Predicting Older Adults’ Driving Difficulties Using the Roadwise Review

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The Roadwise Review has been reported to provide an effective means of self-assessing and predicting driving difficulties in older adults. We administered it to 73 community-dwelling older drivers (M = 73 years) and also gathered data on self-reported driving difficulties, 2-year retrospective collisions, and moving violations. The accuracy tests and Useful Field of View exhibited substantial ceiling effects that limit predictive utility, and there was a high failure rate on the head and neck flexibility test. Additionally, the Roadwise Review did not predict self-reported driving problems or collision risk. Thus, in current form, it does not appear to be a useful tool for assessing older drivers. Future research efforts should assess predictive validity in a more heterogeneous sample of older adults and with a broader range of outcomes, including on-road driving performance.

Key Words: Cognition—Driving—Vision.

Many older drivers are safe but, when adjusted for distance traveled, there is an increase in collision risk that begins around 50 years of age (see Evans, 2004 for an excellent review). Although recent data qualify this general- ity (Hakamies-Blomqvist, 2004; Tay, 2008), older adults’ greater risk of injury or death and their burgeoning numbers have motivated a growing interest in issues of licensure and assessment.

There has been some success in the effort to predict at-risk older drivers. Owsley, Ball, McGwin, Sloane, Roenker, White, and Overley (1998) investigated prospective collision involvement in licensed older drivers and found a significant correlation with the Useful Field of View (UFOV). Contrast sensitivity deficits are associated with crash involvement in older people who have cataract (e.g., Owsley, Staveley, Wells, Sloane, & McGwin, 2001).

Anstey, Wood, Lord, and Walker (2005) pointed out that accurate self-monitoring is required for safe driving. Accurate self-monitoring can be aided by good evaluation tools, and, to this end, a variety of resources have been developed. Of particular relevance to the present research, the American Automobile Association and the Canadian Automobile Association currently distribute the Roadwise Review. It grew out of work by Staplin, Lococo, Gish, and Decina (2003), who carried out a large-scale study of older U.S. drivers to determine the predictive validity of a battery of tests that included measures of physical, sensory, and cognitive functions. Most of the measures were able to identify collision-involved older drivers. All the measures in the Roadwise Review come from Staplin, Lococo, et al. (2003), with adaptations (e.g., standardized interactive instructions) to allow testing without a test administrator.

There have been some recent efforts to evaluate the Roadwise Review. Myers, Blanchard, MacDonald, and Porter (2008) reported that older adults are generally favorable to the test. Ball and colleagues (2006) used data from a sub-sample of older adults in Staplin and colleagues study and found Subtest 2 of the UFOV, Trails B, and the Motor Free Visual Perception Test predicted prospective at-fault collisions. Edwards and colleagues (2008) administered the Roadwise Review to licensed drivers at least 65 years of age. The UFOV and Trails B predicted self-reported 2-year retrospective collision involvement but did not predict a single-item self-assessment of driving “quality.”

The objective of the present study was to administer the Roadwise Review to a sample of older drivers to determine its ability to predict self-reported driving difficulties and driving history. The research builds on previous work by incorporating a valid measure of self-reported driving along with collision data. We expected the subtests of the Roadwise Review to be correlated with each other and to predict driving, collisions, and moving violations.

METHODS

Participants

The 73 participants whose data are reported (data from two people were lost due to software errors) were recruited from organizations in the Calgary area. Each received $20 (Canadian) or had that amount donated to their parent organization.

Materials and Procedure

The number of self-reported moving violations and at-fault collisions were recorded for the previous 2 years (see also Edwards et al., 2008), along with demographic data such as distance driven, age, and so forth. Next, the Roadwise Review, in the form of the research-friendly Driving Health Inventory, was given. It consists of 11 tests...
administered in the following: fixed order, four tests of acuity, rapid pace walking, head and neck flexibility, delayed recall, visualizing missing information, Subtest 2 of the UFOV, Trails A, and Trails B. Details can be found in Staplin and colleagues (2003). Following the Roadwise Review, participants completed the Driver Behavior Questionnaire (DBQ; Reason, Manstead, Stradling, Baxter, & Campbell, 1990), which measures how frequently the participants experience difficulties and engage in various behaviors while driving. There are four factors (Lajunen, Parker, & Summala, 2004): aggressive violations, ordinary violations, errors, and lapses. The DBQ predicts collision involvement in diverse populations, including older adults (Parker, McDonald, Rabbitt, & Sutcliffe, 2000). Next, they completed the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). It had a maximum score of 30, with lower scores indicating more cognitive impairment. The predictive validity of the MMSE is inconsistent, but it is commonly used to screen for cognitive impairment (e.g., Margolis et al., 2002; Owsley, Sloane, Ball, Roenker, & Bruni, 1991).

**RESULTS**

Participants ranged from 50 to 88 years ($M = 73$ years, $SD = 7$ years), and 67% were women. Approximately 20% were under a doctor’s care for a serious medical illness or condition, but 85% rated their health as good or excellent. On average, they drove 14,221 km/year ($SD = 10,275$ km). Twelve percent reported having one or two at-fault collisions, and 27% reported one or two moving violations in the last 2 years.

Descriptive statistics for most variables are provided in Table 1. Almost 50% of the participants failed the head and neck flexibility test. Three of the four acuity tests showed pronounced ceiling effects. There is more variability in performance on the low-contrast test of acuity, but still, 77% of the participants had no errors. This is to be expected because all licensed drivers must have high-contrast acuity levels better than is assessed in the Roadwise Review. Still, ceiling effects limit the predictive validity of the tests.

Data from the delayed recall and visualizing missing information tests were positively skewed. For example, approximately 60% of respondents made two or fewer errors on the latter. Trails A and B completion times were both normally distributed, but the UFOV scores exhibited a marked departure from normality. Almost one half of the participants were able to achieve 75% accuracy at the minimum duration of 100 ms, yet 6% of the sample could not perform the test at the maximum duration of 500 ms.

Table 2 provides zero-order correlations between predictor variables and the most important outcome measures, including subscale scores on the DBQ, self-reported collisions, and moving violations. To predict the continuous measures of the DBQ scales, we used ordinary least squares regression. For the dichotomous variables of moving violations and collisions, we used logistic regression. For both types of analyses, we proceeded in two steps: The first entered all the predictors from the Roadwise Review, and the second model added age and MMSE scores.

The results of these modeling efforts are seen in Table 3. No model performed adequately in predicting either moving violations or collisions. We encountered more success in predicting self-reported driving difficulties. The Roadwise Review, either alone or in conjunction with age and MMSE scores, accounted for 25%–30% of the variance in DBQ ordinary violations, lapses, and errors. However, the signs of the regression weights (see Table 2 for zero-order correlations) for the most important predictors are inconsistent and often in an unexpected direction. For example, when predicting DBQ Ordinary Violations, Visualizing Missing Information, Trails A, and Trails B were individually significant in the model. The signs of the regression weights were negative for the first two predictors; more impairment was associated with fewer difficulties. The only predictor that performed well over these three DBQ scales was Trails B, which was significant and positive in two of the three scales. As well, no model would be significant after adjustments for multiple tests.

As an alternative analysis strategy, we used the cut-points of Roadwise Review tests published by Staplin, Gish, and Wagner (2003) to predict retrospective collision status in our sample. These are the individual test scores they found to maximally separate collision-involved and uninjured drivers in a population-based study of more than 1,800 drivers.
As such, they should be the most stable values for prediction of risk. The model was nonsignificant (Nagelkerke $R^2$ of approximately .10) and predicted all drivers to be collision free.

**Discussion**

The tests comprising the Roadwise Review have undergone several recent investigations to determine if they predict driving behavior or collision risk in older adults. The present work builds on previous work in important ways. Ball and colleagues (2006) did not administer the Roadwise Review but rather examined the performance of similar tests from the Maryland Pilot Older Driver Study (Staplin, Lococco, et al., 2003). Compared with the currently marketed Roadwise Review, there are important differences in test content and administration that may impact predictive validity. Edwards and colleagues (2008) used the Roadwise Review and self-reported collisions but did not incorporate a validated measure of driving difficulties as we have done. Descriptive data (i.e., averages and distributional properties) from our study are generally consistent with data reported previously from both convenience samples (Edwards et al., 2008) and population-based studies (Ball et al., 2006).

Our results agree with those of Edwards and colleagues (2008), who found that the Roadwise Review did not predict self-reported driving quality. Although self-reports may be criticized, the DBQ is a valid predictor of collision involvement in older adults (Parker et al., 2000). As well, if test results are not consistent with drivers’ estimates of their driving, then user acceptance of the test will be a challenge.

Ball and colleagues (2006) and Edwards and colleagues (2008) were able to identify those older drivers involved in collisions using the Roadwise Review data. We found no relation between retrospective at-fault collisions and performance on the Roadwise Review. The reasons for this discrepancy are not related to low collision rates. Approximately 12% of our sample reported at least one collision. This compares with Ball and colleagues (2006) (5.5%) and Edwards and colleagues (2008) (19%).

Notably, the average performance of our sample on some of the tests is very different from that reported earlier. On the UFOV, group means were 133 ms in Edwards and colleagues (2008) and 177 ms in Ball and colleagues (2006), much lower than the average of 230 ms found here. Additionally, across studies, collision-involved drivers do not show the same relative impairment on either Trails B or the UFOV, the two most important predictors. On Trails B, our data and Ball and colleagues (2006) show a relative impairment of 3% and 6%, respectively. Edwards and colleagues (2008) reported 49% relative impairment. For the UFOV, our data and Ball and colleagues (2006) show a relative impairment of 27% and 22%, respectively. Edwards and colleagues (2008) reported a 49% loss. Because there have been several iterations of the tests used, some of an unclear and proprietary nature, these discrepancies may not be easy to explain.

There is a pressing need to develop assessment tools to evaluate older drivers. Although the Roadwise Review may be valuable in providing drivers with information on skills related to driving performance, in its current form it does not appear to be useful in the prediction of self-reported driving difficulties or risk in older adults. Floor or ceiling

Table 2. Zero-Order Correlations Between Predictors and Indicators of Driving Behavior

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>DBQ-ordinary violations</th>
<th>DBQ-errors</th>
<th>DBQ-lapses</th>
<th>DBQ-aggressiveness</th>
<th>Collision (yes or no)</th>
<th>Moving violations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking speed</td>
<td>-.174</td>
<td>-.039</td>
<td>-.158</td>
<td>-.143</td>
<td>-.003</td>
<td>.255</td>
</tr>
<tr>
<td>Head–neck flexibility</td>
<td>.147</td>
<td>.175</td>
<td>.081</td>
<td>.060</td>
<td>-.055</td>
<td>.072</td>
</tr>
<tr>
<td>High-contrast acuity (20/80)</td>
<td>-.130</td>
<td>-.115</td>
<td>-.205</td>
<td>-.086</td>
<td>.049</td>
<td>.051</td>
</tr>
<tr>
<td>High-contrast acuity (20/40)</td>
<td>.074</td>
<td>.209</td>
<td>.139</td>
<td>-.181</td>
<td>-.103</td>
<td>-.053</td>
</tr>
<tr>
<td>Low-contrast acuity (20/80)</td>
<td>-.037</td>
<td>-.102</td>
<td>-.051</td>
<td>-.044</td>
<td>.120</td>
<td>.025</td>
</tr>
<tr>
<td>Low-contrast acuity (20/40)</td>
<td>.125</td>
<td>.016</td>
<td>.038</td>
<td>.095</td>
<td>.174</td>
<td>-.031</td>
</tr>
<tr>
<td>Visualizing Missing Information</td>
<td>-.067</td>
<td>-.100</td>
<td>-.129</td>
<td>-.054</td>
<td>.111</td>
<td>.066</td>
</tr>
<tr>
<td>Trails A</td>
<td>-.081</td>
<td>-.114</td>
<td>-.221</td>
<td>-.083</td>
<td>.023</td>
<td>-.066</td>
</tr>
<tr>
<td>Trails B</td>
<td>.236*</td>
<td>.147</td>
<td>-.041</td>
<td>-.006</td>
<td>.075</td>
<td>-.082</td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.186</td>
<td>-.095</td>
<td>-.173</td>
<td>-.181</td>
<td>.078</td>
<td>.025</td>
</tr>
<tr>
<td>UFOV</td>
<td>-.033</td>
<td>.047</td>
<td>.054</td>
<td>-.049</td>
<td>.117</td>
<td>.133</td>
</tr>
<tr>
<td>MMSE</td>
<td>-.118</td>
<td>.001</td>
<td>.134</td>
<td>-.047</td>
<td>.124</td>
<td>.039</td>
</tr>
<tr>
<td>Age</td>
<td>-.129</td>
<td>.069</td>
<td>.015</td>
<td>-.201</td>
<td>-.016</td>
<td>.024</td>
</tr>
</tbody>
</table>

Notes: DBQ = Driver Behavior Questionnaire; MMSE = Mini-Mental State Examination; UFOV = Useful Field of View.
* $p < .05$

Table 3. Predicting Driving Behavior From Age, MMSE, and Roadwise Review—$R^2$ ($p$ value)

<table>
<thead>
<tr>
<th>Model</th>
<th>DBQ-ordinary violations</th>
<th>DBQ-errors</th>
<th>DBQ-lapses</th>
<th>DBQ-aggressiveness</th>
<th>Moving violations</th>
<th>Collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadwise Review</td>
<td>.275 (.033)</td>
<td>.256 (.056)</td>
<td>.259 (.052)</td>
<td>.107 (.768)</td>
<td>.371* (.118)</td>
<td>.386* (.121)</td>
</tr>
<tr>
<td>Age, MMSE, Roadwise Review</td>
<td>.303 (.040)</td>
<td>.297 (.046)</td>
<td>.273 (.084)</td>
<td>.134 (.751)</td>
<td>.409* (.136)</td>
<td>.424* (.142)</td>
</tr>
</tbody>
</table>

Notes: DBQ = Driver Behavior Questionnaire; MMSE = Mini-Mental State Examination. $^*$ Nagelkerke $R^2$. 

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effects on many of the tests limit predictive validity, and high failure rates of some tests will work against user acceptance. Low correlations with self-reported driving difficulty and retrospective collisions are problematic. Although predicting self-reported driving behavior from the Roadwise Review was found, in some instances, to have modest success, a closer examination of the data indicate that more impairment was associated with less difficulty in driving. This finding challenges to acceptance for consumers and policy makers alike.

There are two major limitations to the present study to be addressed in future work. Our sample consisted of self-selected elders who were currently driving. It would be beneficial to collect data on older drivers who have recently given up driving or who have been referred for medical reasons (e.g., low mental status scores), as was done in Staplin and colleagues (2003). As well, it would be useful to determine if the Roadwise Review is able to predict driving performance through on-road tests.

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**References**


