APPLIED PSYCHOLOGY

IAAP
THE INTERNATIONAL ASSOCIATION OF APPLIED PSYCHOLOGY

APPLIED PSYCHOLOGY: AN INTERNATIONAL REVIEW, 2011, *60* (4), 576–599
doi: 10.1111/j.1464-0597.2011.00448.x

Safety in Occupational Driving: Development of a Driver Behavior Scale for the Workplace Context

Sharon Newnam,* Jaimi Greenslade, Cameron Newton and Barry Watson

Queensland University of Technology, Australia

International statistics indicate that occupational, or work-related driving, crashes are the most common cause of workplace injury, death, and absence from work. The majority of research examining unsafe driver behavior in the workplace has relied on general road safety questionnaires. However, past research has failed to consider the organisational context in the use of these questionnaires, and thus, there is ambiguity in the dimensions constituting occupational driving. Using a theoretical model developed by Hockey (1993, 1997), this article proposes and validates a new scale of occupational driver behavior. This scale incorporates four dimensions of driver behavior that are influenced by demanding workplace conditions: speeding, rule violation, inattention, and driving while tired. Following a content validation process, three samples of occupational drivers in Australia were used to assess the scale. Data from the first sample (n = 145) were used to reduce the number of scale items and provide an assessment of the factorial validity of the scale. Data from the second sample (n = 645) were then used to confirm the factor structure and psychometric properties of the scale including reliability and construct validity. Finally, data from the third sample (n = 248) were used to establish criterion validity. The results indicated that the scale is a reliable and valid measure of occupational driver behavior.

INTRODUCTION

Safety is an important concern for all organisations where employees are engaged in occupational driving. An occupational or work-related driver is defined as someone who drives at least once per week for occupational purposes (Murray, Newnam, Watson, Schonfeld, & Davey, 2003). Occupational driving spans a range of industries including transport, courier, police and emergency services (Collingwood, 1997). Light vehicle (< 4.5 tonnes) occupational drivers can be classified as those who are either given a vehicle as part of their salary package or tool of trade (i.e. salary sacrificed or tool of

* Address for correspondence: Sharon Newnam, Centre for Accident Research and Road Safety, Queensland University of Technology, Carseldine, Queensland, Australia 4034. Email: s.newnam@qut.edu.au

Support from the Australian Research Council is gratefully acknowledged.

trade drivers) or those who drive a company vehicle which is shared by other drivers within the organisation (i.e. pooled vehicle drivers) (Newnam & Watson, in press). Another group of occupational drivers are those who use their own or a fleet vehicle in volunteering their driving services (Newnam, Newton, & McGregor-Lowndes, 2009; Newnam & Watson, in press/a). Given the high mileage rates (Haworth, Tingvall, & Kowadlo, 2000), there is greater potential for occupational drivers to be involved in road crash incidents resulting in property damage, injury, and/or fatality.

Road crashes have been globally reported as the most common form of occupational death, injury, and absence from work (Bureau of Labor Statistics, 2004; Haworth et al., 2000; Lynn & Lockwood, 1998). In the United States, for example, occupational drivers accounted for the highest number of fatal work injuries of any occupation (Bureau of Labor Statistics, 2004). Similar trends have also been found in the United Kingdom, even after adjusting for exposure in the vehicle (Downs, Keigan, Maycock, & Grayson, 1999; Lynn & Lockwood, 1998).

Based on past statistics, the literature suggests the existence of a work-related driver effect (see Grayson, 1999), whereby occupational drivers are over-involved in road crashes compared to non-work-related drivers in personal vehicles (Broughton, Baughan, Pearce, Smith, & Buckle, 2003; Clarke, Ward, Bartle, & Truman, 2005; Downs et al., 1999; Lynn & Lockwood, 1998). For example, Maycock, Lester, and Lockwood (1996) found in a sample of 12,500 UK drivers that company car drivers reported 20 per cent more crashes than did drivers of privately owned vehicles. Similar effects have been found in the Australian context with work-related drivers reporting higher crash involvement rates in their work vehicle than their personal vehicle, even after controlling for kilometers driven (Newnam, Watson, & Murray, 2002). Therefore this research suggests that there are unique factors operating within the organisational context that have a negative influence on safety outcomes.

Despite the importance of safe driving in the workplace, there is limited understanding of the determinants of safety outcomes in the occupational driving context (notable exceptions include Newnam, Griffin, & Mason, 2008; Wills, Watson, & Biggs, 2009). One explanation for this is that there is limited understanding of the types of unsafe driving behavior that are prevalent in the workplace context. To date, past research has utilised driver behavior scales adapted from the general driving population, which we argue neglects the impact that the broader workplace environment plays on safety at work and the prevalence of particular unsafe behaviors within this context. Thus, we aim to address this gap in the literature and identify the unsafe driving behaviors that are prevalent within the occupational driving setting. In undertaking this task, this research uniquely applies Hockey's Cognitive-Energetical Model (CEM) to identify the driver behavior decrements that are likely to occur under the organisational conditions of work overload. It is

anticipated that the identification of the unsafe occupational driver behaviors will (1) facilitate research into the predictors and outcomes of unsafe driver behavior at work and (2) enable organisations to monitor safe driving practices on the road.

Previous Research in the Occupational Driving Setting

Based on a model of performance by Campbell, McCloy, Oppler, and Sager (1993), there are unique factors operating within the organisational context that influence role behavior. Previous research in the occupational driving domain has found support for the notion that the organisational context impacts on driver behavior (Newnam et al., 2002; Wills, Watson, & Biggs, 2006). Specifically, Wills et al. (2009) found that drivers' perception of the safety climate was a direct predictor of occupational driver behavior, over situational factors and person-related factors such as attitudes and perceived behavioral control. Further, Wills, Watson, and Biggs (2006) found that particular dimensions of safety climate were related to specific driver behaviors (i.e. work pressure was related to driving while distracted). Even though they are well-conducted studies, a limitation of past research is the conceptualisation of behavior through adapted driver behavior scales, which were originally designed for the general driver population (i.e. Manchester Driver Behavior Questionnaire (DBQ); Reason, Manstead, Stradling, Baxter, & Campbell, 1990) (e.g. Davey, Wishart, Freeman, & Watson, 2007; Newnam et al., 2002; Wills et al., 2006).

Based on their model of human error, Reason et al. (1990) divided risk behavior into two categories, namely errors and violations, and developed the DBQ to measure these concepts in driver behavior. The DBQ has been extensively and successfully applied in the general driver population to assess a range of road safety issues. For example, studies have assessed the utility of the DBQ as a predictor of safety outcomes (e.g. Lawton, Parker, Manstead, & Stradling, 1997; Parker, Reason, Manstead, & Stradling, 1995; Reason et al., 1990), to assess differences across cultures (Lajunen, Parker, & Summala, 2004), and as a measure to evaluate self-report bias (Lajunen & Summala, 2003). In recent years, studies have utilised the DBQ to assess driver behavior in the occupational driving context (e.g. Davey et al., 2007; Newnam et al., 2002; Wills et al., 2006). In these studies, the DBQ items have been adapted (i.e. minor rewording) to the occupational driving setting and the relationship between perceptual measures and safety outcomes has been assessed.

Although the DBQ has been successfully applied within the general driver population, the utility within the occupational driving context is uncertain. First, no clear factor structure has emerged. For example, Wills et al. (2006) found that DBQ items fell on four factors: traffic violations, driver error,

driving while distracted, and pre-trip vehicle maintenance. Newnam et al. (2002) also identified four factors: dangerous driving, speeding, exceeding normal driving limits, and vehicle checking practices. Finally, similar to the original DBQ scale, Davey et al. (2007) proposed that the DBQ items would fall on three factors, namely highway code violations, aggressive violations, and errors. However, the proposed factor structure was only weakly supported, with several items loading above the recommended 0.4 cut-off on more than one factor.

Second, adapted DBQ scales (e.g. Davey et al., 2007; Newnam et al., 2002; Wills et al., 2006) have not incorporated items specifically designed to address behavior prevalent to the occupational driving context. For example, cognitive behavior including inattention due to thinking of work tasks represents a significant deficit that could have a direct and negative impact on occupational safety outcomes (see Salminen & Lahdeniemi, 2002). In support, a study investigating the effects of occupational stress on driver behavior reported a significant (albeit weak, $sr^2 = .06$) relationship between stress, fatigue (defined by inattention and tiredness) while driving, and near misses (Strahan, Watson, & Lennon, 2008). In contrast, some of the adapted versions of the DBQ include scales that are not pertinent in investigating safe driving practices. Specifically, "pre-trip maintenance behaviors" (see Newnam et al., 2002; Wills et al., 2006, 2009) are not relevant in assessing safe on-road driver behavior, but rather determine the efficiency of the workplace safety practices. As such, driver behavior scales should consider context-specific items in their scale development.

Third, some of the behaviors included in adapted DBQ scales lack conceptual clarity when utilised in the occupational safety setting, insofar as they include reference to safety outcomes such as near misses (e.g. nearly hit another car while queuing to enter a main road). In the occupational safety literature, there is an argument that measures of safety behavior need to be distinguished from antecedents and outcomes of those behaviors (Griffin & Neal, 2000). In summary, these arguments lend support for the development of a scale that is conceptually clear and relevant to the occupational driving context.

Therefore we argue that theory and empirical research is required to identify types of behaviors that are prevalent within the occupational driving setting. Although we do not dispute the fact that the fundamental task of driving a car is the same regardless of the purpose of the journey (work or personal), we contend that the workplace is unique and that a behavioral taxonomy should identify those behaviors prevalent and relevant to the workplace context. Thus, based on past research that has established the organisational context as an important determinant of driver behavior (Wills et al., 2006, 2009), we argue that workplace conditions should be taken into consideration when developing an occupational driver scale.

To determine the kinds of behavior that are likely to be prevalent at work, we use Hockey's (1993, 1997) CEM and fit this into the existing literature on occupational driver behavior. We adopted this theory, rather than alternative models of understanding individual behavior (e.g. Theory of Planned Behavior (TPB); Ajzen, 1991), because it incorporates workplace conditions in its consideration of performance. Specifically, this theory explains how a workplace characterised by work overload and competing task demands influences driver behavior. Consistent with the broader safety literature (i.e. Zohar, 2010), we believe that unsafe driving at work is a pattern of behavior that emerges in response to both high task demands and conflicting priorities between productivity tasks and safety behavior. Therefore, a theory that explains how performance is affected by high work overload is relevant in explaining deficits in safety behavior. The remainder of this review will outline Hockey's (1993, 1997) CEM and then explain how occupational driver behavior can be identified by this model.

Theoretical Development

Hockey's (1997) CEM is an integrative model that assumes that individuals are biased toward maintaining high-priority goals. The theory states that individuals strive to minimise mismatch between a goal and the current effectiveness of actions. Minor mismatches are responded to by (automatic) adaptive adjustments of effort within a given effort budget. However, larger discrepancies are managed using regulatory strategies, such as shifting to less complex information management strategies, expending more effort, and prioritising the most relevant tasks (Sonnentag & Frese, 2003). These strategies are associated with latent cognitive and behavioral costs, including fatigue and strain, the use of less complex information management strategies, and decrements in secondary task performance (Hockey, 1997; Sauer, Hockey, & Wastell, 2000).

Drawing on this theory within the occupational driving context, we argue that in situations of stress and work overload, elements of the driver task will be protected. In the occupational driving setting where drivers are under time pressure, such elements include getting to the destination on time. To maintain such tasks, the driver may take short-cuts or engage in strategies that reduce the load on driving. Although individuals may increase their overall effort in an attempt to maintain performance, this strategy is short term and effortful, and thus, other strategies are more likely to be employed. Based on this argument, we contend that in the majority of situations drivers will employ strategies that will result in unsafe driver behavior. Specifically, we propose four unsafe driver behaviors that are likely to emerge under conditions of work overload and stress. Figure 1 presents a diagram of the

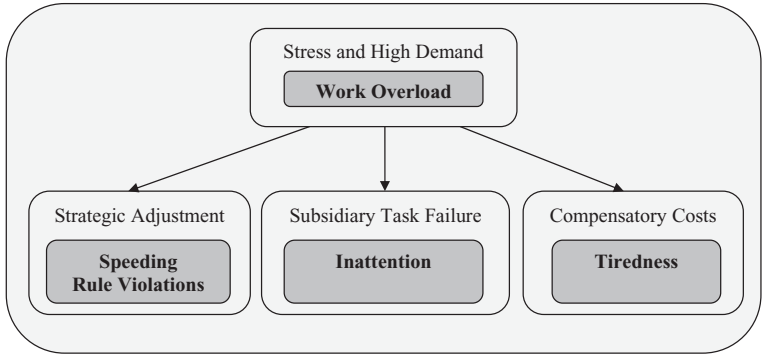

FIGURE 1. A conceptual model of Hockey's CEM within the occupational driving context.

constructs under investigation in this study while each behavior will be discussed in more detail below.

Strategic Adjustment: Speeding and Rule Violations. According to Hockey's model (1993, 1997), individuals respond to conditions of work overload by shifting to less complex information management strategies. Strategic adjustment involves a shift to less effortful modes of processing under stress. For instance, individuals who move towards a faster but less accurate mode of responding may adopt strategies that utilise less working memory involvement or may shift towards a less resource-intensive model of control. Strategic adjustment has been evidenced in the safety literature whereby individuals take more short-cuts, and therefore adopt unsafe behavior if they perceive production pressure to be the priority (e.g. Hofmann & Stetzer, 1996; Hofmann, Jacobs, & Landy, 1995).

In the occupational driving context, strategic adjustment is likely to emerge as speeding and rule violations. More specifically, individuals under conditions of high demand undertake the driving task in a faster and/or less accurate manner to allow them more time to accurately complete their core job task. In this situation, switching to a less resource-intensive model of control preserves the primary goal of completing the driving task, while compromising the secondary goals stipulated by the regulated road safety rules. However, it should also be noted that speeding and rule violations may occur unintentionally as a result of reduced involvement in the primary driving task.

In this paper, we argue that occupational drivers more often adopt strategic adjustment to complete their primary task of driving. This argument is based on research that suggests that speeding is one of the leading contrib-

uting factors to occupational crashes (Haworth et al., 2000). Drivers of employer-owned cars and those driving a car for occupational purposes are among the groups who report a higher engagement in speeding (Stradling, 2000). Further, compared to individuals who drive for personal purposes, occupational drivers have been found to report higher involvement in speeding and a higher likelihood of having been penalised for speeding in the past three years (Stradling, Meadows, & Beatty, 1999). Based on this evidence, we propose that the first dimension of occupational driver behavior is speeding.

Similarly, there is some research to suggest that road rule violations emerge in the occupational driving setting. Specifically, in a study focusing on self-reported traffic offences in the workplace, rule violations emerged as a significant bivariate predictor (Davey et al., 2007). Moreover, in the general driving literature, rule violation is a major determinant of accident involvement (e.g. Mesken, Lajunen, & Summala, 2002; Parker et al., 1995; Reason et al., 1990). Although there is limited evidence in the literature to support rule violations as a dimension within the new scale, the literature utilising adapted driver behavior scales within the occupational driving context has consistently included items assessing rule violations (e.g. Wills et al., 2006, 2009; Newnam et al., 2002). Thus, considering the initial evidence to suggest that rule violations may be a predictor of traffic offences in the occupational driving context and the potentially negative effects of road rule violation on safe driving, we argue that the second dimension of occupational driver behavior is rule violations.

Subsidiary Task Failures: Inattention. The second way in which latent performance decrements emerge is referred to as subsidiary task failures (Hockey, 1993, 1997). Specifically, under conditions of work overload, individuals narrow their focus of attention to primary job tasks while neglecting secondary tasks. Within the driving domain, we argue that this strategy may result in individuals primarily focusing on driving to their destination, as opposed to thinking about their driving behavior (e.g. checking speedometer and mirrors) and the road conditions; as a result, they will be less attentive to safe driving.

Research in the general driving population has found that crashes caused by inattention/distraction have been estimated to account for approximately one-quarter of light vehicle crashes in the United States (NHTSA, 2006). Other research has found that there is a deterioration of the driving task when simple secondary tasks (e.g. distraction type tasks) are performed at the same time (Levy, Pashler, & Boer, 2006; Wester, Bocker, Volkerts, Verster, & Kenemans, 2008). Limited research has been conducted on inattention in the occupational driving context. However, one study has found that risk factors such as being in a hurry, thinking about work, tiredness, and the use of mobile telephones while driving negatively influence safety outcomes

(Salminen & Lahdeniemi, 2002). Due to occupational factors, such as thinking about work tasks and work problems, this latter research is of particular interest when investigating behaviors inherent to the occupational driver task. Therefore, we propose that the third dimension of occupational driver behavior is inattention.

Compensatory Costs: Driving while Tired. The final latent performance decrement that occurs under conditions of work overload is compensatory costs. Compensatory costs occur when individuals maintain primary performance by increasing effort above their subjective limits for maximum effort expenditure. Hockey (1993, 1997) noted that while such a strategy may maintain overall performance, it is a major source of fatigue while undertaking cognitive work.

With regard to occupational driving, we propose that individuals adopting an active strategy engage in additional effort beyond their subjective capacity limit to maintain their driving behavior. While such effort has limited effect over brief periods, engaging in this strategy for longer time periods results in increased tiredness, which is a major component of fatigue (e.g. Arnold, Hartley, Corry, Hochstadt, Penna, & Feyer, 1997; Gander, Marshall, James, & Le Quesne, 2006). In support, subjective ratings of sleepiness while driving have been found to be associated with a decrement in driving behavior (Dinges, Pack, & Williams, 1997; Philip, Sagaspe, Moore, Taillard, Charles, Guilleminault, & Bioulac, 2005). Research on occupational crashes indicates that driving while tired also occurs commonly in populations of occupational drivers (Harrison, Mandryk, & Frommer, 1993). Furthermore, sleepiness while driving has been found to be a contributing factor in approximately 16–23 per cent of occupational road crashes (Horne & Reyner, 1995). This research suggests that tiredness while carrying out activities is a concern for all occupational drivers, and we therefore propose that driving while tired is the fourth dimension of occupational driver behavior.

A New Model of Driver Behavior

In summary, a four-factor occupational driver behavior scale has been proposed. The behaviors identified in the scale include speeding, rule violation, inattention, and driving while tired. These proposed behavioral dimensions are believed to be the on-road behaviors most highly influenced by the work environment. Furthermore, no research has investigated these behaviors within a theoretical framework which identifies the organisational context as an antecedent to deficits in occupational driver behavior.

In the present study, we first assess the content validity of the scale through presenting qualitative data obtained through interviews with occupational drivers and a review of the occupational driving literature. Second, we assess

the factorial validity of the occupational driver behavior scale. In doing this, we propose that occupational drivers' ratings of their own behavior will exhibit distinctions among the four sub-dimensions of performance. Third, we aim to establish reliability and validity (criterion and construct) of the scale. With regard to assessing validity, this study aims to establish criterion validity through investigating the relationship between the four-factor model of occupational driving and a theoretically related construct. Given that the DBQ is the most commonly utilised driver behavior scale and assesses violations and errors which are consistent with the hypothesised dimensions of speeding and rule violations, we believe this scale to be an appropriate construct to establish criterion validity.

Furthermore, based on Hockey's (1993, 1997) CEM which posits that performance decrements will occur under conditions of high demand and stress, this study will establish construct validity by assessing work overload as a predictor of each of the driving decrements. Specifically, we will examine the relationship between drivers' experience of work overload and speeding, rule violations, inattention, and driving while tired. It is argued that drivers who perceive greater work overload are likely to adopt one or more of the strategies identified by Hockey (1993, 1997) and experience the behavioral decrements posited in this study, namely (1) speeding, (2) rule violation, (3) inattention, and (4) driving while tired.

The use of work overload as a predictor of safety performance is supported by research in the occupational driving domain. Specifically, Adams-Guppy and Guppy (1995) found that time pressure was influential in a compromise between speed and safety in a sample of occupational drivers. Other research has also identified the deleterious effects of work overload on attention while driving (Downs et al., 1999; Salminen & Lahdeniemi, 2002). This research suggests that the priority given to production pressures influences safe driver practices in the occupational driving context. Work overload has also been identified as a predictor of safety performance in general safety research. Specifically, employees' perception of the degree to which job performance is affected by inadequate time, training, and resources has been found to influence safety performance (Clarke, 2006; Hofmann & Stetzer, 1996; Hofmann et al., 1995). Thus, it is hypothesised that work overload will impact on all four sub-dimensions of occupational driver behavior.

METHOD

Sample

The research was conducted in partnership with a community-based nursing organisation in a state of Australia. All participants were classified as occupational drivers according to the current definition; those who drive at least

once per week for occupational purposes (Murray et al., 2003). All the participants were classified as light vehicle drivers (< 4.5 tonnes) and three samples of occupational drivers were recruited for this study.

Sample one comprised executive-level employees who were referred to as salary sacrificed drivers; those who are given a vehicle as part of their salary package and use the vehicle for both work and personal purposes. The driving task of the salary sacrificed driver included driving to and from work meetings/events, and between service centers within the agency. Questionnaires were distributed to 273 participants and were returned by 148 individuals (54% response rate). All of the participants drove their vehicle at least once per week for occupational purposes. The majority of the participants were female (65%), with an average age of 44.28 years (SD = 9.59; values range from 22 to 68 years). Participants drove an average of 11.46 hours (SD = 7.33; values range from 1 to 60 hours/week) and 469 kilometers per week (SD = 292.87; values range from 1 to 218 km/week).

Sample two comprised 1,980 nursing staff who drove work vehicles to care for patients in the community. Completed questionnaires were returned by 645 community-oriented staff (33% response rate), all of whom drove a work vehicle at least once per week for occupational purposes. The majority of respondents were female (92%), with an average age of 48.62 years (SD = 9.56; values range from 19 to 72 years). While the response rate in this sample was slightly lower than in sample one, the average age and proportion of females is in line with that reported in Australian nurses (i.e. 45–49 years of age and 90.4% female) (Australian Institute of Health and Welfare, 2009). Therefore, we believe that the sample was representative of the population of nursing staff with respect to age and gender. Participants drove an average of 248.61 kilometers per week (SD = 189.10; values range from 2 to 1,500 km/week) and 17.89 hours (SD = 35.65; values range from 0.5 to 48 hours/week).

Sample three comprised an additional 829 nursing staff who also drove work vehicles to care for patients in the community. Completed questionnaires were returned by 248 community-oriented staff (29% response rate), all of whom drove a work vehicle at least once per week for occupational purposes. Similar to the previous sample, a high proportion of this sample were female (90%), with an average age of 50 years (SD = 9.61; values range from 20 to 72 years). Participants drove an average of 270 kilometers per week (SD = 231.26; values range from 5 to 1,300 km/week) and 19.4 hours (SD = 36.69; values range from 1 to 30 hours/week)

Content Validation

The methodology involved in the development of the new scale was informed by Hinkin (1998). A number of stages were conducted to develop and admin-

ister the scale. First, 38 interviews were conducted with occupational drivers within the participating organisation. These interviews were conducted with community-oriented staff ($n = 23$) and individuals who drove salary sacrificed vehicles ($n = 15$). All participants drove a vehicle at least once per week for occupational purposes.

The first author conducted each of the interviews. To increase the rigor of the findings from this study, at the end of each interview the first author provided a summary of the key points of the discussion and invited participants to amend any aspect of the summary. This process ensured that the first author accurately recorded the responses of each participant and enabled immediate clarification of any ambiguity (see Murphy & Dingwall, 2003). Following the interviews, the first author coded the themes that were expressed with frequency, extensiveness or intensity (Krueger, 1998). To improve the validity and reliability of this process, the first author frequently consulted with the third author who was not present at the interviews. In addition to improving the quality of the research process, introducing a second person to review the data was particularly useful in clarifying the themes and providing explanations of the results.

Two major issues emerged from the discussion regarding participants' perceptions of the factors they believed influenced their safety while driving for occupational purposes. First, the majority of participants within each group recalled thinking about work tasks: "Always have to be thinking about work and driving is automatic". The second issue that emerged from the discussions was thinking about the driving destination: "I think you are more interested in where you are heading and how to get there rather than anything else". Based on these discussions, an inattention factor was integrated into the scale, including items relating to thinking about work tasks and the driving destination.

Second, an extensive review of the literature pertaining to occupational driver behavior was conducted. The search engines used for this task included PychInfo, Proquest, and ScienceDirect. Database searches were conducted using the following keywords: *occupational driving*, *fleet vehicles*, *fleet drivers*, and *work-related driving*. Additional searches were also conducted to extrapolate industry reports from America (e.g. NHSA), the United Kingdom (e.g. Transport Research Laboratory), and Australia (e.g. Monash University Accident Research Centre).

Third, we developed a 15-item scale based on the results from the interviews and literature searches. We will refer to this new scale as the Occupational Driver Behaviour Questionnaire (ODBQ). The 15-item scale was administered to participants as part of a larger questionnaire in each of the samples. Demographic items and a work overload scale were also included in the questionnaire. Sample three participants were the only participants to receive a questionnaire that included the ODBQ and the DBQ scales.

Procedure

The method of distributing the questionnaires was the same in each sample. A list of drivers' names and work delivery details was obtained from the Human Resources department within the participating organisation. Using this information, the study questionnaire and a reply paid envelope was distributed to each of the drivers. To ensure that all participants understood the purpose of the study, an information sheet was provided to the drivers defining motor vehicle safety as one's behavior when driving for work purposes. To ensure anonymity of the participants, all participants were required to return their questionnaire to the first author in a sealed envelope.

Measures

Occupational Driver Behaviour Questionnaire (ODBQ). In the questionnaire, the participants were asked to rate the frequency with which they generally engaged in the various driver behaviors. The items were assessed on a 5-point Likert scale ranging from *Rarely or Never* (1) to *Very Often* (5). All items were designed to be answered in respect of driving for occupational purposes. Specifically, the scale items were prefaced with the statement "In a typical week when driving for work purposes how often do you . . .".

Work Overload. As noted in the introduction, construct validity was assessed by examining the relationship between work overload and the four sub-dimensions of occupational driving. Work overload was assessed by four items adopted from Caplan, Cobb, French, Harrison, and Pinneau (1980). The items were designed to measure drivers' experience of work overload. Items included were "How often does your job require you to work very fast?", "How often does your job require you to work *very hard*?", "How often is there a *great deal* of work to be done?", and "How often does your job leave you with *little time* to get things done?" These items were measured on a 5-point Likert scale, ranging from *Rarely or Never* (1) to *Very Often* (5).

Driver Behavior Questionnaire (DBQ). To establish criterion validity, the relationship between the behaviors identified within the ODBQ and the DBQ were examined. The questionnaire including the DBQ scale was only administered to participants in sample three. The extended version of the DBQ (Lawton et al., 1997; Parker, Lajunen, & Stradling, 1998) was utilised. In the present study, "errors" (eight items), "ordinary violations" (eight items), and "aggressive violations" (four items) scales were assessed on a 5-point Likert scale, ranging from *Rarely or Never* (1) to *Very Often* (5).

Control Variable. The questionnaire provided to the participants also asked them to indicate how many kilometers they drove per week. Research

has found that occupational drivers, on average, accumulate higher mileage in comparison to the average private motorist (Griffiths, 1997), and the above-average annual mileage has been suggested as a potential factor contributing to occupational vehicle crashes (Downs et al., 1999). These findings constituted an argument for using kilometers driven per week as a control variable within this study.

Analysis Overview

Several stages of investigation were conducted to establish the scale as an appropriate measurement tool for occupational driver behavior. The first sample was used to conduct Exploratory Factor Analysis (EFA). Such analysis served to refine the scales and reduce the number of observed variables. As recommended by Tabachnick and Fidel (2001), the number of factors to be retained was determined by factors with eigenvalues greater than one and the scree plot. To reduce the number of items, items with loadings less than 0.30 on any factor or items that loaded on more than one factor with close loadings were deleted. Utilising Confirmatory Factor Analysis (CFA), the second sample was used to assess the fit of the data to the four-factor model and the item loadings on the factors. The goodness of fit statistics used to evaluate the CFA were the root mean square error of approximation (RMSEA) (Steiger, 1990), comparative fit index (CFI) (Bentler, 1992), non-normed fit index (NFI) (Medsker, Williams, & Holahan, 1994), and the SRMR (Jöreskog & Sörbom, 1981). Prior to running the CFA, missing data were examined. Less than 10 per cent of cases had missing data and such data were identified to be missing at random. Therefore, participants with missing data were deleted from the analysis. Combining samples one and two, Cronbach's alpha was utilised to assess the reliability of the scale factors while Pearson's correlation coefficient (r) was utilised to establish construct validity through assessing the relationship between the scale factors and work overload. Finally, sample three was utilised to establish criterion validity by adopting "r" to establish a relationship between the behaviors identified within the ODBQ and a composite measure of the DBQ.

RESULTS

Factorial Structure

Exploratory Factor Analysis. We used the first sample of 148 individuals to refine the scales and to reduce the set of observed variables to a smaller set of variables. We utilised EFA using principal axis factoring and oblique (oblimin) rotation on the 15 items. Oblique rotation was used as we expected the factors to be correlated (Tabachnick & Fidel, 2001). In par-

ticular, we expected that inattention and tiredness would be moderately correlated as drivers who are tired are more likely to be inattentive to the driving task.

Examination of the eigenvalues above one and the scree plot reflected a four-factor solution. The four-factor solution accounted for 65 per cent of the variance. To reduce the number of items, we removed two items with loadings smaller than .30 and one item that loaded on more than one factor with close loadings. We again conducted principal axis factoring with oblique (oblimin) rotation on the remaining 12 items to identify the final factor structure. Four factors accounting for 73 per cent of the variance were retained. According to Hinkin (1998), this represents an acceptable total item variance. The factors were largely consistent with items measuring speeding, rule violation, inattention, and tiredness while driving. The factor loadings for each item in the pattern and structure matrix are shown in Table 1 and the correlations between factors are shown in Table 2.

Confirmatory Factor Analysis. We used the second sample incorporating 645 community staff to provide further support for the scale. Specifically, the overall fit of the model and of item loadings on the factors was investigated using CFA.

We investigated the refined 12 observed variables as indicators of the four latent constructs: speeding, rule violation, inattention, and driving while tired. The four-factor model CFA was estimated in LISREL VIII using maximum likelihood estimation (Jöreskog & Sörbom, 1993). The CFA with the 12 item indicators loaded significantly on their respective constructs (see Table 3) and had good/acceptable fit to the data (χ^2 [48] = 167.82, $p < .001$, RMSEA = .06, CFI = .97, NFI = .96, SRMR = .04).

To provide further evidence for the factor structure, we utilised Anderson and Gerbing's (1988) procedure to assess whether each of the factors was measuring a distinct construct. Specifically, the hypothesised unconstrained measurement model was compared to a series of models in which the relationship between each pair of performance scales was set to 1.00. A χ^2 difference test was performed on the values obtained for the unconstrained and the six constrained models. Anderson and Gerbing (1988) suggest that discriminant validity is established if the χ^2 value is significantly lower in the unconstrained model compared with the constrained models. The results indicated that there were significant differences in the χ^2 value at the .001 probability level for all six comparisons. Thus, the occupational scale factors were distinct from each other in the current analysis.

Assessment of Reliability and Validity

Reliability. Reliability was assessed by combining the 12 scale items from samples one and two. Cronbach's alpha provides an estimate of internal

TABLE 1
Descriptive Statistics and Exploratory Factor Analysis Pattern and Structure* Matrix for the Occupational Driver Behavior Scale (n = 148)

Item	*Mean*	SD	*Inattention*	*Speeding*	*Tiredness*	*Rule violation*
Deliberately exceed the speed limit on a residential road	1.46	.76	–.01 (.15)	**.76 (.71)**	–.04 (.15)	–.11 (.09)
Deliberately exceed the speed limit on a highway or freeway	1.94	1.02	.04 (.26)	**.69 (.73)**	.03 (.26)	.08 (.28)
Deliberately exceed the speed limit when travelling to clients or the office	1.61	.93	.04 (.29)	**.91 (.94)**	.01 (.29)	.03 (.29)
Fail to use your indicators to change lanes	1.37	.76	–.14 (.07)	.12 (.26)	.21 (.29)	**.44 (.49)**
Perform a U-turn in a non-designated zone	1.31	.63	.08 (.19)	.21 (.31)	–.02 (.15)	**.30 (.37)**
Fail to come to a complete standstill at a stop sign	1.31	.62	.12 (.21)	–.15 (.08)	–.08 (.12)	**.81 (.77)**
Drive while thinking about how to get to your destination	2.86	1.09	**.73 (.77)**	.05 (.27)	.05 (.38)	.04 (21)
Drive while thinking about your next patient or work task	3.15	1.27	**.96 (.97)**	–.04 (.24)	.03 (.43)	.04 (.23)
Drive while thinking about work-related problems/issues	3.35	1.17	**.88 (.91)**	.04 (.28)	.03 (.41)	–.01 (.19)
Drive while tired	2.51	1.04	.37 (.61)	.07 (.31)	**.54 (.70)**	–.05 (.18)
Have difficulty driving because of tiredness or fatigue	1.59	.88	.02 (.38)	.08 (.18)	**.92 (.89)**	–.01 (.19)
Find yourself nodding off while driving	1.28	.68	.02 (.29)	.03 (.21)	**.63 (.65)**	.01 (.18)
Total variance explained			33.18%	12.89%	7.71%	6.73%

* Structure matrix loadings are presented in parentheses.

TABLE 2
Exploratory Factor Analysis Factor Correlation Matrix for the Occupational Driver Behavior Scale (n = 148)

Factor	*1*	*2*	*3*
1. Inattention			
2. Speeding	.266		
3. Tiredness	.420	.281	
4. Rule violation	.201	.273	.240

TABLE 3
Confirmatory Factor Analysis for the Occupational Driver Behaviour Scale (n = 645)

Item	*Inattention*	*Speeding*	*Tiredness*	*Rule violation*
Deliberately exceed the speed limit on a residential road		.85		
Deliberately exceed the speed limit on a highway or freeway		.81		
Deliberately exceed the speed limit when travelling to clients or the office		.84		
Fail to use your indicators to change lanes				.54
Perform a U-turn in a non-designated zone				.57
Fail to come to a complete standstill at a stop sign				.54
Drive while thinking about how to get to your destination	.80			
Drive while thinking about your next patient or work task	.97			
Drive while thinking about work-related problems/issues	.87			
Drive while tired			.80	
Have difficulty driving because of tiredness or fatigue			.76	
Find yourself nodding off while driving			.52	

consistency and should be above .7 for new tests (Nunnally & Bernstein, 1994). As shown in Table 4, all of the subscales except the rule violation scale displayed coefficients greater than .70.

Construct Validity. Construct validity was assessed by examining whether work overload was associated with increased unsafe driving behaviors. This validity was assessed using the combined data from the 12 scale items

TABLE 4
Means, Standard Deviations, and Correlation Coefficients for the Combined Sample (n = 793)

Variable	M	SD	*1*	*2*	*3*	*4*	*5*
Inattention	2.73	1.10	(.91)				
Speeding	1.42	0.66	.31***	(.86)			
Driving while tired	1.52	0.63	.55***	.31***	(.71)		
Rule violation	1.21	0.39	.27***	.23***	.22***	(.60)	
Work overload	3.26	1.10	.41***	.16***	.31***	.13***	(.90)

Note: The correlations between scales are bivariate correlations. The correlations between work overload and performance scales are partial correlations controlling for km driven.
Alpha coefficients are shown in parentheses along the diagonal.
* $p < .05$; ** $p < .01$; *** $p < .001$.

obtained from samples one and two. The partial correlations among the performance measures and perceptions of work overload, controlling for distance traveled, are reported in Table 4. The results revealed significant relationships between drivers' perceptions of work overload and speeding, rule violations, inattention, and driving while tired. As such, these results suggest that drivers who report a high work overload more often report engaging in higher speeding, rule violations, inattention, and driving while tired.

It is also important to note that the results indicated stronger relationships between workload and inattention ($r = .41$, $p < .001$) and driving while tired ($r = .31$, $p < .001$), than speeding ($r = .16$, $p < .001$) and rule violation ($r = .13$, $p < .001$). Based on Hockey's (1993, 1997) CEM, these results suggest that workload is less likely to have an effect on aberrant driving behaviors that require a shift to less effortful modes of processing under stress as opposed to those less deviant behaviors that are affected by a narrowing of attention or maximum effort expenditure. In support, past research has found that lapses and errors occur due to cognitive limitations or inaccuracies, while violations result from intentional and motivational influences (Parker et al., 1995; Reason et al., 1990).

Criterion Validity. Criterion validity was assessed by examining the relationship between the behaviors identified in the ODBQ and a composite measure of the DBQ. Only sample three participants received the questionnaire containing both the ODBQ and DBQ scales, and thus, the results are based solely on this sample. The results revealed significant relationships between the DBQ and the four driver behaviors identified in the ODBQ. The results found moderate and positive relationships between the DBQ and speeding ($r = .57$, $p < .001$), rule violation ($r = .49$, $p < .001$), inattention

($r = .37$, $p < .001$), and tiredness while driving ($r = .38$, $p < .001$). These results indicate that criterion validity was established for the ODBQ.

DISCUSSION

The aim of this study was to develop a questionnaire of behaviors specifically designed for the occupational driver task. This study utilised the theoretical model of Hockey (1993, 1997) and included four dimensions of driver behavior that are influenced under conditions of high demand. The dimensions included speeding, rule violation, inattention, and tiredness while driving. All the behaviors identified in the scale have been supported by previous research in the occupational driving field (e.g. Newnam et al., 2002; Stradling et al., 1999; Salminen & Lahdeniemi, 2002). However, this study is unique as there has been no instrument to date that has investigated these behaviors within a theoretical framework identifying the organisational context as an important consideration in understanding deficits in occupational driver behavior.

Following development of the scale, a number of stages were undertaken to establish the scale as a psychometrically sound measure of occupational driver behavior. First, exploratory factor analysis established a 12-item scale covering four dimensions of occupational driver behavior. The four scales with their respective indicators were subsequently supported through a confirmatory factor analysis. In this study, the psychometric properties of the scale generally demonstrated sound reliability and validity (construct and criterion), although there is need to further explore the test–retest reliability of this scale through a longitudinal research design. The results suggested that the occupational driver behaviors examined in this study were an accurate measurement of the constructs under investigation.

This study adds to the occupational driving literature by utilising systematic test construction procedures to develop a scale that focuses on important driver behaviors within the work environment. It is also the first measure of driver behavior that has utilised a theoretical framework or model to identify behaviors prevalent within a particular context or group of drivers. Although we acknowledge that many of the items within the scale would also be relevant to non-work driving (i.e. speeding and rule violations), the purpose of developing this scale was to identify those behaviors prevalent to the occupational driving context. Thus, through guiding the development of the scale on a strong theoretical foundation, we have been able to potentially eliminate any contaminated source of variance associated with adapting measures from contexts with different goal perspectives.

Although this study has a number of strengths, the limitations of the research need to be addressed. First, the rule violation items displayed only moderate loading on their factor and moderate reliability. A possible explanation for these results is that the scale incorporated a small number of items

reflecting minor rule violations. Given that a good proportion of occupational drivers drive company marked vehicles, we anticipated that the rule violations they would engage in would not be overt as these would attract the attention of their organisation (i.e. running a red light). Rather, we anticipated that individuals would engage in minor rule violations reflecting lapses of attention and reduced information processing. Future studies could perhaps incorporate a number of the more overt rule violations to determine if these items improve the scale's psychometric properties.

Second, the scale does not incorporate a broad range of driver distractions that might be prevalent in the occupational driving context; namely driving while using a mobile phone (e.g. Lam, 2002; Salminen & Lahdeniemi, 2002), in-vehicle technology systems (Wikman, Nieminen, & Summala, 1998), and eating and drinking (Jenness, Lattanzio, O'Toole, & Taylor, 2002). In particular, mobile phone use (hands-free and handheld) was included in the initial set of 15 items which, however, showed poor loading in the final analyses. Although past research has found this behavior to be important within the occupational driving context, it may be reflective of the sample utilised in the present study. Specifically, the organisations participating in the questionnaire recently established a policy prohibiting the use of any type of phone in the vehicle. Future research should thoroughly examine mobile phone use, in addition to other types of driver distractions, within the current scale as they have the potential of contributing to safety outcomes.

Third, while the scale was tested using three samples of drivers, there may have been issues with the representativeness of the samples. Specifically, the samples were predominantly female drivers from a community-based organisation. Such drivers may not be typical of all occupational drivers who are male in commercial or government sectors (i.e. Murray et al., 2003). While some research in the occupational driving setting has found that gender does not impact on driver behavior (i.e. Newnam, Watson, & Murray, 2004), further research employing a broader sample of drivers is required to provide additional validity for the scale.

Fourth, a cross-sectional methodology was applied wherein participants were tested at one point in time. This issue raises a number of concerns. For instance, cross-sectional testing means that an examination of test–retest reliability was not possible. Test–retest reliability is necessary to ensure that the scale is reliable and stable in its measurement of performance across time. Further, the use of a cross-sectional sample means that common method variance may have artificially inflated the correlations used to assess the construct validity of the scale. Future research could further examine the construct validity of this scale through investigating the relationship between the scale factors and supervisor ratings of work overload or other organisational factors (e.g. safety climate). This methodology would further inform the construct validity of the proposed scale. Finally, the use of a cross-

sectional methodology meant that the relationship between work overload and driving behavior was only assessed at the between-person level of analysis. That is, we assessed whether perceptions of work overload impacted on driver behavior in general. To gain a more accurate validation of the scale, a longitudinal study examining whether the individual's perceptions of work overload during each trip were associated with unsafe driver behavior at the same point in time would be beneficial.

A fifth limitation relates to the low means reported on the subscales. This finding suggested that drivers were not reporting frequent engagement in the proposed behaviors. A possible explanation for this finding could be self-enhancement, whereby participants are less likely to report engaging in unsafe driving practices. Alternatively, the low mean subscales could be representative of missing data within the samples. Although the response rates in the samples (i.e. 54%, 33%, 29%) were considered adequate, it could be possible that those participants who responded to the scale had generally safer driver practices than those who did not respond. To overcome this issue, future research could attempt to collect objective measures of occupational driver behavior across a larger sample, through utilising possibilities such as in-vehicle telemetry devices like intelligent speed adaptation, eye-tracking devices (i.e. attentional behaviors), or utilising distal measures such as driving infractions (e.g. being stopped for speeding, running lights, illegal left-turns, etc.).

Conclusion

In summary, this preliminary study suggests that the newly developed ODBQ is a psychometrically sound scale for assessing driver behavior in the occupational driving context. At present, no research has captured the behaviors prevalent to the occupational driver task within a theoretical framework. As such, this instrument has the potential to further inform occupational driving research. For instance, research could use the newly developed scale to develop a better understanding of the relationships between antecedents and outcomes specific to occupational driver behavior. Further, the scale could be utilised as a tool for identifying target behaviors and conditions for intervention. Finally, the scale could also be utilised as a diagnostic tool by management in organisations requiring employees to drive at work.

REFERENCES

Adams-Guppy, J., & Guppy, A. (1995). Speeding in relation to perceptions of risk, utility and driving style by British company car drivers. *Ergonomics*, *38*(12), 2525–2535.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211.

Anderson, J.C., & Gerbing, D.W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411–423.

Arnold, P., Hartley, L., Corry, A., Hochstadt, D., Penna, F., & Feyer, A.M. (1997). Hours of work, and perceptions of fatigue among truck drivers. *Accident Analysis & Prevention*, *29*(4), 471–477.

Australian Institute of Health and Welfare (2009). Nursing and midwifery labour force series no. 32. Cat. No HWL 44: Canberra: AIHW.

Bentler, P.M. (1992). On the fit of models to covariances and methodology to the bulletin. *Psychological Bulletin*, *112*(3), 400–404.

Broughton, J., Baughan, C., Pearce, L., Smith, L., & Buckle, G. (2003). *Work-related road accidents*. TRL report 582. Crowthorne: Transport Research Laboratory.

Bureau of Labor Statistics (2004). Census of fatal occupational injuries. United States Department of Labor. http://www.bls.gov/iif/oshwc/cfoi/cfch0003.pdf

Campbell, J.P., McCloy, R.A., Oppler, S.H., & Sager, C.R. (1993). A theory of performance. In J. Schmitt & W.C. Borman Associates (Eds.), *Personnel selection in organizations* (pp. 35–69). San Francisco, CA: Jossey-Bass.

Caplan, R.D., Cobb, S., French, J.R.P., Harrison, R.V., & Pinneau, S.R. (1980). *Job demands and worker health*. Ann Arbor, MI: University of Michigan, Institute for Social Research.

Clarke, D.D., Ward, P., Bartle, C., & Truman, W. (2005). An in-depth study of work-related road traffic accidents. Road Safety Research Report No. 58. London: Department of Transport.

Clarke, S. (2006). Safety climate in an automobile manufacturing plant. *Personnel Review*, *35*, 413–430.

Collingwood, V. (1997). Promoting the safe driving policy in NSW fleets of twenty or more vehicles. In *Staysafe 36: Drivers as workers, vehicles as workplaces: Issues in fleet management* (Report No. 9/51). Ninth report of the Joint Standing Committee on Road Safety of the 51st Parliament, Sydney, Australia.

Davey, J., Wishart, D., Freeman, J., & Watson, B. (2007). An application of the driver behavior questionnaire in an Australian organizational fleet setting. *Transportation Research Part F*, *10*, 11–21.

Dinges, D.F., Pack, F., & Williams, K. (1997). Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4–5 h per night. *Sleep*, *20*(4), 267–277.

Downs, C.G., Keigan, M., Maycock, G., & Grayson, G.B. (1999). *The safety of fleet car drivers: A review* (Report No. 390). Crowthorne: Transport Research Laboratory.

Gander, P., Marshall, N., James, I., & Le Quesne, L. (2006). Investigating driver fatigue in truck crashes: Trial of a systematic methodology. *Transportation Research Part F*, *9*, 65–76.

Grayson, G. (1999). Company cars and road safety. In G.B. Grayson (Ed.), *Behavioural research in road safety IX*. Crowthorne: Transport Research Laboratory.

Griffin, M.A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge and motivation. *Journal of Occupational Health Psychology*, *5*(3), 347–358.

Griffiths, M. (1997). Selecting safe vehicles: Issues in fleet management. In *Staysafe 36: Drivers as workers, vehicles as workplaces: Issues in fleet management.* (Report No. 9/51). Ninth report of the Joint Standing Committee on Road Safety of the 51st Parliament, Sydney, Australia.

Harrison, J.E., Mandryk, J.A., & Frommer, M.S. (1993). Work-related road fatalities in Australia, 1982–1984. *Accident Analysis and Prevention*, *25*(4), 443–451.

Haworth, N., Tingvall, V., & Kowadlo, N. (2000). *Review of best practice fleet safety initiatives in the corporate and/or business environment*. Report No. 166. Melbourne: Monash University Accident Research Centre.

Hinkin, T.R. (1998) A brief tutorial on the development of measures for use in survey questionnaires. *Organizational Research Methods*, *1*, 104–121.

Hockey, G.R.J. (1993). Cognitive-energetical control mechanisms in the management of work demands and psychological health. In A.D. Baddeley & L. Weiskrantz (Eds.), *Attention, selection. awareness and control: A tribute to Donald Broadbent* (pp. 328–345). Oxford: Oxford University Press.

Hockey, G.R.J. (1997). Compensatory control in the regulation of human performance under stress and high work overload: A cognitive-energetical framework. *Biological Psychology*, *45*, 73–93.

Hofmann, D.A., Jacobs, R., & Landy, F.L. (1995). High reliability process industries: Individual, micro, and macro organizational influences on safety performance. *Journal of Safety Research*, *26*, 131–149.

Hofmann, D.A., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. *Personnel Psychology*, *49*(2), 307–339.

Horne, J.A., & Reyner, L.A. (1995). Sleep related vehicle accidents. *British Medical Journal*, *310*, 565–567.

Jenness, J.W., Lattanzio, R.J., O'Toole, M., & Taylor, N. (2002). Voice-activated dialling or eating a cheeseburger: Which is more distracting during simulated driving? *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting*. Pittsburgh, PA.

Jöreskog, K.G., & Sörbom, D. (1981). *LISKEL V: Analysis of linear structural relationships by the method of maximum likelihood.* Chicago, IL: National Educational Resources.

Jöreskog, K.G., & Sörbom, D. (1993). *LISREL 8: User's reference guide*. Mooresville, IN: Scientific Software.

Krueger, R.A. (1998). *Analyzing and reporting focus group results*. Thousand Oaks, CA: Sage.

Lajunen, T., Parker, D., & Summala, H. (2004). The Manchester driver behaviour questionnaire: A cross-cultural study. *Accident Analysis and Prevention*, *36*, 231–238.

Lajunen, T., & Summala, H. (2003). Can we trust self-reports of driving? Effects of impression management on driver behavior questionnaire responses. *Transportation Research Part F*, *6*, 97–107.

Lam, L.T. (2002). Distractions and the risk of car crash injury: The effects of drivers' age. *Journal of Safety Research*, *33*, 411–419.

Lawton, R., Parker, D., Manstead, A.S.R., & Stradling, S.G. (1997). The role of affect in predicting social behaviors: The case of road traffic violations. *Journal of Applied Social Psychology*, *27*, 1258–1276.

Levy, J., Pashler, H., & Boer, E. (2006). Central interference in driving: Is there any stopping the psychological refractory period? *Psychological Science*, *17*(3), 228–235.

Lynn, P., & Lockwood, C.R. (1998). *The accident liability of company car drivers* (Report no. 317). Crowthorne: Transport Research Laboratory.

Maycock, G., Lester, J., & Lockwood, C.R. (1996). The accident liability of car drivers: The reliability of self-report data. TRL Report 219. Crowthorne: Transport Research Laboratory.

Medsker, G.J., Williams, L.J. & Holahan, P.J. (1994). A review of current practices for evaluating causal models in organizational behavior and human resources management research. *Journal of Management*, *20*, 439–464.

Mesken, J., Lajunen, T., & Summala, H. (2002). Interpersonal violations, speeding violations and their relation to accident involvement in Finland. *Ergonomics*, *45*, 469–483.

Murphy, E., & Dingwall, R. (2003). *Qualitative methods and health policy research*. New York: Walter de Gruyter.

Murray, W., Newnam, S., Watson, B., Schonfeld, C., & Davey, J. (2003). *Evaluating and improving fleet safety in Australia*. Canberra: Australian Transport Safety Bureau.

Newnam, S., Griffin, M.A., & Mason, C.M. (2008). Safety in work vehicles: A multi-level study linking safety values and individual predictors to work-related driving crashes. *Journal of Applied Psychology*, *93*(3), 632–644.

Newnam, S.A., Newton, C.J., & McGregor-Lowndes, M. (2009). Predicting the safety performance of volunteers: Does motivation for volunteering influence driving behavior? *Safety Science*, *47*(8), 1090–1096.

Newnam, S., & Watson, B. (in press). Work-related driving safety: A review of past research and the development of an intervention framework. *Safety Science*.

Newnam, S., & Watson, B. (in press/a). A comparison of the driving behavior between remunerated and volunteer drivers. *Safety Science*.

Newnam, S., Watson, B., & Murray, W. (2002). *A comparison of the factors influencing work-related drivers in a work and personal vehicle*. Adelaide: Road Safety Policy, Education and Policing Conference.

Newnam, S., Watson, B., & Murray, W. (2004). Factors predicting intentions to speed in a work and personal vehicle. *Transportation Research Part F*, *7*, 287–300.

NHTSA (2006). The impact of driver inattention of near-crash/crash risk: An analysis using the 100-car naturalistic driving study data. On-line paper. Available at: www-nrd.nhtsa.dot.gov/departments/nrd-13/driver-distraction/PDF/DriverInattention.pdf.

Nunnally, J.C., & Bernstein, I. (1994) *Psychometric theory* (3rd edn.). New York: McGraw-Hill.

Parker, D., Lajunen, T., & Stradling, S. (1998). Attitudinal predictors of aggressive driving violations. *Transportation Research Part F*, *1*, 107–121.

Parker, D., Reason, J.T., Manstead, A., & Stradling, S.G. (1995). Driving errors, driving violations and accident involvement. *Ergonomics*, *38*, 1036–1048.

Philip, P., Sagaspe, P., Moore, M., Taillard, J., Charles, A., Guilleminault, C., & Bioulac, B. (2005). Fatigue, sleep restriction, and driving behavior. *Accident Analysis and Prevention*, *37*, 473–478.

Reason, J., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations: A real distinction? *Ergonomics*, *33*, 1315–1332.

Salminen, S., & Lahdeniemi, E. (2002). Risk factors in work-related traffic. *Transportation Research Part F*, *5*, 77–86.

Sauer, J., Hockey, G.R.J., & Wastell, D.G. (2000). Effects of training on short- and long-term skill retention in a complex multiple-task environment. *Ergonomics*, *43*, 2043–2064.

Sonnentag, S., & Frese, M. (2003). Stress in organizations. In W.C. Borman, D.R. Ilgen, & R.J. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology* (Vol. 12, pp. 453–491). Hoboken, NJ: John Wiley & Sons.

Steiger, J.H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, *25*, 173–180.

Stradling, S.G. (2000). *Driving as part of your work may damage your health*. Crowthorne: Transport Research Laboratory.

Stradling, S.G., Meadows, M.L, & Beatty, S. (1999). *Factors affecting car use choices*. Edinburgh: Transport Research Institute, Napier University.

Strahan, C., Watson, B., & Lennon, A.J. (2008). Can organisational safety climate and occupational stress predict work-related driver fatigue? *Transportation Research Part F: Traffic Psychology and Behaviour*, *11*(6), 418–426.

Tabachnick, B.G., & Fidel, L.S. (2001). *Using multivariate statistics* (4th edn.). Needham Heights, MA: Allyn and Bacon.

Wester, A.E., Bocker, K.B.E., Volkerts, E.R. Verster, J.C., & Kenemans, J.L. (2008). Event-related potentials and secondary task performance during simulated driving. *Accident Analysis and Prevention*, *40*(1), 1–7.

Wikman, A.-S., Nieminen, T., & Summala, H. (1998). Driving experience and time sharing during in-car tasks on roads of different width. *Ergonomics*, *41*, 358–372.

Wills, A.R., Watson, B., & Biggs, H.C. (2004). The relative influence of fleet safety climate on work-related driver safety. In *Proceedings of the Australasian Road Safety Research, Education and Policing Conference*, Perth, Australia.

Wills, A.R., Watson, B.C., & Biggs, H.C. (2006). Comparing safety climate factors as predictors of work-related driving behaviour. *Journal of Safety Research*, *37*, 375–383.

Wills, A.R., Watson, B.C., Biggs, H.C. (2009). An exploratory investigation into safety climate and work-related driving. *Work: A Journal of Prevention, Assessment & Rehabilitation*, *32*(1), 81–94.

Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis and Prevention*, *42*(5), 1517–1522.