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The relationship between the Driver Behavior Questionnaire, Sensation Seeking Scale, and recorded crashes: A brief comment on Martinussen et al. (2017) and new data from SHRP2

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ABSTRACT

We provide a brief comment on the work of Martinussen et al. (2017), who studied the relationships between self-reported driving behavior, registered traffic offences, and registered crash involvement. It is argued that if the number of crashes is small, then the correlation with crashes is also small. Our analysis of the SHRP2 naturalistic driving study shows that the violations score of the Driver Behavior Questionnaire and the Sensation Seeking Scale exhibit small correlations with recorded crashes, and small-to-moderate correlations with recorded near-crashes and measures of driving style.

The recently published paper by Martinussen et al. (2017) is a unique large-sample study ($N = 3683$) on the relationship between the Driver Behavior Questionnaire (DBQ) and recorded violations and crashes.

There are two important findings. First, the authors found that 22.4% of participants who were classified into the 'violating unsafe drivers' group (based on a cluster analysis of self-reported answers to the DBQ and Driver Skill Inventory, DSI) were involved in a recorded traffic offence. This percentage is 2.8 times as high as the average of the other three groups ('skilled safe drivers, 'unskilled safe drivers', and 'low confidence safe drivers'). This finding is consistent with a meta-analysis which showed that a moderate correlation ($r = 0.24$) exists between the DBQ violations score and recorded measures of speed/speeding (De Winter et al., 2015).

Second, the authors found that the four groups did not differ in recorded crash rates. It is important to emphasize, however, that only 1.1% of the participants were involved in a crash (despite the 6-year recording period). This low percentage means that the 'violating unsafe drivers' group contained only 6 or 7 crash-involved drivers (estimated from sample sizes reported in Martinussen et al., 2014). Considering that traffic violations correlate with crashes (Cooper, 1997; Factor, 2014) and young males are overinvolved in crashes (Organisation for Economic Co-operation and Development (OECD, 2006), it would be inappropriate for one to conclude from their data that the 'violating unsafe drivers' group (consisting of 74% males with a mean age of 39 years) is equally safe as the other three groups (consisting overall of 47% males with a mean age of 54 years). With simulations, De Winter et al. (2015) showed that if crash rates are low, then correlations with crash involvement are necessarily small (see also Af Wåhlberg and Dorn, 2009).

Here, we report on DBQ-crash correlations in a newly accessed dataset from the Strategic Highway Research Program (SHRP2) naturalistic driving study (Dingus et al., 2015). The dataset comprised 3215 drivers. We removed drivers with less than 7 months of participation and drivers who drove less than 100 miles, leaving data for 2790 drivers. The mean study length across drivers was 1.31 years ($SD = 0.51$ years). In case no more than two DBQ items were missing for a driver, then the scores for these items were replaced with the value from the single 'nearest neighbor' variable (1 N N); otherwise, the DBQ data for that driver were discarded. Accordingly, DBQ data were available for 2737 drivers. Participants' total scores for the Sensation Seeking Scale Form V (SSS) were retrieved as well ($N = 2781$). Whether the DBQ and SSS correlate with recorded crashes has been a much-debated topic (e.g., Af Wåhlberg, 2010; De Winter et al., 2015).

First, we applied principal component analysis on the 24-item DBQ. Inspection of the scree plot (see supplementary material, Fig. S1)

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Table 1
Spearman rank-order correlations between Driver Behavior Questionnaire (DBQ) scores, Sensation Seeking Scale (SSS) scores, and study variables.

Study variable	*M*	*SD*	ρ DBQ slips	ρ DBQ violations	ρ DBQ lapses	ρ SSS
Age group (1 = 16–19 years, 17 = 95–99 years)	6.1113	4.679	0.00	−0.33*	−0.10*	−0.43*
Gender (0 = male, 1 = female)	0.5219	0.4996	0.07*	−0.06*	0.19*	−0.15*
Distance driven in study period (miles)	10,371.74	7283.22	0.04	0.18*	0.03	0.11*
Number of self-reported crashes in past 3 years (0, 1, 2+)	0.319	0.5815	0.10*	0.13*	0.09*	0.10*
Number of recorded crashes in study period	0.605	1.1488	0.04* (0.04)	0.06* (0.04*)	0.05* (0.05*)	0.10* (0.09)
Number of recorded near-crashes in study period	2.1846	3.35	0.04* (0.03)	0.20* (0.15*)	0.03 (0.02)	0.20* (0.18*)
Number of recorded at-fault crashes in study period	0.4989	1.0664	0.05* (0.04*)	0.05* (0.03)	0.05* (0.05*)	0.10* (0.09*)
Number of recorded at-fault near-crashes in study period	1.2885	2.3802	0.05* (0.04)	0.18* (0.15*)	0.02 (0.02)	0.20* (0.18*)
Number of recorded severity 1 crashes in study period	0.0333	0.1835	0.00 (0.00)	0.02 (0.02)	0.00 (0.00)	0.02 (0.02)
Number of recorded severity 2 crashes in study period	0.0656	0.2711	0.02 (0.02)	0.06* (0.06*)	−0.01 (−0.01)	0.05* (0.05*)
Number of hard starts per mile in a 6-month period	0.0458	0.0786	−0.02	0.07*	−0.01	0.10*
Number of hard stops per mile in a 6-month period	0.1312	0.1384	0.03	0.04*	0.04*	0.08*
Number of hard left turns per mile in a 6-month period	0.1665	0.1457	−0.03	0.21*	0.01	0.27*
Number of hard right turns per mile in a 6-month period	0.1629	0.1341	−0.03	0.24*	0.02	0.27*

Note. * $p < .05$. Correlations for the number of crashes per mile are reported in parentheses. Severity 1 crashes are defined as airbag/injury/rollover, high delta-V crashes (virtually all would be police reported). Severity 2 crashes are defined as police-reportable crashes (including police-reported crashes, as well as others of similar severity which were not reported) (Dingus et al., 2015). Hard starts, stops, and turns are defined as incidences where the acceleration exceeded 0.30 g (Jun et al., 2007). The sample sizes per cell are reported in the supplementary materials (Table S2).

suggested that a three-component solution was appropriate. The three components were obliquely rotated (Promax) and interpreted as (1) slips, (2) violations, and (3) lapses (see Table S1 for loadings). Component scores were calculated using the regression method. Next, Spearman rank-order correlations were computed between the self-report scores (DBQ scores and SSS score) on the one hand, and relevant study variables (age, gender, crash involvement, driving style) on the other (Table 1).

The results in Table 1 confirm the well-known phenomenon that older drivers report fewer violations than younger drivers and that females report fewer violations but more errors than males. It is also found that DBQ errors and DBQ violations correlate with self-reported crashes in the past three years, and with objective crashes and near-crashes during the study period. These correlations were overall small yet mostly statistically significant. The correlations were stronger for DBQ violations and SSS than for DBQ slips and lapses. For crashes of the highest severity level (airbag, injury, rollover), the correlation with DBQ violations was small (ρ = 0.02). Only 3% of drivers were involved in this type of crash. For all crashes, the correlation with DBQ violations was somewhat stronger (ρ = 0.06), and for near-crashes, the correlation with DBQ violations was moderate (ρ = 0.20). These findings support the previous assertion that correlations are smaller if the mean (and therefore the variance) of the number of crashes is higher (Af Wåhlberg and Dorn, 2009; De Winter et al., 2015).

Table 1 also shows that the DBQ violations score was associated with a more adverse driving style (hard starts, stops, and turns), with correlations between 0.04 and 0.24. Finally, it can be observed that the pattern of correlations for the SSS was similar to that for DBQ violations (Table 1; Fig. S2). This is also reflected in the fact that the DBQ violations score was associated with the SSS score (ρ = 0.36), whereas the correlations between the SSS and DBQ slips and DBQ lapses were smaller (ρ = 0.09 and ρ = 0.10, respectively).

Finally, although many of the correlations shown in Table 1 are statistically significant and theoretically interesting, we wish to caution that they are not necessarily practically significant. A boxplot of the SSS scores for non-crash-involved drivers and crash-involved drivers (Fig. 1, top) shows that there is a high degree of overlap of the SSS distributions of both groups, even though the difference was strongly significant, $t(2779) = 5.55$, $p = 3.07*10^{-8}$, Cohen's $d = 0.22$. For near-crashes, the effect was somewhat stronger (Fig. 1, bottom), $t(2779) = 8.77$, $p = 2.97*10^{-18}$, Cohen's $d = 0.35$.

In conclusion, we support the findings and interpretations by Martinussen et al. (2017) and hope that the above points are a useful

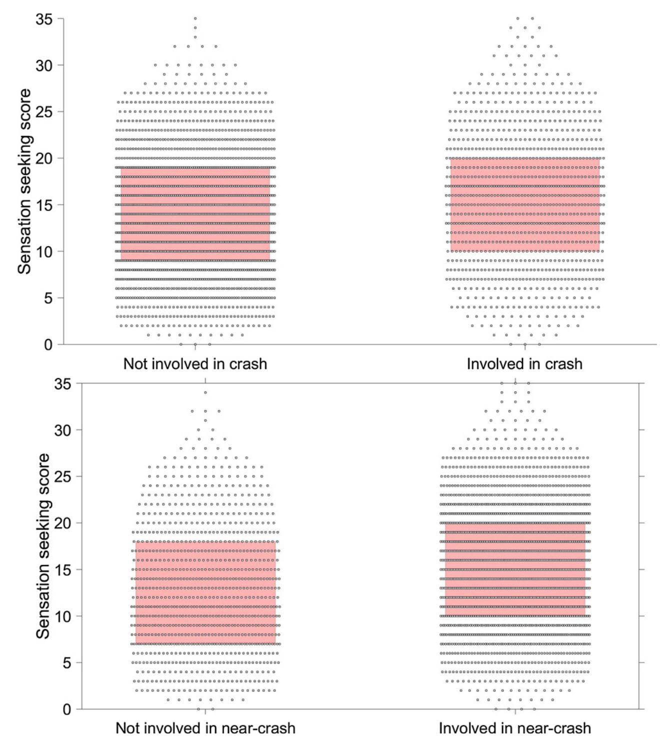

Fig. 1. Top: Sensation Seeking Scale scores for drivers who were not involved in a crash ($N = 1766$) and drivers who were involved in a crash ($N = 1015$). Bottom: Sensation Seeking Scale scores for drivers who were not involved in a near-crash ($N = 917$) and drivers who were involved in a near-crash ($N = 1864$). The red box shows the 25th and 75th percentiles, respectively. The markers represent the individual drivers.

addendum. It appears that DBQ violations, as well as the SSS, exhibit small associations with crash involvement, and small to moderate associations with near-crash involvement and driving style. The predictive validity of DBQ errors (slips and lapses) appears to be weak. Future research should examine the validity of near-crashes as a proxy for crashes.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.aap.2018.05.016.

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