Some options for assessing older driver fitness to drive for licensing purposes

Bohensky, M.[1], Martin, L.[2], Charlton, J.L.[1] & Langford, J.[1]
[1]*Monash University Accident Research Centre*
[2]*Injury Control Council of Western Australia (Inc)*

ABSTRACT

Several licensing models around the world use a screening test in assessing older drivers' fitness to drive. For example, the proposed Australasian older driver licensing model incorporates a screening assessment of older drivers identified as being at-risk by health or other authorities. Some drivers are either 'failed' or 'passed' – with drivers whose test performance has been inconclusive, being referred for further in-depth assessment.

The Useful Field of View (UFOV) screening test has been extensively evaluated over the past decade or so, with results commonly confirming a statistically significant association between test performance and various measures of crash risk. Arguably, this test holds the most potential for licensing authorities.

An Austroads project currently being conducted in Western Australia involves a case-control study to assess the usefulness of UFOV and other assessment options to licensing authorities when assessing older drivers. Around 60 Cases (drivers aged 75 years and older in at-fault crashes within the previous six months) and 60 Controls (drivers aged 75 years and older who have been crash-free over the previous two years) are being compared across a range of measures including performance on the UFOV.

Preliminary results based on 39 Cases and 39 Controls indicate that several measures have a statistically significant association with recent crash involvement. Once all testing has been completed, more sophisticated statistical analyses (e.g. a regression analysis, diagnostic accuracy testing) will be undertaken to evaluate the effectiveness of using these tests for screening older drivers.

This paper explores the different ways in which UFOV and other measures of fitness to drive might assist in the assessment of older drivers generally and within the Australasian licensing model, specifically.

KEY WORDS: older drivers, licensing, functional impairment, screening test, assessment, fitness to drive.

INTRODUCTION

There is a widespread claim that older drivers are over-represented in crashes, particularly when crash figures are adjusted for distance traveled. There are numerous reasons suggested for this increased risk, including the increased frailty associated with ageing, as well as the onset of medical conditions and age-related declines in functional impairments that are likely to impact on driving skills. In the future growth in the number of older drivers is expected as a result of the ageing population. Thus, older driver crashes will become a more significant proportion of the total road toll with predictions estimating fatalities among drivers over age 65 to increase by approximately three-fold (over the 1995 figures) by the year 2025 (Fildes et al., 2001).

The issue of older drivers' reduced capabilities to drive, together with the increase in the number of older drivers, has led to considerable international interest and debate on the best possible management of older driver safety through licensing processes, and in particular, whether older drivers should be required periodically to demonstrate their continued fitness to drive through mandatory assessments (Fain, 2003; Andres, 2004).

Traditionally, older driver safety has been viewed as a general age-related safety issue. This approach has led to the widespread adoption of age-based re-licensing systems whereby driver chronological age is used as a trigger for licence re-assessment. In contrast, in some jurisdictions there are no age-based re-licensing requirements for older drivers, with drivers of all ages being required to prove their fitness to drive only if they come to the notice of licensing authorities as a result of suspect driving.

Supporters of the practice of mandatory licence re-testing argue that older people need to demonstrate they are fit to drive without risk to other road users. Those who oppose age-based, periodic licence re-tests, base their claims on cost-effectiveness, discrimination, equity issues, the inability of licence tests to discriminate those at risk, and the adequacy of self-regulation. In addition, some evidence suggests that sub-groups of older drivers, rather than the group as a whole, may have a higher risk of crashing and that people of a similar age, especially older people, differ significantly in their functional abilities (Janke, 1994; Rabbitt, 1993; Waller, 1992).

There is also evidence that the older driver risk has been overestimated and that once physical frailty (Evans, 1991; Maycock, 1997; Li, Braver & Chen, 2003) and shorter trip distances of older drivers are accounted for (Janke, 1991; Hakamies-Blomqvist, Raitanen & O'Neill, 2002), older drivers' risk is no greater than that of middle-aged drivers. Indeed, New Zealand research (Frith, 2002) indicates that even when none of these factors are accounted for older driver risk per driver per year does not rise above that of middle-aged drivers until the age of 85.

The current study evaluated assessment tools suitable for use within a model licence re-assessment procedure aimed at overcoming the difficulties that age-based systems present. This model, referred to here as the Australasian model licence re-assessment procedure (or the model) (Fildes, Pronk, Langford, Hull, Frith, & Anderson, 2000) was designed so that it could be adopted in all licensing jurisdictions throughout Australia and New Zealand to assist in reducing older driver crash rates. A key component of the model is that older drivers showing some evidence of having a heightened crash risk, undergo an early screening assessment. This level of assessment requires a test which is both simple and quick to administer and has known and adequate validity in distinguishing between safe and unsafe drivers.

The Australasian model was based on a series of developments in the United States, originating with a three-tiered licensing model developed for the Californian Department of Motor Vehicles (Janke & Eberhard, 1998). The model has also been influenced by the National Highway Traffic Safety Administration's (NHTSA) Model Driver Screening and Evaluation Program (Staplin, Lococo, Gish & Decina, 2003a, 2003b, 2003c; Staplin, Lococo, Stewart & Decina, 1999).

The study aims to determine whether older drivers recently involved in crashes (cases) and older drivers not recently involved in crashes (controls) differ in performance on a number of screening assessment options.

METHOD

Recruitment

Drivers aged 80 years and over were recruited to participate in the study. The Insurance Commission of Western Australia identified potential cases on their crash database, and the Western Australian Government Department of Planning and Infrastructure identified potential controls on their licensing database. Potential participants were sent a Letter of Invitation, a Consent Form and a reply-paid envelope. The Consent Form required participants to provide their date of birth and address, to ensure matching of cases to controls was possible. Non-responding drivers were sent a follow-up letter.

An insufficient number of responses were received from cases aged 80 years and over, and as a result the criteria for age was adjusted to 75 years and over in order to achieve the desired test sample of 120. The inclusion criteria for cases were aged 75 years and over; resident in the Perth metropolitan area; involved in a crash in the previous six months; judged responsible for the crash by insurance assessors; and not having sustained head injuries as a result of the crash. The inclusion criteria for controls were aged 75 years or more; resident in the Perth metropolitan area; and not involved in a crash in the previous two years. Controls were matched on age, gender and postcode.

Tests and Procedures

Respondents returning completed consent forms were selected by matching controls to each case by age, gender and postcode. Potential participants were telephoned and invited to participate and a suitable appointment time was made. Each participant was tested individually. Participants were seated in an ergonomic chair at a desk in a quiet room in front of a touch screen. On average, assessments lasted approximately one and a half hours.

The participants completed the Health Screen for Drivers (HSD), followed by the CALTEST, which has been adapted from the California DMV's 'California Battery'. The CALTEST comprises the AutoTrails (Ascending and Descending scores) assessment (developed by Frank Schieber, Heimstra Human Factors Laboratories, University of South Dakota) and the Useful Field of View (UFOV, Ball & Owsley, 1991). The CALTEST is part of a driver screening test developed by the Californian Department of Motor Vehicles in conjunction with the National Highway Traffic Safety Administration (NHTSA) in the mid 1990s. Details of the test protocols for the HSD and CALTEST are described in more detail elsewhere (Charlton, Fildes, Koppel, Oxley & Newstead, 2003; Fildes et al, 2004). A driver evaluation survey was administered to all cases and controls at the end of the screening test session.

<u>The Health Screen for Drivers</u>

The HSD was originally developed for health practitioner pre-screening and referral of at-risk drivers to the relevant licensing authorities for further assessment. The HSD comprises six test items including the Visualisation of Missing Information (VMI), developed by Staplin (personal communication, Staplin, January 2003); the Months Backwards test (Katzman, Brown, Fuld, Peck, Schechter & Schimmel, 1983); two self-report questions for drivers; and two Practitioner (Assessor) ratings. The VMI, adapted from the Motor Free Visual Perception Test (Colarusso & Hammil, 1972), assesses visual closure. Participants are shown 11 complete objects each with four corresponding incomplete objects and asked to identify which one incomplete version would look like the complete object once lines are added. The VMI score is based on total number of errors made. The self-report questions require drivers to (a) indicate whether they have any medical conditions that they think affect their driving and (b) rate perceptions of how family and friends would rate their driving ability. The Months Backwards test requires participants to list the 12 months of the year backwards beginning with December and the time in seconds is recorded. The final component requires the Practitioner/Assessor to rate the driver's level of confusion and the driver's slowness. The final HSD score is derived from a logistic regression equation comprising each of the components of the test.

<u>The CALTEST</u>

The CALTEST is computer-based and requires touch-screen responses by participants. The AutoTrails component is a timed task, which requires participants to touch each numbered circle (1-14), presented on a computer touch screen, as quickly as possible in both ascending and descending order.

The UFOV consists of three sub-tests. In the first sub-test, participants are required to respond to an image of either a car or a truck flashed onto the centre of the screen, followed by a random pattern masking screen. Participants are then required to indicate which image was presented (car or truck). In the second sub-test, participants are again required to identify an image in the centre of the monitor screen, while locating a car simultaneously displayed in the periphery. This is followed by a masking screen. Two screens then appear in succession: first requiring participants to indicate which image was presented centrally and second, where the car in the periphery was located. The third sub-test is a more complex version of the second sub-test, with the peripheral (car) image embedded in a field of distracting stimuli (triangles). For all three tasks, participants' scores are expressed as the display duration in milliseconds (ms) at which the participant performed with 75% accuracy. Scores for each sub-test can range from 16.67ms to 500ms. A composite score can also be calculated, expressed as a percent reduction of useful field of view (Edwards et al., 2005).

Driver Questionnaire

An evaluation questionnaire about the re-assessment process was designed specifically for this study to elicit the experiences and thoughts of the participants on the model licensing re-assessment procedure, as well as demographic information and driving patterns. The questionnaire was constructed in three parts: the first section included questions pertaining to demographic information; the second section was designed to ascertain drivers' acceptability of the screening tests and testing procedures; and the third section included subjective ratings of driving performance, travel patterns and crash history, a medical checklist and self-reported ratings (using a 5-point scale) of health status, vision, physical abilities and speed of decision-making for safe driving. The questionnaire took approximately 15 minutes to complete and was administered in a face-to-face interview style following the screening test. Participants' responses were recorded on a computer.

Analysis

The primary analyses reported in this paper were based on the association between prior crash involvement and the determination of whether the assessment was passed (Y/N). The pass/fail threshold for each measure was based on cut-points reported in previous research for each of the assessments (Ball et al, 1993; Charlton, et al, 2003). In addition, a tri-category assessment protocol was used for the HSD and UFOV, so that these tests would set two thresholds to distinguish three categories (see Fildes et al, 2004). Any result below the lower score would be a fail, any result above the upper score would be a pass and those in-between would require further testing. Threshold scores were identified to optimise the tests' ability to identify correctly both unsafe and safe drivers while maintaining manageable numbers of doubtful cases requiring further assessment.

RESULTS

Participants

Of the 262 cases approached, 74 agreed to participated, as did 250 out of 674 controls contacted. The response rates for cases and controls were 28.2% and 37.1% respectively.

Seventy-eight participants were included in the preliminary analysis presented in this paper, and variables tested included age, gender and driving patterns. As shown in Table 1, the mean age of cases was 81.67 years with a standard deviation of 4.50, and for controls the mean age was 82.13 years with a standard deviation of 3.19 years. The age range for cases was 75 to 92 years, and controls ranged from 78 to 90 years of age. Three quarters of the participants were male. Cases tended to drive more frequently than controls, where almost 70% of cases drove once daily or more often, compared to just over 55% of controls who drove once daily or more. No significant differences were detected between these two groups suggesting they are evenly matched.

Table 1 Comparison of demographic variables for cases and controls

		Cases (n=39)	Controls (n=39)
Mean age in years (SD)		81.67* (4.50)	82.13 (3.19)
Age range in years		75-92	78-90
Gender		76.5% male	74.4% male
How frequently do you drive?	*More than once a day*	8 (25.0%)	4 (10.8%)
	Once a day	14 (43.8%)	17 (45.9%)
	2-3 times a week	10 (31.3%)	16 (43.2%)
Roughly how many kilometres did you drive last week?	*Less than 10km*	1 (3.1%)	0 (0.0%)
	10-25km	3 (9.4%)	2 (5.4%)
	26-50km	6 (18.8%)	10 (31.3%)
	51-100km	7 (21.9%)	10 (31.3%)
	101-200km	11 (34.4%)	9 (28.1%)
	201-400km	4 (12.5%)	5 (15.6%)
	401-600km	0 (0.0%)	0 (0.0%)
	More than 600km	0 (0.0%)	1 (3.1%)

HSD

As shown in Table 2, drivers aged 75 years and over who were involved in a crash six months prior to testing were more likely to fail the Health Screen for Drivers test (all items combined), compared to drivers with no recent crash history when a test score of 75 was set as the threshold. Cases accounted for 70.6% of all fails and the difference between cases and controls reached borderline significance.

Table 2 HSD performance (overall score) and crash risk

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass > 75	27 (44.2%)	34 (55.7%)	61 (78.2%)
Fail ≤ 75	12 (70.6%)	5 (29.4%)	17 (21.8%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

$X^2(1) = 3.69$, $p = 0.055$; OR: 3.02 (95% CI: 0.98-9.25)

Table 3 uses two thresholds for the HSD to categorise those who clearly pass (score ≥ 84), a ‘maybe’ category of drivers who neither clearly pass nor fail (score greater than 70 and less than 84) and those who clearly fail (score ≤ 70). Using these thresholds, 55% of those who clearly passed were controls and 85% of those who clearly failed were cases.

The mean time taken to complete the HSD test (all components) was approximately 10 minutes (10 minutes 38 seconds; +/- 6 minutes 15 seconds).

Table 3 HSD performance (overall score) with 2 cut points

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass ≥ 84	9 (45%)	11 (55%)	20 (25.6%)
Maybe > 70 & < 84	19 (42.2%)	26 (56.5%)	45 (57.7%)
Fail ≤ 70	11 (84.6%)	2 (15.4%)	13 (16.7%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

In addition to the analyses conducted on overall HSD scores, selected sub-tests of the HSD including the VMI and Months backwards tests were also analysed to evaluate their potential as stand-alone pre-screening assessments.

VMI

The association between performance on the Visualisation of Missing Information component of the HSD and crash risk is presented in Table 4. Older drivers recently involved in crashes were more likely to fail the VMI test than drivers with no recent crash history but the difference was not statistically significant.

Table 4 VMI performance and crash risk

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass 0 errors	5 (41.7%)	7 (58.3%)	12 (15.4%)
Fail ≥ 1 error/s	34 (51.5%)	32 (48.5%)	66 (84.6%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

$X^2(1) = 0.39$, $p = 0.53$; OR: 1.49 (95% CI: 0.45-4.91)

When different threshold limits were explored, the association between crash history and test performance was not significant.

Months Backwards

Using a pass/fail threshold of 28 seconds (Table 5), older drivers with a recent crash history were more likely to fail the Months Backwards than those without a recent crash history (approximately 18% vs. 2%) and the difference was of borderline significance.

Table 5 Months Backwards performance and crash risk

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass ≤ 28s	32 (45.7%)	38 (54.3%)	70 (89.7%)
Fail > 28s	7 (87.5%)	1 (12.5%)	8 (10.3%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

Fisher's Exact, two-tailed $p = 0.056$; OR: 8.31 (95% CI: 1.24-53.89)

UFOV

The Useful Field of View assessment was completed by 98.7% (n=77) of drivers in the sample. One case was unable to complete the UFOV due to technical problems and was scored as a fail. Table 6 shows the results of the UFOV component when the threshold is set at 40% UFOV reduction. Older drivers recently involved in crashes were more likely to fail and less likely to pass the UFOV than crash-free older drivers but the difference was not statistically significant.

Table 6 UFOV performance and crash risk

	Case frequency (%)	Control frequency (%)	Total frequency (total %)
Pass - 40% or less UFOV reduction	9 (39.1%)	14 (60.9%)	23 (29.5%)
Fail – more than 40% UFOV reduction	30 (54.5%)	25 (45.5%)	55 (70.5%)
Total	39* (50.0%)	39 (50.0%)	78 (100.0%)

*One case did not complete the UFOV and was counted as a failure.

$X^2(1) = 1.54$, $p = 0.21$; OR: 1.87 (95% CI: 0.70-4.95)

Table 7 shows analysis using two thresholds for the UFOV: those who clearly pass (score ≤ 37%), a ‘maybe’ category of drivers who neither clearly pass nor fail (score greater than 37% and less than or equal to 60%) and those who clearly fail (score >60%). Using these thresholds, 67% of the clearly passing drivers were controls, 52.3% of participants were in the ‘maybe’ category, and 57.9% of those who clearly fail were cases.

Table 7 UFOV performance with two cut-off points

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass - 37% or less UFOV reduction	6 (33.3%)	12 (66.6%)	18 (23.1%)
Maybe - > 37% and ≤ 60% UFOV reduction	22 (53.7%)	19 (46.3%)	41 (52.3%)
Fail – more than 60% UFOV reduction	11 (57.9%)	8 (42.1%)	19 (24.4%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

AutoTrails

The AutoTrails test was completed by 97.8% (n=77) of the drivers tested. One case was unable to complete the test due to technical problems and was scored as a fail. Table 8 summarises the relationship between one component of AutoTrails, AutoTrails Ascending performance measured in terms of time taken, and drivers’ crash risk.

Older drivers recently involved in crashes were more likely to fail the AutoTrails Ascending test than drivers with no recent crash history (72% and 49% respectively) and the difference was significant.

Table 8 AutoTrails Ascending performance (time taken) and crash risk

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass ≤ 23.08s	11 (35.3%)	20 (64.5%)	31 (39.7%)
Fail > 23.08s	28 (59.6%)	19 (40.4%)	47 (60.3%)
Total	39 (50.0%)	39 (50.0%)	78 (100.0%)

$X^2(1) = 4.34$, $p = 0.037$; OR: 2.68 (95% CI: 1.06-6.78)

Table 9 shows the relationship between older drivers' performance on the AutoTrails Descending component of the assessment in terms of time taken and crash risk. Drivers aged 75 and over who were recently involved in crashes did not perform differently on the AutoTrails Descending test in terms of time taken, compared to drivers with no recent crash history. Fifty percent of those who failed the AutoTrails Descending test were cases and 50 % were controls.

Table 9 AutoTrails Descending performance (time taken) and crash risk

	Case frequency (row %)	Control frequency (row %)	Total frequency (total %)
Pass ≤ 23.46s	16 (50%)	16 (50%)	32 (41.0%)
Fail > 23.46s	23 (50%)	23 (50%)	46 (59.0%)
Total	39* (50.0%)	39 (50.0%)	78 (100.0%)

*One case was unable to complete the AutoTrails test due to technical problems and was counted as a fail.
$X^2(1) = 0.00$ $p = 1.0$; OR: 1.00 (95% CI: 0.41-2.45)

DISCUSSION

The purpose of this study was to evaluate the effectiveness of selected screening tests for use in the Australasian model licence re-assessment procedure (Fildes et al, 2001). The model requires assessment instruments of known validity and reliability for testing drivers. Previous research indicates that the HSD, UFOV and AutoTrails tests represent promising tools to identify at-risk older drivers (Ball & Owsley, 1991; Charlton et al, 2003; Fildes et al., 2004).

The preliminary results from the current case-control study indicate that the HSD overall score, AutoTrails ascending and some other assessment protocols are likely to show statistically significant associations with crash involvement, provided that the same trends are sustained in the remaining portion of the study. However it is also likely that using these instruments on a simple pass-fail basis will be of minimal use to licensing authorities in identifying at-risk older drivers. For example, cancelling the licences of all drivers who failed the AutoTrails Ascending Test would result in 71.8% of cases being removed from the road – but would also entail almost one-half of all safe drivers ceasing driving.

Results from two of the tests – the HSD and UFOV – were further analysed to allocate drivers to one of three categories; 'pass', 'maybe' and 'fail' as a possible means to improve test sensitivity and specificity (Molnar et al, 2006). This approach was adopted for consistency with the approach proposed for use of screening tests in the Australasian older driver re-licensing model (Fildes et al, 2004). Ideally, a screening test should be able to predict safe and unsafe drivers with

100% certainty. In practice, however, this is rarely achieved given test and individual variation. Under the model, those deemed to be 'maybe' would go on for a more detailed assessment, involving health care providers and/or on-road tests.

Preliminary results based on a comparison of cases' and controls' performance, suggest that this strategy has resulted in a modest improvement in the significance of the association between pass/fail outcomes and crash involvement. Future analyses will include a regression model of factors associated with passing each assessment and assessment of the diagnostic accuracy of each test as a screening tool for populations of older drivers.

Limitations

The response rate for controls was almost 10 percent higher than that for cases (37.1% vs. 28.2% respectively). This may be the result of a 'healthy volunteer bias,' whereby those least likely to be at risk of a crash are the most likely to volunteer to participate.

These results are also subject to possible selection bias. Older drivers recently involved in crashes received recruitment letters from the Insurance Commission of Western Australia. This may have caused them to suspect they had been invited to participate as a direct result of their crash involvement. It is possible that this (accurate) perception regarding their selection may have led some – and perhaps those most at risk of a crash – to decline participation in the study. Controls, on the other hand, were invited by the Western Australian Government Department of Planning and Infrastructure, which may have aroused less suspicion about their driving record and, therefore, increased their willingness to participate.

There is also potential for the recruitment rate and study results to be influenced by computer literacy of the study participants. Subjects who had no previous experience with computers became anxious when they realised that the test was computer-based at the time of the assessment. The term 'computer' was omitted from all correspondence prior to the assessment, as early trials revealed that some drivers declined to participate in the study when told a computer was involved. Despite the simple touch screen response required and every effort by the Assessor to put the participants at ease, it is possible that test anxiety as well as unfamiliarity and inexperience with computers may have affected performance.

Recommendations for future research

In order to further validate the preliminary findings presented in this paper, the case-control study has been extended to include a clinical assessment and an on-road driving assessment to be conducted by a specialist occupational therapy driving assessor.

CONCLUSION

This study is evaluating the effectiveness of a range of measures that assess fitness to drive among older drivers aged 75 and over. Further analyses are planned once data collection for the full sample is complete in order to establish the predictive powers of the tests for identifying crash-involved drivers. The outcomes of this research have implications for the assessment of older drivers generally and within the Australasian licensing framework specifically.

ACKNOWLEDGEMENTS

We gratefully acknowledge the support of Austroads and the Australian Transport Safety Bureau for funding this project. We particularly wish to thank Mr Bill Frith, Austroads' project manager, for his valuable advice and encouragement for the model licence re-assessment research program. We also acknowledge the valuable collaboration with the Department of Planning and Infrastructure (DPI) Western Australia, the Office of Road Safety, the Insurance Commission of

Western Australia (ICWA) and the Injury Control Council of Western Australia (ICCWA). In particular we wish to thank Jim Stiles, DPI, Manager, Licensing Policy, Chris Costa, former Executive Officer, ICCWA, and Neil Morfitt (ICWA) for their invaluable advice and assistance with recruitment and assessment procedures. We also thank the developers of the Useful Field of View (UFOV) and VicRoads' Health Screen for Drivers (HSD) who agreed to the evaluation of their tests in the study. Importantly, we thank the drivers in Western Australia who volunteered to participate in the study. Without their involvement and generous investment of time and input, this research would not be possible.

REFERENCES

Andres, L. (2004). Motor Vehicle Crashes Among the Elderly: Advocates Cite the Need for Mandatory Retesting of Elderly Drivers. *Journal of Emergency Nursing*, 30(5), 509- 11.

Ball, K., & Owsley, C. (1991). Identifying correlates of accident involvement for the older drivers. *Human Factors*, 33(50), 583-595.

Ball, K., Owsley, C., Sloane, M.E., Roenker, D.L., Bruni, J.R. (1993).. Visual attention problems as a predictor of vehicle crashes in older drivers. *Invest Ophthalmol Vis Sci*, 34, 3110-3123.

Charlton, J., Fildes, B., Koppel, S., Oxley, P. & Newstead, S. (2003). *Health Screen for Drivers (HSD) referral instrument. Stage 3: Validation of HSD and evaluation of Victorian trial.* VicRoads, Report GR2003 R+D871.

Colarusso, R.P. & Hammil, D.D. (1972). *Motor-Free Visual Perception Test.* Western Psychological Services: Los Angeles, C.A.

Congdon, P. (1999). *VicRoads Hazard Perception Test, Can it predict accidents?* Australian Council for Educational Research, Report No CR 99-1.

Edwards, J.D., Vance, D.E., Wadley, V.G., Cissell, G.M., Roenker, D.L., Ball, K.K. (2005). Reliability and Validity of Useful Field of View Test Scores as Administered by Personal Computer. *Journal of Clinical and Experimental Neuropsychology*, 27,529–543

Evans WN, Graham JD. Risk reduction or risk compensation? The case of mandatory safety-belt use laws. *J Risk Uncertainty*. 1991;4:61-73.

Fain, M. J. (2003). Should older drivers have to prove that they are able to drive? *Archives of Internal Medicine*, 163, 2126-2128.

Fildes, B., Pronk, N., Langford, J., Hull, M., Frith, B., & Anderson, R. (2000). *Model Licence Re-Assessment Procedure for Older and Disabled Drivers.* AP-R176, Austroads Inc, Australia.

Fildes, B., Fitzharris, M., Charlton, J., & Pronk, N. (2001). *Older driver safety – A challenge for Sweden's 'Vision'.* Paper presented at the Australian Transport Research Forum, Hobart, April, 2001.

Fildes B., Charlton J., Langford J., Frith W., Pronk N., Newstead S., Oxley J., Oxley P., & Koppel S. (2004). *Model Licence Re-Assessment Procedure for Older Drivers: Stage 2 Research.* Austroads Report AP-R259-04.

Frith, W.J. (2002). *How dangerous are older drivers and how should we approach their safety?* Paper presented at the Older Road User Safety Workshop of the Road Safety Research, Policing and Education Conference, Melbourne, 2002.

Hakamies-Blomqvist, L., Raitanen, T., & O'Neil, D. (2002). Driver ageing does not cause higher accidents rates per km. *Transportation Research, Part F*(5), 271-274.

Janke, M. (1991). Accidents, mileage, and the exaggeration of risk. *Accident Analysis and Prevention,* 23(2/3), 183-188.

Janke, M. (1994). *Age-related disabilities that may impair driving and their assessment: Literature review*. Sacramento: California Department of Motor Vehicles.

Janke MK, Eberhard JW. (1998) Assessing medically impaired older drivers in a licensing agency setting. *Accident Analysis and Prevention.* 3, 347-61.

Katzman, R., Brown, T., Fuld, P., Peck, A., Schechter, R., & Schimmel, H. (1983). Validation of a Short Orientation-Memory-Concentration Test of Cognitive Impairment. *American Journal of Psychiatry, 140 (6),* 734-39.

Li, G., Braver, E., & Chen, L. (2003). Fragility versus excessive crash involvement as determinants of high death rates per vehicle-mile of travel among older drivers. *Accident Analysis and Prevention*, 35, 227-235.

Maycock, G. (1997). Sleepiness and driving: the experience of U.K. car drivers. *Accident Analysis and Prevention*, 29(4), 453-62.

Molnar, F.J., Patel, A., Marshall, F.C., Man-Son-Hing, M., Wilson, K.G. (2006). Clinical Utility of Office-Based Cognitive Predictors of Fitness to Drive in Persons with Dementia: A Systematic Review. *Journal of the American Geriatric Society*, 54, 1809- 24.

Rabbitt, P. (1993). Does it all go together when it goes? The nineteenth Bartlett Memorial Lecture. *Quarterly Journal of Experimental Psychology*, 46A, 385-434

Staplin, L., Lococo, K., Gish, K., & Decina, L. (2003a). *Model Driver Screening and Evaluation Program. Final Technical Report. Volume 1: Project Summary and Model Program Recommendations.* Washington D.C.: National Highway Traffic Safety Administration.

Staplin, L., Lococo, K., Gish, K., & Decina, L. (2003b). *Model Driver Screening and Evaluation Program. Final Technical Report. Volume 2: Maryland Pilot Older Driver Study.* Washington D.C.: National Highway Traffic Safety Administration.

Staplin, L., Lococo, K., Gish, K., & Decina, L. (2003c). *Model Driver Screening and Evaluation Program. Final Technical Report. Volume 3: Guidelines for Motor Vehicle Administrators.* Washington D.C.: National Highway Traffic Safety Administration.

Staplin, L., Lococo, K., Stewart, J., & Decina, L. (1999). *Safe Mobility for Older People Notebook (No. DOT HS 808 853).* Washington D.C.: National Highway Traffic Safety Administration.

Waller, J. (1992). Research and other issues concerning effects of medical conditions on elderly drivers. *Human Factors*, 34(1), 3-24.