style were all positively associated with dangerous driving behaviours. Similarly, Wang, Qu, Ge, Sun and Zhang (2018) 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.

3.3 Emotion and Driving

3.3.1 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 6).

3.3.2 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, Walker and Yim (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, Ben-Ari, Toledo and Farah (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, Shianar and Meiran (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 maneuvers and approaching hazards with less caution and recording higher arousal rates as measured by heart rate. A more recent simulator study conducted by Roidl, Frehse and Höger (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, Xie, & Li, 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, DeVito and Calmia (2019) report greater symptoms of emotional distress (as measured by the HADS scale; see Table 5) were associated with greater aberrant driving behaviours in older adults (M = 62.6 years) (as measured by the DBQ; see Table 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, Wang, Peng and Chen (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, Lajunen, & Rošková, 2016). Friman, Gärling, Ettema, and Olsen (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 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.

3.4 Commuting and Driving Itself on Well-being

3.4.1 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 7).

3.4.2 Commuting, Driving and Well-being

Three studies explored the impact of driving itself on well-being. The first (Ettema, Gärling, Olsson, Friman & Moerdijk, 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, Charlton, & Starkey, 2016; Burdett, Charlton, & Starkey, 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.

3.5 Job Characteristics and Driving

3.5.1 Demographics

Both studies reported either mean age or age ranges. One study gave details of the length of the post-work commute (see Table 8).

3.5.2 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 spillover 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 4.

Studies on stress/anxiety and driving (in alphabetical order)

Authors (year), Title, Location	Sample	Methods	Measures	Results	MMAT Score/Dimension not met (if applicable)
Clapp et al. (2011) Factors contributing to anxious driving behavior: 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 behavior (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	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

			driving with a negative lighting factor Group 5 = stress level of fragile goods transport and driving after stressful work 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. USA	1121 students; 67.4% female; Mean age = 21.3 ± 5.6 Age range 17-55	Online Survey	Questionnaires: Beck anxiety inventory Propensity for angry driving scale DDI	Higher levels of anxiety associated with greater levels of dangerous driving (independent of sex)	3 Unrepresentative Sample
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;	Longitudinal Surveys	Questionnaires: New Zealand population census. Medical outcomes study. Short form driving	HMR's revealed driving anxiety associated with poorer mental and physical health, as well as lower quality of life.	4

	2743 participants; Age range = 55-70		anxiety (x1 question)	Women more likely 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. Australia	75 drivers; 53 female; Mean age = 24.45 ± 7.8; Age range = 17-47	Questionnaires / experiments	Questionnaires: State-trait anxiety inventory DBQ Experimental measures: PGNG n-back task	Trait anxiety found to predict poor DB.	3 Unrepresentative Sample

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

Table 5.

Studies on driving and personality (in alphabetical order)

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 behavior. High levels of openness and extraversion, low levels of conscientiousness were associated with risk-taking behavior.	4

Campbell et al. (2013) Not so fast! An investigation of the real-world speeding behaviors 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 behavior 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 traits in a group of learner drivers. Lithuania	Convenience sample of 475 driving licence candidates; 187 male; Mean age = 23.8 ± 8.06 years Age range = 17-58 years	Online survey	Questionnaires: Scale of risk-taking attitudes to driving Short dark triad scale	Dark personality traits (Machiavellianism, narcissism and psychopathy) are significantly related to riskier driving attitudes (drunk driving, joyriding, violations of road rules).	4
Ge et al. (2014) The effect of stress and personality on dangerous driving behavior 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 behavior; 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 behavior.	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	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	3 Unrepresentative Sample

			(CSII; Bearden et al. (1989) Risk-Aversion (Dählback, 1990) Social issue involvement (Mittal, 1995)	connected with speed limit compliance. Lower concern to conforming to the expectations of others led to greater propensity to comply with the speed limit.	
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 6.

Studies on driving and emotion (in alphabetical order)

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 behaviors 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 behaviors. Follow up regressions indicate greater suicidality, appetite gain/loss, panic and ill-temper significantly	3 Unrepresentative Sample

				associated with aberrant driving. 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: Relevance of driving to self-esteem Sensation seeking scale Driving history questionnaire	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
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 behavior from anger and negative cognitions. USA	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 68% female; 45% in the higher aggression group	Survey	Driver aggression subscale of the Driving Anger Scale (Deffenbacher et al. 1994) Number of RTCs and speeding tickets 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)	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

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 behavior in simulator: mean speed, acceleration and braking; speeding behavior 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. Germany	73 drivers; 46 female; Mean age = 42.6 ± 12.8 Age range = 18-65	Simulator study	Emotion induction, combining autobiographical imagination and affective music. Driving simulation	Emotions were found to change behaviour in two ways: directly, by promoting aggressive driving or indirectly, by altering attentional effects on driving.	3 Unrepresentative Sample
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 DAS Skill questionnaire General Causality Orientation Scale (GCOS; Deci & Ryan, 1985) State and Trait Anxiety Inventory (STAI; Speilberger et al., 1983)	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 dangerous overtaking maneuvers.	4

Wu et al. (2018) A questionnaire survey on road rage and anger-provoking situations in China China	1400 drivers; 64.86% male; Age range = 18-60+; 38.71% >6 years driving experience	Online survey	Reactions under anger-provoking situations Measures to prevent road rage	When encountering aberrant overtaking, 61.3% driver 'angry but tolerant'. Being flashed by high beams by driver in the opposite direction provoked an enraged 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. 71.5% of participants chose 'improve public transportation' as a means to reduce road rage.	3 Limited information with regard to origin/validity of the measures used

Table 7.

Studies examining the impact of commuting and driving itself on well-being (in alphabetical order)

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

undergraduate psychology students. New Zealand	114 held full licence, 4 had licence temporarily revoked, 33 held restricted licence and 9 held a learner licence; The 160 participants reported 583 unwanted driving incidences (M = 3.64, SD = 3.74)		Driving violations questionnaire The Good life survey	and strongly with the number of incidences the driver experienced in the previous year. Drivers rating highly on the dimension of pleasure were more likely to experience unwanted driving incidences. Higher levels of happiness related to life satisfaction and well-being facilitate pro-social and adaptive behaviour, seemingly safeguarding drivers against committing deliberate traffic violations.	
Turgeman-Lupo & Biron (2016) Make it to work (and back home) safely: the effect of psychological stressors on employee behaviour while commuting by car. The Netherlands	216 employees commuting to work by car; 54% males; Mean age= 35.9 years Average commuting distance (one-way) = 29 km	Longitudinal Survey	Questionnaires: Perceived abuse supervision Work-family conflict Commuting norms scale DBQ	Abusive supervision and work-family conflict both positively related to unsafe driving behaviour during the commute.	4

Table 8
Studies examining the impact of job characteristics on driving (in alphabetical order)

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 (HADS; Zigmond & Snaith, 1983) Risk-taking and RTC involvement DBQ Driver fatigue	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 decision making.	4

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 indicative of unsafe driving	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

4. Discussion

The purpose of the current paper 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 behavior 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, Gil & Berlanga, 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.

Anxiety surrounding driving following an RTC has been studied relatively frequently, however driving anxiety, which can range from a reluctance to drive to a driving phobia has garnered less research attention. Furthermore, there was no research sourced which examined the potential for driving itself to induce anxiety. The current review found five papers which explored the impact of anxiety on driving (Clapp et al., 2011; Dula et al., 2010; Hempel et al., 2017; Shahar, 2010; Wong & Titchener, 2015). Across the studies, the message is clear - higher levels of anxiety equate to both higher incidences of RTC involvement and dangerous driving practice. Indeed, individuals high in anxiety demonstrate more errors, lapses and violations, as measured by the DBQ. Whilst much of the literature points to errors and violations as being the result of cognitive overload in highly anxious individuals (Wong & Titchener), the observed increase in propensity to commit violations is less obvious. Indeed, intuitively, one may expect that anxious drivers would be more afraid of being involved in a collision, of violating laws in general and of police officers in particular. However, Shahar (2010) offers that although highly anxious individuals do not intentionally violate traffic laws - they do so more frequently than their low anxiety counterparts due to the same cognitive overload mechanism implicated in

errors and lapses. This offers a new outlook on the attitudinal nature of driving violations for the highly anxious road user. In relation to non-situational stress, general life stress (such as the death of a friend/family member) experienced during ones' lifetime also has a part to play in a driving context; Clapp et al., (2011) uncovered unique associations between accident distress and anxious behaviour. Taken together, such findings are indicative of a potential vulnerability for anxious driving behaviour following a collision by those who have experienced greater life stress. This is a key area in the remit of driving anxiety, as knowledge of the association between general life stress and propensity to develop anxious driving practice is central to those who continue to drive following a collision. Further, it would be of interest whether general life stress carries over into driving anxiety in individuals who have not been involved in an RTC. That said, the stress and anxiety inducing nature of driving, as well as the impact of extraneous stress and anxiety on driving would appear to be an important consideration in the current context.

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 behavior 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, Mallia, Lazuras & Violani, 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, Barraclough and Freeman (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, Frehse & Höger, 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, Wang, Peng & Chen, 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, Charlton, and Starkey (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, Bodner, & Ben-Zion, 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.

4.1 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.

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