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Validation of the Driver Behaviour Questionnaire in a representative sample of drivers in Australia

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ABSTRACT

The Driver Behaviour Questionnaire (DBQ) is a widely used measure of driving behaviours that may increase a driver's risk of crash involvement. However, there are several different versions of the DBQ varying in terms of number of items and factor structure. The aim of the current research was to assess the construct validity of the popular 28-item four-factor DBQ solution in a representative sample of drivers in Australia. A further aim was to test the factorial invariance of the measure across gender, age and also between fleet and non-fleet drivers using multigroup confirmatory factor analyses. Data on a range of attitudes towards road safety were collected using an online survey. A stratified sampling procedure was undertaken to ensure the age, gender and location distributions of participants were representative of the Australian population. A total of 2771 responses were obtained from fully licensed motor vehicle drivers (male: 46%). Confirmatory factor analysis supported the 28-item four-factor DBQ in the Australian sample. The DBQ was also found to be gender-invariant and strong partial measurement invariance was found for drivers aged from 26 to 64, but not for younger (17–25) or older (65–75) drivers. Modifications to the DBQ suggest how the DBQ can be improved for use in these two age groups.

1. Introduction

The Driver Behaviour Questionnaire (DBQ) is widely recognised as an effective measure of aberrant driving behaviours that have been associated with an increased risk of experiencing motor vehicle crash (Reason et al., 1990). The original DBQ by Reason and colleagues (1990) contained 50 items that loaded onto three descriptive factors: driving violations, driver error and attentional lapses. Violations are distinct from errors and lapses as they encompass behaviours which deliberately contravene safe driving practices. Hence, violations require an "intent" to act against laws relating to safe driving. An example of a violation would be when drivers disregard the posted speed limit on certain roads. In contrast, errors are unintended behaviours, for which the planned outcome was different to what was achieved. This may inadvertently expose drivers to risky situations that could lead to crash involvement. For instance, an error would be when a driver brakes too quickly on a slippery road. In contrast, lapses differ from errors and violations in that they are unintentional slips in memory or attention that do not on their own lead to an increased risk of crash involvement. This may include the driver forgetting where they left their car or unintentionally travelling in the wrong lane.

Since its development, there have been a number of alternative representations on the original factor structure of the DBQ. Lawton et al. (1997) argued for an additional factor representing aggressive forms of violations. These include behaviours such as sounding the horn to indicate annoyance or chasing another driver to express anger. The number of items included has also varied, resulting in inconsistent measurement instruments. For example, the original items suggested by Reason et al. (1990) were retained in: a 24-item three-factor solution (Aberg and Rimmo, 1998; Parker et al., 1995b); a 28-item four-factor solution (Mattsson, 2012); and a 27-item four-factor solution used on data from Finland, Britain and The Netherlands, which omitted one item related to drinking alcohol and driving (Harrison, 2009, 2011; Lajunen et al., 2004; Lajunen and Summala, 2003). However, others have found different item and factor configurations better suit their data. By way of example, alternative forms of the DBQ include a 32-item four-factor Swedish DBQ (Rimmö, 2002); a 22-item four-factor Persian DBQ (Nordfjærn et al., 2014); and a 50-item four-factor solution based on data from drivers in Australia (Blockey and Hartley, 1995). The inconsistencies in factor structure suggest that certain items may be interpreted in different ways by respondents. For example, items viewed as deliberate errors may be interpreted by some as unintentional violations.

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These differences in resulting factor structures despite the number and nature of individual items, have, in part, been attributed to cultural differences among the different driving populations. The interpretations of items are likely to vary across cultures, particularly for those loading on the violations factor. These, by definition, are embedded within a set of rules or societal norms that may vary between driving populations. One example of this is the drinking and driving item, which has been noted by researchers for not being applicable in certain driving cultures (Lajunen et al., 2004; Nordfjærn et al., 2014). This item has also been criticised as being particularly vulnerable to socially desirable responses (Lajunen et al., 2004). Xie and Parker (2002) compared scores on a 22-item DBQ with those on a Chinese-specific DBQ which had seven additional new items and found that the violations scale of the Chinese DBQ was more sensitive to driver characteristics (age, gender) than the DBQ violations scale. The predictability of errors and lapses was similar across the generic and cultural specific scales, highlighting again that violations may be set within cultural boundaries of "appropriate" or "compliant" behaviour.

Using data from drivers in Australia, Blockey and Hartley (1995) obtained responses on the original 50 item DBQ and found that the optimal factor solution differed significantly from that proposed by Reason et al. (1990). In contrast to the original DBQ factor structure shown by Reason and colleagues, Blockey and Hartley (1995) found three factors, which they described as general errors, dangerous errors and dangerous violations. They speculated that these differences might be attributed to differences in age, gender or culture between the original British and the Australian sample. However, the Australian sample was relatively small ($N = 135$), which might better explain the lack of consistency with the original factor structure. More recently, agreement was found in an Australian sample for the 27-item four-factor version (errors, lapses, violations and aggressive violations; with the drink-driving item excluded) of the DBQ proposed by Lajunen et al. (2004) and Lawton et al. (1997). Specifically, in a large study of 5168 novice drivers in Victoria, Australia, Harrison (2011) found this factor structure was appropriate, with only three items (11%) loading on to different factors than what was originally suggested by Lajunen et al. (2004) and Lawton et al. (1997). Further, Harrison (2009) has suggested the 27-item four-factor structure is relatively stable over a six month period.

Despite the inconsistences in factor structure among the various driving populations administered the DBQ, there is broad agreement that the DBQ scores are significantly related to self-reported crash involvement. In particular, higher scores on the violations factor are associated with increased reports of motor vehicle crash (De Winter and Dodou, 2010; Harrison, 2009; Nordfjærn et al., 2014; Parker et al., 1995b). Drivers who report more frequent violation behaviours, for example speeding, also report receiving more traffic tickets (Blockey and Hartley, 1995) again highlighting relationships between DBQ scores and potential crash-related behaviours. Self-reported crash involvement has also been associated with more frequent reports of aggressive violations (Harrison, 2009; Xie and Parker, 2002), lapses (De Winter and Dodou, 2010; Harrison, 2009) and errors (Nordfjærn et al., 2014). Therefore, although there may be differences across driving cultures as to what constitutes each factor, the factors themselves continue to be associated with dangerous outcomes for drivers. However, af Wåhlberg et al. (2011) caution that the relationship between crash history and violation scores may be unique to self-reported accidents and may not exist when actual crash data are examined. There are currently no data to refute this claim.

The DBQ has also been found to be a robust instrument for identifying the types of drivers who undertake more aberrant driving behaviours and are therefore at potentially higher crash risk. Both age and gender have been found to predict scores on the DBQ. Males have been shown to report violation behaviours more frequently (Aberg and Rimmo, 1998; Blockey and Hartley, 1995; Harrison, 2009; Parker et al., 1995a; Reason et al., 1990) and when considered separately, aggressive violations (Harrison, 2009). Females tend to report more behaviours classified as lapses (Blockey and Hartley, 1995; Parker et al., 1995a; Reason et al., 1990; Xie and Parker, 2002). Self-reported errors have generally not been found to differ across gender (Reason et al., 1990). However, error subscales resulting from re-structured DBQ scales have shown gender differences on factors labelled as dangerous errors (Blockey and Hartley, 1995). Blockey and Hartley (1995) defined dangerous errors as slips and mistakes that could potentially harm another driver. Five of the nine items in their dangerous error scale are from the original slips and lapses subscale proposed by Reason et al. (1990). Therefore, the number of items originally associated with lapses might explain the gender difference reported by Blockey and Hartley (1995). It therefore appears that when gender differences are found, males tend to report more violations and females report more frequent lapses.

As drivers age they tend to report less aberrant behaviours. Studies that have utilised a broad age range (from young novice drivers to drivers over 60) have shown that older drivers report fewer violations (Aberg and Rimmo, 1998; Blockey and Hartley, 1995; Harrison, 2009; Reason et al., 1990) and fewer aggressive violations (Harrison, 2009) compared to younger drivers. However, the frequency of reported lapses does not alter across different age groups (Aberg and Rimmo, 1998; Parker et al., 1995a). Errors also appear to remain stable across age (Harrison, 2009; Reason et al., 1990). One exception to these findings, is the findings by Aberg and Rimmo (1998) who found that in a sample of 1429 drivers in Sweden, inattention errors increased with age. However, the subscale of inattention errors used by Aberg and Rimmö included additional items not included in the original or subsequent shortened versions of the DBQ. This may explain the contrasting age differences reported.

The DBQ has also been used to measure aberrant behaviours and potential crash risk of professional drivers, or those who drive a company car. When examining commercial drivers, the findings remain relatively consistent with those reported for the general driving population. Sullman et al. (2002) confirmed a four-factor (errors, violations, aggressive violations and lapses) version of the 28-item DBQ in a sample of 328 truck drivers in New Zealand. In this sample, violation scores, but not scores on the other three factors, reliably predicted self-reported crash involvement. Violation scores have also been found to be associated with self-reported crashes using small samples of professional bus drivers from Canada (af Wåhlberg et al., 2011) and Iran (Varmazyar et al., 2013). Using 433 fleet drivers in Australia, however, Davey et al. found that a 20-item three-factor solution (violations, aggressive violation and errors) best fit their data and a larger number of items loaded on to the aggressive violations factor (9 of the 20) than the other two factors. This may suggest that when drivers commit violations in company cars there is a strong motivation to do so. These motivations may result from underlying hostile aggression or be associated with other pressures relating to the conduct of the role, such as meeting scheduling requirements of the role itself. However, this was not directly tested as Davey et al. did not compare DBQ structure or subscale means between fleet and non-fleet drivers. Such a comparison has been relatively unexplored in the literature. Given that violations are bound in context, this is an important limitation in the current understanding of aberrant driving behaviour.

An added further limitation of the current literature regarding the performance of the DBQ is that a number of the studies have compared the observed subscale means between groups of drivers without verifying whether these groups have responded to, or interpreted, the DBQ in the same manner. While methods have