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Rowe, R., Andrews, E. and Harris, P. (2013) Measuring risky-driving propensity in pre-drivers: The Violation Willingness Scale. *Transportation Research Part F: Traffic Psychology and Behaviour*, 19. pp. 1-10. ISSN: 1369-8478

<https://doi.org/10.1016/j.trf.2013.01.003>

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Measuring risky-driving propensity in pre-drivers:

The Violation Willingness Scale

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Abstract

There is a growing recognition that the antecedents of risky driving attitudes can be traced to the pre-driving period. Few measures of driving-specific risk taking aimed at pre-drivers (defined here as those who are not permitted to drive independently) have been validated, however, meaning our understanding of the development of risky driving attitudes is limited. This paper reports the construction of a self-report Violation Willingness Scale (VWS) for pre-drivers, examination of the existing Attitudes to Driving Violations Scale (ADVS) in pre-drivers and some preliminary data on the development of propensity to risky driving. Study One found that the VWS and ADVS had strong psychometric properties in a sample of pre-drivers aged 16-19 years of age. Study Two found the VWS and ADVS showed moderate to strong and somewhat independent relationships with a number of existing measures of risky driving behaviour in a sample of fully licensed drivers (age range 18-65 years). This evidence supports the ADVS and VWS as valid tools to measure the propensity to risky driving in pre-drivers. We also discuss preliminary evidence on the relationship between propensity to risky driving and stage of driver training and experience, which indicates that willingness to commit most violations diminishes with driving experience while attitudes and willingness to speed become riskier.

Keywords: young drivers; violations; attitude

1. Introduction

Road traffic crashes present a serious public health challenge. On UK roads in 2010 1,850 road users were killed and 22,690 were seriously injured (Department for Transport, 2011). As well as representing an enormous human tragedy, car crashes involve substantial economic impact, costing an estimated £15 billion in the UK during 2010 (Department for Transport, 2011). Young drivers are consistently identified as being at increased risk of crash involvement; Drivers aged 17-21 years form 7% of the UK driving population, but are involved in 13% of injury-causing crashes (Department of Environment Transport and the Regions, 2000).

Although deficits in skill are likely to contribute to the high injury rates among young drivers, propensity to violate the laws and conventions of safe driving also makes a strong contribution (Blows, Ameratunga, Ivers, Lo, & Norton, 2005; Reason, Manstead, Stradling, Baxter, & Campbell, 1990). Violations of this sort include speeding, dangerous overtaking, and ignoring traffic lights. Ivers et al. (2009) showed that young drivers in the top third of the distribution of risky driving had a 50% increase in crash liability.

Attitudes to risky driving may have their antecedents in the pre-driving period, defined here as the period before independent driving is allowed on public roads. In the UK this includes people without a driving licence and provisional licence holders who are allowed to drive under supervision for training purposes. Indirect evidence for the importance of the pre-driving period comes from research showing that driving risk can be predicted from early characteristics such as behavioural difficulties during adolescence (Woodward, Fergusson, & Horwood, 2000). More direct evidence shows that driving attitudes have similar correlates in pre-drivers and full-drivers. Waylen and McKenna (2008) showed that attitudes to dangerous driving were riskier in males than females and were related to social

deviance and sensation seeking during the 11-16 age period, prior to any experience of driving. Comparable results regarding sex differences were reported by Mann and Lansdown (2009) and Rowe, Maughan, Gregory & Eley (in press). Four studies have addressed the development of risky attitudes to driving across adolescence. Harre, Brandt and Dawe (2000) reported that attitudes were riskier in New Zealand Year 12 students (mean age = 16.4) than Year 10 students (mean age = 14.2). Waylen and McKenna (2008) reported that average attitudes to risk remained relatively constant across adolescence. Affinity for speed remained constant after age 12 in boys but showed a pattern of increasing riskiness in girls to age 13, which was followed by a decrease between ages 13 and 16. Rowe et al. (in press) found that attitude to speeding was positively associated with age in a sample aged 14-23, but that this effect was explained by greater driving experience at older ages. Particularly strong evidence for the importance of pre-driving attitudes can be provided by longitudinal studies that show prediction to post-licence behaviour. We are aware of only two studies that have done this. Mann and Sullman (2008) found speeding intentions measured in pre-drivers predicted violation behaviours (zero-order correlation = .28) 12 months later, when they had learnt to drive. Rowe et al. (in press) found that pre-driving attitudes to speeding predicted self-reported driving violations 3 years later (zero-order correlation = .13) with borderline significance and this relationship was no longer significant when age, sex and mileage were included as covariates.

Many questions remain to be answered about the development of attitudes to risky driving in pre-drivers. It is not clear whether driving attitudes change as a result of driver training and experience or whether all aspects of driving attitudes follow the same developmental path. Novice drivers commit more violations as they gain experience (de Winter & Dodou, 2010) and it seems plausible that this experience effect might extend into the learning phase of driving as well. Consistent with this position, Rowe et al. (in press)

found attitudes to speeding were riskier in fully licenced drivers than in learners and pre-drivers. Conversely, Harre et al. (2000) found that driving experience was unrelated to risky attitudes in their relatively small scale New Zealand study. In their longitudinal study, Mann and Sullman (2008) found many attitudes to speeding were safer when their participants had full licences than when they were pre-drivers, although they reported speeding to be more enjoyable as full drivers. However, these changes over time also seem to have been present in the members of their initial sample who did not become drivers during the course of their study. Therefore these effects cannot be attributed to driver training. Given the mixed pattern of findings currently available, it seems this issue is worthy of further attention.

The pre-driving period may be a good time to target interventions to improve driving attitudes before risky driving becomes habitual (Harre, et al., 2000) and road safety organisations do target pre-drivers in their education programmes (Mann & Lansdown, 2009). Evaluations of this work are rare, but some studies report pre-driving interventions that did not lead to improvements in attitudes to risky driving (Harre & Field, 1998) or had limited short term effects (Poulter & McKenna, 2010). It may be possible to design and target interventions for pre-drivers more effectively with a better understanding of the development of attitudes to risky driving.

An important step towards understanding the development of risky attitudes in pre-drivers is to develop appropriate measures for this population. Most self-report measures of driving risk available in the literature address the frequency of violations over a specified period (e.g., Reason, et al., 1990) and therefore are not applicable to people who do not drive independently. Yet, it is possible to phrase questions on attitudes to driving risk so that they can be answered by pre-drivers. As noted above, a few measures of risky driving suitable for pre-drivers have been used in the literature. For example, Harre et al. (2000) assessed speed preference and attitudes to risky driving such as dangerous overtaking and running red lights.

Evidence concerning the validity of such measures could include (1) similar correlates to measures of driving risk (e.g., sex differences, sensation-seeking) and (2) correlation with other measures of driving risk when applied to populations of drivers. One well used measure of risky driving attitudes that can be applied to pre-drivers is the Attitudes to Driving Violations Scale (ADVS, West & Hall, 1997). The ADVS measures agreement to statements such as “Decreasing the speed limits on motorways is a good idea” and is largely focussed on attitudes to speeding. When presented to fully licensed drivers, this scale is associated with crash involvement and has a moderate correlation ($r=.52$) with a well validated measure of driving speed (West & Hall, 1997). However, although the questions from the ADVS may be answered by pre-drivers as well as drivers, its application to this population has been limited to one study (Rowe, et al., in press).

We believe a new measure of risk-taking propensity in pre-drivers may complement available measures. To this end, we develop the Violation Willingness Scale (VWS) in this paper. Our approach brings two new features. First, we designed the measure to map onto the Manchester Driver Behaviour Questionnaire (DBQ, Reason, et al., 1990), which has been very influential in the self-reported measurement of risky behaviour in drivers for more than 20 years (de Winter & Dodou, 2010). This measure distinguishes ordinary violations, such as speeding and ignoring red lights, from aggressive violations, such as chasing other drivers (Lawton, Parker, Manstead, & Stradling, 1997). These two forms of violation are correlated and form part of a second order general violations factor (Lajunen, Parker, & Summala, 2004). A recent meta-analysis including 70 studies of the DBQ found a correlation of .13 between violations and crash involvement (de Winter & Dodou, 2010). Further evidence of validity comes from studies showing that violations are correlated with other factors that predict crash risk including gender, age and mileage (Reason, et al., 1990). The DBQ cannot be answered by pre-drivers, as it measures frequency of driving violations over the previous 6

months. The VWS measures willingness to commit driving violations in eight hypothetical situations in which participants imagine themselves to be driving. The violations listed are linked to those assessed in the DBQ including speeding, crossing red traffic lights, forcing entry into a flow of traffic, tailgating and making angry gestures to other drivers. For example one situation is “You are running late for an appointment”. Items address how willing the participant feels they would be to perform particular violations (such as to “speed in a residential setting”).

The application of the concept of behavioural willingness is the second novelty of our approach. Behavioural willingness measures have been developed to capture situations in which people typically plan or intend to behave in one way, but may be prepared to behave differently should the circumstances permit or sanction. As shown in a number of studies (Gibbons & Gerrard, 1995; Gibbons, Gerrard, Blanton, & Russell, 1998), young people may not intend to engage in risky behaviours such as smoking, unprotected sex and reckless driving. However, their willingness to take risks under certain circumstances may predict future behaviour, particularly where behaviours are not habitual. For example, in a longitudinal study, willingness to smoke when the situation was conducive was a better predictor of later smoking than expectation of smoking (Gibbons, et al., 1998). We believe willingness to commit violations may be a particularly helpful approach to measuring propensity to risky driving in pre-drivers because willingness may be measured without prior driving experience. We also believe a behavioural willingness approach may be useful in driving in general as this may be a domain in which attitudes may often be risk averse, but risks will be taken when circumstances are conducive.

This paper aims primarily to advance measurement of attitudes to driving risk in pre-drivers. We construct and validate the VWS for this purpose (Aim 1) and also present evidence on the application of the ADVS to a non-driver population (Aim 2). Our secondary

aim is to provide a preliminary examination of the development of attitudes across driver training (Aim 3). Following previous work (Rowe, et al., in press), we hypothesise that ADVS scores will become riskier with driving experience. We predict that violation willingness will follow a similar pattern. In Study One we explore the performance of the VWS scale and the ADVS in a sample of pre-drivers. In Study Two we examine the correlation of these scales with well-documented measures of risky behaviour in a sample of fully licensed drivers.

2. Study One

In this study we examined the performance of the ADVS and the VWS in a sample of young pre-drivers. We tested the psychometric properties of these scales and their associations with each other and with age and sex. We expected males to display riskier attitudes on both measures, but had no a priori hypotheses about relationships with age in such a narrow age range. We also explored the effect of licence status (none or provisional) on the VWS and ADVS.

2.1. Method

2.1.1. Participants

Participants were recruited from attendees at Drive for Life road safety events for young people that took place across South Yorkshire, UK. Drive for Life presentations took place in schools and colleges as part of the General Studies curriculum. All data used here were collected prior to presentation of the intervention using paper questionnaires. After exclusion of participants aged 20 or over, and those with a full driving licence or incomplete licence information, the sample provided 717 observations. All VWS questions were answered by 656 participants and 655 answered all ADVS questions; the psychometric

properties of these scales were examined using these participants. Missing items were replaced with participant scale means when less than 20% of scale items were missing. Sufficient information to allow inclusion in the remaining analyses was provided by 680 participants. The mean age of this sample was 16.86 years ($SD=.80$, range 16-19 years, 84% aged 16 or 17 years) and 47% were male. Provisional licences were held by 42% of participants and the remaining 58% did not have any form of licence. In the UK a provisional licence must be held before on-road driver training may begin. Provisional licence holders are only allowed to drive under the supervision of a qualified driver. A full licence is awarded when participants have successfully completed all components of the driving assessment and qualifies drivers to drive independently. Participants provided signed informed consent. The study was approved by the Department of Psychology, University of Sheffield Ethics committee.

2.1.2. Measures

2.1.2.1. The Violation Willingness Scale

The VWS asked participants to imagine that they had passed their driving test and are in each of 8 driving scenarios. The participants were asked to indicate how likely they were to respond in a number of ways to each scenario, providing 14 items in total. The general instructions given with the measure were:

“In all of these situations, please imagine that you have passed your driving test and are driving your own car. Please tell us how you think you might drive in these situations. For each question we would like you to tick the box which shows how likely you would be to do the action stated immediately above the scale.”

For example one scenario involved “another driver pulls out in front of you, forcing you to slow down”. Regarding this scenario the participants rated how likely they would be to: “Sound your horn”, “Make an angry gesture to the other driver” and “Chase this car with the intention of confronting the other driver”. All the items included in the questionnaire are detailed in Table 1. These behavioural options were based on driving violations measures in the DBQ (Reason, et al., 1990). Responses were measured on a 7-point scale with labelled end-points of 1 (‘Not at all likely’) and 7 (‘Very likely’). Higher scores on the VWS indicate greater willingness to violate.

2.1.2.2. Attitudes to Driving Violations

The ADVS (West & Hall, 1997) contains 7 statements such as “Decreasing the speed limits on motorways is a good idea”. Responses are made on a 5 point scale labelled Strongly Disagree (scoring 5) to Strongly Agree (scoring 1) so higher scores indicate riskier responses. In a sample of 406 drivers the ADVS had a Cronbach’s alpha of .76 and correlated with self-reported speeding and crash involvement (West & Hall, 1997).

2.2. Results

2.2.1. Psychometric properties

2.2.1.1. Violation Willingness Scale

Descriptive statistics for each item are shown in Table 1. First, we ran a principal components analysis to determine the underlying structure of the VWS. This analysis identified a first component (eigenvalue=5.27) accounting for 38% of the variance, a second component (eigenvalue=1.43) accounting for 10% of the variance and a third component (eigenvalue=1.24) accounting for 9% of the variance. No other components had eigenvalues exceeding 1. Inspection of the scree plot (available on request) indicated that a single

component provided the most parsimonious account of the data. We inspected promax rotated loadings for three and two component models (details available on request). In both cases there were items with loadings greater than .3 on more than one factor and the components were not easily interpretable. Therefore we judged that a single component solution was most appropriate. As shown in Table 1, all items from the questionnaire loaded strongly onto this component. Cronbach's alpha analysis showed these items formed a highly reliable scale ($\alpha=.87$) and therefore we calculated a single VWS score as the scale mean.

2.2.1.2. Attitudes to Driving Violations Scale

A principal components analysis revealed only 1 component with an eigenvalue above 1 (eigenvalue=2.61), which accounted for 37% of the variance. All items loaded positively onto this component (loading range .54-.73). Cronbach's alpha reliability was .71, supporting the formation of a single scale. Following West and Hall (1997), we calculated the scale as the total score across the items.

2.2.2. Correlates of the Violation Willingness Scale and Attitudes to Driving Violations Scale

In simple analyses, males reported riskier ADVS scores (mean=19.16, SD=4.33, 95% CI: 18.68, 19.64) than females (mean=16.76 SD=3.85, 95% CI: 16.37, 17.16, $t(678)=-7.64$, $p<.001$). The correlation of ADVS with age did not reach significance ($r=-.07$, $p=.07$). Provisional licence holders had riskier attitudes to violations (mean=18.35, SD=4.28, 95% CI: 17.85, 18.84) than those without a licence (mean=17.54, SD=4.20, 95% CI: 17.12, 17.96, $t(678)=-2.45$, $p=.015$). The correlation between the VWS and ADVS was .36 ($p<.001$). The VWS showed a similar sex difference; males were more willing to commit violations (mean=3.18, SD=1.12, 95% Confidence Interval (CI): 3.05, 3.30) than were females (mean=2.52, SD=.95, 95% CI: 2.43, 2.62, $t(678)=-8.20$, $p<.001$). Violation willingness was negatively correlated with age ($r=-.13$, $p<.001$). In contrast to the ADVS, however,

provisional licence holders were less willing to commit violations (mean=2.65, SD=1.10, 95% CI: 2.52, 2.78) than were participants with no licence (mean=2.96, SD=1.05, 95% CI: 2.86, 3.06, $t(678)=3.73$, $p<.001$). Provisional licence holders remained less willing to commit violations ($p=.006$) after age was controlled.

3. Study Two

Study One demonstrated that the ADVS and VWS had acceptable psychometric properties in a sample of pre-drivers. West and Hall (1997) have already established that the ADVS correlates with behavioural measures in a sample of drivers. This study focuses on the correlates of the VWS with driving behaviour. If the VWS measures propensity to commit violations in non-drivers, then it would be predicted to correlate with behavioural measures of driving violations in fully licenced drivers. We also examine whether the VWS and ADVS are useful complimentary measures by testing whether they predict driver behaviour independently.

3.1. Method

3.1.1. Participants

Members of the University of Sheffield volunteers database were invited to participate in the study via e-mail. Only participants with a full UK driving licence were eligible for the study. Volunteers followed a link to an on-line questionnaire. Six hundred participants began the survey. One 80 year old participant was removed from the dataset as an outlier. Five hundred and nineteen participants answered all VWS items and this sample was used to assess the psychometric properties of the scale. Five hundred and twenty three participants provided sufficient data to form all the scales analysed below (using individual scale mean replacement to deal with <20% missing items on any scale). These participants

had a mean age of 33.98 (SD=12.81, range 18-65) and 62% were female. Those who did not provide full data had usually withdrawn from the questionnaire part way through. A logistic regression model showed males (92%) were more likely to have provided full data than were females (85%, OR=2.0, 95% CI: 1.1, 3.5, $p=.019$) while age was a non-significant predictor ($p=.197$).

In order to assess the test-retest reliability of the VWS, all participants were invited to provide their email address if they were prepared to complete a follow-up questionnaire 2 weeks later. Two hundred and ninety-five respondents provided their e-mail addresses and 212 participants completed the follow-up questionnaire with sufficient information to match to their initial questionnaire and to score the VWS. There was no significant difference between male (37.7%) and female (41.4%) participation at time 2 ($p=.325$), while younger participants were less likely to participate at time 2 than older participants (OR for 1 SD increase in age=1.2, 95% CI: 1.0, 1.5, $p=.024$). None of the driver behaviour measures predicted participation at time 2 (all $ps>.65$). The study was approved by the University of Sheffield, Department of Psychology Ethics Committee.

3.1.2. Measures

The VWS and ADVS were measured as described in sections 2.1.2.1 and 2.1.2.2 respectively.

3.1.2.1. Driving speed

The speed subscale from the Driving Style Questionnaire (French, West, Elander, & Wilding, 1993) was used to measure driving speed. This scale assesses the frequency of 3 items (e.g., “drives fast”) on a 6 point scale ranging from 1 (very infrequently) to 6 (very frequently). Consistent with the original report of the measure, the scale is scored as the total

of the three item scores. This measure has good test-retest reliability and correlates with observed driving speed (West, French, Kemp, & Elander, 1993).

3.1.2.2. *Driving violations*

Driving violations were measured using the ordinary and aggressive violation scales from the DBQ (Lawton, et al., 1997; Reason, et al., 1990). The questionnaire asks about the frequency of various driving behaviours during the previous year on a 6 point scale ranging from never (scoring 0) to nearly all the time (scoring 5). *Ordinary violations* comprised the mean of 8 items such as speeding and ignoring red lights. *Aggressive violations* comprised the mean of 3 items including making threatening gestures to other motorists and taking part in unofficial races.

3.1.2.3. *Driving Experience*

Participants were asked the date they had obtained their licence (allowing calculation of time since licence was obtained) and to report their usual weekly mileage (as 0, 1-50, 51-100, 101-200 or 200+). Mileage was treated as a continuous variable in analyses, scored on a scale of 1-4.

3.2. Results

3.2.1. Psychometric properties of the Violation Willingness Scale

A principal components analysis identified three components with an Eigenvalue above 1. The first component accounted for 28% of the variance (Eigenvalue=3.96), the second accounted for 11% (Eigenvalue=1.49) and the third accounted for 9% (Eigenvalue=1.20). Again the scree plot (available on request) was consistent with a single component solution and promax rotated three and two component solutions did not identify interpretable components (details available on request). Therefore we concluded that a single

component model was the most appropriate in drivers. Descriptive statistics and component loadings are shown in Table 1. All items showed high loadings ($>.35$) with the exception of item 1c (loading=.25). This item addressed chasing another car with the intention of confronting the driver. Cronbach's alpha analysis showed that the items formed a reliable scale ($\alpha=.80$) and removal of item 1c did not improve the reliability of the scale. Therefore we formed the VWS scale as the mean of all items to make it comparable to Study One. The scale mean was 2.31 ($SD = .77$). We checked that key results were not substantively different when item 1c was removed from the scale. The scale showed a similar mean at follow-up (mean=2.40 $SD=.78$). The test-retest reliability was .91.

3.2.2. Correlates of the Violation Willingness Scale

As shown in Table 2, males were more willing to commit violations than were females. VWS scores decreased across age but were not related to years licence held or weekly mileage. These relationships are similar to those shown by the other driving behaviour measures (Table 2), all of which were more risky in males and some of which declined with age. All the measures except the VWS correlated significantly with weekly mileage.

As shown in Table 3, the VWS was moderately related to the ADVS and the aggressive violations scale and strongly related to speed and ordinary violations. We tested whether the VWS added to prediction of driver behaviour above the ADVS and demographic and driving experience measures (Table 4). The ADVS was a significant predictor of all the behavioural scales prior to inclusion of the VWS as a predictor, with riskier attitudes to violations correlating with riskier behaviour. After including the VWS, the ADVS remained a significant positive predictor of ordinary violations and speeding (both $ps<.001$). The ADVS showed a weak negative relationship with aggressive violations after violation willingness

was held constant. The VWS accounted for significant additional proportions of variance in the final models (all $p < .001$); 35% regarding ordinary violations, 27% regarding aggressive violations, and 22% regarding speed.

3.2.3. Comparisons between pre-driver, learner and fully licensed drivers on the Attitudes to Driving Violations Scale and Violation Willingness Scale

Figure 1 compares mean VWS scores for participants with no licence and a provisional licence (Study One) with VWS scores for the fully licensed drivers in this study. A one-way ANOVA showed that there was a significant effect of licence ($F(2, 1200) = 54.34$, $p < .001$) on the VWS and a Bonferroni post-hoc test showed that all levels differed from each other (all $p < .001$). In order to test whether this effect was independent of the effects of age and sex, we ran a regression model predicting the VWS from licence status, sex, and age. In this model participants with no licence remained significantly more willing to commit violations than both provisional and full licence holders but the comparison between provisional and full licence holders was non-significant after Bonferroni adjustment ($p > .05$).

Figure 2 shows fully licensed drivers had riskier ADVS scores than provisional licence holders, who in turn had riskier ADVS scores than non-licence holders. A one-way ANOVA confirmed this effect was significant ($F(2, 1200) = 93.72$, $p < .001$) and a Bonferroni post-hoc test showed that attitudes were significantly riskier in fully licensed drivers than in provisional licence holders ($p < .001$) and non-licence drivers ($p < .001$). Attitudes were also riskier in provisional licence holders than in non-licence holders ($p = .041$). Again we ran a regression model to test whether these comparisons remained significant after control for age and sex. We included an additional age-square term in this model as inspection of the scatter-plot indicated the age-attitude relationship was non-linear. Both the linear ($p < .001$) and

quadratic ($p=.016$) effects of age were significant in this model. All comparisons between licence groups remained strongly significant in this model.

The differential effects of licence stage on the ADVS and the VWS was not anticipated. One difference between the VWS and ADVS that might explain this pattern of results is that the ADVS is largely focussed on speeding whereas the VWS addresses a range of other violations as well as speeding. In our final analysis we tested whether the effects of licence stage for the speeding items (the mean of the three relevant items) from the VWS were the same as the effects for the overall scale. A one-way ANOVA showed that there was significant effect of licence status on willingness to speed ($F(2, 1195)=30.08, p<.001$). A Bonferroni post hoc test showed that non-drivers (mean=2.94, se=.08) did not differ from provisional licence holders (mean=2.89, se=.10; $p=.100$) but that fully licensed drivers were significantly more willing to speed (mean=3.65, se=.07) than both non-drivers ($p<.001$) and pre-drivers ($p<.001$). The effect of licence group on speeding willingness remained strongly significant after control for age and sex.

4. General Discussion

In this paper we had three aims. First, we set out to develop and validate the VWS, a new measure of willingness to commit driving violations that can be used with pre-drivers. Second, we aimed to study the performance of the ADVS in pre-drivers. Third we aimed to provide some preliminary data on the development of attitudes to risky driving across the stages of driver training. In respect of the first aim, we found that the VWS items formed a single scale and showed the predicted relationships with sex and the existing ADVS measure of attitudes to driving violations in pre-drivers. These findings show that the VWS items could be answered coherently by the target population and are supportive of our hypothesis that the VWS measures propensity to commit violations.

One advantage of the VWS over many existing measures of driving behaviour is that it addresses willingness to violate in specified hypothetical situations, allowing the questions to be answered by pre-drivers. The questions can also be answered by those who do hold full driving licences. We took advantage of this feature in Study Two to further examine the validity of the VWS measurement. We found that the VWS had a similar structure in drivers and correlated strongly with the ordinary violations scale of the DBQ and the speed sub-scale of the DSQ, both of which are well used measures of driving behaviour. That the VWS correlates with behavioural measures in drivers is consistent with the hypothesis that the VWS measures propensity to commit violations in pre-drivers.

Study One also provided evidence on the validity of the ADVS as a measure of driving attitudes in pre- and learner drivers. The ADVS demonstrated acceptable psychometric properties and correlated with sex and the VWS measure. West and Hall (1997) have previously demonstrated that the ADVS correlates with other self-report measures of driver behaviour and we replicated these relationships in Study Two. We tested whether the VWS and ADVS predicted the behavioural measures independently. In all cases, the VWS predicted substantial additional portions of variance independently from the ADVS, particularly regarding ordinary violations. This is not surprising as the violation willingness items were based on the items in the DBQ violations scale whereas the ADVS items largely address driving speed.

The violation willingness measure also accounted for variance in the speed subscale of the DSQ after accounting for the ADVS. It is possible that the VWS offers additional prediction here because speeding is determined by more than attitudes to speeding. For example, aggressive drivers may drive faster specifically to exert dominance over other motorists. This and other similar factors might be measured by the VWS but not the ADVS. Consistent with this hypothesis, higher scores on the ADVS did not predict more aggressive

violations when the VWS was included as a predictor. The ADVS did predict additional variance in both ordinary violations and speed, indicating that the VWS and ADVS may be useful as complimentary measures.

In order to provide further evidence on the validity of the VWS and the ADVS it would be useful to validate the measure with non-self-reported measures, such as simulator performance, to avoid the potential confound of common method variance in correlations between self-report scales (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). An important step for future research is to identify the extent to which scores on the VWS in pre-drivers predict future driving behaviour across time. A study applying these measures in pre-drivers and following them up after they have obtained a full licence and established their driving habits would be particularly helpful.

Our third aim was to provide preliminary evidence on the development of driving attitudes across driver training. We did this by comparing the scores on the VWS and ADVS of participants with no licence, who have not driven on the public roads under any circumstances, provisional licence holders who were learning to drive under supervision (both from Study One) and fully licensed drivers (Study Two). Comparisons between studies are limited in that results may be confounded by between-study differences in recruitment procedures and the context in which the questionnaires were completed. However, the pattern of comparisons between studies is consistent with comparisons between non-licence holders and provisional licence holders within Study One and the ADVS shows a similar pattern of development to that identified by Rowe et al. (in press). Therefore the between-study analyses seem to provide interpretable preliminary data on development across driver training and experience.

The ADVS showed riskier scores in fully licensed drivers compared to provisional licence holders and in provisional licence holders compared to participants with no licence. This effect was consistent with previous work using this scale (Rowe, et al., in press). In contrast, we found that provisional and full licence holders were less willing to commit violations than participants who did not hold a licence. This unanticipated contrast in the results appeared to be due to differential effects of licence status on willingness/attitudes towards speeding and towards other sorts of violations. Willingness to commit speeding violations in the VWS was greater in fully licenced drivers compared to provisional licence holders and participants without a driving licence. Therefore this effect was consistent with the pattern observed for the ADVS rather than with the other items in the VWS.

In interpreting these findings, it should be noted that participants choose when to obtain a provisional licence and to take their driving test. Therefore differences between licence groups might represent a self-selection effect rather than an effect of driver training. Longitudinal research tracking drivers across training is required to provide definitive evidence on this issue. Previous longitudinal work indicated that changes in ADVS score were due to the effects of experience (Rowe, et al., in press). It may be that the effects of experience on attitudes/willingness towards speeding are different from the effects of experience on other sorts of violation. Driving experience may show young people that there are more factors to prevent violation in the driving environment than they are expecting. This effect is worthy of further research, not least because interventions that seek to reduce violations might try to accelerate the natural decline in willingness to violate at the time of driver training. In contrast there may be aspects of driver training and experience that make drivers feel more comfortable with speeding. Targeting interventions to reduce and reverse this effect may also have important safety benefits.

Further evidence will be required to understand the development of driving attitudes and willingness to speed and commit other violations, ideally using longitudinal designs. We believe the results of this paper make a strong case for the inclusion of the VWS and ADVS in this endeavour as well as in addressing many other theoretical and practical questions that remain regarding willingness to commit driving violations in pre- and learner drivers. We also believe that these measures can provide useful tools for researchers and practitioners who want to evaluate the effectiveness of road safety interventions for pre-driving participants.

5. Acknowledgements

We are grateful to the South Yorkshire Safer Roads Partnership for supporting Study One data collection and to Rosie Webster for data entry. We are grateful to Connor Heapy, who was supported by a Sheffield Undergraduate Research Experience Grant from the University of Sheffield, for Study Two data collection.

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Table 1. Descriptive statistics and component loadings for the Violation Willingness Scale items from Studies One and Two.

Item	Pre-Driver (Study One)		Driver (Study Two)	
	Mean (SD)	Loading	Mean (SD)	Loading
1. Another driver pulls out in front of you, forcing you to slow down.				
a. Sound your horn	4.75 (1.81)	.39	2.75 (1.85)	.48
b. Make an angry gesture to the other driver	3.87 (2.03)	.57	2.28 (1.57)	.54
c. Chase this car with the intention of confronting the other driver	1.83 (1.54)	.53	1.08 (.47)	.25
2. You are running late to pick up a friend at the station. You see traffic lights ahead are changing and realise you cannot cross them before they turn red.				
a. Speed up and go through the red light	1.82 (1.39)	.52	1.73 (1.20)	.50
3. You are trying to pull out of a T-junction and busy traffic is making this difficult.				
a. Edge out slowly so that you block the road, forcing other drivers to let you out	2.89 (1.80)	.56	2.72 (1.59)	.42
4. The driver in front is driving slower than you would like to on a country road. There is not room to overtake.				
a. Drive very close to the car in front	2.42 (1.50)	.62	2.10 (1.37)	.60
b. Sound your horn or flash your lights to tell the other driver to go faster	2.91 (1.91)	.67	1.26 (.78)	.38
5. On a motorway, a car in front is driving slowly in the middle lane.				
a. Go past in the inner lane (i.e., undertake)	2.53 (1.65)	.53	1.98 (1.39)	.47
b. Sound your horn or flash your lights to tell the other driver to go faster	2.40 (1.72)	.62	1.31 (.95)	.38
6. You are running late for an appointment.				
a. Break the speed limits while driving in a town	2.40 (1.53)	.70	2.86 (1.75)	.69
b. Break the speed limits while driving on country roads	3.03 (1.88)	.70	3.56 (1.88)	.74
c. Break the speed limits while driving on a motorway	3.27	.69	4.58	.67

	(2.05)		(1.99)	
7. You are driving on a motorway and two lanes are closing due to road works.				
a. Force your way into the queue just before the lane closes	2.75 (1.71)	.68	2.04 (1.34)	.60
8. You have stopped at traffic lights and there is a car in the lane next to you.				
a. When the lights change, race away from the traffic lights to beat the driver next to you	2.38 (1.75)	.72	2.05 (1.51)	.50

Table 2. Relationships between the driving measures and demographic and driving exposure variables.

Measure ²	Males	Females	t ¹	Correlations		
	Mean (SD)	Mean (SD)		Age	Years licenced	Weekly Mileage
Violation willingness	2.41 (.84)	2.24 (.71)	2.47*	-.11**	-.08	.06
Attitudes to driving violations	21.94 (4.35)	20.70 (3.96)	3.33***	-.27***	-.20***	.13**
Ordinary violations	.97 (.61)	.77 (.51)	4.04***	-.09	-.05	.19***
Aggressive violations	.65 (.57)	.52 (.52)	2.64**	.01	.04	.15***
Driving style questionnaire – speed	9.14 (3.40)	8.23 (3.08)	3.13**	-.18***	-.13**	.14**

*p<.05 **p<.01 *** p<.001

¹t statistic comparing male and female means (df=521)

²All measures are scaled so that higher scores indicate more risky responses

Table 3. Simple correlations amongst violation willingness and existing measures of driving attitudes and behaviour. All $p < .001$.

	Violation Willingness	Attitudes to Driving violations	Aggressive violations	Ordinary violations	Driving Style Questionnaire - Speed
Violation Willingness	1				
Attitudes to Driving violations	.44	1			
Aggressive violations	.55	.18	1		
Ordinary violations	.76	.50	.58	1	
Driving Style Questionnaire - Speed	.66	.55	.33	.76	1

Table 4. Multiple predictor models of the driving behaviour measures.

	Ordinary violations ²	Aggressive violations ²	Driving style questionnaire - Speed ²
<i>Baseline model¹</i>			
R-squared	.09	.04	.09
<i>Baseline & ADVS</i>			
ADVS	.47*** (.39, .55)	.16** (.07, .25)	.51*** (.43, .59)
R-squared	.28	.06	.31
<i>Baseline, ADVS & VWS</i>			
ADVS	.19*** (.13, .25)	-.09* (-.17, -.01)	.29*** (.22, .36)
VWS	.66*** (.60, .72)	.58*** (.50, .66)	.52*** (.45, .59)
R-squared	.63	.33	.53

*p<.05 **p<.01 *** p<.001

ADVS=Attitude to Driving Violations Scale

VWS= Violation Willingness Scale

¹Baseline model includes age, sex, years licence held and weekly mileage

²Regression coefficients are β weights with 95% confidence intervals in brackets.

Figure 1. Mean scores on the Violation Willingness Scale for each stage of licence. Error bars show 1 standard error.

Figure 2. Mean scores on the Attitudes to Driving Violations Scale for each stage of licence. Error bars show 1 standard error.

