Journal of Safety Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

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The Driver Behavior Questionnaire as accident predictor; A methodological re-meta-analysis

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ARTICLE INFO

Article history:
Received 13 November 2014
Received in revised form 10 March 2015
Accepted 20 August 2015
Available online xxxx

Keywords:
Driver Behavior Questionnaire
Common method variance
Self-report
Exposure
Dissemination bias

ABSTRACT

Introduction: The Manchester Driver Behavior Questionnaire (DBQ) is the most commonly used self-report tool in traffic safety research and applied settings. It has been claimed that the violation factor of this instrument predicts accident involvement, which was supported by a previous meta-analysis. However, that analysis did not test for methodological effects, or include contacting researchers to obtain unpublished results. *Method*: The present study re-analyzed studies on prediction of accident involvement from DBQ factors, including lapses, and many unpublished effects. Tests of various types of dissemination bias and common method variance were undertaken. *Results*: Outlier analysis showed that some effects were probably not reliable data, but excluding them did not change the results. For correlations between violations and crashes, tendencies for published effects to be larger than unpublished ones and for effects to decrease over time were observed, but were not significant. Also, analysis using the proxy of the mean of accidents in studies indicated that studies where effects for violations are unknown have smaller effect sizes. These differences indicate dissemination bias. Studies using self-reported accidents as dependent variables had much larger effects than those using recorded accident data. Also, zero-order correlations were larger than partial correlations that controlled for exposure. Similarly, violations/accidents effects were strong only when there was also a strong correlation between accidents and exposure. Overall, the true effect is probably very close to zero ($r < .07$) for violations versus traffic accident involvement, depending upon which systematic tendencies in the data are controlled for. *Conclusions*: Methodological factors and dissemination bias have inflated the mean effect size of the DBQ in the published literature. Strong evidence of various artifactual effects is apparent. *Practical applications*: A greater level of care should be taken if the DBQ continues to be used in traffic safety research. Also, validation of self-reports should be more comprehensive in the future, taking into account the possibility of common method variance.

1. Introduction

1.1. Self-report data and the DBQ

The use of self-reported data continues to be very popular within traffic safety research particularly when examining individual differences. This practice, especially when using poorly validated scales, has been criticized on several accounts as yielding unreliable and biased data with potentially inflated effect sizes (af Wåhlberg, 2009, 2010a). The most popular of the plethora of available driver behavior self-report instruments is the Manchester Driver Behavior Questionnaire (DBQ; Reason, Manstead, Stradling, Baxter, & Campbell, 1990). The DBQ has undergone many modifications over time, and now most often measures three or four aspects of driving behaviors: lapses, errors, Highway Code violations (e.g., speeding), and aggressive violations. A recent meta-analysis of the DBQ by de Winter and Dodou (2010) highlighted the extent of the scale's usage, with 174 published studies containing a total of 45,000 respondents. This meta-analysis reported that violations predicted crashes with an overall correlation of .13, based on zero-order effects reported in tabular form. The authors interpreted this finding as evidence of the validity of the tool as well as its relevance to road safety research. However, a commentary of this meta-analysis by af Wåhlberg, Dorn, and Freeman (2012) argued that this correlation may be spuriously inflated due to method effects, such as common method variance, and other methodological limitations associated with self-report data. Despite this criticism, the favorable view of the DBQ has continued to be argued in an updated meta-analysis by these authors (de Winter, Dodou & Stanton, 2014).

However, the present paper should not be taken as evidence that violations and errors of the DBQ type are not associated with accident involvement. It is very possible that they are, as there is a fair amount of (two-source) evidence available which says that citations (which are usually given for behaviors that are similar to the DBQ violations)

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http://dx.doi.org/10.1016/j.jsr.2015.08.003
0022-4375/

correlate with crashes. The problem lies with the methods used; the general conclusion about violations from the DBQ might be correct, but for the wrong reasons. The present paper argues that the DBQ does not measure actual differences in behavior to any reasonable degree, but various self-report biases. It is therefore not useful as an instrument in research or applied settings.

1.2. Method effects

Apart from real effects, there exist several alternative explanations to associations in published self-report data; mainly common method variance (CMV). CMV may occur when the same data source is utilized to obtain measures of independent and dependent variables. More specifically, one of the reasons that questionnaires should be validated against an objective, external criterion, is that if the dependent variable is measured with the same method as the independent parameters, systematic measurement error/bias (CMV) which influences both independent and dependent variables can increase or decrease the true associations. This is well known in many other research areas (Chang, van Witteloostuijn, & Eden, 2010; Cote & Buckley, 1987; Hessing, Elffers, & Weigel, 1988; Lindell & Whitney, 2001; Moorman & Podsakoff, 1992; Ng, Eby, Sorensen, & Feldman, 2005; Sharma, Yetton, & Crawford, 2009), but has almost been completely overlooked in traffic safety research (af Wåhlberg, 2009; for exceptions see Barraclough, af Wåhlberg, Freeman, & Watson, 2014; Harrison, 2010; Lajunen, Corry, Summala, & Hartley, 1997).

1.3. Dissemination bias

One of the common problems encountered when undertaking meta-analysis is (in the terminology of Bax & Moons, 2011) dissemination bias, an umbrella term for when the outcome of a study influences its availability. Publication bias is the most well known of these, with negative findings having less of a chance of being published, or being published later than others (Vevea & Woods, 2005). However, there is also selective reporting bias, where the researchers choose to publish the most impressive figures (Ioannidis, Munafò, Fusar-Poli, Nosek, & David, 2014). These mechanisms will tend to yield an overly optimistic view of the evidence for a particular association (i.e., many readers will get the impression that effect sizes are large and homogenous, especially as papers with large effects tend to get cited more, when this is not the case).

1.4. Suspected CMV and dissemination bias in the DBQ

Returning to the DBQ, it can be noted that this most popular self-reported road safety instrument has rarely been validated against an objective behavioral criterion such as officially recorded crash events. Instead, its popularity and purported validity is based almost entirely upon its ability to predict self-reported accident involvement. Also, the meta-analysis of de Winter and Dodou (2010) tested negative for publication bias, but did not include tests of dissemination bias, and did not include unpublished effects. Given these outstanding issues, there is a need to undertake a new meta-analysis of the DBQ, which also examines systematic differences within data and dissemination bias, with the inclusion of effect sizes that have not been published before.

If CMV inflates the DBQ-accident association when self-reported accidents are used as the dependent variable, then the results of de Winter and Dodou (2010) meta-analysis will have over-estimated the true population effect. This may prove an extremely important issue (and oversight) for road safety as it has been estimated that more than 20% of the variance measured in a typical research measure can be attributed to CMV biases (Cote & Buckley, 1987; Crampton & Wagner, 1994; Doty & Glick, 1998).

Also, it has been noted on many occasions by the present authors that published DBQ studies often indicate that accident data has been gathered, but no correlations between accidents and DBQ scales were presented. This means that some results have not been reported, possibly those that were weaker than others. Alternatively, the results are often only presented in a multivariate form that is not interpretable and negating the possibility of making necessary correlation conversions for subsequent meta-analyses. At worst, it could therefore be suspected that a selective reporting bias exists for the DBQ, with authors withholding weak effects from publications (whether or not this is intentional cannot be tested, and is therefore not a topic of the present study).

Another problem that has been noted before is that most of the published DBQ studies do not control for differences in mileage (af Wåhlberg et al., 2012), while asking people how often they do certain things. This might create another kind of CMV, because respondents might think in terms of how often they engage in a certain behavior over time, instead of over driving time. Those who drive more will then naturally report more aberrant behaviors (through exposure), although they actually behave in a similar way to other drivers, if counted per kilometer. And as exposure increases accident risk, those who drive more will also tend to report more crashes.

The basic idea of the DBQ would seem to be that respondents who violate more when driving cause more crashes, per kilometer. It is very different to say that those who drive more have a larger absolute count of violations and crashes. If this is the case, both the violation and accident count are caused by exposure, thus eradicating the link between DBQ violations and crashes.

1.5. Meta-analytic approaches to counter method effects

The possible problems of CMV and dissemination bias associated with the DBQ can be tested in several different ways in a meta-analytical context, which are outlined below. Firstly, one of the methods in CMV research is to compare the effect sizes from same-source and different-source datasets. If CMV is inflating effects, the first group will have larger effects, as found by some authors (Crampton & Wagner, 1994; Harms & Crede, 2010; Reijntjes, Kamphuis, Prinzie, & Telch, 2010).

For the DBQ, the basic methodological hypothesis in this meta-analysis is that effect sizes have been inflated when same-source data has been used. This means that other-source data yield smaller effects. For the DBQ, this will involve comparisons of studies in which self-reported accidents have been used as criterion with those where recorded accidents have been used. One single study has previously used this method (af Wåhlberg, Dorn, & Kline, 2011), but as statistical power was low, as in most single studies, this report was inconclusive.

Secondly, dissemination bias is often tested with so-called funnel analysis and statistical tests. It is uncertain, however, whether these tests are acceptably sensitive to actual bias (Pham, Platt, McAuley, Klassen, & Moher, 2001). Given the increased accessibility of researchers all over the world, a different method can be used to counter and estimate dissemination bias, however. This is simply to contact researchers who for any reason can be suspected to have unpublished results. Such a method has previously yielded rather large differences (>40%) between datasets (e.g., Judge, Colbert, & Ilies, 2004). As noted, the contact method would seem to be readily applicable to the DBQ, due to the fair number of apparently unpublished results.

Thirdly, the effect of non-control of exposure can be meta-analytically estimated in several ways. First, in similarity with the test for CMV for crash source, effects in studies that have controlled for exposure can be compared with those that did not. Alternatively, effects can be compared within studies, if both zero-order and controlled effects have been reported. Yet another method was devised for the present study, however. This was to correlate the (zero-order) effect for DBQ violations versus accidents with the effect for exposure versus accidents in the same studies. If a fair positive correlation is found in this analysis, it would indicate the tendency for DBQ effects to be large only when

Please cite this article as: af Wåhlberg, A.E., et al., The Driver Behavior Questionnaire as accident predictor; A methodological re-meta-analysis, *Journal of Safety Research* (2015), http://dx.doi.org/10.1016/j.jsr.2015.08.003