



Screening for Cognitive Impairment: Ontario's Enhanced Road Test (ERT)

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Traffic Injury Research Foundation
Private Motor Truck Council Webinar
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Overview

- > Prevalence of cognitive impairments
- > Cognitive impairments and crash risk
- > On road tests versus simulator tests
- > Critical components of road test route
- > Critical driving behaviours to test
- > Conditional licensing
- > Enhanced Road Test pilot

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Introduction

- > Cognitive road tests differ from conventional tests.
- > Cognitive road test is defined as a performance-based test designed to identify drivers who are unfit due to cognitive impairment from a medical condition (e.g., Alzheimer's, stroke, TBI) or mental deficits due to advancing age.
- > Cognitive road tests may involve on-road tests in regular or instrumented vehicles, simulators or both.
- > On-road tests considered "gold standard".

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Introduction

- > Canadians 80+ are the fastest growing segment of the senior population; they continue to drive.
- > In 2009, Canadians aged 65+ accounted for 14% of the population and $\frac{3}{4}$ of them had a valid licence.
- > In 2012 seniors aged 65+ accounted for 19% of road fatalities.
- > In 2036 this age group will represent about 25% of the entire population.
- > In a medium growth scenario, StatsCan estimates the number of people 80+ would be 2.6x greater in 2036 than 2009.

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Cognitive impairments: prevalence

- > Aging is a complex process and effects of aging manifest themselves in varied ways.
- > Elderly drivers are more prone to cognitive impairments, but drivers of any age may be affected.
- > Cognitive impairments can occur due to head injuries, stroke, Parkinson's, epilepsy, seizures.
- > 2% to 10% of all dementia cases begin before age 65 (Alzheimer's Society, 2011).

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Cognitive impairments: prevalence

- > Common medical illnesses or conditions which often occur later in life are grouped in 3 categories based on high prevalence and potential to impair functional abilities necessary for driving:
 - » Sensory (visual, auditory)
 - » Cognition (stroke, Alzheimer's, sleep apnea, sedating medications)
 - » Motor skills (arthritis, hemiplegia)

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Cognitive impairments & crash risk

- > An estimated 50,000 strokes annually in Canada; 315,000 Canadians living with effects of stroke.
- > 1 in 8 people 65+ and 45% aged 85+ have Alzheimer's.
- > Prevalence of sleep apnea in adults 65+ in more than 1.7%.
- > Chronic medical conditions are associated with elevated crash risk including dementia, epilepsy and sleep apnea.
- > Research suggests medical events may be more frequently cause of senior driver crashes than younger age groups.

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On-road tests

- > Research has focused on use and design of road test to assess driving fitness.
- > A growing interest due to rising senior population and concerns about the crash risk they pose to themselves and others.
- > Simulator tests promising; more research needed.
- > Road tests are considered the gold standard because they measure operational skills for safe driving combined with cognitive skills (i.e., face validity and real-world driving environment).

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On-road tests

- > Some road tests are better designed to gauge fitness to drive and are more sensitive to identify errors typical of cognitively impaired drivers.
- > Many limitations associated with typical road tests.
- > Older drivers tend to make more errors when navigating on their own than when following step-by-step instructions from examiner.
- > Performance-based road tests need to be modified to include more challenging components (e.g., navigation requiring memory, secondary tasks).

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On-road tests

- > To date, there has been considerable variation in road tests in terms of vehicles, routes and tasks, resulting in a lack of consensus regarding a valid and reliable assessment.
- > There has been large variability in the results of cognitive on-road and simulator-based assessments.
- > The limitation of existing road tests and importance of standardized procedures to improve them have been underscored in several studies.

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On-road tests

- > Key design features of road tests include:
 - » 40-50 minute test duration
 - » initial familiarization period with vehicle
 - » core set of mandatory maneuvers and other test items
 - » additional client-specific items
 - » additional items such as hazard perception, memory planning task, navigation
 - » account for experienced drivers' normal patterns and bad habits.
- > Importance of initial off-road drive prior to on-road test.

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On-road tests

- > Issue is whether purpose of test is to determine competence under conditions they usually drive rather than driving skills per se.
- > Issue relevant to vehicle driven, familiarity with location of route to reduce test anxiety as well.
- > Research consistently suggests drivers with more cognitive impairments are more likely to demonstrate errors during complex part of test.
- > Test results could be a basis for conditional licensing (i.e., specific conditions (e.g., CA).

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Road test route components

- > **Strong consensus from experts:**
 - » 4-way, 2-way stop intersections
 - » left and right turns
 - » stop sign
 - » merge requiring increase in speed
 - » roadway requiring lane positioning
 - » route requiring lane changes
 - » roadways requiring varying speeds > 70km/hr
 - » environment requiring backing up
 - » yield situation with sign
 - » following another vehicle

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Critical driving behaviors

- > **Strong consensus from experts:**
 - » speed maintenance; maintaining lane positions
 - » stopping at red lights; not at green lights
 - » merging at appropriate speed with visual scanning, awareness of critical stimuli
 - » appropriate lane position during turns
 - » backing up awareness of surroundings
 - » not spending excessive time at intersections
 - » maintaining performance during cognitive burden
 - » slowing to potential hazards
 - » yielding appropriately
 - » space cushion

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Conditional licensing

- > Drivers may be restricted to driving in designated areas or under specific conditions (e.g., California, some Australian states, Sweden, Belgium, Netherlands, Finland).
- > Restrictions are commonly used for impairments where driver can compensate (e.g., use of oversized mirrors, modified vehicle, limited hours or radius, without passengers, not on motorways).

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MTO Enhanced Road Test

- > Certain cognitive deficits and declines increase the risk of crashing.
- > Challenge: how to identify & respond.
- > Age alone insufficient for licensing decisions.
- > Ministry of Transportation, Ontario (MTO).
 - » Explore ways to determine cognitive fitness to drive.
 - » Conditional licensing vs. suspending or revoking license

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Background to the road test

Development:

- > Reviewed research and received expert advice.
- > Analyzed other cognitive road tests.
- > Result: modified version of MTO's G2 test.
 - » Comprehensive, standardized, & scored.
 - » Easier to adopt by Driver Examiners (DEs).

Enhanced Road Test (ERT)

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Background to the road test

Challenges:

- > New
- > Balancing cognitive load
- > Scoring behaviour
- > Existing constraints/
business processes



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The Enhanced Road Test

- > Not a medical diagnosis.
- > Does not identify medical causes.
- > Does not replace medical exams.
- > Provides an indication of possible cognitive impairment.
 - » Poor driving habits? Does not definitively distinguish between both.
- > ERT is a screening tool designed to flag drivers rather than a thorough assessment.

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The Enhanced Road Test

- > Consists of 5 components:
 - » Pre-test
 - » Driving part 1
 - » Feedback
 - » Driving part 2
 - » Post-test
- > Applies different types of cognitive load.
- > Total time: 45-55 minutes of which 37-45 minutes are on road.
- > Experienced drivers only.

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Table 1: Overview of the Enhanced Road Test

Section	Location	Time	Test components
Pre-test	Parking lot	4-5 min	<ul style="list-style-type: none"> > Meet and observe applicants > Driver identification and verification > Vehicle inspection > Preamble
Driving Part 1	Parking lot	4-5 min	<ul style="list-style-type: none"> > Backing out > Three-point-turn
Low and moderate intensity	Residential and business areas	12-14 min	<ul style="list-style-type: none"> > Manoeuvres (left turns, right turns, stop intersections, through intersections, lane changes, curve) > Behaviour observations

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The Enhanced Road Test

- > Based on RODE (Record of Driving Errors by Barco et al. 2015);
- > Most common behaviors associated with cognitive impairment.

BEHAVIOUR (P1 + P2 pnts = 2)	1 st	2+
Difficulty remember/follow instructions	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Difficulty paying attention	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty apply rules of road	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Difficulty anticipate/plan/ decision-making	<input type="checkbox"/>	<input type="checkbox"/>
Completed	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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The Enhanced Road Test

Feedback	Parked on street	4-5 min	<ul style="list-style-type: none"> > Driver self-evaluation > Feedback component > Explain next task (Hazard-commentary task)
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"Feedback component" adapted from Société de l'assurance automobile du Québec (SAAQ).

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The Enhanced Road Test

Driving Part 2 Moderate and high intensity	Business areas	17-21 min	> Hazard-commentary task combined with one driving along
			> Multiple-directions task (two) combined with two turns each
			> Adjust-controls task combined with one driving along and one turn
			> Route-finding task combined with three turns and a three-point turn
			> Manoeuvres (remaining left turns, right turns, stop intersections, through intersections, lane changes, yields, and a curve) > Behaviour observations

Hazard-commentary adapted from Alberta Infrastructure and Transportation; multiple direction test from CA DMV; adjust-control from Barco (2015)

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The Enhanced Road Test

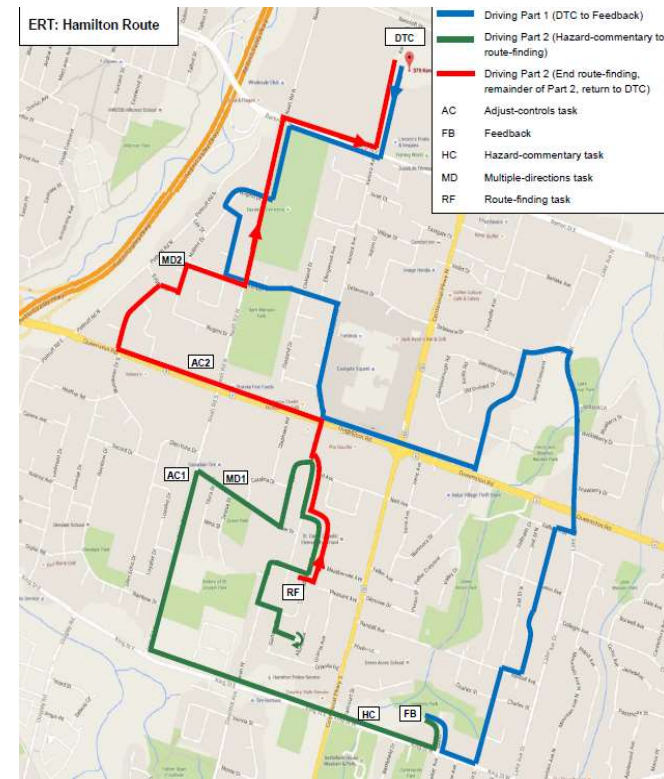
<p>Post-test</p>	<p>Parking lot</p>	<p>4-5 min</p>	<ul style="list-style-type: none"> > Driver self-evaluation > Calculate results > Communicate results to applicants
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Sample route map: Hamilton

- > Increase cognitive load:
 - » complexity;
 - » frequency;
 - » duration; and,
 - » timing.
- > Balance.



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ERT outcomes

Table 1: Generalized interpretation of ERT results

		Results of second attempt		
		Pass	Indeterminate	Fail
Results of first attempt	Indeterminate	Sufficient improvement	No improvement	No improvement (decline)
	Fail	Sufficient improvement	Insufficient improvement	No improvement (decline)
Result		Re-instate G licence	Suspend licence; refer to MMRP for possible referral to FAC	Cancel licence, refer to MMRP

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Pilot study of a new road test to assess cognitive fitness to drive

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ABSTRACT

The Traffic Injury Research Foundation (TIRF) developed and evaluated a new road test, called the Enhanced Road Test (ERT), to assess a driver's cognitive fitness to drive for the Ministry of Transportation in Ontario, Canada (MTO). The ERT was designed to flag individuals for potential cognitive impairment, but was not meant to indicate, or assess the level of impairment. Practical feasibility for implementation of the ERT was determined in a pilot study as well as its ability to differentiate drivers with and without cognitive impairment. The research design included both process and outcome evaluation components. The qualitative process evaluation was conducted using surveys administered to participant drivers (N = 70) and feedback obtained from driver examiners involved in the pilot (N = 3). The quantitative outcome evaluation used an experimental design to administer the ERT to a sample of drivers with (N = 42), and without (N = 28), mild cognitive impairment. Regression analysis was conducted and scoring functions of the ERT were compared through a Receiver Operating Characteristic (ROC) curve analysis.

Survey results revealed that drivers did not raise specific concerns about the ERT and that examiners believed more training on driving behaviours associated with cognitive impairment and some scoresheet formatting changes would be beneficial. ROC Area Under the Curve (AUC) results revealed that some components of the ERT were better at identifying individuals whose driving skills declined. These components are the adjust-control, route finding and divided attention tasks. Two final scoring schemes for the ERT are proposed as well as several recommendations for its possible implementation.

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Scoring & evaluation of ERT pilot

- > Different process and outcome evaluations.
 - » E.g., MoCA (Montreal Cognitive Assessment).
- > Two scoring models.
- > Both had high sensitivity (81.8%/73%) and specificity (71.4%/61.0%).
- > Strong correlation for some tasks.
- > Removed expressway.

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Conclusions

- > Results are very promising.
- > Received positive feedback.
- > DE training re scoring is critical with respect to significant scales and behavioral components.
- > Exploratory study - further validation is needed.
- > ERT is still under review by MTO
- > Results demonstrate ERT is ready for wider implementation in province and continued monitoring.

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Recommendations going forward

- > Continue validation with larger sample of drivers and DEs, over a longer period of time
- > Consider a more thorough evaluation of two scoring models.
- > Training for DEs to use ERT.
- > Balance cognitive load.



Image retrieved from University of West Florida website.

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