CAN WE PREDICT THE ON-ROAD PERFORMANCE OF OLDER DRIVERS?

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Summary: A study of drivers aged 50-90 was carried out to assess which, if any, of a range of measures were useful in predicting on-road performance. The study had three phases. In Phase One almost 2000 drivers completed an extensive self-report questionnaire, the Aging Driver Questionnaire, or ADQ. In the ADQ they described their personal and driving history, their driving behaviour and their attitudes and opinions on a variety of driving issues. Measures of general health, personality and intelligence were also taken. In Phase Two a subsample of those completing the ADQ (N=600) completed an extensive battery of laboratory tests of their cognitive and physiological capacities. In Phase Three 200 of this laboratory test sample completed two assessed on-road drives. The key results were that a) scores on the Manchester Driver Behavior Questionnaire (DBQ) showed that relatively high levels of errors and lapses behind the wheel were predictive of involvement in active accidents, while passive accident involvement was associated with a relatively high number of lapses, b) lapses were also associated with some indices of on-road performance, c) in general, performance on the cognitive and physiological laboratory tests was not associated with on-road performance and c) the best predictor of on-road performance was a relatively good score on a multiple choice test of driving knowledge, an assessment of driving knowledge offered in multiple choice format.

INTRODUCTION

As reported in previous seminars, the Older Driver Project comprised three phases of research designed to uncover measures that might be useful in assessing the driving capabilities of older drivers. In the first phase almost 2,000 drivers aged 50-90 completed a lengthy self-report questionnaire (the Aging Driver Questionnaire, ADQ) covering a range of issues including their current driving behaviour and habits, areas of perceived strength and weakness, confidence and opinions about a range of possible road safety interventions. In Phase Two, 550 of those who had returned the ADQ went on to complete several hours' worth of laboratory testing, assessing a variety of cognitive and physiological abilities, and also measuring personality, intelligence, driving knowledge and general health. This paper reports on the relationships between the driving behaviour and performance measures collected in Phases One and Two of the programme, and a range of on-road driving performance measures collected during Phase Three. This third phase, in which older drivers' driving capabilities were assessed by Approved Driving Instructors (ADIs), will be described in detail in this paper.

METHOD

Participation was voluntary and offered, for ethical reasons, after a full account had been given of what the assessment would involve. Six hundred participants from the previous two phases were invited to take part and 436 volunteered to do so. The final two hundred volunteers were selected using information obtained from the ADQ. Criteria used in the selection procedure included having taken no advanced driving qualifications or tuition and not having driven professionally. Further selection criteria aimed to ensure a good age range, in so far as this was possible, and an equal representation of both sexes.

Two assessment drives (route A and route B) were completed by each participant on two occasions, in the majority of cases, one week apart. Order of route presentation was counterbalanced. Volunteers drove their own vehicle. One drive was completed in the morning, the other in the afternoon. ADIs, trained in the administration of the assessment, accompanied the volunteer in the passenger seat giving directional instructions and noting performance. Four ADIs worked on the assessment programme. Both routes were in suburban areas of Manchester and took approximately 35 minutes to drive, covering distances of 9.7 miles and 8.8 miles.

Each assessment was structured in three parts. The first and third sections were alike and consisted of continuous assessment, scored in a manner identical to the UK driving test. Driver faults, serious faults and dangerous faults were recorded in relation to 35 items, grouped into fourteen categories. The number of items in each category varied. The second section consisted of a series of assessed situations such as turning right at a cross roads or reversing for five metres. Eighteen manoeuvres/situations were assessed on Route A and fourteen on Route B. A separate grade was awarded for each. Grades ranged from 1 to 6. A performance rating of ‘6’ (very good) indicated that the driver had demonstrated no faults, ‘5’ (good) that the driver had shown one driving fault, ‘4’ (adequate) more than one driving fault, ‘3’ (inadequate) one serious error, ‘2’ (poor) more than one serious error and ‘1’ (dangerous) more than one dangerous error.

After the assessment was complete the ADI awarded a global score between 1 and 5. The global score, a subjective measure, was designed to reflect the personal opinion of the ADI concerning the volunteer’s driving performance and was not a simple summary of the other measures. The volunteer ended the assessment session by completing a second copy of the mood evaluation form and filling out a questionnaire rating their performance and answering a series of questions concerning their assessment experience.

Measures

Five indices of performance were calculated:

- Route A continuous performance, a measure of the number and seriousness of driving faults noted by the ADI. This was computed by scoring 1 point for each driver fault, 2 for serious faults and 3 for dangerous faults.
- Route B, continuous performance, assessed as for Route A.
- Overall score for performance on a total of 32 assessed manouevres. This score reflects performance on both drives as the manoeuvres/situations encountered on each were not the same.

- Global scores separately for Routes A and B: which reflect the ADI's overall impression of the driver on a 5-point rating scale designed to measure driver safety.

Inter-Rater Reliability Among Assessors.

The on road project design allowed for comparison between ADIs on all measures to ensure that a good degree of inter-rater reliability had been achieved. However, comparison of continuous assessment scores on all sections revealed that one of the four ADIs had scored significantly more faults than the others. Further, no correlation existed between this ADI's score and the score awarded to participants on their second assessment. Significant correlations existed between the other ADI's. Data collected by this ADI on the continuously assessed sections was therefore excluded from further analysis. This reduced the number of complete (two route) data sets to 113, the number of Route A data sets to 154 and the number Route B to 160.

RESULTS

Overall, driving performance was good, although this may reflect the nature of the sample.

- Route A continuous performance: mean score was 9-17, range 1-21
- Route B, continuous performance: mean score was 11.07, range 2-21
- Overall score for performance on a total of 32 assessed manouevres, mean score was 5.2, indicating more than adequate performance on the manoeuvres and assessed situations. The range of scores obtained was 4.7-5.9.
- Global score, Route A: mean rating was 3.79, range 2-5.
- Global score, Route B: mean rating was 3.70, range 2-5. The mean global ratings given by ADIs for both routes indicated that they felt the older drivers were 'not bad'.

The next step was to consider the relationships between on road performance and demographics, variables from the ADQ and laboratory test scores. In order to reduce the data to manageable proportions for such an analysis, simple bivariate correlations between each of the five on-road indices and a wide range of potential predictor variables were computed. Those with significant bivariate correlations were retained and subsequently entered into stepwise multiple regression analyses predicting scores on each of the five on-road indices. The regression equations were built up as follows: on the first step, age sex and annual mileage were forced into the regression equation. On a second step, scores on the DBQ scales and on the driving knowledge test were entered stepwise, and on the third step those laboratory variables with significantly associated with four or five of the on-road measures were entered stepwise. This analysis strategy allowed for the influence of age sex and mileage to be statistically removed from the analysis, so that the additional influence, if any, of the psychological variables could be assessed. Table 1 shows that the only significant predictors of continuous assessment scores for Route A were a relatively high score on driving knowledge and good flexibility, which together accounted for almost 8% of the variance in scores.

Table 2 shows that there were three independent and significant predictors of continuous assessment scores on Route B. These were DBQ lapses, knowledge test score and height, which together accounted for 20% of the variance in scores. Those who the ADIs marked relatively

well tended to report fewer DBQ lapses, to score well on the driving knowledge test and to be relatively tall.

Table 1: Predicting continuous assessment score, Route A.

Variables	Beta	t	sig.
Age	.06	0.64	Ns
Mileage	.04	0.38	Ns
Sex	.02	0.18	Ns
Knowledge test score	-.23	-2.55	.01
Flexibility	-.24	-2.72	.01

Adjusted R^2 = .079, F = 3.31, p < .01

Table 2: Predicting continuous assessment score, Route B.

Variables	Beta	t	sig.
Age	.12	1.37	Ns
Mileage	-.04	-0.49	Ns
Sex	-.16	-1.39	Ns
DBQ lapses	.17	2.24	.03
Knowledge test score	-.28	-3.42	.001
Height	-.33	-3.11	.002

Adjusted R^2 = .20, F = 7.07, p< .001

As shown in Table 3, scores on being female, scoring relatively well on the knowledge test and having a good respiratory capacity predicted manoeuvres and assessed situations. Together these factors accounted for 14.4% of the variance ion scores.

Table 3: Predicting performance on manoeuvres/assessed situations.

Variables	Beta	t	sig.
Age	-.06	-0.71	Ns
Mileage	.60	0.77	Ns
Sex	.20	1.97	.05
Knowledge test score	.21	2.70	.01
Respiratory capacity	.34	3.57	.001

Adjusted R^2 = .144, F = 7.00, p =<.001

Table 4 shows that only respiratory capacity contributed significantly to prediction, accounting alone for 7% of the variance in global scores on Route A.

Table 4: Predicting global score, Route A.

Variables	Beta	t	sig.
Age	-.13	-1.46	Ns
Mileage	.05	0.60	Ns
Sex	.12	1.11	Ns
Respiratory capacity	.28	2.83	.01

Adjusted $R^2 = .073$, $F = 4.55$, $p<.01$

As shown in Table 5, global ratings for Route B were predicted by a relatively high score on the driving knowledge test and a relatively good respiratory capacity, which together accounted for 15% of the variance in scores.

Table 5: Predicting global score, Route B.

Variables	Beta	t	sig.
Age	-.07	-0.85	Ns
Mileage	.11	1.37	Ns
Sex	.01	0.11	Ns
Knowledge test score	.26	3.37	.001
Respiratory capacity	.18	1.90	.06

Adjusted $R^2 = .150$, $F = 7.31$, $p< .001$

To summarise,

- Age and mileage were not significantly associated with any of the five on-road measures.
- Gender was only marginally related to one of the five on-road measures
- Score on the driving knowledge test, administered as part of the ADQ, was significantly associated with four of the five on-road measures. In each case, those with higher scores on the driving knowledge test performed relatively well in the on-road tests.
- A relatively strong respiratory capacity, as measured by spirometer, was significantly predictive of good scores on three of the five on-road measures.
- A high score on DBQ lapses was significantly predictive of one of the five on-road indices.
- None of the cognitive tests was consistently predictive of any of the ADIs on-road assessments.

DISCUSSION

Performance on a surprise driving knowledge test emerged as the most consistent predictor of on-road performance. This was a multiple choice test using items taken from the bank of questions used in the current learner driver theory test. However, as the items used were chosen for their particular relevance to the older driver, the test cannot be considered as functionally equivalent to the actual learner driver theory test, which uses sets of items carefully balanced and validated for use together. Nevertheless, that theoretical and practical knowledge about driving is of significant importance in relation to actual performance is an interesting finding. It should be noted that although relative score on this test was an important predictor of on-road performance, in absolute terms driving knowledge test scores were not high. That is, the older drivers in the

sample did not do especially well on the test, which currently has a pass mark of 32 correct of 35 items attempted. However learner drivers are prepared for such a test, whereas the participants in this research had no warning and thus no time to prepare. In fact, the average length of time since participants last saw the Highway Code was reported at 17 years.

Taking this finding at face value it seems that knowledge of driving theory is important for actual on road performance. If this is the case then it is possible that intervening to improve knowledge of driving theory would increase levels of safety and driver ability. This could be done relatively easily by sending updated information to those aged seventy plus in the UK who are renewing their licenses. However, a cautious approach to these findings is necessary. It is possible that performance on the driving knowledge test may reflect, more generally, a continuing interest in and engagement with the task of driving. This suggestion is made all the more plausible by the association of DBQ lapse score with one of the continuous assessment measures. A relatively high scores on DBQ lapses, which has been shown previously to be linked in this sample to accident involvement (Parker, McDonald, Rabbitt and Sutcliffe 2000) may also reflect a lack of interest in and engagement with driving. Alternatively, both a high number of lapses and a poor performance on the driving knowledge test may be acting as indices of general mental deterioration, a speculation strengthened by the significant correlation ($r=0.31$, $p<.01$) between DBQ lapse score and Cornell Medical Index score. At the same time, three of the five on-road measures were predicted by respiratory capacity, a measure that may be acting as a general measure of cardiovascular health. All of these tentative lines of evidence can be seen as pointing to the conclusion that mental alertness is the key to continuing proficient driving performance, although more research would clearly be necessary before this conclusion was established as reliable.

Of equal interest are those variables that might have been expected to explain a proportion of variation but did not. Neither age, gender nor mileage has consistent predictive relationships with on-road performance. This suggests that chronological age offers at best a crude indicator of likely competence and performance levels, and that those with an interest in road safety should consider using a more sensitive indicator. Within this sample at least, there were no gender differences in performance, with males and females equally likely to do well. Moreover there was no evidence of a practice or familiarity effect, in that reported annual mileage was not predictive of performance. Neither was general health, as measured by the Cornell Medical Index, predictive of on-road performance among this sample.

However, it must be noted that some of these slightly surprising findings may have been due to sampling effects in this study. The sample who took part in the on-road assessments was self-selected, a consequence not of poor methodology but of necessity. This will have had consequences, one being that the standard of driving in the group as a whole is likely to have been relatively high, as poor or nervous drivers will not have agreed to take part. This may also mean that drivers who demonstrated a low level of driving skill may have lacked insight (hence having agreed to take part), whilst those poor drivers who did have insight did not agree to take part.

Overall, the standard of driving ability demonstrated in this sample was fairly good. The emergence of driving knowledge test score, respiratory capacity and DBQ lapse score as significant predictors of performance points to the possible benefits of self-administered

diagnostic tests, maybe including the DBQ and a test of driving knowledge for older drivers seeking to assess their own abilities.

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