Medical office-based cognitive assessment as a screening tool for fitness to drive in older adults

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Summary

Background

Demographic ageing means more older drivers on the road than in previous decades. Older drivers have a higher crash rate per kilometre driven and the driver contribution to those crashes is higher in older age than middle aged drivers. Age is the strongest risk factor for cognitive impairment.

Currently, there is no universally accepted protocol for a general practice (General Practitioner (GP)/Nurse Practitioner (NP)) medical office-based driving assessment or for the use of cognitive tests in fitness to drive assessment. There is also no universally accepted cognitive test for the purpose of assessing fitness to drive.

Recognising the importance of public safety and being sensitive to the personal impact of driving cessation on the older person's independence and emotional well-being, as well on those dependent on them, this report is offered to inform GP/NP assessors and those involved in the fitness to drive assessment process.

Findings

- For older people who are considered to be physically and mentally healthy, current evidence does not support the routine use of cognitive assessment as part of fitness to drive assessment.
- Global cognitive assessments (e.g. Montreal Cognitive Assessment **(**MoCA), Mini-Addenbrooke's Cognitive Examination (mini-ACE)), while giving an indication of general cognitive ability, do not accurately predict on-road driving performance.
- Trail Making Test (TMT), Maze assessment and reaction time tests are moderately associated with on road driving performance.
- A battery of assessments (e.g. DriveSafe DriveAware, Fit2Drive) improves the predictive accuracy of driving performance but have reduced clinical utility due to increased time and complexity of administration, and they may not be universally accessible.
- Driving is a complex, cognitively demanding activity. There is no single cognitive assessment that accurately represents driving performance. In assessing driving ability, a person's health trajectory remains an important consideration, alongside information from support people or informants about driving safety, prior crash history, minor collisions or near miss events. These factors should be considered in conjunction with all aspects of NZTA's *Medical aspects of fitness to drive, a guide for health practitioners* (https://www.nzta.govt.nz/assets/resources/medical-aspects/Medical-aspects-of-fitness-to-drive-a-guide-for-health-practitioners.pdf)
- When the assessor is uncertain about the individual's capacity to drive safely for cognitive or functional reasons, the On-Road Safety Test (ORST) can be considered alongside other medical assessments, to give a more complete indicator of driving ability. The ORST is a free, brief, non-clinical on-road test available throughout New Zealand from participating offices of VTNZ, VINZ and the AA. Alternately, where the main concern is about cognitive deficit, an Occupational Therapy Driving Assessment can give more specific information about the impact of cognition on driving ability and assist with making recommendations about driving restrictions and driving cessation. Cost and regional variation impact accessibility.

Recommendations

- Whilst this literature review is primarily focused on cognitive assessment, visual acuity and standard visual field assessment, along with health stability, basic dexterity and foot and lower limb ability remain relevant.
- When the assessor has concerns about cognitive ability, the Trail Making Test (TMT) could be an alternative to more global cognitive assessment tools, such as the Mini-Mental

State Examination (MMSE), MoCA or Mini-ACE to reflect driving performance. Consideration of a test of reaction times may aid prediction of on road driving safety.

- Recognising there is no perfect office-based test, if there is uncertainty of cognitive or functional ability to drive, an On Road Safety Test or, if appropriate, an Occupational Therapy Driving Assessment will add useful information.

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Background

The population of Aotearoa is ageing, and the number of older drivers is increasing. Age is the strongest risk factor for cognitive conditions such as dementia and mild cognitive impairment (MCI). While many older people remain competent drivers, physical and cognitive decline can compromise driving safety. Individuals with neurological conditions (e.g. stroke, Parkinson's disease, traumatic brain injury) may experience deficits that affect their driving ability.[1] This review focusses mainly on aspects of cognition and driving, and we acknowledge there are many physical and health related conditions that are also important to consider.

There is an increasing number of older drivers on the roads as New Zealand's demographic ageing works its way through the population. Coupled with the increasing prevalence of dementia from 3.8%-4% among those age 60+ to 13.7%-14.4% in the 80+ [2], the number of cognitive assessments completed by healthcare providers is increasing proportionately.

Cognition and driving performance

Driving is a cognitively demanding activity that requires the integration of multiple mental processes including attention, memory, executive functioning, visuospatial perception and decision-making. In particular, the competing multiple complex attentional tasks are challenging for all. These functions enable drivers to perceive and interpret road conditions, anticipate hazards and respond appropriately. Even mild impairments in any of these domains can significantly increase crash risk, particularly in complex or high-pressure driving environments.[3] Cognitive impairment and dementia can lead to slower reaction times, difficulty in processing information and impaired judgment, all of which are critical for safe driving. Additionally, a reduced field of view (i.e. related to both vision and cognition) can make it harder to notice hazards in the peripheral vision and respond in a timely way, further increasing the risk of crashes.

Sometimes driving has been learned in early life and practiced consistently through life and so driving functions may be preserved despite other cognitive pathway loss. To some degree driving involves automatic responses linked to neural networks relatively protected in the early stages of dementia. The growing number of people living in the community with cognitive and memory problems, MCI and dementia drives the need to revisit the place of cognitive tests in driving assessment.

Road crash trends, 2020-2022

Data on all road crashes are maintained in a central register by NZTA. Age of drivers of light vehicles involved in fatal and serious road crashes are presented in Figure 1 and Figure 2. The number of light vehicle kilometres travelled (VKT) - 2020 -2022 is calculated. There are fewer older drivers than drivers in younger age groups and the total contribution to number of crashes contributed by older drivers is low. Older drivers drive less kilometres in a year than younger drivers, however older drivers have a higher rate of crash per kilometre driven (Figure 1). In addition, the driver contribution to fatal and serious road crashes is established using standardised procedures. Older drivers have a higher driver contribution to road crashes compared with other age groups (Figure 2).

It is important to interpret this road crash data cautiously as ageing alone is not a contributing factor to road crashes; many older adults continue to drive safely into their advanced age.

Multimorbidity and frailty related to ageing are more common in older adults. A survey in adults aged 80 years and above observed that being a low-mileage driver (driving ≤20km per week) was associated with a higher per-distance driven crash rate than for those driving >200km per week. Self-reported health is associated with mileage driven per week (i.e. low mileage drivers had reduced functional performance and more health conditions).[4] A collection of physical and cognitive health conditions likely put older drivers at increased risk of on road crashes and is the impetus for the office-based DL9 assessment of fitness to drive mandated by age criteria to ensure public safety and the safety of the older driver.

Note: DSI, Death and Serious Injury; VKT, vehicle kilometres travelled. Please see Appendix 1 for detail on the ascertainment of the NZTA crash data.

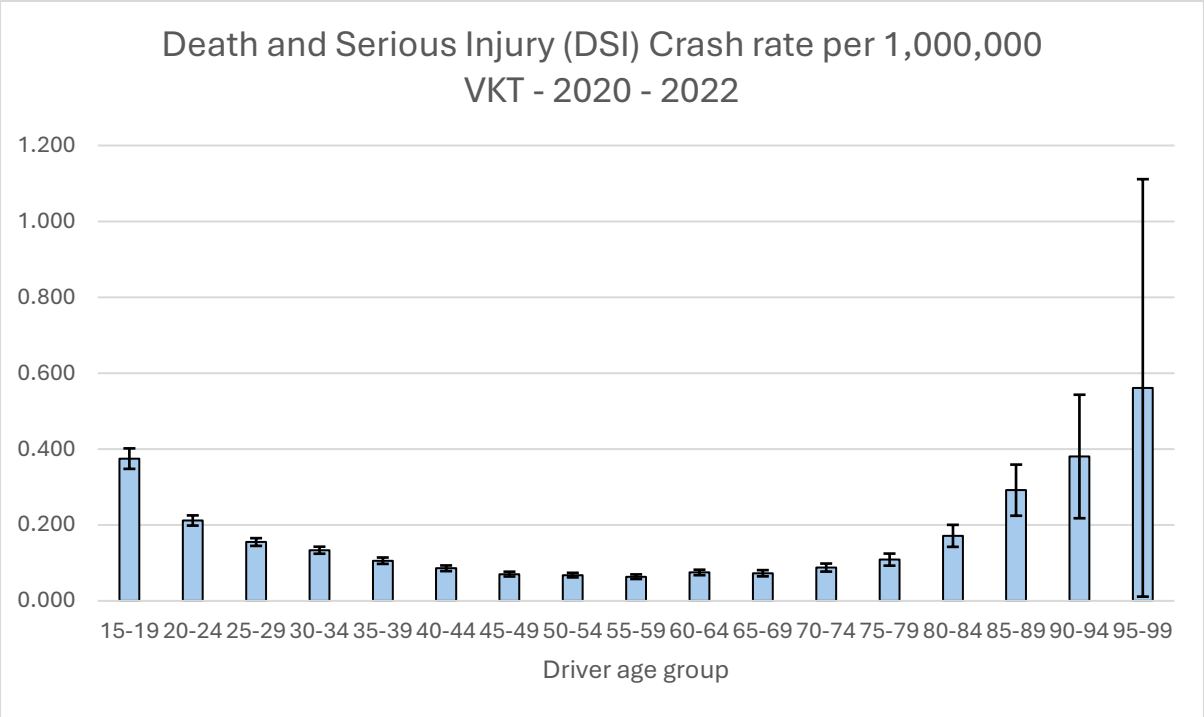

Figure 1: Crash rate per million kilometres driven by driver age group.

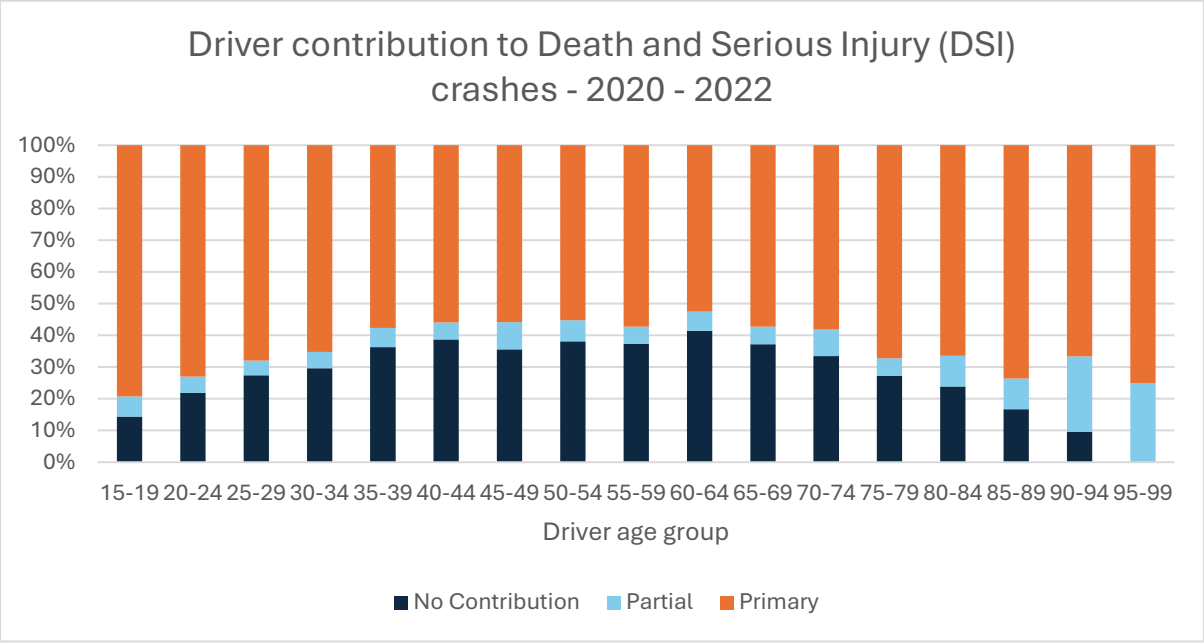

Figure 2: Driver contribution to fatal and serious light vehicle crashes by age group.

Current practice and challenges

Fitness-to-drive evaluations are mandatory for older people aged 75+ and involve a combination of self-reporting and a medical assessment. On-road driving tests are also available if required.

Cognitive assessments have been thought to offer a potentially efficient and objective method to screen for impairments that may affect driving. However, their use remains inconsistent, and there is no universally accepted protocol for their application in this context.[2] In addition there has been push back from advocates for older people about the routine use of cognitive screening during the medical assessment for driving. Discussions with GPs highlight the difficulties and joys of driver assessment with older people.[5]

An updated literature review

A growing body of research has explored the relationship between cognitive test performance and driving ability. A meta-analysis by Reger et al. (2004) found small but significant correlations between neuropsychological test performance and on-road driving outcomes.[6] Multiple composite batteries of tests appear to be better than individual cognitive tests in predicting driver safety,[1] and executive function, attention, visuospatial ability and global cognition are significant predictors of driving performance in individuals with Alzheimer's disease and MCI.[2]

NZTA acknowledged a recent concern raised by older adult advocacy groups about cognitive assessments completed in cognitively 'healthy' older adults by health practitioners to determine fitness to drive. Given the public safety implications and the personal impact of driving cessation, it is essential to base decisions on robust, evidence-based criteria. A comprehensive review of the utility of cognitive assessments was conducted to help clarify their role, guide clinical and licensing decisions, and ensure assessments are as fair, effective and ethically sound as possible.

This review did not include other non-cognition related aspects of the driving assessment. The Medical aspects of fitness to drive, a guide for health practitioners resource should be used as usual.

Literature search methods

Literature review: Research question: What is the sensitivity and specificity of off-road cognitive screening tools in predicting driving-related safety incidents among cognitively healthy community-dwelling older adults?

- Population: (healthy) older adults
- Context: Screening tool for fitness to drive (tools, free-no cost)
- Concept: Cognitive function
- Outcomes: crashes, motor vehicle collisions, on road driving performance.

We conducted a rapid scoping search to provide a broad overview of current findings on the association between cognitive assessment tools and driving-related safety incidents among cognitively healthy community-dwelling older adults.

The process involved:

- Keywords search

Keywords:	Synonym 1	Synonym 2	Synonym 3	Synonym 4	Synonym 5
cognitive assessment	neuropsychological testing	cognitive screening	mental status examination	cognition	psychometric evaluation
older adults	aged	elderly	ag*ing		
driving	driving performance	fitness to drive			
crashes	motor vehicle collisions				

- Limited timeframe from 2020 to present (September 2025)
- Sources: Databases Ovid MEDLINE, SCOPUS, Epistemonikos; publications recommended/referred by experts in the field.
- RT and NK screened all articles (review title, abstract) to select articles within the scope focussing on the ability for off-road cognition testing to predict on-road driver performance and road traffic crashes. This is followed by reviewing the full article to the purpose of the tools (description of the tools), key findings from the articles and cost/availability for clinical use. Several factors not related to cognition were also reviewed and commented on. Relevant evidence about other aspects of the driving assessment were also reviewed.

Interviews with experts

We also consulted with several experts with a special interest in older driver assessment with a range of expertise and background (see list below) seeking further understanding and sensing of literature findings and better contextual consideration.

Experts interviewed:

- Professor Susan Kurrle, Director, Cognitive Decline Partnership Centre, Faculty of Medicine and Health, Curran Professor in Health Care of Older People Northern Clinical School, University of Sydney.
- Professor Ian Cameron, Professor of Rehabilitation Medicine John Walsh Centre for Rehabilitation Research, School of Health Sciences, University of Sydney and author of ANZSGM Dementia and Driving position statement.
- Dr Rebecca McLean, Principal Investigator, NZ PATHS cohort study of older drivers, Senior Lecturer Department of Preventive and Social Health, University of Otago Dunedin.
- Dr Nicola Starkey, Professor in the School of Psychological and Social Sciences at the University of Waikato. Specialist driving simulation researcher.
- AP Lisa Keay, Epidemiologist and Visual Health researcher, Head of the School of Optometry & Vision Science, University of Sydney and developer of the DriveSafe DriveAware tool.
- Professor Katherine Wallis, University of Queensland and evaluator of the 3 domains driving assessment process.
- Dr. Matthew Croucher, Psychiatrist of Old Age, Te Whatu Ora | Health New Zealand.

Findings

There are probably a small number of older drivers at risk of crashing, and the task of identifying them without unfairly categorising and penalising 'false positive' test performers as “too risky to drive” is difficult. On the other hand, the cost of a ‘false negative’ is high from a public health perspective.

When considering appropriate tests for driving ability, the dynamic nature of performance requirements, and the competing attention load on cognition can be approximated to some degree. There are no perfect medical office-based tests for driving ability. Observing and assessing the driving performance in an on-road real world environment is the pragmatic way to assess performance and is argued to be the most accurate. Of course, on road testing may not be required as the majority of current drivers in older age are safe drivers.

- The On Road Safety Test (ORST) is available free in Aotearoa New Zealand.
- The Occupational Therapy Driving Assessment - involving an in-office (off-road assessment) as well as the on-road in depth driving assessment - provides more cognition specific information, however may be less accessible due to cost and is not available everywhere in NZ.

Predicting motor vehicle crashes is inherently complex. The accumulation of dynamic and largely uncontrollable risks on the road (e.g. other road vehicles, animals, weather elements), build on top of driver ability and behaviour as well as car performance to make this task extremely challenging.

Here we focus on the component that *cognition of the driver* adds to that mix. Assessment of components of cognition and their association with driving performance are considered.

Neuropsychology of driving.

Driving is probably one of the most complex instrumental activities. It requires synchronised activities of the neuropsychological system involving the sensory, cognitive and physical functions. Vision and hearing are vital for detecting stimuli. Cognitive function is vital for

- sustaining attention
- processing and managing multiple inputs
- making sense of information
- risk evaluation (i.e. anticipating others' behaviour - other drivers, pedestrians, cyclist etc.)
- holding information
- ignoring distractions while focusing on relevant cues
- judging distance, speed and positioning within the lanes (i.e. visuospatial processing and perceptual skills)
- making split second decisions and converting this information into psychomotor outputs
- executing coordinated movements in a timely manner.

While ageing is linked to sensory impairment, physical frailty and changes in cognitive function, a compensatory mechanism is often present to offset decline, such as planning routes, avoiding challenging conditions and driving less and slower.

Executive function, made up of cognitive flexibility and inhibitory control, provides the cognitive abilities for planning, prioritising, problem-solving and controlling impulses. Various tests (e.g. Trail Making Test) can assess executive function, but these were not developed for the complex neuropsychology system for safe driving. Reaction time tests assess the ability to perceive the surrounding environment, process the information and to initiate and execute a response. Reaction time is validated in tests of stopping distance and has high face validity for assessing driving performance.

In contrast, memory testing in the context of driving assessment can measure working memory and long-term memory, assessing a person's ability to remember and recall information relevant to driving tasks. For example, long term memory testing reflects how well a person can remember a route, knowledge and adherence to the rules; working memory holds information like a destination or a sequence of steps in their mind to complete the task. This is useful for following a map, remembering a complex route or recalling a sequence of actions. Memory testing is not as useful for safety aspects of driving performance.

Multidomain assessment tools are likely necessary to evaluate an older person's driving performance more accurately. Simulators can be useful for assessing reaction times and the attention shifts required for driving, but they may not be accessible to most clinics. Pen and paper or computer-based tools are a step down from on-road and driving simulation. A known challenge of these tools is balancing between the length of the assessment vs. usability in a clinic setting.

Synthesis of findings from the literature review

What are the current findings (since 2020) on the relationship between cognitive assessments and driving performance of healthy older drivers?

The literature review summary, outlined in Table 1, relates the utility of cognitive testing to driving performance. Associations with driving performance were found in some studies, however caution must be exercised in assuming causality. Specific cognitive assessments have been found to be associated with specific driving errors (e.g. errors when changing lanes), but they have low sensitivity for identifying unsafe drivers.[7] [8] Most cognitive assessments were not designed to evaluate driving performance, which may explain the poor prediction rates. It also should be noted that some tests may be measuring a combination of performance, such as the reaction time test, also contributed to by motor and neurological function as well as cognition.

Studies supporting an association with driving performance:

1. TMT-A (selective attention) and TMT B (set-shifting executive function and visual attention) test and driving performance. TMT was found consistently to be useful for screening for on-road performance. The accuracy of TMT in predicting the likelihood of passing or failing the on-road test is mixed but TMT-B demonstrates better accuracy than TMT-A.[9] TMT-A can be timed to understand the older persons dexterity related barriers to completion, and then TMT B timed to understand the additional cognitive ability in completion (on top of the functional aspects). There were no studies that considered literacy levels in test completion.
2. Simple reaction times (assessing reaction time and accuracy in response to stimulus) was moderately useful for screening driving performance.[10]
3. Visual Field of View (UFOV3, assess visual processing, visual screening, visual attention, and selective attention) was moderately predictive of driving performance.[10]

4. Block design (assessing visuospatial and visuo-constructive ability), Maze test (assessing attention, visuo-constructive ability, and executive function of planning and foresight) and Rey's Figure (assessing executive functions in planning capacity, time management for tasks and visuospatial skills) were moderately associated with driving performance.[8 10]
5. Traffic situational understanding and road sign testing (3-minute copy of 3 domains screening, and traffic sign naming test (TSNT)) and written exam for driving decision (WEDD) were moderately associated with driving performance.[11]
6. SIMARD-MD (assessed verbal memory, number processing (converting numbers to words), and sematic word fluency) was modestly associated with driving performance.[12, 24]

Aspects of cognition having **no or weak association** with driving performance included: global cognition screening scores such as MoCA, MMSE, Addenbrooks Cognitive Exam, digit span recall (short term memory), clock drawing and collection attention tests. These were not associated with driving performance or unsafe driving.

Composite assessments explicitly developed to evaluate older adults' driving performance (DriveSafe DriveAware, Fit2Drive) show superior utility in identifying those with difficulty on the road compared to cognitive assessment alone. Tools such as the TSNT and WEDD may be used as part of a comprehensive driving evaluation (CDE) and are less useful as standalone tools.

Block design and subscales of the formal neuropsychological testing such as Wechsler Adult Intelligence Scale (WAIS),[10] and composite multi-domain driving assessment processes including: Multi-D, Fit2Drive, Candrive evaluations showed promising associations with driving performance and crash risk; better than cognitive testing alone. [13 14 15] A greater range of factors than cognition alone should be considered.

Other aspects of the driving assessment from the literature

Driving assessment cannot only be about cognition. There are other aspects to consider:

- A history of crashes predicts more crashes, and near misses (dings and dents) indicate a high risk of crash.
- Poor general health is associated with driver performance: fallers have more crashes[16] and those with slower walking speed are more likely to fail the on road test;[17] the functional reach test predicts driving ability for people with dementia,[18] and a three minute traffic sign recognition test predicts driving behaviour.
- Behavioural aspects can be assessed; high alcohol use and low perception of the risks of driving go with more crashes.[19]
- Visual function is strongly associated with driving performance. Cataract extraction reduces crash risk.[20]

We did not review specific health aspects in driving assessment so do not comment on epilepsy, medication use, cardiac disease, syncope, diabetes control, and other significant health risks to driving. The *Medical aspects of fitness to drive* resource covers these aspects in detail.

Experts' views

Interviews for deeper fact checking and views emphasised the increase in participation in driving in older ages with the ageing demographic and lifetime driving patterns in NZ. Reiteration of the

continuity aspects of knowing the health conditions and history about general health and chronic conditions were prominent in discussions.

There was general agreement no one cognitive test accurately represents driving ability and a range of assessments may be better, i.e. physical function for driving, vision, cognition may all be required. Cognition is required for more than driving and if cognitive testing is required to investigate possible dementia or other neurological conditions, then appropriate tests should be selected for that purpose.

There is a breadth of actions available for health professionals, from help transitioning older drivers out of driving by prompting planning for cessation, through encouraging self-regulation of driving, to advising it is time to stop driving. Common avoidances include avoiding nighttime and bad weather driving, however one large NZ study shows only 50% of older drivers self-regulate.[21]

Urgent development of other methods of transport is required such as ride share and senior uber, as there is a strong awareness of the detrimental effects of loss of independence related to cessation of driving and the mental and physical health consequences.

There was general emphasis on the need for an overall assessment rather than cognition alone. Motor function must be adequate for driving (e.g. ability to turn the head, hold the wheel, move the legs adequately). The On-Road Safety Test (ORST) conducted in a structured environment may not fully reflect driving performance in real-world conditions.* Assessment accuracy is improved when ORST result is interpreted alongside other medical and cognitive assessments, providing a more complete indicator of safe driving. [22] The history of crash and near miss events (dings and dents) is most useful; whether it is a familiar car and familiar places for the older driver; the views of those around the person of their driving ability (e.g. would you let the grandchildren ride with them?); and the necessity for chronic condition management to be optimised were all emphasised. Those with early dementia may be able to continue to drive safely but more frequent assessment will be needed.

** n.b. NZTA regards passing the ORST as satisfactory evidence of current on-road driving ability*.

Experts' opinion to the utility of various cognitive test approaches:

- Drive safe-drive aware (website) perceived to be very useful as developed specifically for driving assessment, however there is a cost, and the ease of application may be questioned.
- Visual attention – partly assessed by the Trail Making Test – and visual fields were reported as important. Visual Fields of View test is useful but not necessarily available widely as it is performed by the optometrist.
- Trail Making Test B is recognised as a useful measure of the cognition and visual attention shifting required for driving, however physical disability can interfere with the ability to complete this test. Therefore, Trail Making Test A time could be considered in TMT B performance.
- Adequate reaction times are recognised as essential for stopping quickly and avoiding crashes. Reaction times can be assessed via computerised testing and a standardised way to do this may be able to be developed in future.* Reaction time testing is testing more than cognition, as motor and neurological function are required.

  **n.b. NZTA is not aware of any proposed development of a tool.*

Conclusions

Driving is a complex activity involving multiple competing attentional tasks and high cognitive loads. There is no single medical office-based cognition test to definitively predict driving ability, and some older people with mild dementia may continue to drive safely. Continuity aspects of knowing the health conditions and history of older adults and functional changes over time are important in the medical office-based driving assessment, supporting continuity of care in the driving assessor.

Vision assessment, especially acuity and visual fields, are essential considerations in the medical office-based assessment. Consideration of crash history, dents and dings, health risks (e.g. seizure, medications, chronic condition stability); physical function and motor ability (i.e. basic dexterity and foot and lower limb ability) remain relevant as outlined in the *Medical aspects of fitness to drive, a guide for health practitioners*.[22]

For older people considered to be physically and mentally healthy, current evidence does not support the routine use of cognitive assessment as part of fitness to drive assessment.

To screen a healthy population for cognitive impairment causes more harm than good because of false positives. The assessor should allow their usual clinical judgement to raise suspicion of cognitive concern (e.g. older person is vague, can't find their licence, have multiple other conditions and medications that may impair cognition), then use a cognitive test because there is an indication. Also being mindful licence endorsement for passenger travel and heavy truck licences require normal cognition (i.e. no cognitive impairment). For those with a clinical suspicion on cognitive issues the global measure may be used for assessing cognition for the purposes of managing cognitive problems.

Cognitive tests alone are not strongly associated with driving performance and, if used, are best combined with functional and vision assessment. Global cognitive assessments (e.g. MoCA, mini-ACE), while giving an indication of general cognitive ability, do not accurately predict on-road driving performance.

Cognition tests associated with driving performance which may be available and easy to use include:

- Trail Making test A and B (Appendix 2) could be an alternative to more global cognitive assessment tools, such as MMSE, MoCA or Mini-ACE if, or when, a practitioner wants to be more certain of a person's cognitive function in the absence of noticeble issues warranting concern.
- A reaction time test, if acceptable and available, would enhance driving assessment - understanding motor and neurological function contribute to reaction time. Further steps to develop the mecahnisms for testing and establish feasibility are required.

Assessments developed specifically to evaluate older adults' driving performance (DriveSafe DriveAware, Fit2Drive) show superior utility (accuracy and clinical utility) in identifying those with difficulty on the road compared to cognitive assessment alone, however these may have a cost and time barrier in New Zealand. Traffic situational understanding and road sign testing may be a practical way of assessing driving ability.

When the assessor is uncertain about the individual's capacity to drive safely for cognitive or functional reasons, the On-Road Safety Test (ORST) (https://nzta.govt.nz/driver-

licences/renewing-replacing-and-updating/renewing-for-seniors/on-road-safety-test-guide) can be considered alongside other medical assessments, to give a more complete indicator of driving ability. The ORST is a free, brief, non-clinical on-road test available throughout NZ from participating offices of VTNZ, VINZ and the AA.

Alternately, where the main concern is about cognitive deficit, an Occupational Therapy Driving Assessment can give more specific information about the impact of cognition on driving ability and assist with making recommendations about driving restrictions and driving cessation. Cost and regional variation impact accessibility.

The clinical decision of the assessor should not be replaced by cognition assessment and the decision to recommend driving cessation can be for many and a combination of reasons.

Driving assessments should also incorporate discussion about future driving cessation, advocacy for greater transport options and holistic consideration of patients' broader well-being.

Table 1. Summary of studies of the association between cognitive screening tools and driving performance in cognitively healthy older drivers.

Cognitive specific assessment		Global assessment	Executive function	Visuospatial organisation	Processing speed	Attention capacity	Reaction time	Working memory	Motor performance	Summary: association with driving performance
MMSE*		✓								Not or low sensitivity for identifying unsafe drivers [7 10]
MoCA*		✓								Lack ability to predict driving performance. [9]
Addenbrooke's Cognitive Examination-revised*		✓								Lack ability to predict driving performance. [9]
TMT-A				Visual screening	✓	Selective attention				- Small to moderate association [10] - TMT A: <=80 sec (100% sensitivity), <=178 sec (100% specificity); suitable for clinical assessment [9]
TMT-B (subtest in MoCA)[a]			Set-shifting	Visual screening	✓	Visual attention				- Moderate association [10] - TMT B: <=80 sec (100% sensitivity), <=178 sec (100% specificity); suitable for clinical assessment [9]
Clock drawing (part of MoCA or Mini-ACE)			✓	✓		✓		✓		Did not meet psychometric criteria for predicting on road performance. [9]
Useful Field of View (computer administer, cost attached $6 to $12 per assessment)	UFO V1				✓					No association [10]
	UFO V2			Visual processing, visual screening		Visual attention, Divided attention				Small association [10] Low sensitivity & specificity (<0.8) [13];

[a] The Trail Making Test (TMT) measures visual attention and executive function, including cognitive flexibility and visual scanning. It assesses how quickly a person can connect a sequence of numbered circles (Part A) and how quickly they can alternate between connecting numbers and letters (Part B). The test provides information on visual search speed, processing speed, and the ability to switch between mental tasks.

	UFO V3[b]			Visual processing, visual screening		Visual attention, selective attention				Moderate association [10]
Snellgrove Maze task[c]			✓ (planning and foresight)	Visuoconstruction skills		✓				Fair ability to discriminate pass-fail on-road assessment: AUC for the Maza time scores: 0.67; AUC for the Maze task error: 0.77 [23] Not predictive of crashes [14]
Simple reaction time[d]							✓			Small to moderate association [10]
Digit span						✓		✓		No association [8]
Rey's figure[e]			✓							Moderate association [8]
3-minute copy reproduction version[f]								✓ + short term non verbal memory		Moderate association [8]
Block design, subtest of WAIS-IV, WISC-V, WASI-II Cost varies (licenced)				✓						Moderate association [10]
Collection Attention Tests						✓				No association [8]

[b] The UFOV3 (Useful Field of View) driving assessment measures selective attention, which is the ability to identify a target while ignoring distractors. It is the third subtest of the UFOV test and is performed by asking the participant to identify a central target while it is presented on a screen that also contains numerous other visual distractors, like triangles.

[c] The Maze Test was developed as a pencil and paper test of attention, visuoconstructional ability and executive functions of planning and foresight. Participants complete a simple demonstration (or practice) maze first to establish the rule set, and then complete the maze task.

[d] reaction time measures how quickly a person can perceive a hazard, process the information and initiate a response.

[e] Rey's Complex Figure test measures visuospatial ability, visual memory, attention and planning skills. It involves tasks of copying and recalling a complex geometric figure to assess a person's ability to visually perceive, construct, and remember complex visual information. (Appendix 2)

[f] The "3-minute copy reproduction version" for driving assessments, part of the 3-Domains screening toolkit, (https://medical-school.uq.edu.au/using-3-domains-screening-toolkit-older-driver-medical-assessment) measures a driver's cognitive ability to recognise and recall road signs by matching them to corresponding situations within a 3-minute timeframe.

SIMARD-MD[g], A Modification of the DemTect							Verbal memory		Validity test (ROC curve) was completed to predict pass/fail on the road test in 86 cognitive impaired older drivers. AUC = 0.692, 95%CI = 0.578, 0.806; p=0.003 indicates that test performance is better than chance but only modest discriminative ability. [12]
Driving specific assessments on driving performance									
Cognitive specific assessment	**Global assessment**	**Executive function**	**Visuospatial organisation**	**Processing speed**	**Attention capacity**	**Reaction time**	**Working memory**	**Motor performance**	**Summary: association with driving performance**
Multi-D[h]			Central visual motion			✓		Postural sway	Multi-D, AUC=0.85 77.1% sensitivity, 82.1% specificity.[13] Poorer performance on the Multi-D test was associated with a 22% increase crash rate over 24 months. [14]
Fit2Drive[i] = MMSE+TMT-B	MMSE	Set-shifting	Visual screening	✓	Visual attention				Excellent accuracy in predicting the ability of an older driver to an on-road driving test. [15] The Fit2Drive calculator can be accessed at http://fit2drive.org.

[g] SIMARD-MD, derived from the DemTect cognitive screening test, is a screening tool for identifying cognitively impaired medically-at-risk drivers. SIMARD-MD assessed verbal memory, number processing (converting numbers to words), and sematic word fluency. 24. Dobbs BM, Schopflocher D. The Introduction of a New Screening Tool for the Identification of Cognitively Impaired Medically At-Risk Drivers: The SIMARD A Modification of the DemTect. *Journal of primary care & community health* 2010;1(2):119-27. doi: 10.1177/2150131910369156 [published Online First: 2010/07/01]

[h] The Multi-D driving assessment measures a range of abilities relevant to safe driving, including complex reaction time, cognitive flexibility, executive function, balance, and motion detection. The test combines scores from its various computer-based and motor subtests to estimate a client's risk of failing an on-road driving test

[i] A Fit-to-Drive assessment measures a person's medical and functional abilities to determine if they can drive safely, which includes evaluating physical strength, motor skills, vision and cognitive functions like concentration, memory and judgment. It also assesses the ability to apply road rules with adequate response times.

	Description of the tool	Summary: association with driving performance
Candrive risk assessment tool (RST)	Candrive RST includes MoCA 5-word delayed recall question, MoCA abstraction question, road sign recognition question, need for assistive walking device (reflect physical mobility challenges-marker of frailty)	RST has four risk categories: low, low-medium, medium and high. RST identify drivers in the medium-high risk group were 1.8 times more likely than driver at low risk (score <50) of self-reported collisions. [25] The predicted absolute risk of at-fault collision was 0.094 and adjusted relative risk 5.26 (9.81-9.84) among those in high-risk categories.[26] The authors recommend RST should only be applied when the clinician has genuine uncertainty about fitness to drive (FTD) in the context of medical conditions and be a starting point for addressing FTD.
Hazard Perception test (HPT) [#]	HPT assess situational awareness, visual scanning, decision-making and reaction time.	Low sensitivity & specificity (<0.8) [13]
DriveSafe DriveAware (Cost attached) (https://drivesafedriveaware.com/)	DriveSafe DriveAware is a standardised touch screen cognitive screening assessment on the awareness of the driving environment and one's own driving abilities	- 91% sensitivity 86% specificity and met clinical utility. [9] - Evidence supports utility for first-level screen of cognitive fitness to drive. [27]
Traffic sign naming test (TSNT)[j]	TSNT assess participants' working knowledge of various common traffic signs encountered while driving (name 12 signs and then describe what they would do if they observed that sign while driving (i.e. function)).	Fair ability to discriminate driving performance on the standardised on the road test, AUC=0.748[11]
Written exam for driving decision (WEDD)	WEDD assess a participant's knowledge of rules of the road and ability to logically apply the rules to basic decision making and reasoning during common encounters that can occur while driving.	Fair ability to discriminate driving performance on the standardised on the road test, AUC=0.709 [11]
Rivermead Behavioural memory test	Everyday memory function, focusing on real-life tasks and problems that are frequently encountered after acquired brain damage.	Low prediction of driving performance
Safety Advice For Elderly drivers (SAFE)	a checklist comprising 23 evidence-based risk factors for impaired driving fitness including anamnestic (e.g. accident history), sensory (e.g. visual acuity), motor (e.g. neck rotation), cognitive (MMSE, TMT-B performance) and medical (e.g. diseases with risk of sudden unconsciousness) factors	Most frequently identified risk factors were a **MMSE score of 28 or lower** in 33 participants (44.6 %), a **TMT-B score of 120 s or higher** in 21 participants (28.4 %), **avoidance behaviour** in 15 participants (20.3 %), **accidents in the last two years** in eleven participants (14.9 %), and **limited neck rotation** in six participants (8.1 %). | Ori SAFE not predictive |Extended SAFE with additional evidence-based risk factors, such as TMT-A performance, maze performance (SMT), age, annual mileage and number of prescription drugs improved diagnostic accuracy. [28]

[j] The Traffic Sign Naming Test (TSNT) measures a driver's knowledge of traffic signs

The Multiple Errands Test-Home Version (MET-Home)	Performance based assessment. Consist of 14 tasks: locating various items (8 tasks), obtaining information and writing it down (4 tasks), asking the examiner what time it is 5 min after beginning of the test, and lastly stating when they have completed the assessment.	In this pilot study, MET-Home, stand-alone tool or in combination with TMT or MMSE, is not associated with driving outcomes (pass-fail) [29]

Note: * dementia screening tool

Grey = low or no association. TMT-B, Trail Making Test - B; MMSE, Mini Mental State Examination; Useful field of view, UFOV; WAIS-IV, Wechsler Adult Intelligence Scale; WISC-V, Wechsler Intelligence Scale for Children; WASI-II, Wechsler Abbreviated Scale of Intelligence.

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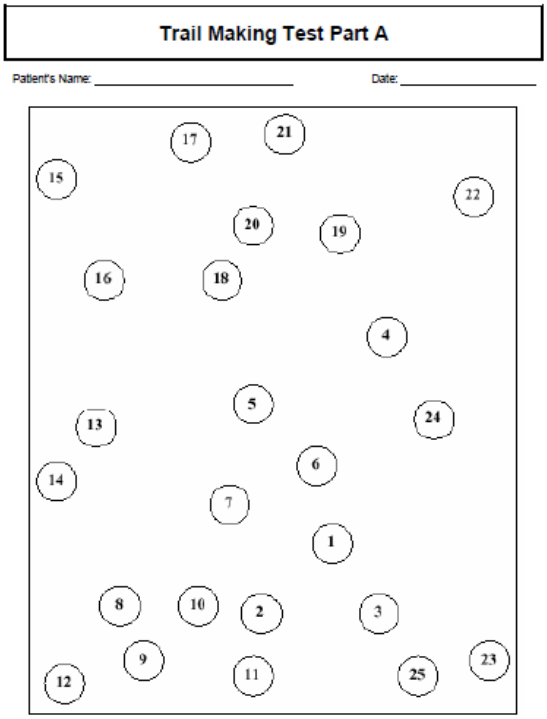
Appendix 1: Detail on road crash data

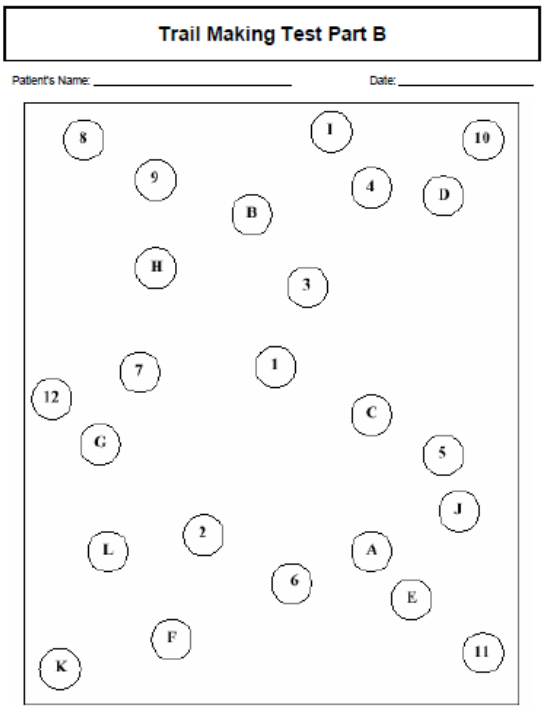
- This data is provided from the road traffic crash database; Crash Analysis System (CAS) version 2.14.0.
- NZTA maintains CAS, which is updated once a Traffic Crash Report (TCR) is received from NZ Police sometime after the crash.
- Data is limited to fatal and serious crashes for the years 2020 to 2022, as recorded in CAS to date - 9/12/2025.
- To be recorded in CAS, a crash must have occurred on a road. The CAS definition of a road is any street, motorway or beach, or a place to which the public have access with a motor vehicle, whether as of right or not e.g. a public car park.
- Data is limited to crashes with a driver of the following vehicle types as recorded in CAS:
    - bus
    - car/wagon
    - SUV
    - ute
    - van
- Due to NZ Police reporting time frame and subsequent data processing, there is a lag from the time of a crash to full and correct crash records within CAS.
- Fatal crash report data is usually recorded in CAS within one working day of NZTA receiving it from NZ Police. Serious Injury and Minor injury crash report data is usually recorded in CAS within 4 weeks. Data relating to non-injury crashes may take up to 7 months before it appears in CAS.
- Due to the nature of non-fatal crashes, it is believed these are under-reported, with the level of under-reporting decreasing with the increasing severity of the crash.
- Due to the Covid-19 pandemic, NZ had a 4-level Alert system in place from 21 March 2020 until this changed to a Traffic Light system from 3 December 2021 to 12 September 2022. The amount of traffic on the roads during level 4 lockdowns was greatly reduced, which consequently reduced the number of road crashes. Road movements under the Orange and Red levels of the Traffic Light system would also be reduced due to the restrictions in place, so data from these periods will not align with previous trends.
- Vehicle kilometres travelled (VKT) data used in this analysis was produced as part of a research report co-authored by Principal Economics and filtered to the years 2020 - 2022.
- Vehicle types included in this analysis are:
    - hatchback
    - station wagon
    - saloon
    - convertible
    - utility
    - sports car
    - light van
    - heavy van
- The underlying synthetic unit record file is based on real individual data but has been modified to protect privacy while maintaining realistic characteristics for research and analytical purposes. It is intended for research and analytical purposes only.
- More details on how VKT data has been generated, including its accuracy can be found in the report - https://nzta.govt.nz/resources/research/reports/745

Appendix 2: Examples of the tests described in Table 1

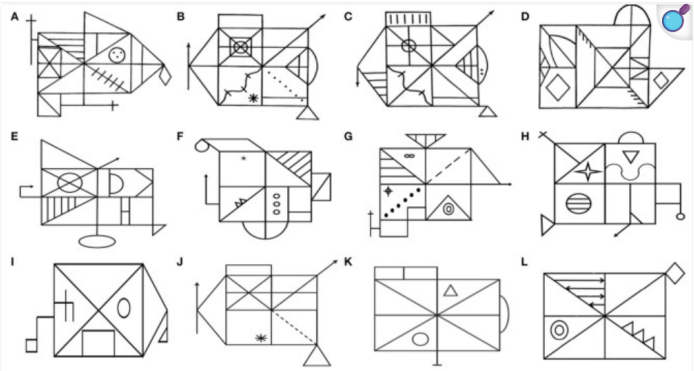
Trail Makers test A, start with a sample demonstration.



Trail Makers B, start with an explanation and a sample



Reys Figure test for driving assessment.



Equivalent and simplified versions of Rey–Osterrieth Complex Figure (ROCF). In 1941, Rey developed the classic ROCF **(A)**. To avoid the learning effect by using the same figure twice, some studies have developed multiple equivalent versions of the ROCF, such as the Taylor figure **(B)**, the modified Taylor figure **(C)**, the Mark figure **(D)**, and various versions of the Medical College of Georgia Complex Figures **(E–H)**. Subsequently, multiple simplified versions of ROCF **(I, K, L)** were developed. The Benson figure **(I)** is less affected by executive function. **(K)** has been proven to be suitable for the elderly. Kim developed **(L)** for digital assessment tools. Similarly, the simplified Taylor figure **(J)** has also been confirmed to suit the low-educated elderly.

https://pmc.ncbi.nlm.nih.gov/articles/PMC8438146/figure/F1/
Xiaonan Zhang, Liangliang Lv, Guowen Min, et. Al. Overview of the Complex Figure Test and Its Clinical Application in Neuropsychiatric Disorders, Including Copying and Recall. Front Neurol. 2021 Aug 31;12:680474. doi: 10.3389/fneur.2021.680474