Transitions and Community Participation following Stroke

Table 3: Assessment Tools for Pre-Driver Screening and Research Correlating Tools with Driving Risk

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on Behalf of the Canadian Stroke Best Practice Recommendations
Transitions and Community Participation following Stroke Writing Group

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Table 3: Assessment Tools for Pre-Driving Screening and Research Correlating Tools with Driving Risk

Data was aggregated by the Toronto Rehabilitation Driving Best Practice Group under the leadership of Geoff Law OT Reg. (Ont) with the contributions from student occupational therapist Luisa Cao. Current document was summarized by Debbie Hebert OT Reg. (Ont).

<table>
<thead>
<tr>
<th>Assessment/Domain</th>
<th>Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dynavision</strong></td>
<td>The following Dynavision tests were used in the research to determine fitness to drive:</td>
<td></td>
</tr>
<tr>
<td>Domain: visual scanning, peripheral visual awareness, visual attention, visuomotor reaction time, execution of visuomotor response sequence, basic cognitive skills (short term memory), and physical and mental endurance Administration Time 15 – 20 min.</td>
<td></td>
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</tr>
<tr>
<td>Test Mode</td>
<td>Pass Criterion based on a pass/fail “behind the wheel test”</td>
<td>Accuracy In predicting outcome</td>
</tr>
<tr>
<td>Mode A 60 sec.</td>
<td>50 responses/min</td>
<td>66%</td>
</tr>
<tr>
<td>Mode B 60 sec. with 1 sec. light speed</td>
<td>40 responses/min</td>
<td>68%</td>
</tr>
<tr>
<td>Mode B 60 sec. with on sec. light speed presented every 5 sec.</td>
<td>30 responses/min</td>
<td>68%</td>
</tr>
<tr>
<td>Mode A 4 min.</td>
<td>195 responses/4 min</td>
<td>75%</td>
</tr>
<tr>
<td>Mode A 60 sec. + Mode A 4 min</td>
<td>77%</td>
<td>7%</td>
</tr>
</tbody>
</table>
| The use of the MVPT to inform ability to return to driving depends on the version used. The original version of MVPT, which is no longer commercially available, has the greatest amount of research evidence and at one time was considered the most predictive test of on-road performance (Bouillon, 2006). Findings linking MVPT performance with fitness to drive are inconsistent (Dickerson, 2014) and should not be used as a sole screening tool (Korner-Bitensky, 2000). Note: Positive predictive value was also found to vary with hemisphere. Ball, K., Roenker, D., Wadley, V., Edwards, J., Roth, D., McGwin, G., . . . Dube, T. (2006). Can high-risk older drivers be identified through performance-based measures in a department of motor vehicles setting? *J Am Geriatr Soc*, 54(1), 77-84. Bouillon, L., Mazer, M., & Gelinas, I. (2006). Validity of the Cognitive Behavioral Driver’s
lesioned with the right hemisphere lesions having greater accuracy than the left hemisphere lesions (Mazer, 1998).

<table>
<thead>
<tr>
<th>Version</th>
<th>Study</th>
<th>Suggested cut-off scores</th>
<th>Positive Predictive Value/ Negative Predictive Value</th>
<th>Time cut-off scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPT</td>
<td>Bouillon et al., 2006; Korner-Bitensky et al., 2000; Mazer et al., 1998</td>
<td>≤ 30 = needs further driving evaluation</td>
<td>86.1%/58.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oswaldski, 2007 (older drivers)</td>
<td>≤ 32 = needs further driving evaluation</td>
<td></td>
<td>&gt; 6.27s = predicts on-road failure</td>
</tr>
<tr>
<td></td>
<td>Ball et al., 2006</td>
<td>≤ 32 = older drivers 78+ years as likely to be involved in at-fault crashes.</td>
<td>Pass on road = 7.1 +/- 6.5; Fail on road = 10.6 +/- 5.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bouillon et al., 2006</td>
<td>&gt; 6.11 sec fail on road test; Pass on road = 4.63 mean (2.30 SD); Fail on road = 6.11 mean (2.45 SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVPT-3 (Third Ed.)</td>
<td>Gibbons, et al., (2017)</td>
<td>&gt; 57 = predicts on-road test pass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Assessment Tools for Pre-Driving Screening

<table>
<thead>
<tr>
<th>MVPT – 4 (Fourth Ed.)</th>
<th>&lt; 41 = predicts on-road test failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 38 – fit to drive</td>
<td></td>
</tr>
<tr>
<td>19-37 = “grey zone”</td>
<td></td>
</tr>
<tr>
<td>≤ 18 + unfit to drive</td>
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</table>

- MVPT and Trail Making B, poor performance on both tests 22 times more likely to fail on-road evaluation (Mazer, 1998)

**Trail Making Test A – (TMT-A) and B (TMT-B)**

**Domains:**
- **TMT-A:** visual scanning, planning, and motor processing speed (Roy & Molnar, 2013)
- **TMT-B:** visual scanning, planning, processing speed, and attention/cognitive flexibility (Roy & Molnar, 2013)

This test has been highly correlated with driving performance. Time and errors both correlate with driving after stroke (Marshall et al., 2007). At an earlier point in time, the combination of the MVPT and the TMT-B resulted in the most predictive model: poor performance on both tests = 22x more likely to fail on-road evaluation (Mazer, 1998). There is however, a large amount of variability in determining cut-off points. A conservative estimate from the data below would be a 3 min or 3 error cut-off. It is suggested that there shouldn’t be strict adherence to a cut-off, but instead considering performance on Trails B in the context of how a person scores on other measures. It has also suggest that method of establishing the cut-off is important. Those established based on on-road performance vs. crash history may be more directly related to a screening process

- Note: Several published guidelines have recommended use of the TMT-B to assess driving safety. TMT-A may also be used to discriminate between safe and potentially unsafe cognitively impaired older drivers (Lee & Molnar, 2017). See chart below:

<table>
<thead>
<tr>
<th>Author</th>
<th>Cut-off indicating needs further Driving Evaluation</th>
<th>Strength of association</th>
<th>Method of Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedard et al., 2008</td>
<td>TMT-A: &gt;48 sec = indicative of unsafe driving TMT-B: &gt;39.5 sec = needs further driving evaluation</td>
<td>PPV: 60.3%, NPV: 57.6%</td>
<td>Statistical correlation and ROC curve analysis for</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Authors</th>
<th>Test A</th>
<th>Test B</th>
<th>Performance</th>
<th>PPV</th>
<th>NPV</th>
<th>On-road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classen et al.</td>
<td>TMT-B: &gt;106 sec predict of poor on-road performance</td>
<td></td>
<td>Driving Performance</td>
<td>80%</td>
<td>48.1%</td>
<td>On-road</td>
</tr>
<tr>
<td>Devos et al.</td>
<td>TMT-B: &gt;90 sec predict of unsafe driving</td>
<td></td>
<td></td>
<td>69%</td>
<td>52%</td>
<td>Unsafe driving</td>
</tr>
<tr>
<td>Gibbons et al.</td>
<td>TMT-A: ≥ 69 = Pass ≤ 25 Fail (100% sensitivity) TMT-B: ≥178 = Pass (100% sensitivity) ≤ 80 Fail (100% sensitivity) (see chart p.5 for tri-chotomization))</td>
<td></td>
<td>In-clinic assessment and On-road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mazer et al. 1996</td>
<td>TMT-A: ≥ 1 error = needs further driving evaluation TMT-B: ≥3 errors = need for driving evaluation</td>
<td>p&lt;.01, PPV = 85.2%, NPV = 48.1%</td>
<td>On-road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papandonatos et al., 2015 (older adults)</td>
<td>TMT-A: &gt; 48 sec = indicative of unsafe driving TMT-B: 108 sec = indicative of unsafe driving</td>
<td></td>
<td>On-road</td>
<td></td>
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**Color Trails Test:**
Domains:
selective attention, motor speed, visuospatial abilities, and executive functions *(Elkin-Frankston et al., 2007)*

Similar to TMT, but involves alternation between numbers and two colors (1-pink, 2-yellow, 3-pink, etc.)

**Evidence on predicting driving performance:**
- The CTT can be used as an alternative to the TMT to predict on-road performance. The CTT may be particularly useful for those individuals who are less familiar with the Latin alphabet *(Elkin-Frankston et al., 2007)*

**Suggested time cut-offs:**
- > 60s = predicts road test failure *(Hartman-Maeir et al., 2008)*

**Clock drawing test:**
Domains: visual-spatial construction, visual perception, and abstract conceptualization *(Oswanski et al., 2007)*

**Evidence on predicting driving performance:**
- The Clock Drawing Test is a significant predictor of seniors’ driving capabilities *(Oswanski et al., 2007)*
- Predicts on-road driving performance *(Vanlaar et al., 2014)*

**Suggested cut-offs:**
- Four Point Scale: ≤ 3/4 = need further driving evaluation *(Oswanski et al., 2007)*
- Seven Point Scale: ≤ = Unfit to drive, ≥ Fit to drive *(Gibbons, 2017)*

Methods of administration and scoring of Clock Drawing Test can vary. See *AMA Physician’s Guide to Assessing and Counseling Older Drivers* found in the Candrive website for 1 method *(Freund Clock Scoring)* of administering and scoring The Clock Drawing Test:

(http://www.ama-assn.org/ama/pub/upload/mm/433/phyguidechap3.pdf)

**References:**

**American Medical Association. AMA physician’s guide to assessing and counseling older driver’s.**


Schurr, Stephanie. *Driving After Stroke: Clinical Use of Pre-Driving Screen Data.*
Useful Field of View (UFOV)

Domain: Tests visual memory, visual attention, and divided attention with structured and unstructured components.

The concept of “useful field of view” refers to the brain’s ability to comprehend visual info with the head and eyes in a stationary position. This test is administered on a computer.

The UFOV is one of the most extensively researched and promising predictor tests for a range of driving outcomes measures, including driving ability and crash risk (Wood & Owsley, 2014).

- Performance on the UFOV corresponds with crash history (Novack et al., 2006), future crashes (Owsley, 1994), and pass/fail on-road driving test (Myers et al., 2000; Novack et al., 2006; Stav et al., 2008).

Suggested cut-off scores (UFOV-2):

- ≥ 300 ms = need further driving evaluation
- PPV: 61.9%  NPV: 86.1% (Bedard et al., 2008)
- Drivers aged 75+: > 353 ms = 2x as likely to be involved in at-fault crashes (Ball et al., 2006)


### Evidence on predicting driving performance:
- Single-Letter Cancellation Test is significantly associated with on-road test outcome *(Mazer et al., 1998)*

#### Suggested cut-off scores:
- ≥ 5 errors = 3x more likely to fail on-road test *(Mazer et al., 1998)*
  - PPV: 78.9%  NPV: 44.6%

### Evidence on predicting driving performance:
- Bells Test is significantly associated with on-road test outcome *(Mazer et al., 1998)*

#### Suggested cut-off scores:
- ≥ 4 errors = predictive of unsafe driving *(Mazer et al., 1998)*
  - PPV: 77.8%  NPV: 44.6%

### Cognitive Screening

**Mini-Mental State Exam**

Domains: Orientation to time and place, immediate recall, short-term verbal memory, calculation, language, and construct ability.

Current best practice suggests utilization of the MMSE with other tests to predict on-road performance as it is not adequate as a benchmark on its own *(Hollis et al., 2015)*.

#### Suggested cut-off scores:
- ≤ 24/30 may indicate the presence of a cognitive impairment, but determining fitness to drive would require additional assessment *(Molnar et al., 2009)*
- <20/30 = likely unsafe to drive *(Molnar et al., 2009)*

If the MMSE has already been administered, and the clinician has concerns about driving capacity, a score of 24 would equate a score of 18 on the MoCA and could be used as a benchmark for driving risk *(Hollis et al., 2015)*. However, ≤ 24 on the MMSE is not adequately sensitive to predict on-road performance.

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Montreal Cognitive Assessment (MoCA):

**Domains:**
attention and concentration, executive functions, memory, language, visuocspansional skills, conceptual thinking, calculations, and orientation (Nasreddine et al., 2005).

While one study found that MoCA was predictive of fitness to drive, it is recommended to work best in combination with other cognitive tools and not as a stand-alone test. (Bowers et al., 2013; Esser et al., 2016; Kwok et al., 2015)

**Suggested cut-off scores:**
- $< 25$ = discriminate pass/fail on-road (Kwok et al., 2015)
- $\leq 18$ = should raise concerns about driving (Hollis et al., 2015)
- $< 12$ = likely to fail (Esser et al., 2016)
- $\geq 27$ = pass, $\leq 16$ fail (Gibbons et al., 2017)

**Driving Batteries**

**DriveABLE® Competence Screen**

**Domains:**

While recent evidence on the DriveABLE® tool supports its utility with regard to predicting on-road performance using its own standardized protocol, there

Vrkljan, B.H., McGrath, C.E., & Letts, L.J. (2011). Assessment tools for evaluating fitness to drive: A critical appraisal of...
### Motor Speed & Control, Visual Attention, Spatial Judgement; Executive Function

Computer-based tasks used in concert with on-road DriveABLE test  
Administration time: 50 minutes

<table>
<thead>
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<tr>
<td>The positive predictive validity of the DriveABLE® Office Competence Screen in identifying those who would fail the DriveABLE® Road Test was 97% (n = 32 of 33). - Negative predictive validity was 47% - The sensitivity was 76% with a specificity of 90% (Vrkljan, McGrath, &amp; Letts, 2011)</td>
<td></td>
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</tbody>
</table>

### Cognitive Behavioral Driver’s Inventory (CBDI)

**Domains:**  
cognitive and behavioural skills required for driving  
Administration time: 1–1.5 hours.  
Available at [https://www.cbdionline.com/](https://www.cbdionline.com/)

<table>
<thead>
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<tbody>
<tr>
<td>&lt; 45/50 = predicts failures on-road (Bouillon et al., 2006)</td>
<td></td>
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<tr>
<td>PPV: 62% NPV: 83%</td>
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### Vision Assessment

<table>
<thead>
<tr>
<th>Ministry of Transportation Requirements</th>
<th>Vision Standards - Class G and M</th>
</tr>
</thead>
</table>
| Province specific websites [http://www.mto.gov.on.ca/english/dandv/driver/medical-review/standards.shtml](http://www.mto.gov.on.ca/english/dandv/driver/medical-review/standards.shtml)  | “Ontario Regulation 340/94 (s. 18) requires that an applicant for or a holder of a Class G, G1, G2, M, M1 or M2 licence must have,  
•A visual acuity as measured by Snellen Rating that is not poorer than 20/50, with both eyes open and examined together with or without the aid of corrective lenses; and  
•A horizontal visual field of at least 120 continuous degrees along the horizontal meridian and at least 15 continuous degrees above and below fixation, with both eyes open and examined together” [http://www.mto.gov.on.ca/english/dandv/driver/medical-review/standards.shtml](http://www.mto.gov.on.ca/english/dandv/driver/medical-review/standards.shtml) |
| Canadian Council of Motor Transport Administrators | In Ontario, a vision waiver can be applied for people seeking Class G licenses who lack 120 degrees of horizontal vision as long as certain |
Sensori - Motor Assessment

### Range of Motion (ROM) & Strength
- Range of motion assessments should be made of any joints required to operate a vehicle for example neck, spine, upper and lower limbs. Restrictions and painful range of motion should be noted.
- Strength of the muscle groups should also be assessed to determine any restrictions which might limit action
- Potential ability to participate with impaired limbs should be considered and need for devices or strategies anticipated identified.

### Sensation
- Somatosensory impairment of the limb should be assessed to determine ability of the limbs to move with adequate speed and strength with vehicle. Somatosensation of the in the foot and proprioception of the ankle/foot will be of particular interest for braking and acceleration. (Vrklijan et al., 2011)

### Gait and Physical Performance Tests
  - > 7 seconds = Red Flag
- **The Short Physical Performance Battery** (Guralnik et al., 1994) in Mielenz et al., (2017)
  - associated with reduced driving exposure and increased cessation in older drivers


|---|