Psychometric Properties of the Montreal Cognitive Assessment (MoCA) in a Chinese Sample with Lower Education Level Using Item Response Theory

Hao Luo, PhD¹,² Björn Andersson, PhD³ Jennifer Tang, PhD² Gloria Wong, PhD² Terry Lum, PhD²

¹ Tsinghua University
² The University of Hong Kong
³ Beijing Normal University
**Mild Cognitive Impairment**

**Definition**

Mild cognitive impairment (MCI) represents an intermediate state of cognitive function between the changes seen in aging and those fulfilling the criteria for dementia and often Alzheimer’s disease (Petersen, 2011).

- The estimated prevalence of MCI in population-based studies: 10-20% in persons older than 65 years of age.
- Most persons with MCI are at risk for the development of dementia.
- Political drives for screening or case findings of MCI.
- It is recommended that more sensitive measures, such as the Montreal Cognitive Assessment (MoCA), should be used for detecting MCI.
Diagnosis of MCI should be made with caution

- People who get labelled with disease, or pre-disease, (and their families) might experience tremendous anxiety and distress.
- A MCI diagnosis and even a statement of suspected MCI should be made with caution.
- It is important to understand how the available screening tools function in different culture and people from different demographic backgrounds.
Montreal Cognitive Assessment (MoCA)

- MoCA is a 10-minute cognitive screening tool to assist first-line physicians in detection of MCI.
- Proposed in 2005 and validated in many studies.
- The validity of the MoCA was typically studied by clinical groups.
  - Relatively small number of normal subjects;
  - People who seek AD service tend to have higher social economic status.
- Different cutoff values have been suggested:

<table>
<thead>
<tr>
<th>Country</th>
<th>Cutoff Values</th>
<th>Group</th>
<th>AD Cutoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original(Nasreddine et al., 2005)</td>
<td>90 normal+94 MCI+93 AD</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Hong Kong(Chu et al., 2015)</td>
<td>115 normal+87 MCI+64 AD</td>
<td>22/23</td>
<td></td>
</tr>
<tr>
<td>Taiwan(Tsai et al., 2012)</td>
<td>38 normal+71 MCI+98 AD</td>
<td>23/24</td>
<td></td>
</tr>
<tr>
<td>Mainland China(Lu et al., 2011)</td>
<td>6283 normal+1687 MCI+441 dementia</td>
<td>13/14; 19/20; 24/25</td>
<td></td>
</tr>
</tbody>
</table>
Research questions

Objectives of this study

- Study the psychometric properties of the MoCA using a population-based sample.
- Examine the properties of each item with respect to the difficulty and discrimination power.
- Investigate whether the items function differently for respondents with different educational levels.
Participants

- Longitudinal Study on Ageing-in-Place Scheme at HKHS Rental Estates: Baseline Health and Wellbeing Status and 2-Year Outcome.
- Collected baseline data between July and November 2014.
- N=2081 residents aged 65 years or older in 11 public rental estates of the Hong Kong Housing Society.
- Trained interviewers conducted face-to-face interviews with the Cantonese MoCA administered to eligible tenants.
- Fitness, health, and wellbeing information were also collected through both survey questionnaires and tests.
**Measures**

**Montreal Cognitive Assessment (MOCA)**

**Version 7.1 Original Version**

**VISUOSPATIAL / EXECUTIVE**

- **Copy cube**
  - **Copy box with 5 points**
- **Draw clock** (10 past eleven)
  - 3 points

**NAMING**

- **Contour**
  - Numbers
  - Hands

**MEMORY**

- Read list of words, subject must repeat them. Do 2 trials, even if trials successful do a recall after 5 minutes.
  - 1st trial: 2 points
  - 2nd trial: 1 point

**ATTENTION**

- Read list of digits (1 digit/sec.). Subject has to repeat them in the forward order.
  - 2 points
- Subject has to repeat them in the backward order.
  - 2 points

**LANGUAGE**

- Read list of letters. The subject must tap with his hand at each letter A. Requires if 2 errors.
- Serial 7 subtraction starting at 100.
  - 3 points
- 4 or 5 correct subtractions:
  - 3 points
  - 2 points
  - 1 point
  - 0 points

**ABSTRACTION**

- Similarity between e.g. banana - orange = fruit
- train - bicycle = watch - ruler

**DELAYED RECALL**

- Has to recall words with no cue
  - FACE
  - VELVET
  - CHURCH
  - DAISY
  - RED
  - Points for delayed recall only

**Optional**

- Date
- Month
- Year
- Day
- Place
- City

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**MoCA IRT**

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Add 1 point if $12$ yr only

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MoCA IRT
**Statistical analysis**

- Use item response theory (IRT) to explore item functioning and the precision of measurement.
  - IRT is used “to study the relationship between individual differences on a latent variable (e.g., cognitive deficits) assumed to underlies item responses and the probability of responding in a particular response category”.
  - Becoming increasingly popular for studying clinical scales.
  - Item and scale information quantify the precision of measurement.
- Conduct a differential item functioning (DIF) analysis to study the effect of eduction on item functioning.
## Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>total sample</th>
<th>no education</th>
<th>with education</th>
<th>$\chi^2/t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1876</td>
<td>995</td>
<td>1083</td>
<td></td>
</tr>
<tr>
<td>Female, N</td>
<td>1012</td>
<td>548</td>
<td>464</td>
<td>67.6</td>
</tr>
<tr>
<td>%</td>
<td>53.94</td>
<td>64.32</td>
<td>45.31</td>
<td>$p = 0.000$</td>
</tr>
<tr>
<td>Age, mean</td>
<td>79.3</td>
<td>81.5</td>
<td>77.5</td>
<td>11.0</td>
</tr>
<tr>
<td>(SD)</td>
<td>(8.0)</td>
<td>(7.3)</td>
<td>(8.1)</td>
<td>$p = 0.000$</td>
</tr>
<tr>
<td>MoCA, mean</td>
<td>18.6</td>
<td>15.9</td>
<td>20.9</td>
<td>-19.4</td>
</tr>
<tr>
<td>(SD)</td>
<td>(6.1)</td>
<td>(5.9)</td>
<td>(5.3)</td>
<td>$p = 0.000$</td>
</tr>
</tbody>
</table>
Scale information functions

- Whole sample
- No education
- Some education
Item information functions for no DIF items

- Trail
- Clock Shape
- Clock Hand
- Naming
- Digits for/backward
- Target detection

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Item information functions for no DIF items

- Serial subtraction
- Sentences repetition
- Fluency
- Verbal abstraction
- Short-term memory
- Orientation

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Item information functions for items with DIF

Cube

Clock Number

Cognitive ability

Item information

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MoCA sum scores and ability estimates
Conclusions

- The item response model generally fit well.
- Certain items of the MoCA have fairly low precision overall, leading to potential misclassification of individuals.
- Substantial DIF with respect to education level was detected for two items.
- To improve the precision of identifying MCI, ability estimates are recommended.
References


