OLDER DRIVER ERRORS ON VICROADS 'REVIEW' TESTS

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ABSTRACT

This study was conducted to obtain information about older driver errors, using information recorded during licence review tests of drivers reported to VicRoads as possibly unsafe. This information was required for use in improving the current form of on-road test used by occupational therapists to assess drivers with various functional impairments. Data were extracted from VicRoads files for a 12 month period; 533 road test cases were analysed; average driver age was 76.1 years. Performance scores were derived for intersection negotiation, lane changing, low speed manoeuvres, positioning & speed control, safety margin and car control. Some errors required the Licence Testing Officer (LTO) to intervene, and details of these errors were recorded separately in terms of type of error, driving manoeuvre attempted and driving context. It was found that test outcome (pass/fail) was primarily determined by whether or not the LTO intervened. Separate logistic regression analysis with driver performance scores (from observations recorded throughout the test) and driver age correctly predicted 94% of test outcomes. The strongest predictors were intersection score (% negotiated satisfactorily), position on road score (% of observations satisfactory), and safety margin score (% of observations satisfactory). Results were consistent with other research on older driver performance and crash involvement. Some implications for on-road testing are noted.

BACKGROUND

As the proportion of older drivers in our community increases, a challenge for both licensing authorities and the wider community is how to achieve an optimal balance between maintaining road safety and preserving the independence and community mobility of people as they age (McKnight, 2000). Older drivers tend to have increasing numbers of functional impairments, but these do not necessarily reduce their ability to drive safely. For example, drivers with only musculoskeletal impairment present no greater risk than the general driver population, although they may need to be assessed in order to identify vehicle modification and related training requirements (Macdonald & Scott, 1993; Sprigle, Morris, Nowachek, & Karg, 1995; Torpey & Francis, 1992). However, there is accumulating research evidence of the role of ageing-related *cognitive* decrements as a primary causal factor in the elevated crash risk of older drivers (Cooper, Tallman, Tuokko, & Beattie, 1993; Daigneault, Joly, & Frigon, 2002; Lundberg, Hakamies-Blomqvist, Almkvist, & Johansson, 1998; Stutts, Stewart, & Martell, 1998). Some medical conditions, or the drugs used to treat them, may also reduce driving abilities (Darzins & Hull, 1999; Roller & Gowan, 2001).

A road test is usually required as part of both initial driver licensing and the licence review process, because current methods of off-road assessment are inadequate for some aspects of driving ability (Withaar, Brouwer, & Van Zomeren, 2000). Also, on-road tests have higher face validity, which is important to someone whose licence may be under threat (Fildes et al., 1999; Hunt, Morris, Edwards, & Wilson, 1993; Korteling & Kaptein, 1996; Underwood, 1992). Therefore, on-road testing should be able to identify those older drivers whose risk has increased to an unacceptable level, whether the cause is ageing-related cognitive decrements, specific medical problems, or other factors. Unfortunately, there is little evidence to support the validity of currently used methods in relation to subsequent crash risk. Information about driver errors – of 'normal' drivers of all ages, as well as those with elevated crash risk – is one of the pre-requisites for development of more valid and sensitive on-road assessment systems (Dobbs, Heller, & Schopflocker, 1998; Macdonald & Scott, 1993; Marotolli & Richardson, 1998; Withaar et al., 2000). Dobbs et al. (1998) commented that

> Any error might be very important in identifying the person as unsafe, or it might be the type of error that is characteristic of experienced drivers and not indicative of declining competence. … More detailed analyses of the errors, … and the conditions of the driving errors may help to further refine the meaning of the errors for the purposes of developing an empirically based scoring scheme. (p.369)

The aim of the present study was to obtain such information, using on-road licence review test records from VicRoads – the Victorian licensing authority. The work is part of a larger project to develop an improved procedure for occupational therapy (OT) assessments of functionally impaired and older drivers.

The Victorian driver licence review process

Licensed drivers can be reported to VicRoads by anyone who is concerned about their driving competence; many such reports are by police. VicRoads staff then determine whether a medical report and/or tests are required to assess the licence holder's competency to continue driving. If testing is required, this is performed either by a specialist Licence Testing Officer (LTO) or – in the case of drivers identified as having complex medical conditions or cognitive impairments – by an OT. The present paper presents some results from analyses of LTO on-road review tests. These are conducted by a small number of specialist LTOs, usually in an automatic, dual-controls vehicle with the LTO as supervising driver. The test usually commences from the driver's home and encompasses familiar locations such as the local shopping centre, medical facilities, and so

on. Most tests are during off-peak traffic conditions, include angle parking and/or kerb parking, and last at least 45 minutes.

PROJECT DATA

Information for analysis was extracted from VicRoads file records of score sheets and from associated licence holder records. Details of test performance, along with demographic, referral and medical details, were documented by a research assistant (an experienced occupational therapist), working under the supervision of the first author. Information was transcribed for later computer entry.

Sampling and driver details

The potential data set consisted of every motor vehicle licence review test undertaken during the preceding 12 month period (2000) for which there was an on-road test record. Cases were excluded if the test had been undertaken in the driver's own vehicle. A total of 533 cases were analysed, representing 496 individuals (a few had been tested more than once). Average driver age was 76.1 years (range 24 to 100 years; 233 were older than 80); 68% were males. Police were the main referral source (63% of cases), compared to medical referrals (23%), public/family members (8%) and "other", including self-referrals (3 %). The remaining referrals were from OTs and the VicRoads medical advisors.

RESULTS

Test outcomes

In the sample of 533 licence 'review' tests analysed, the LTO conducting the test failed 49% of drivers. Closely related to this, the LTO intervened, using the test vehicle dual controls if necessary, on at least one occasion (up to a maximum of 12 occasions) during 48% of the tests. Almost all drivers for whom there was an intervention were failed; very few (9 out of 533) were failed if no such intervention occurred, as shown in Table 1.

Table 1. Relationship between test pass/fail and whether or not there was an LTO intervention during the test.

	PASS	**FAIL**	Total cases
LTO Intervention	1	253	254
No Intervention	270	9	279
Total cases	271	262	533

Such interventions are grounds for immediate failure during entry-level licence testing. However, during review tests there is some accommodation of 'bad habits' that are common among experienced drivers and do not affect safety (eg. rolling over stop lines at intersections). Consistent with this general policy, it is usual to allow the test to continue following an LTO intervention, for as long as is considered safe. Due to this policy, in the present sample of review tests there were up to 12 interventions per test (mean = 3.6).

Situations in which LTOs intervened

LTOs intervened in a broad range of situations, which have been categorised in terms of specific combinations of driving manoeuvre–error–context. The most common combinations are shown in Table 2. Aggregating across different categories, it can be seen that the most frequent problems precipitating LTO interventions involved errors associated with intersection negotiation manoeuvres (n = 255), failure to give way or poor gap selection (n = 158), failing to maintain the vehicle in an appropriate position on the road (n = 149), inappropriate speed – either too fast or too slow (n = 116) and problems with low speed manoeuvres (n = 59).

Table 2. The most frequently recorded situations (manoeuvre–error–context combinations) in which there was an LTO intervention.

SITUATIONS IN WHICH LTO INTERVENTIONS OCCURRED (specific manoeuvre-error-context combinations)			# of occasions across all tests (n= 533)	# of license tests with one or more
Specific manoeuvre or aspect of performance	Error	Context		
Negotiate intersection	Fail to give way	Intersection: general	78	63
Negotiate intersection	Fail to give way	Intersection: roundabouts	24	23
Negotiate intersection	Poor judgement, e.g. in gap selection	Intersection: general	28	14
Negotiate intersection	Disobey other law, e.g. travel straight head from right turn lane	Intersection: general	36	31
Lane change/merge	Poor gap selection	Lane changing	28	25
Negotiate intersection	Position on road	Intersection: turning right	45	35
Negotiate intersection	Position on road	Intersection: general	44	32
Maintain lateral position	Position on road	Straight stretch of road	60	40
Maintain progress	Speed too fast	Straight stretch of road	66	46
Maintain progress	Speed too slow	Behaviour affects other vehicles	50	34
Low speed manoeuvre	Poor judgement, e.g. in clearance margins	Parking	32	28
Low speed manoeuvre	Gap selection	Parking	27	22

Performance scores and errors recorded during the test

Separately from situations requiring interventions, LTOs record specific errors in relation to each of six types of driving manoeuvre or aspect of performance: intersection negotiation, lane-changing or diverging, position on road, low speed manoeuvres, safety margin and car control. The form layout permits scoring according to satisfactory/unsatisfactory criteria for each observation opportunity. Driving manoeuvre categories, subtasks and errors are drawn from POLA (Programmed Observation for Licence Assessment) – the Victorian entry level licence test (VicRoads, 1999). For the purposes of the present analysis, a percentage score was calculated for each of the six performance categories, representing the percent of observations that were recorded as satisfactory. Scores are shown in Table 3, along with the mean number of observations in each category per test**.**

Table 3. Driver Performance Scores (mean percent of observations recorded as satisfactory, i.e. no error recorded) for each of six categories of driver performance observations.

	DRIVER PERFORMANCE SCORES					
	Intersection Negotiation	**Lane-Changing /Diverging**	**Position on road**	**Low Speed Manoeuvre**	**Safety Margin**	**Car Control**
Performance score mean (range of number of observations per test)	**59%** 16.2 (4 – 29)	**35%** 3.2 (0 – 15)	**60%** 6.5 (0 – 16)	**55%** 1.6 (0 – 3)	**89%** 3 (0 – 5)	**86%** 2.7 (0 – 3)

Each of the performance scores above was based on the percentage of satisfactory observations (total number of performance opportunities completed successfully divided by total number attempted) for each of the six types of performance categories. When performance was not satisfactory, errors were recorded. The different types of errors recorded within each of the six performance categories are shown in tables 4 to 7.

In Table 4 it can be seen that the most frequent errors made by drivers in changing lanes and low speed manoeuvres were failure to look back over the shoulder to check that it was safe, followed by failure to check mirrors and failure to use indicators. When negotiating an intersection, failure to check mirrors and to use turn indicators were the two most common errors, followed by poor judgement (usually relating to gap selection), vehicle positioning during a turn, failure to obey the road sign or signal, and poor approach (safe approach speed and smooth deceleration).

Table 5 shows errors recorded during observations of the driver's maintenance of appropriate vehicle position and speed. It can be seen that poor positioning of the vehicle on clearways without any lane markings was the most common type of error, followed by poor lane keeping, and travelling too slowly for the conditions. Exceeding the speed limit was less common, and travelling too fast for the conditions was rare.

Table 4. Types of error: percent of all tests (n=533) on which the error was recorded, and mean number of errors per test when errors made – separately for Low Speed Manoeuvres, Intersection Negotiation & Lane Changing.

ERROR TYPES	**Related to Low Speed Manoeuvres**	**Related to Intersection Negotiation**	**Related to Lane Changing**
Fail to turn head to check back over shoulder	45% of tests; Mean # = 1.4	N/A	62% of tests; Mean # = 3.4
Fail to check mirrors	13% of tests; Mean # = 1.3	69% of tests; Mean # = 6.5	26% of tests; Mean # = 1.9
Fail to use turn indicators	12% of tests; Mean # = 1.3	49% of tests; Mean # = 2.7	31% of tests; Mean # = 1.8
Poor gap selection	11% of tests; Mean # = 1.1	N/A	10% of tests; Mean # = 1.1
Poor positioning of vehicle	10% of tests; Mean # = 1.2	N/A	N/A
Poor gap selection/judgement	N/A	43% of tests; Mean # = 1.9	N/A
Poor position on road/when turning	N/A	39% of tests; Mean # = 2.1	N/A
Fail to obey sign/signal	N/A	30% of tests; Mean # = 1.6	N/A
Poor approach (speed before an intersection)	N/A	14% of tests; Mean # = 1.8	N/A
Poor speed control for lane changing	N/A	N/A	2% of tests; Mean # = 1.1

Table 5. Types of error: percent of all tests (n=533) on which the error was recorded, and mean number of errors per test when errors made: Position on Road and Speed Control.

ERROR TYPES related to maintenance of appropriate speed and position on the road Percent of tests on which error type was recorded, and mean number of that error type per test				
Unlaned clearway	**Lane keeping**	**Too slow for conditions**	**Exceeding speed limit**	**Too fast for conditions**
40% of tests; Mean # = 3.2	34% of tests; Mean # = 2.6	31% of tests; Mean # = 3.0	17% of tests; Mean # = 2.0	3% of tests; Mean # = 2.5

Errors related to maintenance of adequate safety margins (separately from intersection or lane changing performance) are shown in Table 6. These were rare, except for driving too close to parked cars which was recorded in 15% of tests.

Table 6. Types of error: percent of all tests (n=533) on which the error was recorded, and mean number of errors per test when errors made: Safety Margins.

ERROR TYPES related to maintenance of safety margins Percent of tests on which error type was recorded, and mean number of that error type per test			
Parked Cars	**Following distance**	**Stop too close**	**Too close to object**
15% of tests; Mean # = 1.6	4% of tests; Mean # = 1.2	2% of tests; Mean # = 1.2	2% of tests; Mean # = 1.2

Errors relating to car control were least common, as shown in Table 7. The small proportions of tests in which such errors were noted is not surprising given that these were experienced drivers, driving mostly automatic cars and car control skills are usually considered to be the most highly automatised, making them most resistant to the effects of ageing-related decreases in level of attentional resources (Bolstad & Hess, 2000). Of these errors, steering was most often affected (steering technique), possibly due to inadequate attentional resources being available during some situations when the driver was distracted, focussing attention on other issues.

Table 7. Types of error: percent of all tests (n=533) on which the error was recorded, and mean number of errors per test when errors made Car Control.

ERROR TYPES related to car control Percent of tests on which error type was recorded, and mean number of that error type per test			
Steering	**Braking**	**Accelerator**	**Gear choice**
12% of tests; Mean # = 2.2	5% of tests; Mean # = 2.0	3% of tests; Mean # = 2.4	1% of tests; Mean # = 1.7

Predictors of test outcome (pass/fail)

As reported earlier, tests during which there was at least one LTO intervention almost invariably resulted in the driver failing, and only nine drivers failed in the absence of any LTO intervention. From this it appears that whether or not the LTO had to intervene was the primary determinant of test outcome. LTOs did not calculate any scores in arriving at their pass/fail decision. It was therefore of interest to identify the predictive value of the performance scores calculated for the present study, which were based on all observations recorded by the LTO throughout the test, in relation to test outcome. Logistic regression analysis was used, which required recoding of the non-normally distributed performance scores into either three or four categories.

Entering the six performance scores into the logistic regression model correctly predicted 93.9% of pass/fail outcomes ($\chi^2 = 232.7$, p = .000; Nagelkerke $R^2 = .84$). Addition of driver age to this model did not improve prediction. The variables most strongly associated with test outcome were scores related to negotiating intersections, and to maintaining the vehicle in an appropriate position on the road. Omitting the two or three weakest variables reduced the predictive power of the model very little; the full model is shown in table 8; table 9 shows the bivariate correlation matrix.

Table 8. Logistic regression model.

Variables	Wald	Significance	Exp(B)
Intersection Negotiation Score	24.68	.000	.04
Position on Road Score	13.50	.000	.15
Lane Changing	2.39	ns	.43
Low Speed Manoeuvring	0.03	ns	.94
Car Control	1.01	ns	.45
Safety Margin	7.10	.008	.10
Driver Age	1.15	ns	1.04

Table 9. Bivariate correlation matrix (Spearman's rho).

	Performance Scores						Age
	Lane Changing	Low Speed Manouevres	Safety Margins	Car Control	Intersection Negotiation	Position on Road	
Low Speed Manoeuvres	.11						
Safety Margins	.06	-.32					
Car Control	.06	-.04	.16				
Intersection Negotiation	.03	-.29	.54	.15			
Position on Road	.07	-.13	.26	-.08	.09		
Age	.18	-.04	.07	-.10	-.08	-.06	
Test Outcome	-.66	-.59	-.33	-.40	-.83	-.63	.39

DISCUSSION

If it is assumed that errors requiring LTO interventions are a valid assessment criterion, it seems that the types of error currently being recorded in the Victorian LTO licence review test are suitable for use in assessing older drivers, at least those without major physical or cognitive impairments as in this sample. Future analysis will investigate in greater detail the relationship between specific types of error and test outcome for comparison with other studies, for example, with the work of Staplin and colleagues (1998). At the very least, the high proportion of cases correctly classified on the basis of errors made throughout the test shows that the LTOs conducting these tests are operating in a highly reliable manner, with little if any effect of other factors such as referral source or documented medical details.

Errors associated with LTO intervention were highly predictive of membership of the fail group – a relationship supported by Brendemuhl et al (1988) and Hunt et al (1997). Previous research by Dobbs et al (1998) represents the most comprehensive previous work in this field. They found that errors most predictive of Pass/Fail outcomes were: hazardous errors (i.e. likely to require LTO intervention or accommodation by surrounding traffic); positioning errors (less major than those included in hazardous errors); overcautiousness (comparable to ' Speed too slow', or Progress impeding other drivers); scanning errors (poor observation, head checks, etc). These errors together predicted 57% of variation in global performance ratings. No such global ratings were available in the present study independent of test outcome itself. Outcome was based on the LTO's global rating, since this was no doubt influenced by recorded errors, the higher percentage of cases correctly classified in the present regression analysis is not surprising.

The types of errors most strongly related to test outcome in the present study are consistent with other published findings. In particular, older drivers' are known to have difficulty coping with intersections, and older drivers are more likely than others to be involved in intersection accidents (Fildes, 1997; Hakamies-Blomqvist, 1993; Ryan, Legge, & Rosman, 1998) which is usually interpreted as evidence of their decreased information processing capacity and related propensity to become cognitively overloaded in complex situations. Also, older drivers' compensatory mechanisms tend to break down in ambiguous and complex driving situations such as at some intersections, especially in individuals with perceptual and cognitive deficits (Brouwer & Ponds, 1994). Schlag (1993) comments that "elderly drivers require more information before they decide, and they need more time for their decisions. This is especially true under conditions of insecurity and complexity"(p. 54). Similarly, Hunt et al. (1997) found in a comparison of older drivers with early dementia and an age-matched control group, that those with dementia had greater difficulties at intersections, slower speed, worse lane control, and more unexpected and frequent braking than the controls.

While the content and structure of the current licence review test is excellent, the common use of self-selected routes close to the homes of drivers undergoing testing may sometimes result in an inadequate number of opportunities for observation of the full range of errors (seen by zero values for 'range' of number of observations per test, in Table 3). Testing in some rural areas and outer suburban environments may pose particular concerns. Clearly, the needs of the client group have to be balanced against those for a reliable, equitable and safe assessment system. One possibility would be to ensure that tests on routes that do not meet a standard set of criteria are the basis for only a 'restricted' licence (confining drivers to their local area) consistent with practice by OT driver assessors.

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