The Relationship Between Driving Anxiety and Driving Skill: A Review of Human Factors and Anxiety-Performance Theories to Clarify Future Research Needs

Joanne E. Taylor, *Massey University*

Frank P. Deane, *University of Wollongong*

John Podd, *Massey University*

This article examines theory and identifies gaps in research related to the role of driving skills in driving anxiety. Increasingly, investigators have examined the clinical features of driving anxiety and the more severe situation of driving fear and phobia, but the possible involvement of driving skills has been neglected. This is surprising given the potential implications for skills training and remediation in the assessment and treatment of some of those who experience driving anxiety, fear, and phobia. The largest body of relevant research comes from the driving and human factors literature on the relationship between anxiety and driving performance. The main theories addressing the relationship between anxiety and performance are examined, with specific attention to studies that have applied theoretical models to the driving situation. The paper identifies the need for further research regarding the relationship between driving skills and performance for individuals reporting driving anxiety. The implications for assessment and treatment are outlined, such as the role of driving task characteristics in planning exposure therapy.

Anxiety, fear, and phobia related to driving have received increasing research attention over the last decade, especially regarding fears of driving reported in clinical and non-clinical samples (for a review, see Taylor, Deane, & Podd, 2002). A recent pilot study of a non-probability convenience sample in New Zealand found that 8% of a sample of 99 community dwellers reported a moderate to extreme level of driving anxiety and 7% reported moderate to extreme driving fear, using a scale from 0 (no anxiety/fear) to 10 (extreme anxiety/fear; Taylor & Paki, 2008). These rates are relatively high although further epidemiological research is needed to more accurately determine the general population rate of driving fear and phobia. *Anxiety* and *fear* are both alerting signals but fear tends to signal a known, external, definite threat and to be experienced as a stronger emotion, while anxiety signals dangers that are less clear and specific (Craske, 2003). The term *phobia* is more frequently associated with the concept of fear and signals a level of fear that indicates psychological disorder.

In terms of driving, such concerns range from mild anxiety with no avoidance behaviour or other impact on daily functioning, through to severe anxiety and fear, that reaches phobic level and impacts significantly on social, occupational, and personal functioning. Some people describe feeling anxious or nervous about driving in certain situations, such as reversing from a driveway (perhaps because of a minor accident in that situation), while others develop such an extreme anxiety of driving that driving is avoided altogether. This variability along the continuum of driving anxiety is reflected in the wide range of driving situations in which people describe experiencing anxiety or fear. Such situations include motor vehicle accidents (MVAs) or crashes[1], unexpected panic attacks, getting lost, vehicle malfunction, driving in certain unpleasant road situations or weather conditions, errors by other drivers, or making mistakes and annoying other drivers (Ehlers, Hofmann, Herda, & Roth, 1994; Taylor et al., 2002). For some, concern may focus on one of these issues, such as avoiding an accident at a certain intersection, while the concern for others is part of a broader pattern of anxiety, such as panic disorder with agoraphobia or generalised anxiety disorder.

There is growing understanding of the nature of anxiety and fear related to driving and of its often complex pattern of concerns (Ehlers et al., 1994; Taylor et al., 2002). However, an aspect that has not been thoroughly examined relates to the extent that driving skill might play a part in driving anxiety. Driving can be considered a skill which involves many different aspects of behaviour, such as sensorimotor coordination, psychophysical judgement, attention, emotion, and reaction time. These components combine to affect how the

driver performs the task (Evans, 1991; Little, 1970). These skills could affect the onset and/or maintenance of driving anxiety. For example, early learning and skill development opportunities may be inadequate, leading to problems with performance such as an MVA or near-miss. However, not everyone who experiences an MVA or near-miss develops anxiety related to driving. Alternatively, self-perception of driving skill could explain some of this variability and could be a factor in the development and maintenance of driving anxiety, irrespective of actual driving skill. This might also be related to other variables such as confidence in oneself as a driver. There is support for the idea that some people underestimate their skills and abilities (Ehrlinger & Dunning, 2003), while others fail to recognise their lack of skill or overestimate it (Dunning, Johnson, Ehrlinger, & Kruger, 2003). Self-perception of driving skill may therefore be important, and anxiety could be one reason for an unrealistic or inaccurate self-view. Other clinical findings show that self-efficacy can increase in people with driving phobia without specific skills training, but in the context of exposure therapy (Alpers, Wilhelm, & Roth, 2005).

In New Zealand, according to the Land Transport Safety Authority (LTSA, 1999), fear can lead to panic reactions, over-caution, and problems with identifying cues, which could be expressed behaviourally as driving slowly or hesitantly, a lack of smooth operation of the vehicle, or rule-breaking such as ignoring red lights. However, the LTSA (1999) do not document the material upon which these conclusions are based and do not justify their predictions. The lack of investigation of the possible relevance of driving skill to driving anxiety is surprising, given the amount of research that has been devoted to the role of skills in other types of anxiety and fear problems, such as social phobia and test or examination anxiety. Review of the role of skills in social phobia provides an example that may have parallels for driving fears.

Individuals with social phobia fear a variety of social and performance situations because of concerns that they will act in a way that will be humiliating or embarrassing, or that they will show visible anxiety symptoms, such as sweating or shaking (Turner & Beidel, 1989). One of the major theories of the etiology of social phobia suggests that people with social phobia have problems with verbal and non-verbal social skills. However, lack of social skills is not relevant in all cases of social phobia. There is also unclear evidence for whether social skills deficits are a cause, maintaining factor, or consequence of social phobia (Rapee & Spence, 2004). For example, excessive anxiety can inhibit appropriate responding, thereby affecting social performance (Rapee & Heimberg, 1997). Furthermore, avoidance limits opportunities for success and mastery over important social tasks, maintaining the anxiety problem. Social skills deficits may therefore be a primary causal factor for some people with social phobia, while for others they may maintain the anxiety and avoidance behaviour (Rapee & Spence, 2004).

In cases where social skills are relevant, social skills training can be considered a useful approach to assessment and treatment for social phobia (Andrews, Crino, Hunt, Lampe, & Page, 1994; Barlow, Esler, & Vitali, 1998; Chambless & Hope, 1996; Heimberg, 1989; Wells & Clark, 1997). Consistent with this analogy, it makes sense to consider the possible relevance of driving skills for at least some of those who have driving anxiety and fear, particularly given that driving is an activity that is dependent upon the acquisition of a complex set of skills (Groeger, 1988). Not only must drivers be competent at operating their own vehicle, but they must also be proficient at dealing with the environment in which they are driving. For someone who has difficulty acquiring these skills or has lost confidence in their ability to drive, they may develop anxiety, or even fear, towards the driving task. Like social phobia, skills deficits may play a role in the cause of driving anxiety for some people, and for others could be more relevant as a maintaining factor or consequence of driving anxiety. In other cases, mild levels of anxiety might serve to facilitate driving skill and improve driving performance or, at the very least, have no detrimental effect.

However, minimal research has explicitly investigated whether driving skills play a role in driving anxiety, even though such research may have important implications for assessment and remediation with some individuals who experience driving anxiety, fear, or phobia. For example, if the focus of fear for some people with driving anxiety is on some actual driving skills deficit, perhaps subsequent to an MVA, then the use of a skills assessment and/or driving instruction may be beneficial and could enhance treatment efficacy and efficiency. Similar utility may be gained where individuals have low self-confidence in their driving ability and perceive it to be worse than is actually found upon formal assessment. A recent case example described a woman with a fear of driving resulting from lack of driving skills and self-efficacy (Wiederhold, Wiederhold, Jang, & Kim, 2000). The authors noted:

> *She reported having never been comfortable driving and had not obtained a driver's license until the age of 24. She stated that everyone told her that she was a bad driver and she began doubting her ability to drive... When asked what bothered her about freeway driving she said, "I'm scared I won't know what to do". (p.1036)*
> *Although there was no assessment of driving skills in this case, it illustrates the possible role of skills (and associated lack of confidence) in driving fear. For others, difficulties in driving skills might be a consequence of driving anxiety, while still others could have enhanced skill as a result of moderate levels of anxiety (e.g., exercise more caution and thorough searching skills).*

Research that has approximated the investigation of driving skills in cases of driving anxiety and fear are the few studies that have used behavioural avoidance tests (BATs) as part of the assessment process (Taylor et al., 2002). A BAT measures a person's ability to remain in the presence of the feared object or situation, and can include an assessment of thoughts, behaviour, and the amount of anxiety experienced during the test (Bellack & Hersen, 1998). For example, a driving BAT

might involve a hierarchy of driving tasks that progress from relatively simple to complex situations (e.g., sitting in the driver's seat in a parked car or driving in a parking lot, through to driving on the motorway and changing lanes). Level of anxiety is typically recorded during each task and the test terminated when anxiety prevents the person from proceeding any further.

Ehlers et al. (1994) describe the use of a driving BAT as part of the assessment of their sample of people with driving phobia, although the purpose was not to assess driving skill but to gather physiological data including heart and respiratory rate. Kuch (1989, 1997) mentions behavioural tests as useful assessment measures, although does not discuss the assessment of driving skills, despite the suggestion that a defensive driving course may be a useful part of an intervention. Some authors have noted their use of road tests as part of an assessment and/or exposure programme for driving phobia in both research and case studies, but have not provided detailed information about the links between driving anxiety and driving skills (e.g., Flynn, Taylor, & Pollard, 1992; Kuch, 1988; Levine & Wolpe, 1980; Williams & Rappoport, 1983; Williams, Dooseman, & Kleifield, 1984; Williams, Kinney, Harap, & Liebmann, 1997; Wolpe, 1982). The only study that has explicitly examined driving skill and driving fear compared 50 non-clinical fearful and 50 control drivers using standardised on-road assessment (Taylor, Deane, & Podd, 2007). This exploratory study found that fearful drivers made more errors on the driving assessment than control drivers, after controlling for test anxiety, driving history (including driving accidents and incidents), and diagnosis. However, the pattern of specific errors was identical for both groups, where errors in search techniques were most frequent. This finding suggests that driving fear and anxiety are not necessarily associated with the *types* of errors made, but that a higher *number* of errors are made when someone is anxious or fearful about driving. This finding needs to be replicated in more diverse clinical samples, although explanation of the finding is difficult given the lack of previous research.

It is unclear why the relationship between driving anxiety and driving skill has not been studied in more detail, although there are potential practical difficulties that may have discouraged researchers. For example, participant recruitment may be difficult given that at least some of those who have driving anxiety will likely be reluctant to do the very thing that they fear, especially when driving skills are the focus of assessment. This would particularly affect recruitment of those with more severe anxiety and fear who may be less likely to put themselves in a situation that is extremely unpleasant for them (Ehlers et al., 1994; Taylor et al., 2002). However, some authors have described their clinical observations regarding the driving performance of people with driving phobia (e.g., Kuch & Swinson, 1989). They indicate that actual loss of control in the driving situation is rare despite being a common focus of fear, and that no accidents have occurred during exposure therapy when conducted properly. In contrast to these general findings, Kuch (1989) notes that one phobic driver experienced actual loss of self-control during exposure therapy, " 'froze' during a panic attack and inadvertently crossed four lanes of traffic" (p. 268). The complexity of the traffic situation and difficulties in maintaining experimental control over the many variables inherent in such a situation may also be a deterrent to research.

Many of these difficulties in assessing skills could be overcome with the use of driving simulators, although this may affect ecological validity for at least some people with driving anxiety. Virtual reality is another option that is likely to become more realistic and externally valid (Wood, 1996), and has already been used in reports of treatment for driving phobia (e.g., Wald & Taylor, 2003; Walshe, Lewis, Kim, O'Sullivan, & Wiederhold, 2003). Since driving is a performance-related task, it would seem sensible to further investigate whether driving skills are relevant to some of those with driving anxiety, particularly in light of the possible implications for efficient assessment and treatment for this group. Given the minimal research in this area, literature and theory on human factors related to driving was examined to try to identify information that could facilitate an understanding of the relationship between driving anxiety and driving skill, and inform future research efforts.

Research on Human Factors in Driving

The broader driving literature uses the term *anxiety* as a general emotional concept in relation to driving and does not specifically mention *fear* other than as it relates to the early stages of learning that are characterised by some level of fear, which decreases as driving skill increases (Evans, 1991). The distinction between anxiety and fear is important given that most of the relevant literature on human factors in driving looks at the relationship between anxiety and driving performance.

Research on the role of anxiety in driving has come from studies of personality typologies and disorders (e.g., Evans, 1991; Foot & Chapman, 1982; Heimstra, Ellingstad, & DeKock, 1967; Little, 1970; Loo, 1979; Shinar, 1978; Shoham, Rahav, Markovski, Chard, & Baruch, 1984; Silverstone, 1988; Ulleberg & Rundmo, 2003; Wilson & Greensmith, 1983), stress (e.g., Gulian, Glendon, Matthews, Davies, & Debney, 1988, 1990; Heimstra, 1970; Hentschel, Bijleveld, Kiessling, & Hosemann, 1993), and test anxiety (Strohbeck-Kühner, 1999). The results from these studies are mixed, with some suggesting that anxiety inevitably impairs driving (e.g., Shoham et al., 1984), and others concluding that there is no relationship between the two factors (Strohbeck-Kühner, 1999), or that anxiety may have some facilitative or positive effects that are specific to driver behaviour and driving skills (e.g., Kottenhoff, 1961; Payne & Corley, 1994; Ulleberg & Rundmo, 2003). Studies also vary in terms of methodology (i.e., whether they use self-report or laboratory-based measures) and sample (i.e., patient or non-patient groups).

A few studies have examined the relationship between anxiety and some aspect of driving performance using self-report measures. In an investigation of driver factors that increased proneness to accidents and traffic offences, Shoham et al. (1984) reported that, among their sample of 492 Israeli drivers

who participated in corrective driving courses, anxiety as measured with the Taylor Anxiety Scale was correlated with traffic offences (as was impulsiveness and sensation-seeking), although the specific coefficient was not reported. A standard multiple regression analysis indicated that only 15% of the variance in traffic offences was explained by separately considering a range of psychological variables, including anxiety, impulsivity, internalisation of norms, and sensation seeking ($R = .39$), and the contribution of anxiety was small ($\beta = -.04, p > .05$). However, adding the interactions between the variables meant that the model accounted for 35% of the variance in traffic offences ($R = .59$), with anxiety making a statistically significant contribution to the model ($F = 4.52, p < .05$). The authors considered that, as well as "reckless" drivers, "anxious" drivers are one type of "traffic offender", where conflict between emotional reactions and the need for rapid decision-making may increase accident risk.

However, these results were based solely on one self-report measure of the psychosomatic signs of anxiety, traffic offence data were obtained from only 196 participants, and the comparison group of bus drivers was assumed to have no traffic offences. Given these limitations, the results of this study need to be interpreted with caution and provide insufficient evidence that anxiety necessarily impairs driving. In a more recent study of predictors of risk-taking driving behaviour, Ulleberg and Rundmo (2003) surveyed 1932 Norwegian adolescents and reported that those scoring high on measures of altruism and trait anxiety (from the NEO Personality Inventory) were more likely to have a positive attitude regarding traffic safety and described less risk-taking behaviour (including speeding and rule violations). They proposed that anxiety might result in increased care and defensiveness when driving because of a heightened awareness of accident risk. These two studies have drawn quite different conclusions about the effect of anxiety on driving, although their dependent variables are diverse (i.e., traffic offences versus self-reported risk-taking behaviour).

Most other studies of the relationship between anxiety and psychophysical and motor performance have been conducted in laboratory settings. Strohbeck-Kühner (1999) examined the relationship between the more specific construct of test anxiety and the outcome of sensory and motor performance tests in the context of appraisal of fitness to drive using driving assessments. Participants were 181 drivers in Germany, most of whom were attending for a first appraisal of their driving, and 86% had a history of various traffic offences. The performance tests included measures of the functional areas relevant to fitness to drive, such as reaction time, concentration, visual attention, and orientation abilities. The Test Anxiety Inventory was given before participants completed the performance tests (time 1), and the Worry-Emotionality Questionnaire (a measure separate from the TAI subscales) was given both before and after the performance tests (times 1 and 2). No correlation was found between the various anxiety measures and psychophysical performance on the driving tests. Instead, the emotionality and worry components of test anxiety were found to be consequences rather than causes of deficits in psychophysical performance, where deficits led to an increase in emotionality and worry at time 2 while good driving performance feedback reduced both components of anxiety that were measured at time 2. At time 2, only worry was correlated with reaction time during driving performance.

In a study of reaction time and steering skill with 50 neurotic patients in Sweden, Kottenhoff (1961) found that neuroticism and anxiety scale scores correlated with a measure of steering skill (i.e., steering a rudder stick), and concluded that both neuroticism and anxiety might function as alerting or activating mechanisms. Another patient study looked at whether 52 unmedicated anxious patients meeting DSM-III-R criteria for generalised anxiety disorder or adjustment disorder with anxious mood were poorer drivers than 34 healthy volunteers, as well as the effects of anxiolytics on driving performance (O'Hanlon, Vermeeren, Uiterwijk, van Veggel, & Swijgman, 1995). A standardised on-road driving test was used and the main outcome measure was total test standard deviation of lateral position, which is an index of road tracking error or "weaving". Healthy volunteers and anxious patients drove similarly when not treated with medication.

Other laboratory-based studies have found that more general psychophysical and motor performance abilities are negatively affected by anxiety, although this appears to depend on the complexity and difficulty of the task (Jones & Cale, 1997). For example, Terelak (1990) found no correlation between state anxiety and simple reaction time tasks, although anxiety impaired the performance on a motor-coordination task. Eysenck and Byrne (1992) showed that those with high levels of anxiety were more prone to be distracted by other stimuli and show longer reaction times than those with low levels of anxiety. Furthermore, those with high anxiety showed poorer performances when they were required to make differential reactions (Britt & Blumenthal, 1993) or complete tracking tasks (Butki, 1994; for state as well as trait anxiety: Payne & Corley, 1994). In contrast, Nagane (1990) found that those with high state anxiety made fewer errors in a tracking task than those with low state anxiety.

In summary, the relationship between driving skills and anxiety has received little attention in the human factors literature on driving as well as in research specific to driving anxiety. Of the work that has been done, studies have used varying methodologies, participant samples, and variables to represent driving skill or performance. As a result, findings are mixed and indicate that anxiety may impair, may have no effect on, or may enhance driving but could also be a consequence of problems with driving performance. In attempting to explain the impaired performance on psychomotor tests due to anxiety, researchers have drawn on findings regarding the limited information-processing capacity of highly anxious people, specifically that those with high anxiety require more time and practice to learn task-specific actions (e.g., Schulz & Schönpflug, 1988). For example, Terelak (1990) demonstrated an association between trait anxiety and learning efficiency in a psychomotor coordination task. Calvo

and Ramos (1989) found that those with high and low levels of anxiety showed comparable performances when those with high anxiety were able to engage in additional practice, and their performance deteriorated for more difficult tasks when there was no practice opportunity. A brief review of information processing theories may help to shed some light on these findings.

Theories of the Relationship Between Anxiety and Performance

Although no theories explicitly address the role of anxiety in driving, anxiety can be viewed as a factor that threatens to limit information processing capacity. This is particularly the case when the focus of anxiety is on driving itself. The degree to which anxiety affects a driver's information processing capacity depends to some degree on its severity (Silverstone, 1988) (as well as other factors associated with the complexity of the driving situation). The notion that anxiety has different effects on driving performance according to its severity is consistent with the Yerkes-Dodson law (Yerkes & Dodson, 1908) which describes a curvilinear relationship between anxiety and performance. A moderate amount of anxiety is required for optimal performance on skilled tasks and enables the driver to carry out all of the basic skills required for driving, as well as to pay sufficient attention to potential hazards so that the appropriate action can be taken if required (Walklin, 1993). Increases in anxiety beyond this point can reduce the capacity for skilled motor movements, complex intellectual tasks, and the perception of new information (Andrews et al., 1994). Silverstone (1988) considers that such high levels of anxiety interfere with driving performance and increase the risk of an MVA. Yinon and Levian (1988) found that anxiety about being in the presence of other drivers lead to the division of attention between self- and task-relevant stimuli. The law also proposes that the optimal level of anxiety is lower for difficult tasks than for easy ones, so that high levels of anxiety have more detrimental effects on the performance of difficult or complex tasks as opposed to easy ones.

There are several other theories relevant to explaining the relationship between anxiety and performance that also have the capacity to add to an understanding of the anxiety-driving performance relationship. The present paper focuses on Processing Efficiency Theory (Eysenck & Calvo, 1992) which has superseded some of the earlier models, including Cognitive Interference Theory (Sarason, Sarason, & Pierce, 1990) and Information Processing Theory (Humphreys and Revelle, 1984, cited in Eysenck, 1992).

Processing Efficiency Theory (PET)

Eysenck and Calvo (1992) proposed Processing Efficiency Theory, which explains the anxiety-performance relationship more fully than previous theories (Murray & Janelle, 2003) and assumes that worry and self-concern have both positive and negative effects on performance (Eysenck & Calvo, 1992). The negative effects occur because worry serves to pre-empt some of the resources of the working memory system (Eysenck, MacLeod, & Mathews, 1987). The working memory system allows concurrent transient storage of information and ongoing processing of task information, and is thought of as a three-part system that temporarily holds and manipulates information while cognitive tasks are performed (see Baddeley, 1992a, 1992b, 1994). The negative effects of worry are determined partly by the demands the task makes on the parts of the working memory system. The positive effects occur because of the motivational function that worry serves, in that worry about task performance can mean that extra processing resources or effort is allocated to the task in an attempt to improve performance and thereby reduce worry (Eysenck, 1992). These aspects of PET have the potential to clarify how anxiety about driving can have a range of effects on driving performance.

These assumptions lead to an important theoretical distinction between *performance effectiveness* and *processing efficiency*. Performance effectiveness refers to the quality of task performance, while processing efficiency represents the relationship between the effectiveness of performance and the corresponding effort or processing resources invested in performance (Eysenck, 1992). According to the theory, anxiety can have different effects on performance effectiveness and processing efficiency, with the former being more impaired than the latter. Anxiety is thought to reduce processing efficiency because of its effect on working memory, although "the compensatory use of additional effort will often prevent anxiety from impairing performance effectiveness" (Eysenck & Keane, 1995, p. 456).

Several studies have supported the predictions made by PET using various verbal and motor tasks (although none relate specifically to the task of driving; see Eysenck, 1992; Eysenck & Calvo, 1992). The theory can also be used to explain the effects of anxiety on driving performance. It is particularly helpful in identifying the components of the information processing system that are most affected by anxiety, most notably the working memory system, because anxiety tends to lead to worry and other task-irrelevant thoughts as well as allocating more processing resources to monitoring and attending to the environment (Eysenck, 1992). For example, Beck and Emery (1985) argue that "because the [anxious] patient 'uses up' a large part of his [or her] cognitive capacity by scanning for threatening stimuli, the amount available for attending to other demands is severely restricted" (p. 31). For those who are anxious when driving, this is likely to result in additional demands on processing resources evidenced by increased scanning, searching ahead, risk estimation, anticipation of the traffic situation, and excessive attention to threat. These behaviours may be evidence of additional effort to compensate for impaired processing efficiency. PET thereby helps to explain cases where anxiety has no detrimental effect on driving performance, because increased effort may be countering the effects of anxiety on processing efficiency. The theory also allows for the fact that anxiety can both impair and improve driving performance.

Matthews and colleagues' (see Matthews, 2001, for a review) interpretation of their driving simulation

results is consistent with PET. In contrast to research on the more general effects of anxiety on driving, Matthews and colleagues have attempted to identify the information processing functions that mediate the effects of stress (including anxiety) on performance impairment in driving. Stress variables used were based on factor analyses of the Driving Behaviour Inventory (Glendon et al.) and its revision, the Driver Stress Inventory (DSI; Matthews, Desmond, Joyner, Carcary, & Gilliland, 1997). These measures were considered to represent vulnerabilities to different types of stress outcome. Their analyses identified a factor on both measures called *Dislike of Driving*, which has been characterised as corresponding to anxiety responses to driving and, at the extreme, to driving phobia (Matthews, 2001). The types of items loading onto this factor on the DSI included "I feel tense or nervous when overtaking another vehicle", "I find myself worrying about my mistakes when driving", and "I am disturbed by thoughts of an accident or the car breaking down". (It is unclear why the factor was labelled *Dislike of Driving* as opposed to something more reflective of the item content, such as anxiety about driving.) Other factors identified were *Aggression*, *Hazard Monitoring*, *Thrill-Seeking*, and *Fatigue*. Matthews et al. (1997) reported evidence for criterion and discriminant validity of the DSI. In particular, "Dislike of Driving was associated with negative, emotion-focused strategies such as self-criticism, which may be distracting, but also lead to greater behavioural caution" (Matthews et al., 1997, p. 323).

Dislike of Driving has been associated with a lower incidence of speeding convictions (Matthews, Dorn, & Glendon, 1991; Matthews, Tsuda, Xin, & Ozeki, 1999). Although those with high scores for Dislike of Driving were safer in terms of lower self-reported speed, they tended to make more self-reported driving errors (Matthews et al., 1991, 1997). While it was possible that drivers high in Dislike of Driving could be genuinely deficient in driving skills, results from objective, on-road driving performance indicated no such general skill deficit (Matthews, 2001). Dislike of Driving was most strongly associated with emotion-focused coping, which consisted of strategies such as "blamed myself for getting too emotional or upset", "wished I was a more confident and forceful driver", and "criticised myself for not driving better" (Matthews, 2001). Matthews considered that such distracting effects of emotion-focused coping or self-criticism might account for the relationship between Dislike of Driving and error proneness. The model posited a compensation hypothesis where negative self-appraisals may bias the choice of driving strategy in favour of behavioural caution, which would result in improved safety and no change in overall accident risk (Matthews et al.).

The prediction from this model, that Dislike of Driving should relate to attentional impairment, was then investigated by Matthews, Sparkes, and Bygrave (1996) using a driving simulator. Hypotheses regarding attentional impairment were derived from Multiple Resource Theory (MRT; Wickens, 1984, 1991), in that performance impairments were considered to be associated with Dislike of Driving due to reduced resource availability. In brief, the theory provides a framework for determining the degree of compatibility between various component tasks, proposing the existence of several different resource supplies, including the stage of processing (early, late), the modality (auditory, visual), and the processing code (spatial, verbal). Wickens has shown that interference in a dual-task situation will be more likely when the different tasks draw on the same pool of processing resources, and these findings have been supported by other researchers (e.g., Hancock, Wulf, Thom, & Fassnacht, 1990; Ranney, 1994).

Matthews et al. (1996) found that participants high in Dislike of Driving showed significantly poorer control (in terms of degrees of heading or lateral tracking error) in single-task driving than those low in Dislike of Driving. In contrast with predictions from MRT, there were no differences between groups on dual-task performance. This suggested that the anxiety-related impairment in performance was stronger when the driving task was relatively undemanding (Matthews, 2001). Dislike of Driving was also related to poor driving performance on straight rather than curved road sections. Matthews explained these results by arguing that drivers may adapt well to demanding dual-task situations by increased effort, thereby suppressing the effects of cognitive interference. In single-task driving situations, the driver may consider the task less demanding of effort and fail to sustain sufficient effort to maintain performance, instead diverting their attention to processing associated with worry (Matthews, 2001; Matthews & Desmond, 2001). Many other studies have been conducted to assess the effects of dual-task driving situations on performance, although none of these are specifically related to anxiety (e.g., Janelle, Singer, & Williams, 1999; Recarte & Nunes, 2000; Wetherell, 1981). These findings help to give some preliminary understanding of how the information processing demands of different driving tasks might be affected by anxiety, which may or may not influence driving performance.

Conclusions and Future Research Directions

Prior research has examined the role of anxiety in driving, although only one exploratory study has specifically investigated this within the context of the driving skills of a sample of people reporting driving anxiety and fear. This study found that those with driving anxiety made more errors in the on-road assessment compared to the control group (Taylor et al., 2007). However, existing research on driving anxiety, fear, and phobia has neglected this important issue, despite its potential implications for assessment and intervention for at least some people who report driving anxiety. Studies on human factors in driving report mixed results as to whether anxiety impairs, has no effect on, or facilitates driving performance, perhaps because of varying methodologies, samples, and variable definitions used. Furthermore, most theories of driving do not deal with the role of anxiety in any detail. Theories of the relationship between anxiety and general performance exist, but do not specifically relate this to the dynamic nature of driving. In contrast, the conceptualisation forwarded by

Matthews and colleagues (see Matthews, 2001) appears to be the sole link in the existing literature between theories of the anxiety-performance relationship and those specific to the driving situation. In their research, the anxiety-related impairment in driving performance was *stronger* when the driving task was relatively undemanding, suggesting that drivers may adapt to demanding dual-task situations through increased effort, which then suppresses the effects of any cognitive interference from worry. In contrast, the driver may consider single-task situations less demanding of effort and fail to sustain sufficient effort to maintain performance, instead diverting attention to processing associated with worry. This was not investigated by Taylor et al. (2007) but would be a useful addition to a replication study.

Given that the conceptualisation of Matthews (2001) draws on well-developed anxiety-performance theory and appears to provide the first link to driving and driving-related anxiety specifically, a promising avenue for future research would be to replicate and extend these ideas. PET and MRT provide good initial frameworks for such studies, but there is a need to better integrate the existing laboratory-based theory with real-life difficulties that people with driving fears experience. For example, increased understanding of the content of worry as well as the characteristics of the driving task may further facilitate treatment strategies. Furthermore, the moderating role of the characteristics of the driving task may be relevant in planning exposure therapy, where those situations associated with greater cognitive interference and performance impairment may be addressed later in a graded hierarchy. Determining whether the content of certain worrying thoughts are associated with greater performance impairment given certain task characteristics would also be of clinical relevance. A good starting point for further investigating these questions would be to explore the driving skills of those identified with problematic levels of driving anxiety.

Difficulties in understanding the link between driving anxiety and driving skill probably also relate to the relative complexity of driving anxiety, fear, and phobia as a clinical phenomenon (Ehlers et al., 1994; Taylor et al., 2002). Anxiety about driving can form the sole presenting problem, as in a specific phobia, or can be part of a broader pattern of anxiety and avoidance behaviour, such as in panic disorder with agoraphobia, generalised anxiety disorder, and post-traumatic stress disorder. Furthermore, driving anxiety can take non-clinical as well as clinical forms, where severity of anxiety seems to occur along a continuum from mild anxiety to extreme fear and avoidance behaviour. The effect of anxiety on the ability of the driver to process information is likely to be impacted by the severity of the anxiety experienced. For example, someone who has a mild level of anxiety only in specific driving situations may be more likely to have their driving facilitated by the mild anxiety and associated increase in arousal and attention. In contrast, someone with a severe level of phobic anxiety may become so aroused and distressed that they are unable to concentrate on driving and may avoid many driving situations in order to not experience this distress. Therefore, various relationships between driving anxiety and skill might exist for people with different kinds of anxiety. The etiology of the anxiety is also likely to be relevant to understanding whether driving skills will be relevant in assisting the person to better manage their anxiety. For example, a person who demonstrates early anxiety and avoidance in relation to learning to drive and gives themselves limited opportunities to practice and learn is likely to benefit from appropriate driving instruction, given that their anxiety is primarily related to limited skill development. In the case of post-MVA driving anxiety in someone with good pre-accident driving skills, issues may be raised in terms of self-confidence and self-efficacy as opposed to any acquired skill deficit. Obviously, this depends on the specific characteristics of the accident, such as whether the person was considered at fault in the crash.

An additional factor is the focus of the fear, in that those with a fear of an MVA are more likely to have an external focus while those who are most anxious about a panic attack while driving tend to be more internally focused. Finally, different aspects of driving performance may be related to anxiety in different ways. For example, lack of experience or lack of control over the car could be causes of driving anxiety, while problems with concentration, judgement, and decision-making might be better conceived of as consequences of anxiety, although it may also be possible that a feedback loop is operating as opposed to a causal chain of events. The difference between driving *skill* and driving *performance* may also be relevant, in that other aspects of driver behaviour may be more useful and practical than errors during on-road assessments (Taylor et al., 2007). In particular, people with driving fears often engage in maladaptive safety behaviours in an effort to protect themselves from unexpected dangers when driving, such as distracting oneself with the radio or conversation with a passenger, maintaining an excessive following distance, braking or slowing down at green lights, driving well under the speed limit, and giving way unnecessarily (Koch & Taylor, 1995). These kinds of often subtle behaviours may account for the lack of differences between driving-fearful and control groups in terms of driving accidents and incidents.

The factors identified above are likely to affect whether anxiety impacts on information processing and, ultimately, driving performance. These variables have a role in determining whether driving skills play a role as a cause, maintaining factor, or consequence of driving anxiety in individual cases where skills are relevant. Mild levels of driving anxiety could also facilitate driving skill and improve driving performance or, at the very least, have no detrimental effect. The relationships among this complex set of variables need to be disentangled in future research, with attention to the possible interaction effects between (1) the characteristics of the driving task, (2) worry content, (3) type and etiology of anxiety, and (4) driving performance. For example, the finding of increased errors amongst driving-fearful individuals (Taylor et al., 2007) might only apply for certain types of driving tasks (e.g., single-task versus more demanding driving situations). Worry content may have an additional interaction effect, with

detrimental performance only evident for certain types of worry thoughts as well as driving task circumstances. A good starting point would be to examine the driving skills of a sample of people with driving phobia. The clearest case where some assessment and possible remediation of driving skills would be most relevant is where the person has had limited driving experience and opportunities for practice, perhaps as part of a pattern of early fearfulness. Other researchers (e.g., Kuch, 1989) have recommended that, in general treatment work with people with driving fears, an attempt should be made to rule out skill deficits, perhaps through a driving lesson. A course in defensive driving may also be appropriate for some people whose driving anxiety develops following an MVA. However, more research is needed to clarify the multiple ways that anxiety and driving skills may affect each other and under what circumstances in individuals who experience fear of driving.

References

Alpers, G. W., Wilhelm, F. H., & Roth, W. T. (2005). Psychophysiological assessment during exposure in driving phobic patients. *Journal of Abnormal Psychology, 114*, 126-139.

Andrews, G., Crino, R., Hunt, C., Lampe, L., & Page, A. (1994). *The treatment of anxiety disorders.* Cambridge: Cambridge University Press.

Baddeley, A. D. (1992a). Is working memory working? *Quarterly Journal of Experimental Psychology, 44A,* 1-31.

Baddeley, A. D. (1992b). Working memory. *Science, 255,* 556-559.

Baddeley, A. D. (1994). Working memory: The interface between memory and cognition. In D. L. Schacter & E. Tulving (Eds.), *Memory systems* (pp. 351-367). Cambridge, MA: MIT Press.

Barlow, D. H., Esler, J. L., & Vitali, A. E. (1998). Psychosocial treatments for panic disorders, phobias, and generalized anxiety disorder. In P. E. Nathan & J. M. Gorman (Eds.), *A guide to treatments that work* (pp. 288-318). NY: Oxford University Press.

Beck, A. T., & Emery, G. (1985). *Anxiety disorders and phobias: A cognitive perspective.* NY: Basic Books.

Bellack, A. S., & Hersen, M. (1998). *Behavioral assessment: A practical handbook* (4th ed.). Boston, MA: Allyn and Bacon.

Blanchard, E. B., Hickling, E. J., & Kuhn, E. (2003). Of "crashes" and "accidents": A comment on Stewart and Lord. *Journal of Traumatic Stress, 16,* 527-528.

Britt, T. W., & Blumenthal, T. D. (1993). Social anxiety and latency of response to startle stimuli. *Journal of Research in Personality, 27,* 1-14.

Butki, B. D. (1994). Adaptation to effects of an audience during acquisition of rotary pursuit skill. *Perceptual and Motor Skills, 79,* 1151-1159.

Calvo, M. G., & Ramos, P. M. (1989). Effects of test anxiety on motor learning: The processing efficiency hypothesis. *Anxiety Research, 2,* 45-55.

Chambless, D. L., & Hope, D. A. (1996). Cognitive approaches to the psychopathology and treatment of social phobia. In P. M Salkovskis (Ed.), *Frontiers of cognitive therapy* (pp. 345-382). NY: Guilford.

Craske, M. G. (2003). *Origins of phobias and anxiety disorders: Why more women than men?* Oxford: Elsevier.

Dunning, D., Johnson, K., Ehrlinger, J., & Kruger, J. (2003). Why people fail to recognize their own incompetence. *Current Directions in Psychological Science, 12,* 83-87.

Ehlers, A., Hofmann, S. G., Herda, C. A., & Roth, W. T. (1994). Clinical characteristics of driving phobia. *Journal of Anxiety Disorders, 8,* 323-339.

Ehrlinger, J., & Dunning, D. (2003). How chronic self-views influence (and potentially mislead) estimates of performance. *Journal of Personality and Social Psychology, 84,* 5-17.

Evans, L. (1991). *Traffic safety and the driver.* NY: Van Nostrand Reinhold.

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective.* Hove, UK: Erlbaum.

Eysenck, M. W., & Byrne, A. (1992). Anxiety and susceptibility to distraction. *Personality and Individual Differences, 13,* 793-798.

Eysenck, M. W., & Byrne, A. (1992). Anxiety and susceptibility to distraction. *Personality and Individual Differences, 13,* 793-798.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6,* 409-434.

Eysenck, M. W., & Keane, M. T. (1995). *Cognitive psychology: A student's handbook.* Hove, UK: Erlbaum.

Eysenck, M. W., MacLeod, C., & Mathews, A. (1987). Cognitive functioning and anxiety. *Psychological Research, 49,* 189-195.

Flynn, T. M., Taylor, P., & Pollard, C. A. (1992). Use of mobile phones in the behavioral treatment of driving phobias. *Journal of Behavior Therapy and Experimental Psychiatry, 23,* 299-302.

Foot, H. C., & Chapman, A. J. (1982). Road safety and driver behaviour. *Ergonomics, 25,* 863-865.

Glendon, A. I., Dorn, L., Matthews, G., Gulian, E., Davies, D. R., & Debney, L. M. (1993). Reliability of the Driving Behaviour Inventory. *Ergonomics, 36,* 719-726.

Groeger, J. (1988). Underlying structures: Driver models and model drivers. In T. Rothengatter & R. de Bruin (Eds.), *Road user behaviour: Theory and research* (pp. 518-526). Assen, The Netherlands: van Gorcum.

Gulian, E., Glendon, A. I., Matthews, G., Davies, D. R., & Debney, L. M. (1990). The stress of driving: A diary study. *Work & Stress, 4,* 7-16.

Gulian, E., Glendon, I., Matthews, G., Davies, R., & Debney, L. (1988). Exploration of driver stress using self-reported data. In T. Rothengatter & R. de Bruin (Eds.), *Road user behaviour: Theory and research* (pp. 342-347). Assen, The Netherlands: van Gorcum.

Gulian, E., Matthews, G., Glendon, A. I., Davies, D. R., & Debney, L. M. (1989). Dimensions of driver stress. *Ergonomics, 32,* 585-602.

Hancock, P. A., Wulf, G., Thom, D., & Fassnacht, P. (1990). Driver workload during differing driving maneuvers. *Accident Analysis and Prevention, 22,* 281-290.

Heimberg, R. G. (1989). Cognitive and behavioral treatments for social phobia: A critical analysis. *Clinical Psychology Review, 9,* 107-128.

Heimstra, N. W. (1970). The effects of 'stress fatigue' on performance in a simulated driving situation. *Ergonomics, 13,* 209-218.

Heimstra, N. W., Ellingstad, V. S., & DeKock, A. R. (1967). Effects of operator mood on performance in a simulated driving task. *Perceptual and Motor Skills, 25,* 729-735.

Hentschel, U., Bijleveld, C. C., Kiessling, M., & Hosemann, A. (1993). Stress-related psychophysiological reactions of truck drivers in relation to anxiety, defense, and situational factors. *Accident Analysis and Prevention, 25,* 115-121.

Janelle, C. M., Singer, R. N., & Williams, A. M. (1999). External distraction and attentional narrowing: Visual search evidence. *Journal of Sport and Exercise*

Psychology, 21, 70-91.

Jones, G., & Cale, A. (1997). Goal difficulty, anxiety and performance. *Ergonomics, 40,* 319-333.

Koch, W. J., & Taylor, S. (1995). Assessment and treatment of motor vehicle accident victims. *Cognitive and Behavioral Practice, 2,* 327-342.

Kottenhoff, H. (1961). Interrelations of steering skill measures in neurotic and other patients. *Perceptual and Motor Skills, 12,* 289-290.

Kuch, K. (1988). Eliminating posttraumatic driving phobias: A reply to Dr. Blonstein. *The Behavior Therapist, 11,* 238.

Kuch, K. (1989). Treatment of post-traumatic phobias and PTSD after car accidents. In P. A. Keller & S. R. Heyman (Eds.), *Innovations in clinical practice: A source book* (Vol. 8, pp. 263-270). Sarasota, FL: Professional Resource Exchange.

Kuch, K. (1997). Accident phobia. In G. C. L. Davey (Ed.), *Phobias: A handbook of theory, research and treatment* (pp. 153-162). Chichester, UK: Wiley.

Kuch, K., & Swinson, R. P. (1989). Phobias, panic, and self-control. *Journal of Anxiety Disorders, 3,* 171-177.

Land Transport Safety Authority (1999). *New Zealand Driver Developer Resource.* Wellington, New Zealand: Author.

Levine, B. A., & Wolpe, J. (1980). *In vivo* desensitization of a severe driving phobia through radio contact. *Journal of Behavior Therapy and Experimental Psychiatry, 11,* 281-282.

Little, A. D. (1970). *The state of the art of traffic safety: A comprehensive review of existing information.* NY: Praeger.

Loo, R. (1979). Role of primary personality factors in the perception of traffic signs and driver violations and accidents. *Accident Analysis and Prevention, 11,* 125-127.

Matthews, G. (2001). A transactional model of driver stress. In P. A. Hancock & P. A. Desmond (Eds.), *Stress, workload, and fatigue* (pp. 133-163). Mahwah, NJ: Erlbaum.

Matthews, G., & Desmond, P. A. (2001). Stress and driving performance: Implications for design and training. In P. A. Hancock & P. A. Desmond (Eds.), *Stress, workload, and fatigue* (pp. 211-231). Mahwah, NJ: Erlbaum.

Matthews, G., Desmond, P. A., Joyner, L., Carcary, B., & Gilliland, K. (1997). A comprehensive questionnaire measure of driver stress and affect. In T. Rothengatter & E. C. Vaya (Eds.), *Traffic and transport psychology: Theory and application* (pp. 317-324). Amsterdam: Pergamon.

Matthews, G., Dorn, L., & Glendon, A. I. (1991). Personality correlates of driver stress. *Personality and Individual Differences, 12,* 535-549.

Matthews, G., Dorn, L., Hoyes, T. W., Davies, D. R., Glendon, A. I., & Taylor, R. G. (1998). Driver stress and performance on a driving simulator. *Human Factors, 40,* 136-149.

Matthews, G., Sparkes, T. J., & Bygrave, H. M. (1996). Stress, attentional overload and simulated driving performance. *Human Performance, 9,* 77-101.

Matthews, G., Tsuda, A., Xin, G., & Ozeki, Y. (1999). Individual differences in driver stress vulnerability in a Japanese sample. *Ergonomics, 42,* 401-415.

Murray, N. P., & Janelle, C. M. (2003). Anxiety and performance: A visual search examination of the Processing Efficiency Theory. *Journal of Sport & Exercise Psychology, 25,* 171-187.

Nagane, M. (1990). Development of psychological and physiological sensitivity indices to stress based on state anxiety and heart rate. *Perceptual and Motor Skills, 70,* 611-614.

O'Hanlon, J. F., Vermeeren, A., Uiterwijk, M. M., van Veggel, L. M., & Swijgman, H. F. (1995). Anxiolytics' effects on the actual driving performance of patients and healthy volunteers in a standardized test. *Neuropsychobiology, 31,* 81-88.

Payne, R. B., & Corley, T. J. (1994). Motivational effects of anxiety on psychomotor performance. *Perceptual and Motor Skills, 79,* 1507-1521.

Ranney, T. A. (1994). Models of driving behavior: A review of their evolution. *Accident Analysis and Prevention, 26,* 733-750.

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35,* 741-756.

Rapee, R. M., & Spence, S. H. (2004).The etiology of social phobia: Empirical evidence and an initial model. *Clinical Psychology Review, 24,* 737-767.

Recarte, M. A., & Nunes, L. M. (2000). Effects of verbal and spatial-imagery tasks on eye fixations while driving. *Journal of Experimental Psychology: Applied, 6,* 31-43.

Sarason, I.G., Sarason, B. R., & Pierce, G. R. (1990). Anxiety, cognitive interference, and performance. *Journal of Social Behavior and Personality, 5,* 1-18.

Schulz, P., & Schönpflug, W. (1988). Anxiety as a motivating factor and stressing agent. In C. D. Spielberger & I. G. Sarason (Eds.), *Stress and anxiety* (Vol. 11, pp. 3-17). Washington: Hemisphere.

Shinar, D. (1978). *Psychology on the road: The human factor in traffic safety.* NY: Wiley.

Shoham, S. G., Rahav, G., Markovski, R., Chard, F., & Baruch, I. (1984). "Anxious" and "reckless" drivers. *Deviant Behaviour, 5,* 181-191.

Silverstone, T. (1988). The influence of psychiatric disease and its treatment on driving performance. *International Clinical Psychopharmacology, 3(Suppl.),* 59-66.

Stewart, A. E., & Lord, J. H. (2002). Motor vehicle crash versus accident: A change in terminology is necessary. *Journal of Traumatic Stress, 15,* 333-335.

Stewart, A. E., & Lord, J. H. (2003). Some crashes are more unintentional than others: A reply to Blanchard, Hickling, and Kuhn. *Journal of Traumatic Stress, 16,* 529-530.

Strohbeck-Kühner, P. (1999). Test anxiety in driving-fitness appraisals: The anxiety-performance relationship. *Zeitschrift für Differentielle und Diagnostische Psychologie, 20,* 39-57.

Taylor, J, Deane, F., & Podd, J. (2002). Driving-related fear: A review. *Clinical Psychology Review, 22,* 631-645.

Taylor, J. E., Deane, F. P., & Podd, J. V. (2007). Driving fear and driving skills: Comparison between fearful and control samples using standardised on-road assessment. *Behaviour Research and Therapy, 45,* 808-818.

Taylor, J. E., & Paki, D. P. (2008). *Wanna drive? Driving anxiety and fear in a community sample. New Zealand Journal of Psychology, 37,* 42-48.

Terelak, J. (1990). Individual differences in anxiety level and psychomotor performance. *Personality and Individual Differences, 11,* 771-775.

Turner, S. M., & Beidel, D. C. (1989). Social phobia: Clinical syndrome, diagnosis, and comorbidity. *Clinical Psychology Review, 9,* 3-18.

Ulleberg, P., & Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science, 41,* 427-443.

Walklin, L. (1993). *Instructional techniques and practice for driving instructors* (2nd ed.). Cheltenham, England: Stanley Thornes.

Wald, J., & Taylor, S. (2003). Preliminary research on the efficacy of virtual reality exposure therapy to treat driving phobia. *CyberPsychology and Behavior, 6,* 459-465.

Walshe, D. G., Lewis, E. J., Kim, S. I., O'Sullivan, K., & Wiederhold, B. K.

(2003). Exploring the use of computer games and virtual reality in exposure therapy for fear of driving following a motor vehicle accident. *CyberPsychology and Behavior, 6,* 329-334.

Wells, A., & Clark, D. M. (1997). Social phobia: A cognitive approach. In G. C. L. Davey (Ed.), *Phobias: A handbook of theory, research and treatment* (pp. 3-26). Chichester, UK: Wiley.

Wetherell, A. (1981). The efficacy of some auditory-vocal subsidiary tasks as measures of the mental load on male and female drivers. *Ergonomics, 24,* 197-214.

Wickens, C. D. (1984). Processing resources in attention. In R. Parasuraman & D. R. Davies (Eds.), *Varieties of attention* (pp. 63-101). NY: Academic Press.

Wickens, C. D. (1991). Processing resources and attention. In D. L. Damos (Ed.), *Multiple-task performance* (pp. 3-34). London: Taylor & Francis.

Wiederhold, B. K., Wiederhold, M. D., Jang, D. P., & Kim, S. I. (2000). Use of cellular telephone therapy for fear of driving. *Cyberpsychology & Behavior, 3,* 1031-1039.

Williams, S. L., Dooseman, G., & Kleifield, E. (1984). Comparative effectiveness of guided mastery and exposure treatments for intractable phobias. *Journal of Consulting and Clinical Psychology, 52,* 505-518.

Williams, S. L., Kinney, P. J., Harap, S. T., & Liebmann, M. (1997). Thoughts of agoraphobic people during scary tasks. *Journal of Abnormal Psychology, 106,* 511-520.

Williams, S. L., & Rappoport, A. (1983). Cognitive treatment in the natural environment for agoraphobics. *Behavior Therapy, 14,* 299-313.

Wilson, T., & Greensmith, J. (1983). Multivariate analysis of the relationship between drivometer variables and drivers' accident, sex, and exposure status. *Human Factors, 25,* 303-312.

Wolpe, J. (1982). *The practice of behavior therapy* (3rd ed.). NY: Pergamon.

Wood, K. J. (1996). *Driving reassessment following neurological damage: An integrated approach.* Unpublished doctoral dissertation, Massey University, Palmerston North, New Zealand.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology, 18,* 459-482.

Yinon, Y., & Levian, E. (1988). Presence of other drivers as a determinant of traffic violations. In T. Rothengatter & R. de Bruin (Eds.), *Road user behaviour: Theory and research* (pp. 274-278). Assen, The Netherlands: van Gorcum.

Address for Correspondence

Joanne Taylor
School of Psychology
Massey University
Private Bag 11-222
Palmerston North
New Zealand

Phone (06) 356 9099
Fax (06) 350 5673
email J.E.Taylor@massey.ac.nz.

Notes

[1] The use of the term "accident" versus "crash" has been the subject of much debate in the recent literature (Blanchard, Hickling, & Kuhn, 2003; Stewart & Lord, 2002, 2003).

The relationship between driving anxiety and driving skill: A review of human factors and anxiety-performance theories to clarify future research needs

Taylor JE

2008