

Design of on-road test routes: validity issues for assessment of functionally impaired drivers

Di Stefano, M.¹, Macdonald, W.²

¹School of Occupational Therapy; ²School of Human Biosciences
La Trobe University, Bundoora, Victoria, Australia
email: m.distefano@latrobe.edu.au

Abstract

Licensing authorities are faced with the challenge of designing on-road assessment procedures that are both valid and reliable. In the case of drivers with diagnosed medical conditions or disabilities, requirements for valid assessment need to be considered in relation to the kinds of functional impairments that might reduce driving competence and increase crash risk; an important determinant of assessment validity is the kind of test route used. This paper describes the characteristics of routes, including associated driving manoeuvres and traffic conditions, which are currently being used in Victoria by specialist occupational therapy driver assessors (OTDAs).

Data were obtained by in-depth interviews of 22 OTDAs, representing 50% of the total group active in Victoria at the time of this study; seven were based in rural or regional locations. All OTDAs reported using a standard test route for clients seeking an open (i.e. not geographically restricted) licence. Compliance with professional guidelines was very high for items designated as compulsory, but was more variable for those categorized as desirable. As well as variation between routes in numbers of each main type of driving manoeuvre, differences between rural versus urban routes were noted, with those in rural areas being less cognitively demanding. Implications for more detailed specifications of standard route requirements for such assessments are discussed, focusing particularly on requirements to achieve greater validity.

Keywords

Driving test, test routes, functionally impaired driver, occupational therapist driver assessor

Introduction

The development of more valid and equitable driving tests needs to take account of empirical evidence concerning current practice. In the case of Victorian drivers with diagnosed medical conditions or disabilities which might significantly reduce their driving competence, assessment requires information about the current practices of Occupational Therapy Driver Assessors (OTDAs), since these assessments are referred to in legislation and accepted as a license test in this jurisdiction (1). To promote a high standard of OTDA professional practice, professional guidelines have been developed jointly by the OT professional group and the licensing authority (2, 3). Such guidelines which cover referral, off and on-road assessment, documentation and communication requirements as well as licensing procedures, were initially developed in the mid-1980s, reviewed in the late 1990s, and are currently applied nationally, to varying degrees (4).

Conceptual frameworks to support validity

In developing and implementing a test of driving performance, it is important to ensure that it will be valid for its intended purpose. At the very least, it should have construct and content validity. *Content* validity is secondary to construct validity; it requires that the test incorporates a representative sample of performance components for each construct to be assessed. *Construct* validity requires that the behavioural dimensions, or constructs, that are measured in a test should validly represent those aspects of performance that are most relevant – reflecting key components of the activity, and appropriate in view of the assessment *objectives*.

The objectives of OTDA driving assessment are somewhat different from those of entry level licence tests, although both have a paramount concern with road safety. The great majority of OTDA clients are *not* novice drivers, so skill development is not a central issue as it is in entry-level licence testing. Rather, most OTDA clients are experienced but functionally impaired drivers, and there are a range of possible purposes of their assessment. These are primarily to identify and assess the extent of negative impacts of

their particular medical, disability or ageing conditions on their driving competence. Additional objectives might be to identify and assess the need for driver training that would assist in development of effective compensatory behavioural strategies, or to identify the most appropriate kind of compensatory vehicle modifications. Further, (as in Victoria), sometimes there is a requirement to establish whether the driver demonstrates sufficient competence in executing a range of driving manoeuvres in a wide range of road-traffic conditions to justify maintenance of either a full or a restricted driver licence (5,6).

With these aims in mind, conceptual frameworks to support identification of requirements for establishing the construct validity of OTDA assessment procedures have been discussed by Macdonald, Pellerito & Di Stefano (7). Based on this work regarding construct validity of OTDA assessment procedures, on-road evaluations of driving performance (5) and information processing concepts (8), the following list identifies the key driver competencies and aspects of performance that need to be addressed by an OTDA.

Perceptual-Cognitive Driving Competencies

- Accurate schemata, mental models, and expectancies concerning road traffic system operations and behavior of other drivers – which supports more automatized perceptual/cognitive performance and so increases the availability of attentional resources for allocation to other aspects of driving performance
- Sufficiently fast information processing rate to enable perception, cognitive processing and well coordinated responses to the large amounts of information in complex and often fast-changing traffic situations
- Maintain efficient visual searching/scanning of the environment (using vehicle headlights as required)
- Well developed perceptual / cognitive skills (based on mental models and expectancies): the ability to “read” traffic situations, maintain high situation awareness, and identify specific hazards in good time to respond effectively
- The ability to select appropriate driving responses taking account of own abilities in relation to task demands, based on situation awareness and perception of specific hazards together with personal “calibration”
- Executive control abilities and skills in dividing attention between different aspects of the overall task, modifying in accord with changing task demands and priorities, sustaining vigilance as required and resisting distractions
- Can sustain concentration for extended periods

Vehicle Control Competencies

Execute motor responses in a timely and well-coordinated fashion, supported by highly automatized motor skill components. This includes:

- Change speed or lateral position smoothly
- Maintain safety margins by appropriate
 - Speed for conditions
 - Lateral and anterior/posterior position within lane or carriageway
 - Position in relation to stationary objects/vehicles
- Control vehicle smoothly and accurately during low-speed manoeuvres
- Use secondary controls (e.g., vehicle horn and turn indicators) as required.

Perceptual-cognitive competencies are centrally important. This is because they are implicated in and to some degree underpin all aspects of driving performance, and because drivers with perceptual-cognitive impairments have been shown to have an increased crash risk (9-11). Accordingly, it is essential that OTDA test routes are designed to ensure adequate opportunities for the assessment of perceptual-cognitive competencies in a wide range of road traffic conditions, including the kinds of complex, rapidly-changing and highly attention-demanding situations that are often encountered by drivers in modern road traffic systems.

This paper reviews some findings from a research program to assist in further developing the procedures used by OTDAs. Specifically, results documenting the characteristics of the test routes currently used in Victoria are reported and evaluated in relation to assessment validity requirements.

Specific questions investigated were:

- What are the characteristics of the drivers undertaking OTDA on-road assessment in Victoria?

- How do the characteristics of OTDAs' standard on-road assessment routes compare with the route design criteria specified in the professional guidelines?
- Does route content vary between urban and rural locations?
- What opinions are held by this expert group regarding changes or additions to route features that might promote improved assessment?

Methods

Recruitment of Occupational Therapists

The target group for this study were OTDAs currently working in Victoria. Recruitment occurred over a two month period. Information about the study and an invitation to participate was mailed to all on the state licensing authority's (VicRoads) list of registered OTDAs, and to others listed in the professional association's private practitioner's resource book. One reminder letter was sent to non-respondents. Volunteers were also solicited via the professional newsletter and state OT Driving Special Interest Group. Forty four OTDAs were identified as currently active at the time the study was implemented.

Volunteers were included if they had been active in conducting standard assessments on this route (as opposed to 'local area' assessments) *during the previous two years*.¹ Participating OTDAs were paid a token amount to compensate them for their time and costs. Approval for the study was obtained from the La Trobe University Human Ethics Committee.

Semi-structured interviews

Interviews were usually held at the participant's workplace. Detailed notes were made on the interview schedule relating to demographic, client characteristic and OTDA opinion details. In addition, route information was collected based on categories included in the OTDA professional guidelines for conducting on-road assessments.

Results

Characteristics of the OTDAs and their clientele

A total of 22 therapists met the criteria for participation and were given approval to participate by their managements: seven were based in rural or regional centres whilst the remainder were located in suburban areas of the state's large capital city (Melbourne). This sample represented 50% of the target population. Typical reasons given by OTDAs for being unavailable to participate were their absence on leave, or other commitments, during the data collection period.

The 22 participants had worked in the driver assessment field for an average of 8 years (minimum of 2 years) and performed on average 93 assessments per year (range 12–280). They were asked to nominate two issues related to clients' performance impairments as the most prevalent in their client group. Fifteen OTDAs stated that impairments usually related to *both* physical and cognitive medical conditions, and the second most commonly reported issue was general ageing-related impairment. Almost 60% of the participating OTDAs worked primarily with clients aged 66 years or over, with only 9% (n = 2) dealing mainly with clients aged 26–45 years. Across all OTDAs, the most prevalent medical conditions among their clients were cerebrovascular accidents, dementia, closed head injuries and more general, ageing-related impairments.

The great majority (n = 18) of OTDAs had used the same standard assessment route for three or more years; the remaining four had been using their current route for one to two years. The majority of OTDAs (n = 17) had undertaken the task of route development or modification jointly with a driving instructor who was experienced with the kind of routes used in Victorian entry level licence testing, and half (n = 11) reported

¹ Standard assessments entail use of a pre-established route with an associated set of detailed driver instructions concerning the specific manoeuvres to be performed. Successful completion of a standard assessment permits the driver to retain a driver licence without any geographical restrictions. In contrast, a 'local area' assessment entails driving around a route in the vicinity of the driver's own home; if completed satisfactorily, such an assessment results in a conditional licence whereby driving is permitted only within that defined region.

having referred to the route design guidelines specified by the OT professional association's competency standards for impaired driver assessment (2,12).

Description of OTDA standard assessment routes

Each of the 22 participating OTs responded to questions about their standard assessment route, some of which is summarised in Table 1 in relation to the route design criteria specified by the OT professional guidelines for route design. (The OTDAs were not told at the time that the listed route features were those specified in the guidelines.) It can be seen that overall compliance was very high for these 'compulsory' features across both the total group and for the regional/rural sub-group.

Table 1. Percentage of compulsory (according to professional guidelines) route features reported to be used, separately for the whole OTDA group versus the sub-group working in regional/rural areas.

ROUTE FEATURES SPECIFIED IN GUIDELINES AS COMPULSORY	Percent of all OTDAs (n = 22) reporting use in standard route	Percent of Regional / Rural OTDAs (n = 7) using in standard route
<i>Drive along following road with the following features:</i>		
Single lane road with centre line	100	100
Multi-laned road	100	100
Crossing (pedestrian/children/railway)	96	100
Strip shopping centre	91	86
Single lane road with no centre line	82	71
<i>Negotiate intersection (straight through or turn) in the following contexts:</i>		
Intersection w. parked cars occluding view	100	100
Intersection controlled with Give Way sign	100	100
Intersection controlled with Stop sign	100	100
"T" intersection	100	100
Roundabout	100	100
Intersection controlled by traffic lights	96	86
<i>Perform other driving tasks or manoeuvres:</i>		
Quiet drive through low density area / familiarisation opportunity	100	100
Lane change to left	100	100
Lane change to right	100	100
Parking: 90 degree/angle, or reverse	100	100
Vary required vehicle speed	100	100
Lane change when instructed, and as required e.g. to go around parked cars	91	86
Locate a street sign	32	29
<i>Types of environmental conditions</i>		
Low density traffic	100	100
High density traffic	100	100
Road with visual distractions, e.g. traffic, pedestrians, scenery	100	100
Distractions e.g. intentional general discussion /answering questions in vehicle to create distraction	82	100

Table 2 shows comparable data for route features specified in professional guidelines as 'desirable' rather than compulsory. As might be expected, there is much more variability in the percentages of such features represented in these 22 standard routes.

Table 2. Percentage of ‘desirable’ (according to professional guidelines) route features reported to be used, separately for the whole OTDA group versus the sub-group working in regional/rural areas.

ROUTE FEATURES SPECIFIED IN GUIDELINES AS ‘DESIRABLE’	Percent of all OTDAs (n = 22) reporting use in standard route	Percent of Regional / Rural OTDAs (n = 7) using in standard route
<i>Drive along road with the following features:</i>		
Speed zone changes	100	100
Merging / slip lane	91	100
Road marking information (e.g. exit arrows)	77	86
Speed humps	77	57
Curved /highly cambered road	73	57
One way street	64	86
Freeway / Highway (70+km/h speed limit)	46	43
100km/hr speed limit	46	43
Trams	36	14.3
No entry street	27	57
Road dips	27	43
Narrow bridges (one car at a time)	9.1	14.3
Unsealed roads (specified for rural areas)	0	0
<i>Negotiate intersection (straight through or turn) in the following contexts:</i>		
Traffic lights with a turning arrow	96	86
Non uniform intersection	77	57
Multilaned roundabout	59	43
<i>Perform other driving tasks or manoeuvres:</i>		
Locate and negotiate a carpark	77	57
Turning onto a high speed road	73	57
Navigational task (e.g. return to entry point from within a shopping centre carpark)	59	57
“U” turn*	46	43
Simulated emergency braking	18	29
Overtaking	18	29
<i>Types of environmental conditions</i>		
Underground carpark	18	14.3

OTDA opinions regarding their current routes

The second group of interview questions prompted the OTDAs to report their opinions regarding their route: general satisfaction, need for improvements and route related recommendations relevant to developing National standards. The key results, presented separately for OTDAs working with urban or rural routes are presented in Table 3.

Table 3: Details of OTDA opinions regarding current “standard” routes. NB: responses presented in terms of % but note small numbers for the rural/regional routes group.

Question posed	Percent of OTDAs (n = 15) using urban/suburban routes	Percent of OTDAs (n = 7) using rural / regional routes
Satisfied that your on-road test route assesses the necessary driver competencies?	Yes mostly: 87 Yes often: 13	Yes mostly: 57 Yes often: 14 Yes sometimes: 14 No: 14
If you could, would you like to change any aspect of your route?	Yes: 93	Yes: 86

Question posed	Percent of OTDAs (n = 15) using urban/suburban routes	Percent of OTDAs (n = 7) using rural / regional routes
What features would you change?	Responses mainly related to <i>additional</i> features, of which the most common were: <ul style="list-style-type: none"> – Traffic present for lane change: 40 – Lane change on busy road: 33 – High speed driving (100km): 20 – Lane change at high speed: 20 – Strip shopping: 13 – Road hazard presence: 13 – Complex navigational task: 13 	Responses mainly related to <i>additional</i> features, of which the most common were: <ul style="list-style-type: none"> – More difficult parking task: 57 – Lane change on busy road: 43 – High speed driving (100km): 43 – Traffic present for lane change: 43 – More traffic generally: 43
Any recommendations for National OTDA standard route design guidelines?	– Compulsory 100 km speed zone: 27	– Compulsory 100 km speed zone: 57

Discussion

This study was conducted to document the kinds of driving manoeuvres and traffic conditions characterising the standard routes currently used by Victorian OTDAs, including the extent to which these adhere to professional guidelines for route design and OTDAs' opinions concerning possible improvements.

The study sample consisted of 22 OTDAs, all with substantial experience using standard assessment routes. They worked mainly with older drivers presenting with mixed cognitive-physical or primarily cognitive issues. Route characteristics were compared to those documented in the sub-section of the professional guidelines relating to on-road assessments: this refers to route feature types but not numbers of each type. Reported compliance with these guidelines for the design of OTDA standard routes was generally high regarding the inclusion of compulsory test features (Table 1), which supports the applicability of these features in both urban and regional/rural locations. Further research is warranted to explore why compliance was particularly low for "locating a street sign." However, for route features listed as 'desirable', inclusion levels were much more variable (Table 2). These latter features included some quite demanding driving manoeuvres or conditions which are routinely encountered by many drivers (e.g. negotiating multi-laned roundabouts, 100km speed zones, and overtaking). Their absence from some standard test routes raises the possibility that these routes may be lacking in sufficiently complex features to adequately test a driver's perceptual-cognitive resources and co-ordinated motor responses under time pressure; some of the key driver competencies described in the introduction to this paper.

This is a particular concern when evaluating drivers with compromised cognitive or motor abilities for whom one of the key test goals is to assess the impact of impairment upon driver competencies; if some of the less demanding routes are accepted as valid, these drivers may be passed inappropriately and granted a non-restricted license. The issues relating to adequate route difficulty were raised by the OTDAs themselves, especially those based in rural/regional areas (Table 3): suggestions for improving route design often referred to increasing task complexity by means such as high speed driving and the presence of more traffic. Also, it is noteworthy that OTDAs reported increasing test difficulty by engaging the driver undergoing assessment in informal conversation during some segments of the assessment drive and including visually distracting roadways in their test routes to assess attentional resources and allocation.

Implications for improvement of test validity

It is clear that test route features – including the driving manoeuvres required, levels of traffic and the road and environmental conditions – will together have a major impact upon both the construct and

content validity of the on-road assessment process. These requirements must be balanced against the need for routes to be calibrated in relation to difficulty and specific task requirements that are agreed as reasonable expectations for *all* licensed drivers. The need for road tests to be sufficiently difficult is widely acknowledged (13-17) however little is mentioned in the literature about *the urban versus rural testing context*. The design of on-road routes must also consider other factors: Occupational Health and Safety standards may be compromised when assessing drivers with unpredictable cognitive or behavioral limitations in high demand driving contexts and the inclusion of some route features may be impractical due to time or access issues.

In the interviews, many OTDAs sought information about *specific numbers of items* for testing routes. Such detailed assessment requirements are difficult to find for any type of road test, and are commonly only discussed for tests used for research purposes (18). More research efforts should be directed towards developing and trialling detailed test route criteria that also considers urban/rural context issues. This will be helpful to establish whether some test routes should be designated as “low demand” and therefore only suitable for assessing drivers who are willing to accept a local area licence condition.

Conclusion.

The currently implemented OTDA professional guidelines for test routes were developed in the late 1990s, around the same time that Victoria’s POLA entry-level test was introduced. It is timely now, with the introduction of a new empirically developed Victorian Graduated Licensing Test, to also revisit the OTDA test procedure, with a view, at least initially, to improving test validity. This study has provided evidence that some common test route standards are applicable throughout the state. However, there is suggestive evidence that the use of some routes, particularly in rural/regional areas, might need to be confined to ‘local area’ rather than standard assessments.

References

1. **Victorian State Government.** Road Safety Act 27 and Road Safety Procedures Regulations. 1988 Victorian Government Printers.
2. **OT-Australia Victoria.** (Author). Competency standards for Occupational Therapy Driver Assessors. 1998.
3. **VicRoads.** *Resources and Guidelines for OT Driving Assessors* Melbourne, Roads Corporation; 2000.
4. **Di Stefano, M. & Macdonald, W.** An Introduction to Driver Assessment and Rehabilitation, in: W.Curtin, M. (Ed). *Occupational Therapy and Physical Dysfunction*. (6th ed). Philadelphia: Elsevier; 2008 (in press).
5. **Di Stefano M, Macdonald W.** On-the-Road Evaluation of Driving Performance. In: Pellerito J, ed. *Driver Rehabilitation and Community Mobility: Principles and Practice*. St. Louis, Missouri: Elsevier Mosby; 2006:255 - 274.
6. **Stav WB.** *Driving Rehabilitation: A guide for Assessment and Intervention* San Antonio: PsychCorp; 2004.
7. **Macdonald W, Pellerito J, Di Stefano M.** Introduction to Driver Rehabilitation and Community Mobility. In: Pellerito J, ed. *Driver Rehabilitation and Community Mobility: Principles and Practice*. Philadelphia: Elsevier; 2006:5 - 35.
8. **Wickens CD, Hollands JG.** *Engineering Psychology and Human Performance*. 3rd ed New Jersey: Prentice Hall; 2000.
9. **Dubinsky RM, Stein AC, Lyons K.** Practice Parameter: Risk of Driving and Alzheimer’s Disease: an evidence-based review. *Neurology*. 2000; 54(2 of 2):2205 - 2211.
10. **Kasznik A, Keyl P, Albert M.** Dementia and the older driver. *Human Factors*. 1991;33(5):527-537.
11. **Stutts J, Stewart JR, Martell C.** Cognitive test performance and crash risk in an older driver population. *Accident Analysis and Prevention*. 1998; 30(3):337 - 346.
12. **Schneider C.** Competency Standards for Occupational Therapy Driver Assessors. In: Best M, Di Stefano M, Evans O, eds. *Implementing Change: the role of Standards*. Melbourne, Australia: Ergonomics Society of Australia, Inc; 1998: 158 - 162.

13. **Christie R.** (National Road Transport Commission). Driver Licensing Requirements and Performance Standards including driver and rider training. 2000.
14. **Fox GK, Bowden SC, Smith DS.** On-Road Assessment of Driving Competence After Brain Impairment: Review of Current Practice and Recommendations for a Standardized Examination. *Archives of Physical Medicine and Rehabilitation*. 1998; 79(October, 1998):1288 - 1296.
15. **Macdonald W.** (VicRoads). An Evaluation of Occupational Therapy Driver Assessment Protocols and Recommendations for a Reliable and Valid Standard Test: Report to VicRoads. 1996
16. **Siegrist SE.** (Accident Prevention bfu Human Research Department, Swiss Council.). Driver Training, Testing and Licensing: Towards theory -based management of young drivers' injury risk in road traffic. Results of EU - Project GADGET, Work Package 3. 1999. Report No.: 1/99/500.
17. **Withaar FK, Brouwer WH, Van Zomeren AH.** Critical Review: Fitness to drive in older drivers with cognitive impairment. *Journal of the International Neuropsychological Society*. 2000;6:480 - 490.
18. **Mallon K, Wood JM.** Occupational therapy Assessment of Open-Road Driving Performance: Validity of Directed and Self-Directed Navigational Instructional Components. *American Journal of Occupational Therapy*. 2004; 58(3):279- 286.