The webinar, “The Development of Normative Data and Comparison Standards for the Cognition Measures Employed in the CLSA” will begin shortly.

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The Development of Normative Data and Comparison Standards for the Cognition Measures Employed in the CLSA

Presented by Dr. Holly Tuokko

12 to 1 p.m. ET | January 16, 2018

Change in cognitive functioning is characteristic of normal aging and is evident beginning in mid-life. However, changes in cognition also may be associated with underlying pathology such as Alzheimer Disease.

The research team, led by Dr. Holly Tuokko and funded by the Alzheimer Society of Canada and the Pacific Alzheimer Research Foundation, is examining detailed information about the cognitive performance of English and French-speaking participants in the Canadian Longitudinal Study on Aging (CLSA). The researchers are characterizing typical performances of neurologically healthy people on the cognitive measures employed in the CLSA for use as standards when identifying cognitive impairment. They are also developing various easily-accessed, plain language tools (e.g., derived variables, online tools for generating cognitive classification) for use by clinicians and researchers regarding cognitive functioning as measured in the CLSA.

Register online at http://bit.ly/clsawebinars

Webinars will be broadcast using WebEx. Further instructions will be sent by email

www.clsa-elcv.ca
The Development of Normative Data and Comparison Standards for the Cognition Measures Employed in the CLSA

Holly Tuokko, PhD, RPsych
University of Victoria
PURPOSE OF THE SESSION

• Provide a snapshot of the procedures used to develop the Canadian comparative standards for the CLSA cognition measures

• To solicit input regarding the tools being generated for use by researchers and clinicians
Funding

Funding for our research is provided by

Société Alzheimer Society

Pacific Alzheimer Research Foundation
Our Aims: The purpose of our funding

Examine how Canadians typically perform on measures of cognitive functioning

Understand the health and lifestyle factors that affect cognitive functions

To develop sets of normative comparison standards for the measures of cognitive function from the CLSA for French- and English-speaking Canadians

To create a tools for interpretation that can be used to generate classification of individuals for use in research and clinical practice

To lay the foundation for refinement of the Canadian norms for cognitive measures in French and English, as longitudinal data from CLSA becomes available
Why are Canadian comparison standards needed?

• Existing normative standards based on non-Canadian samples
• Existing normative standards may be outdated
• Existing normative standards for measures may not cover the full spectrum of ages from mid-life to later life
Why are Canadian comparison standards needed?

• Existing normative standards may not take into consideration important health and lifestyle factors
• Existing normative standards may be available for individual measures only
<table>
<thead>
<tr>
<th>Cognitive Measure</th>
<th>CLSA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comprehensive (n=30,184)</td>
<td>Tracking (n=21,241)</td>
</tr>
<tr>
<td>Memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rey Auditory Verbal Learning Test (trial 1 recall and 5 minutes delayed recall)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Executive Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Alteration Test</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Miami Prospective Memory Test</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Stroop (Victoria version)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Controlled Oral Word Association Test (FAS)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Animal Fluency</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Psychomotor Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice Reaction Times</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Cognitive measures in the Canadian Longitudinal Study on Aging

Holly Tuokko, Lauren E. Griffith, Martine Simard & Vanessa Taler

To cite this article: Holly Tuokko, Lauren E. Griffith, Martine Simard & Vanessa Taler (2016): Cognitive measures in the Canadian Longitudinal Study on Aging, The Clinical Neuropsychologist, DOI: 10.1080/13854046.2016.1254279

To link to this article: http://dx.doi.org/10.1080/13854046.2016.1254279
Methodology behind the standards
CLSA Tracking Baseline
N=21,241 participants

Neuro-typical subsample
N=19,415

Deleted 1,826 (8.6%) participants

Complete cognitive & demographic data available
N= 14,855

Incomplete data (n=4,549; 21.4% of 21,241), due to (not mutually exclusive & may overlap with neuro-filter) the following:
• Missing education level (n=84; 0.4% of 21,241)
• Missing language on at least one Cognitive test (n=3,777; 17.8%)
• No consent to record testing session (140; 0.8%)
• REY I & II: missing or bad/no recording (1,767; 8.3%)
• AF: missing or bad/no recording (799, 3.8%), or prompt suspected or given (491; 2.3%)
• MAT: missing or bad/no recording (2,406; 11.3%), or scored 0 (n=748; 4.0% of 18,835) (Note 2)

Deleted 745 (5.0%) bilingual speakers

FINAL SAMPLE: Completed all cognitive tests in either English or French
N=14,110 → English n=12,350 (87.5%) & French n=1,760 (12.5%)
What Variables are related to cognitive test scores?

- Age – some cognitive test scores decrease nonlinearly with age in English sample
- Education level – highly skewed
- Sex – no differences
- Language – differences on some cognitive test scores
- “Secondary” covariates examined
  - Self-rated general health
  - Self-rated mental health
  - Depression (yes/no based on CES-D10)
  - Self-rated eyesight
  - Self-rated hearing
Step 1. Prepare the data
Step 2. Estimate best-fitting regression models
Step 3. Get weighted empirical cumulative distributions and cut-off scores for performance of neuro-healthy Canadians on each cognitive test
Step 4. Assess performance on multiple tests using the battery approach

Check Assumptions
- Skewness
- Linearity
- Weighting

Split Sample

English: By Sex & Education Level (& Age Decade)
French: by Sex & Education Level

Linear

Piecewise Linear & “Smoothed” (for English Rey-Immediate Recall, Rey-Delayed Recall and MAT)

Standardized cut-off scores (Z-scores )
Cut-off scores on original scale
T-score cut-offs
**Step 3.** Obtaining empirical weighted cumulative distributions and cut-off scores

For each participant, have:
1) Observed Cog Test Score \(Y\)
2) Predicted Cog Test Score \(Y'\): from best-fitting regression model for that person

Compute each participant’s **residual score** \((Y' - Y)\)

For each Sex-Education (and AgeDecade) group, obtain \(M_{\text{resid}}, SD_{\text{resid}}\) of the residuals

Compute each participant’s **standardized residual score**:
\[
Z_{\text{resid}} = \frac{Y' - Y - M_{\text{resid}}}{SD_{\text{resid}}}
\]

For each Sex-Education (and AgeDecade) group, obtain:
- **Weighted** (using CLSA inflation weights) cumulative frequency distribution of the standardized residuals, and
- \(Z\)-scores corresponding to the percentile ranks (PR) of interest \(\{Z_{PR}, \text{for PR=1, 2, 5..., 99}\}\)

Transform \(\{Z_{PR}\}\) to scores on the original scale \(\{C_{PR}\}\):
\[
C = Z \times SD_{\text{group}} + M_{\text{group}}
\]

Transform \(\{Z_{PR}\}\) to T-scores \(\{T_{PR}\}\):
\[
T = Z \times 10 + 50
\]
The ISSUE with Multiple Tests:
When a clinician assesses a client on more than one test, the probability that the client will fall in an “atypical” range on at least one of those tests increases, only because there are multiple tests. We want to avoid misdiagnosing people simply on such chance occurrences.

We can control for this!
Tools for Researchers and Clinicians
Derived variables

• Percentile rank for each participant for each cognitive measure

• Impaired/Not impaired for battery
Web-based Clinical Tool

- Mock Up
Welcome to
Comparative Standards for
Cognitive Measures

based on CLSA data

Continue
Please enter your client’s information:

**Age**
Number input
valid age from 45 to 89 * Required

**Sex**
- Female
- Male * Required

**Language**
- English
- French * Required

**Education Level**
1. Less than high school
2. High school grad
3. Some post secondary
4. Post secondary degree * Required

[Continue]
Please enter your client’s scores on Cognitive Tests (please enter at least one):

**Rey Auditory Verbal Learning Test**

- (Rey 1) Immediate Recall
- (Rey 2) 5 min Delayed Recall

**Animal Fluency**

Scoring Procedure
- Strict
- Lenient

**Score**

- number input
- number 0 to 50

**Mental Alteration Test (MAT)**

**Score**

- number input
- number 0 to 52

[Buttons: Reset, Continue]
Rey Auditory Verbal Learning Test

Your client’s score compared to (English/French) speaking Canadian (men/women) of age (age) and education level (education level):

Rey 1 (Immediate Recall)

X Percentile Equivalent to T-score of Y
Rey Auditory Verbal Learning Test

Your client’s score compared to (English/French) speaking Canadian (men/women) of age (age) and education level (education level):

Rey 2 (5 min Delayed Recall)

![Graph showing percentile equivalent]
Animal Fluency

Your client’s score compared to (English/French) speaking Canadian (men/women) of age (age) and education level (education level):

<table>
<thead>
<tr>
<th>Scores</th>
<th>Rey</th>
<th>AF</th>
<th>MAT</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strict</td>
<td>Lenient</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lenient scoring procedure

5% cut-off

X Percentile Equivalent to T-score of Y
Animal Fluency

Your client’s score compared to (English/French) speaking Canadian (men/women) of age (age) and education level (education level):

X Percentile Equivalent to T-score of Y
Mental Alteration Test

Your client's score compared to (English/French) speaking Canadian (men/women) of age (age) and education level (education level):

% Rank: 1 5 10 20 25 30 40 50 60 70 80 90 95 99

T_Score: 0 25 50 100

5% cut-off

X Percentile Equivalent to T-score of Y

Test Score

Client Score
Summary
To determine whether a client deviates from the norm on several tests simultaneously, we recommend using the approach that...{more words to come here}
Summary
To determine whether a client deviates from the norm on several tests simultaneously, we recommend using the approach that ...{more words to come here}

Your client’s performance:

Rey-Immediate:

Rey-Delayed:

AF (S):

MAT:

<table>
<thead>
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<th>Rey</th>
<th>AF</th>
<th>MAT</th>
<th>Summary</th>
</tr>
</thead>
</table>

Overall probability of being below
% on
4 Tests is:

> 25%
Summary
To determine whether a client deviates from the norm on several tests simultaneously, we recommend using the approach that ...{more words to come here}

Your client’s performance:

- **Rey-Immediate**: Overall probability of being below % on 4 Tests is: < 2%
- **Rey-Delayed**: Overall probability of being below % on 4 Tests is: < 2%
- **AF (S)**: Overall probability of being below % on 4 Tests is: < 2%
- **MAT**: Overall probability of being below % on 4 Tests is: < 2%
INPUT RE: TOOLS

1. Relevant?
2. User-friendly?
3. Preferences on derived variables?
4. Preferences on the look of web-based tool?
5. Is there an interest in acquisition of CLSA cognitive measures (administration and scoring) at a small cost (for cost recovery)?
Additional Investigations

• Tracking versus Comprehensive

• English versus French

• Validity of the norms for identifying cognitive impairment at baseline
PURPOSE OF THE SESSION

• Provide a snapshot of the procedures used to develop the Canadian comparative standards for the CLSA cognition measures

• To solicit input regarding the tools being generated for use by researchers and clinicians
Questions?
“The Global Importance of Frailty and Pre-Frailty in Middle Aged Adults”

Dr. Darryl Leong

February 22, 2018 | 12 p.m. EST

Register: bit.ly/clsawebinars