Using the Driver Behaviour Questionnaire to Predict Crashes and Demerit Point Loss: Does it Get Better with Larger Sample Sizes?

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Abstract

The Driver Behaviour Questionnaire (DBQ) continues to be the most widely utilised self-report scale globally to assess crash risk and aberrant driving behaviours among motorists. However, the scale also attracts criticism regarding its perceived limited ability to accurately identify those most at risk of crash involvement. This study reports on the utilisation of the DBQ to examine the self-reported driving behaviours (and crash outcomes) of drivers in three separate Australian fleet samples (N = 443, N = 3414, & N = 4792), and whether combining the samples increases the tool's predictive ability. Either on-line or paper versions of the questionnaire were completed by fleet employees in three organisations. Factor analytic techniques identified either three or four factor solutions (in each of the separate studies) and the combined sample produced expected factors of: (a) errors, (b) highway-code violations and (c) aggressive driving violations. Highway code violations (and mean scores) were comparable across the studies. However, across the three samples, multivariate analyses revealed that exposure to the road was the best predictor of crash involvement at work, rather than DBQ constructs. Furthermore, combining the scores to produce a sample of 8649 drivers did not improve the predictive ability of the tool for identifying crashes (e.g., 0.4% correctly identified) or for demerit point loss (0.3%). The paper outlines the major findings of this comparative sample study in regards to utilising self-report measurement tools to identify "at risk" drivers as well as the application of such data to future research endeavours.

Introduction

A tremendous amount of research effort is directed towards understanding and preventing traffic crashes each year world-wide. Most often, self-report measurement tools are utilised that attempt to predict those at greatest risk of crash involvement (af Wåhlberg, Dorn & Kline, 2011). In regards to such tools, the Manchester Driver Behaviour Questionnaire (DBQ) (Reason et al., 1990) is the most popular self-report driving assessment tool globally (Mattsson, 2012). It is repeatedly used in the prediction of individual differences in crash involvement, and to a lesser extent, predicting those who incur demerit points (Wishart et al., in press). While the DBQ has taken different forms, most often it involves three factors: highway code violations (e.g., speeding), aggressive violations, and errors.

The DBQ has been utilised extensively in a variety of countries to address a number of issues, including: age and gender differences, novice drivers, vehicle type, survey bias, driver education programs, mental health issues, cross cultural studies, etc [see de Winter and Dodou (2010) for an overview of the many areas of research in which the DBQ has been employed]. Studies reporting DBQ usage have identified associations between self-reported aberrant driving practices and; unsafe driving behaviours or traffic offences (eg. Charlton, 2004; Forward, 2006); aggressive behaviours (eg. Björklund, 2008); and assessing the risk of crash involvement (eg. af Wåhlberg et al., 2011; Reason et al., 1990). Although, it is noted that the factor structure can change (ranging from three to five) across different driving groups and in different cultures (Wishart et al., in press).

In contrast, less research has used the DBQ to examine the self-reported driving behaviours of those who drive company sponsored vehicles (Davey et al 2007; Freeman et al., 2009; Newnam et al., 2002, 2004; Sullman et al., 2002; Xie & Parker, 2002). This is somewhat surprising given that professional drivers not only have different driving demands, but they also have higher exposure to crash risk (Newman et al., 2002; Öz, Özkan, & Lajunen, 2010). This crash risk is not only due to higher levels of exposure to the road environment, but also as a result of time and scheduling pressures and other distractions (Stradling et al., 2000). This increased risk has been demonstrated in databases, as occupational driving crashes are the most common form of injury or death in the workplace (Haworth, Tingvall & Kowadlo, 2000) with fatalities in Australia involving motor vehicles accounting for 46% of all workplace fatalities (Safe Work Australia, 2012). Preliminary studies have reported that fleet drivers report higher crash involvement in their work vehicle compared to their private vehicle usage, and are also less likely to conduct vehicle safety checking practices e.g., tyre pressure on their work vehicle (Newman et al., 2002). In regards to specific studies, Freeman et al., (2009) and Davey et al (2007), both of which are included in this current study, utilised the DBQ to examine two samples of professional drivers' self-reported driving behaviours and revealed a combination of highway code violations and aggressive violations predicted crash involvement. Öz et al. (2010) examined the self-reported driving behaviours of 230 male professional drivers and reported those with low work orientation scores (e.g., culture) reported significantly more DBQ related-violations than those with high scores for work orientation. Additionally, the DBQ has been utilised to examine taxi, bus and company drivers in China (Xie & Parker, 2002), as well as truck drivers aberrant driving behaviours (Sullman et al., 2002). However, it is noted that the majority of studies have utilised relatively small samples (Blockey & Hartley (1995), and thus there is a need to explore the usefulness of the DBQ with larger fleet samples.

Methodological Issues

Despite the popularity of the DBQ, questions have been raised regarding the psychometric properties of the tool as well as its ability to accurately predict those most likely to be involved in a crash (af Wåhlberg, 2009; af Wåhlberg, Dorn & Freeman, 2012; Wishart et al., in press; Newman & VonSchuckmann, 2012). On the one hand, de Winter and Dodou's (2010) meta-analysis of DBQ studies demonstrated that violations predicted crashes with an overall correlation of .13 (based on zero-order effects reported in tabular form), which the authors believed was evidence of the usefulness of the tool to understand driving behaviours for various populations. In contrast, a commentary of this meta-analysis by af Wåhlberg, Dorn and Freeman (2012) asserted that this correlation is spuriously inflated due to method effects e.g., common method variance, self-report bias, etc. Within fleet settings, Newman and VonSchuckmann (2012) highlighted the following three limitations of the DBQ: (a) varying factor structure, (b) non-focus on factors that impact upon professional drivers and (c) ambiguous items such as "near-misses". Additionally, it has been suggested that the very low mean scores present on some factors limits the usefulness of the tool to accurately measure the impact of safety-related interventions (Harrison, submitted for publication). This problem is further amplified when correlations are drawn with relatively rare dependent variable events such as crashes (Wishart et al., in press). Despite these concerns, it is noted that endeavours to develop alternative work-related driving assessment tools have not been particularly successful (Newman & VonSchuckman, 2012; Wishart et al., 2012). As a result, there is a renewed focus to ascertain the usefulness of the DBQ to identify "at risk" drivers. Given this, the present research aimed examine the predictive ability of the DBQ across different fleet samples as well as a combined sample, to determine whether larger sample sizes increases its predictive efficacy. In short, larger samples increase the chance of finding a statistically significant difference as they are understood to more reliably reflect the wider population. In regards to factor analysis, larger sample sizes also tend to provide more stable effects, reducing the variability in factor loadings across repeated samples (Browne, 1968; MacCallum, Widaman, Zhang & Hong, 1999).

Method

Participants

The sample for the current study is drawn from combining data from three separate studies: (i) Freeman et al. (2009), which reports responses of 4792 professional drivers in an Australian fleet setting, (ii) Davey et al. (2007) who sampled 443 Australian fleet drivers, and (iii) Wishart et al. (2014) who surveyed 3414 fleet drivers in Queensland, producing a total sample size of 8649[1]. Males constituted 74.3 percent of the combined sample while women were 25.6 percent. The mean age of the sample was 43.4 (range 17 to 70) years. In terms of work-related driving exposure, just under one third of the overall sample reported driving less than ten thousand kilometres per year for work (32.1%) while one fifth (20.7%) reported driving between ten and twenty thousand kilometres annually. The remainder (44.2%) reported driving over twenty thousand kilometres in the past twelve months for work.

The largest proportion of participants did not report a crash in the past 12 months for work (e.g., 88.3%, n = 7561). However, 10.7% (n = 914) reported one crash while a smaller percentage (1.1%) reported two or more crashes. Similarly, 89.3% had not received a traffic offence in the past 12 months (n = 7632) while 8.8% received one offence and 2% received two or more offences. Figures for self-reported work-related crashes and traffic offences in the previous 12 months are shown in Table 1.

Table 1. Self-reported work related crashes and traffic offences in past 12 months

	Frequency	Valid %
CRASHES		
None	7561	88.3
One crash	914	10.7
Two crashes	70	.8
Three or more crashes	21	.3
Total	8566	100
OFFENCES		
None	7632	89.2
One offence	753	8.8
Two offence s	135	1.6
Three or more offences	37	.4
Total	8557	100

Materials and Procedure

The same modified version of the DBQ was used in the three separate studies, consisting of 20 items. Questions relating to lapses were omitted as this factor has not been found to have significant associations with crash involvement (Lawnton et al., 1997). Minor modifications to some DBQ questions were also made to ensure the questionnaire was representative of driving conditions in Australia as experienced by the study participants. For example, references to the specific direction that another car may be turning ("left" or "right") were removed with the more general term "turning" deemed to be sufficient for the purposes of the studies[2]. Respondents were required to indicate on a seven point scale (1 = never to 7 = always) how often they commit each of the *errors* (8 items), *highway code violations* (8 items) and *aggressive violations* (4 items). Data from the three studies were combined to create the current study's sample. A number of socio-demographic questions were included in the questionnaire to determine participants' age, gender, driving history (e.g., years of driving experience, number of traffic

[1] While the three studies all focus on fleet drivers, they are separate to one another.

[2] The DBQ has been shown to be robust to minor changes to some items, altered to reflect specific cultural and environmental contexts (Blockey & Hartley, 1995; Davey et al., 2007; Freeman et al., 2009; Ozkan & Lajunen, 2005; Parker et al., 2000).

offences and crashes) and their driving exposure (e.g., annual kilometres driven). The studies used similar methodologies, as the questionnaire was either sent through the company's internal mail system to volunteers (Davey et al., 2007; Freeman et al. 2009) or volunteers completed the questionnaire during a half-day workshop (Wishart et al., in press).

Results

The internal consistency of the DBQ scale scores were examined by calculating Cronbach's alpha reliability coefficients. Similar to previous Australian and New Zealand research (Blockey & Hartley, 1995; Dobson et al., 1999; Sullman et al., 2002), the factors for each of the four studies exhibit comparative internal consistency (see Table 2). Examination of the scores for the combined sample reveal that the items coded as Errors and items traditionally associated with highway code violations had a similar reliability coefficient (.79), while aggressive violations, which consisted of only 4 items, had the lowest reliability (.61).

Table 2. Alpha reliability coefficients of the DBQ scales

	Davey et al. (2007)	Freeman et al. (2009)	Wishart et al. (in press)	Combined Sample
Errors (8 items)	.77	.78	.78	.79
Highway Code Violations (8 items)	.80	.77	.77	.79
Aggressive Violations (4 items)	.60	.56	.61	.61

A series of t-tests of the three factors revealed that the mean of *Highway Code Violations* (i.e. speeding) is significantly greater than the mean of *Errors* [t (8644) = -39.82, $p < .001$] and also significantly greater than the mean of *Aggressive Violations* [t (8644) = -37.18, $p < .001$]. The average means for *Error* and *Aggressive Violation*s were also significantly different, [t (8644) =-2.32, $p = .02$]. The findings suggest that speeding is the most common driving behaviour reported by the survey participants, which is consistent with previous research on professional drivers (Newnam et al., 2004; Sullman et al., 2002).

Table 3 reports the mean and standard deviation scores for the three highest ranked items, in each study and the three highest ranked items drawn from the combined sample. The highest scores drawn from across the three studies were: *Exceed the speed limit on a highway* (*M* = 2.35, *SD* = 1.26); *Become angered by another driver and show anger* (*M* = 1.79, *SD* = 0.92); and *Stay in a closing lane and force your way into another* (*M* = 1.78, *SD* = 0.94). The results reinforce that *Highway Code Violations* are the most common form of aberrant behaviour reported by fleet drivers in the current sample.

Table 3. Mean scores for highest ranked items in studies

Highest Ranked Items	M	SD
Davey et al. (2007) n = 443		
1. Exceed the speed limit on a highway	2.19	1.14
2. Sound your horn to indicate your annoyance	1.89	.87
3. Race away from the traffic lights to beat driver beside you	1.85	1.04
Freeman et al. (2009) n = 4792		
1. Exceed the speed limit on a highway	1.96	1.01

2. Stay in a closing lane and force your way into another	1.65	.82
3. Race away from the traffic lights to beat driver beside you	1.63	.86
Wishart et al. (in press) n = 3414		
1. Exceed the speed limit on a highway	2.93	1.37
2. Become angered by another driver and show anger	2.02	1.04
3. Stay in a closing lane and force your way into another	1.95	1.05
Combined Sample		
1. Exceed the speed limit on a highway	2.35	1.26
2. Become angered by another driver and show anger	1.79	.92
3. Stay in a closing lane and force your way into another	1.78	.94

Principle components analysis with oblique rotation was undertaken to determine the factor structure of the DBQ. After converged rotation in 26 iterations, a three-factor solution was revealed that accounted for 44.61% of the total variance. The first factor accounted for 31.54% of the total variance and contained ten items, consisting of all eight original *Error* items, one *Highway Code Violation* item and one *Aggressive Violation* item. The second factor comprised six items, all of which were drawn from the *Highway Code Violations* scale. The third factor contained four items, these being the remaining *Aggressive Violations* items and one *Highway Code Violation* item.

Three of the twenty DBQ items cross-loaded, each drawn from the original *Highway Code Violation* scale. These cross-loading items could be reasonably considered to have an association with the other factors. For example, to *cross a junction knowing traffic lights have already turned* could be viewed as a driver error. Similarly, *drive especially close to car in front* and *race away from the traffic lights to beat driver beside you* could also be considered to be aggressive driving acts. These cross-loadings are consistent with those observed in Davey et al., (2007) and Wishart et al., (2014).

All items and factors for the 20-item DBQ are reported in Table 4. Cronbach's alpha reliability coefficients were calculated for the three new factors. Errors had the highest reliability coefficients (.81), with highway code violations slightly lower (.77) and aggressive violations having the lowest reliability of the three obtained factors (.65).

Table 4. Factor structure of the modified DBQ

Items	F1	F2	F3
Fail to notice pedestrians are crossing in your path of traffic	.68		
When overtaking underestimate the speed of an oncoming vehicle	.68		
Nearly hit cyclist while turning	.64		
Miss 'Stop' or 'Give Way' signs	.64		
Fail to check rear-view mirror before pulling out or changing lanes	.61		
Nearly hit car in front while queuing to enter a main road	.61		
Pull out of a junction so far that you disrupt the flow of traffic	.59		
Attempt to overtake someone you hadn't noticed turning	.55		
Skid while braking or cornering on a slippery road	.53		
Drive even though you suspect you are over legal blood-alcohol limit	.32		
Exceed the speed limit on a highway		-.82	

Disregard the speed limit on a residential road		-.70	
Race away from the traffic lights to beat driver beside you		-.53	.33
Drive especially close to car in front to signal to driver to go faster		-.52	.37
Cross junction knowing traffic lights have already turned	.39	-.41	
Stay in a closing lane and force your way into another		-.37	
Sound your horn to indicate your annoyance to another driver			.75
Become angered by another driver and show anger			.64
Become angered by another driver and give chase			.50
Become impatient with slow driver ahead and overtake on inside			.46
Amount of variance explained (%)	31.5	7.7	5.3

The bivariate relationships between participants' self-reported driving exposure, work crashes, offences and DBQ factors are presented in Table 5. While the actual predictive relationship between participants' self-reported driving outcomes (e.g., crashes, fines) and the DBQ factors will be examined through multivariate analyses in the following section, some noteworthy bivariate relationships are reported at this point.

In the combined sample, age did not have a meaningful association with the other demographic factors or with crashes and offences at work, and older drivers did not necessarily drive for longer periods. In regards to gender, on average men reported greater amounts of driving than women. Age was identified as having a significant negative relationship with errors, highway and aggressive violations. This indicates that as drivers gain more experience, they are less likely to engage in aberrant driving behaviours on public roads, although the strongest of these negative effects, between age and highway code violations, was not large (r = -.24). A number of statistically significant bivariate relationships were evident between the self-reported number of crashes, number of demerit point losses, and participants' DBQ scores or driving exposure. These relationships are the major focus of the following predictive analyses.

Table 5. Pearson correlations between the major driving variables

	1	2	3	4	5	6	7	8
1. Age	--	$-.16^{**}$	$.03^{*}$	$-.07^{**}$	$-.24^{**}$	$-.19^{**}$	$-.03^{**}$	$-.02^{*}$
2. Gender		--	$-.27^{**}$	$.04^{**}$	$.08^{**}$	$.03^{**}$	$-.03^{*}$	$-.04^{**}$
3. Kilometres per year			--	$-.01^{***}$	$-.05^{**}$	$-.04^{**}$	$.12^{**}$	$.10^{*}$
4. Errors				--	$.59^{**}$	$.50^{**}$	$.13^{**}$	$.11^{**}$
5. Highway code violations					--	$.59^{**}$	$.09^{**}$	$.09^{**}$
6. Aggressive violations						--	$.09^{**}$	$.1^{**}$
7. Crashes past 12 months							--	$.14^{**}$
8. Offences last 12 months								--

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Notes: 7 and 8 use the full range of the crashes and offences while at work variables rather than the dichotomous coded version created for the logistic regression.

Prediction of Crashes and Offences

A series of analyses focused on identifying the factors predictive of involvement in a crash or incurring demerit point loss (e.g., fine) over the past 12 months. Due to the relatively low incidence of reported crashes and offences, composite variables for total number of work crashes and total number of work fines were created. No between group differences were found between the three organisations for frequency of crash involvement or incurring demerit point loss. The largest proportion of respondents reported having no crashes at work (88.3%), while 10.7 % reporting one crash and just over 1% reporting having two or more crashes. Similarly, 89.2% of participants reported incurring no traffic offences while at work compared to those who reported one offence (8.8%), or two or more offences (2%). To allow for a more meaningful analysis to be conducted, dichotomous crashes and offences variables were created regarding crash.

Two logistic regressions were employed to evaluate the contributions of the present study's DBQ factors to participants' self-reported crashes and traffic offences after controlling for demographic factors. A model was created assessing the contribution of participants' age, gender, recent driving exposure (kms driven per annum), the key groupings of DBQ factors (errors, highway code violations and aggressive violations) and traffic infringement history (whether or not they reported incurring demerit points or fines and whether they reported having a crash in the past 12 months while at work). Table 6 shows the coefficients, standard errors, Wald statistics, odds ratios (OR) and 95% confidence intervals for the prediction of crashes and traffic offences while at work.

The first logistic regression assessed the contribution of the above mentioned variables' contributions to the prediction of crashes. Age, gender and the number of kilometres driven per year was entered in the first step to examine, as well as control for, their influence before the inclusion of the DBQ factors. The model at step one was a significant predictor of the outcome variable ($\chi^2(3)$ = 110.44, p < .001). Taken together, 2.6% of the estimated total variance was accounted for in the model, 100% of the sample who did not have a crash correctly classified. Consistent with previous research drivers with greater exposure to the road reported more crashes (OR = 1.22, p <.001). Step two involved the inclusion of the three obtained DBQ factors as well as traffic offences incurred at work in the last 12 months, which also proved to be significant [χ^2 (4)=101.10, p < .001] accounting for an additional 2.3% of the estimated total variance. The overall model was also significant [χ^2 (7) = 211.54, p < .001] with the model accounting for 4.9% of the total estimated variance according to the Nagelkerke R^2 statistic. Three items were found to be significant predictors of crashes: *annual kilometres driven* (Wald = 91.75, p = .000); *driver errors* (Wald = 28.45, p < .001) and *self-reported offences occurring at work* in the previous 12 months (Wald = 38.24 , p < .001). Results showed that 100% of the sample who did not have a crash were correctly classified, however only 0.4% (n = 4) of those who did report a work crash were correctly identified.

To better understand the relationship that age, gender, kilometres travelled per annum, DBQ factors, self-reported crashes has with offences, a second logistic regression was conducted. Similar to above, age, the number of kilometres driven per year and gender were entered in the first step to examine, as well as control for, their influence before the inclusion of the obtained DBQ factors. The model at step one was a significant predictor of the outcome variable ($\chi^2(3)$ = 95.73, p < .001). At this step, 2.3% of the estimated variance was accounted for and 100% of the sample who did not have a traffic offence in the last 12 months were classified correctly. Gender and exposure to the road were found to be predictors of traffic offences at work. Step one revealed that men were 1.26 times more likely than women to commit an offence in the previous 12 months, (p < .05) while those with greater exposure to the road reported more traffic offences (OR =1.12, p <.001).

The second step involved the inclusion of the three new DBQ factors as well as being involved in a crash while at work in the last 12 months. This step also proved to be significant [χ^2 (4)=105.59, $p < .001$] accounting for an additional 2.5% of the variance. The overall model was significant [χ^2 (7)=201.36, $p < .001$], with 4.8% of the estimated total variance accounted for in the model, although similar to the prediction of crashes, 100% of the sample who did not receive a traffic offence in the last 12 months while at work were correctly classified while only 0.3% (n = 3) of those who did report receiving a traffic offence in the previous 12 months were correctly identified. Finally, in regards to the explained variance in the overall regression models, comparisons were made between results from the combined sample and data from identical analyses conducted from each of the three studies separately. The overall model for the logistic regression assessing the prediction of crashes in the combined sample accounted for 4.9% of the total variance according to the Nagelkerke R^2 statistic. This compares with figures of 9.7% (Davey et al., 2007: n = 443), 3.2% (Freeman et al., 2009: n = 4792) and 8.8% (Wishart et al., 2014: n = 3414). The overall model for the prediction of traffic offences in the combined sample accounted for 4.8% of the total variance according to the Nagelkerke R2 statistic. Accordingly, figures for the component studies were 11.3 % (Davey et al., 2007), 3.3% (Freeman et al., 2009) and 8.2% (Wishart et al., 2014).

Table 6. Logistic regressions with self-reported crashes and traffic offences while at work in previous 12 months as the dependent variable at step three.

	Crashes						Offences					
					95% C.I. Exp(B)						95% C.I. Exp(B)	
	B	S.E.	Wald	Odds Ratio	Lower	Upper	B	S.E.	Wald	Odds Ratio	Lower	Upper
Age	-.01	.00	2.48	.99	.99	1.00	-.00	.00	.02	100	.99	1.01
Gender	-.01	.09	.01	.99	.84	1.18	-.24	.09	6.70*	.79	.66	.94
Km per year	.20	.02	91.75***	1.22	1.17	1.27	.18	.02	66.61***	1.19	1.14	1.24
Errors	.53	.10	28.45***	1.70	1.40	2.07	.30	.10	8.41**	1.34	1.10	1.64
Highway code violations	.03	.07	.19	1.03	.90	1.18	.19	.07	7.18*	1.21	1.05	1.39
Aggressive violations	.02	.07	.05	1.02	.88	1.17	.09	.07	1.61	1.10	.95	1.27
Crashes at work	-	-	-	-	-	-	.58	.09	38.86***	1.79	1.49	2.15
Offences at work	.58	.09	38.24***	1.79	1.49	2.15	-	-	-	-	-	-
	Model Chi-Squire = 211.54 $p < .001$						Model Chi-Squire = 201.36 $p < .001$					

*$p < .05$, ** $p < .01$, ***$p < .001$

Discussion

The present research aimed to examine the predictive ability of the DBQ across different fleet samples as well as a combined sample, to determine whether larger sample size increases the tool's predictive efficacy. Firstly, DBQ reliability coefficients were found to be relatively robust and were similar across the three different driving populations. Secondly, examination of the overall mean scores with the original DBQ factors revealed similar scores for the three organisations, and *highway code violations* was again reported to be the most frequent driving behaviour exhibited. This finding is consistent with previous research that has found speeding to be the most frequently reported aberrant driving behaviour on public roads (Dimmer & Parker, 1999; Lajunen et al., 2003; Parker et al., 2003). Given this, and the hypothesised additional time pressures placed on many professional drivers, it may be expected that speeding violations are the most common form of aberrant behaviour both exhibited and reported by fleet drivers (Wishart et al., 2014). Thirdly, factor analytic techniques were implemented to assist with the interpretation of the scale scores, which revealed a three factor solution that is again similar to previous research (Sullman et al., 2002; Lajunen et al., 2003; Davey et al., 2007; Freeman et al., 2009; Wishart et al., in press). Driving errors was the clearest factor to interpret, followed by Highway Code Violations and Aggressive Violations. The relationship between the factors was explored with findings similar to previous research on general motorists (Dobson et al., 1999; Ozkan & Lajunen, 2005) and relatively strong correlations were evident between the speeding, aggression and error factors.

Finally, a central aim of the study was to determine whether larger sample sizes increased the DBQ's predictive efficacy. It was hypothesised that larger samples increase the chance of finding a statistically significant difference as they are understood to more reliably reflect the wider population. However, it is noted that a relatively small proportion of the sample reported being involved in a crash or incurring demerit point loss. Nevertheless, consistent with previous research (Sullman et al., 2002, Davey et al., 2007; Freeman et al., 2009), exposure to the road was predictive of being involved in a work crash or incurring demerit point loss. Additionally, making errors were predictive of both outcome measures (to a minor extent), which is again similar to previous research (Blockey & Hartley, 1995; DeLucia et al., 2003; Freeman et al., 2009). However, only 0.4% of self-reported crashes were correctly identified along with 0.3% of those who incurred demerit points. There may be a number of reasons for this outcome. Firstly, and similar to previous research (Davey et al., 2007), only a small proportion of the sample reported being in a crash, which likely contributed to difficulties identifying factors associated with the event (Wishart et al., in press). Secondly, concerns remain regarding the reliability of the self-reported data, not least social desirability responding, memory recall bias, and other method effects (af Wåhlberg, Dorn & Kline, 2010; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Thirdly, a wide range of factors (not currently measured) have the potential to affect any crash outcome, including fatigue, poor driving conditions, crash culpability (etc) and incurring speeding fines may be heavily dependent upon enforcement activities. Taken together, the current findings add to the mixed body of evidence regarding which DBQ factors predict negative driving outcomes. Perhaps at best we can hope that more fleet-based research is published that utilises the DBQ (as well as other assessment tools) to identify the most effective approach to assess driving behaviours and identify high risk drivers, which includes other factors proposed to influence the driving task e.g., distraction, work pressure, etc. Additionally, the rapid development of in-vehicle technology will likely provide a complementary approach to driving assessment (not least by extending the assessment period), which may further be enhanced through the use of official crash records. There is also a strong need to explore other factors that may contribute to increased risk of crash involvement, particularly in regards to professional drivers. Such factors are likely to be found to extend beyond the traditional DBQ, which will warrant a renewed focus on identifying effective methods to identify and control for crash risk.

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