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Introduction

Computerized Cognitive Test (CCT)

- Advantages over the existing paper-and-pencil method of assessing cognitive function
- However, most CCTs lack **speech recognition**, making it difficult to assess cognitive functions related to language

Newly developed CCT (CogMo)

- Can assess cognitive domains related to language using an automatic speech recognition (**ASR**)
- Test content into topics familiar to older adults
- Can be self-administered by **illiterate** older adults using a voice input interface

Aim of this study

- To investigate the **validity** and **reliability** of the CogMo in discriminating cognitive impairment

Methods

Development of CogMo

- Multi-domain** Cognitive functions
- Google Cloud Speech-to-Text API, Tablet PC
- Time: about 15-20 min.

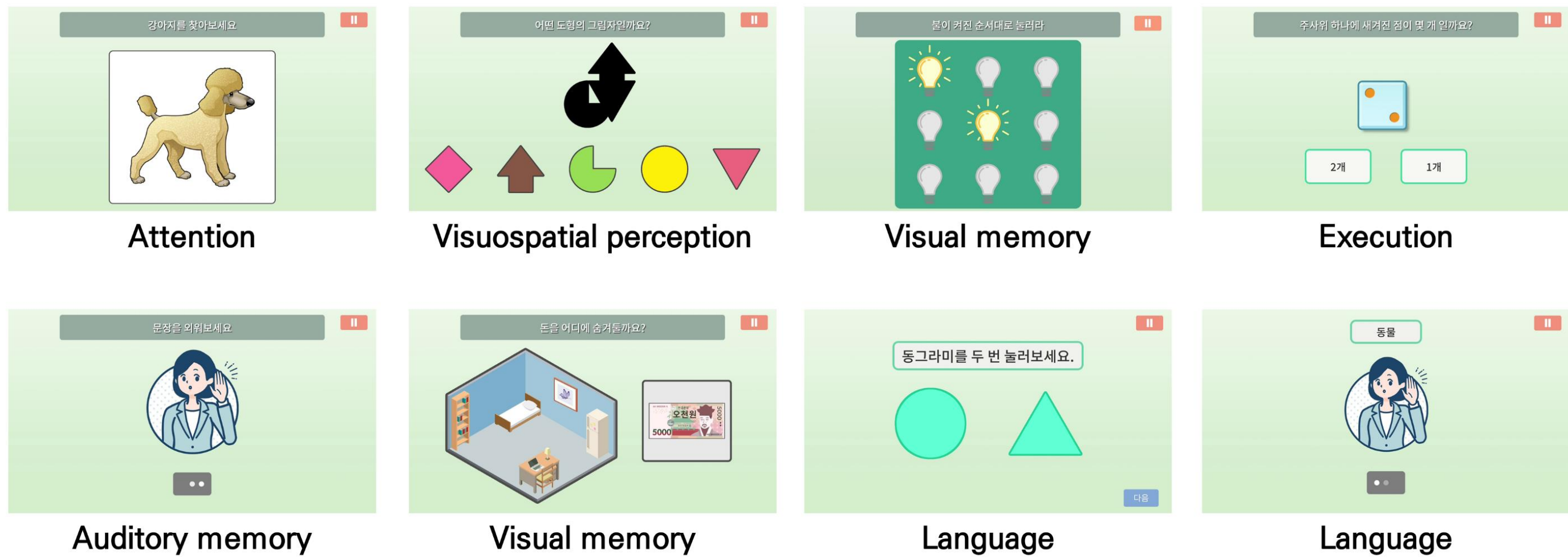


Fig 1. Screen shots of CogMo subtests

Study population

- Age ≥ 65 yrs (74.6±7.4 yrs), Community-dwelling
- Total 100 (normal 70, cognitive impaired 30)
- Those who visit local dementia care center

Assessment of Cognitive Impairment (CI)

- K-MMSE-2
- Cognitive Impairment: age & education ≤ -1.0 SDs

Results

Table 1. Comparison of each item of CogMo between groups

Items	Scale range (points)	Total (n = 100)	Normal (n = 70)	CI (n = 30)	p-value
Finding a puppy	0-18	15.9±3.6	16.9±2.4	13.6±4.7	< 0.01
Matching the shadows	0-18	14.9±3.2	15.6±2.3	13.3±4.2	< 0.01
Ordering the lights					
Forward	0-12	7.6±2.9	8.4±2.4	5.9±3.2	< 0.001
Backward	0-10	5.8±3.1	6.7±2.8	3.7±2.9	< 0.001
Counting the numbers					
Dots	0-15	12.8±3.4	13.8±2.7	10.7±3.9	< 0.001
Dices	0-15	11.2±5.1	13.0±3.9	7.2±5.4	< 0.001
Speaking sentence					
Recall	0-15	5.2±5.9	6.7±6.1	1.7±3.4	< 0.001
Recognition	0-15	11.8±3.9	13.3±2.5	8.2±4.3	< 0.001
Total score (manual)	0-30	20.4±9.5	24.0±7.1	12.1±9.2	< 0.001
Total score (automatic)	0-30	17.2±8.7	20.1±7.6	10.2±7.0	< 0.001
Finding hidden money	0-20	14.5±7.3	17.3±5.2	7.8±7.2	< 0.001
Read and act (manual)	0-10	8.8±2.7	9.0±2.6	8.3±2.7	< 0.05
Read and act (automatic)	0-10	7.7±3.3	8.4±3.2	6.0±3.1	< 0.001
Speaking words (manual)	0-	31.9±11.2	35.6±9.2	23.4±10.9	< 0.001
Speaking words (automatic)	0-	19.0±13.4	23.3±12.9	9.0±8.4	< 0.001
CogMo total score (manual)	0-100	75.1±19.8	83.0±14.7	56.6±17.6	< 0.001
CogMo total score (automatic)	0-100	69.7±20.3	78.1±15.6	49.9±15.9	< 0.001

- ✓ CogMo showed significant differences between the normal cognition and the CI group on **all test items**
- ✓ High correlation (**r = 0.98**, p < 0.001) between the **manual & automatic scoring** of the CogMo total score

Table 2. Correlation between MMSE score and CogMo each item

Items	Correlation coefficient r	P-value
Finding a puppy	0.61	< 0.001
Matching the shadows	0.48	< 0.01
Ordering the lights		
Forward	0.61	< 0.001
Backward	0.65	< 0.001
Counting the numbers		
Dots	0.70	< 0.001
Dices	0.77	< 0.001
Speaking sentence		
Recall	0.56	< 0.001
Recognition	0.75	< 0.001
Total score	0.70	< 0.001
Finding hidden money	0.63	< 0.001
Read and act	0.54	< 0.001
Speaking words	0.61	< 0.001
CogMo total score (0-100)	0.89	< 0.001

- ✓ Strong correlation (**r = 0.89**, p < 0.001) between the CogMo total score and the MMSE score

Table 3. Test-retest reliability of the CogMo

Items	1 <sup>st</sup> measurement	2 <sup>nd</sup> measurement	ICC	p-value
Finding a puppy	14.5±4.5	16.4±2.1	0.65	< 0.01
Matching the shadows	14.6±2.9	14.7±3.7	0.73	< 0.01
Ordering the lights				
Forward	6.8±2.8	6.8±2.7	0.63	< 0.05
Backward	5.2±2.8	4.9±3.1	0.65	< 0.01
Counting the numbers				
Dots	12.0±3.9	12.1±4.3	0.94	< 0.001
Dices	10.2±5.4	10.1±5.2	0.84	< 0.001
Speaking sentence				
Recall	4.3±5.1	4.8±4.8	0.62	< 0.05
Recognition	10.6±4.5	12.7±3.5	0.77	< 0.001
Total score	15.1±8.6	17.8±7.2	0.80	< 0.001
Finding hidden money	10.6±7.9	12.2±7.5	0.70	< 0.01
Read and act	7.4±3.3	7.4±3.3	0.49	0.06
Speaking words (correct answer)	14.0±13.4	16.2±10.6	0.35	0.15
CogMo total score (0-100)	62.3±20.6	64.4±19.8	0.94	< 0.001

- ✓ High test-retest reliability with **ICC = 0.94** (p < 0.001)

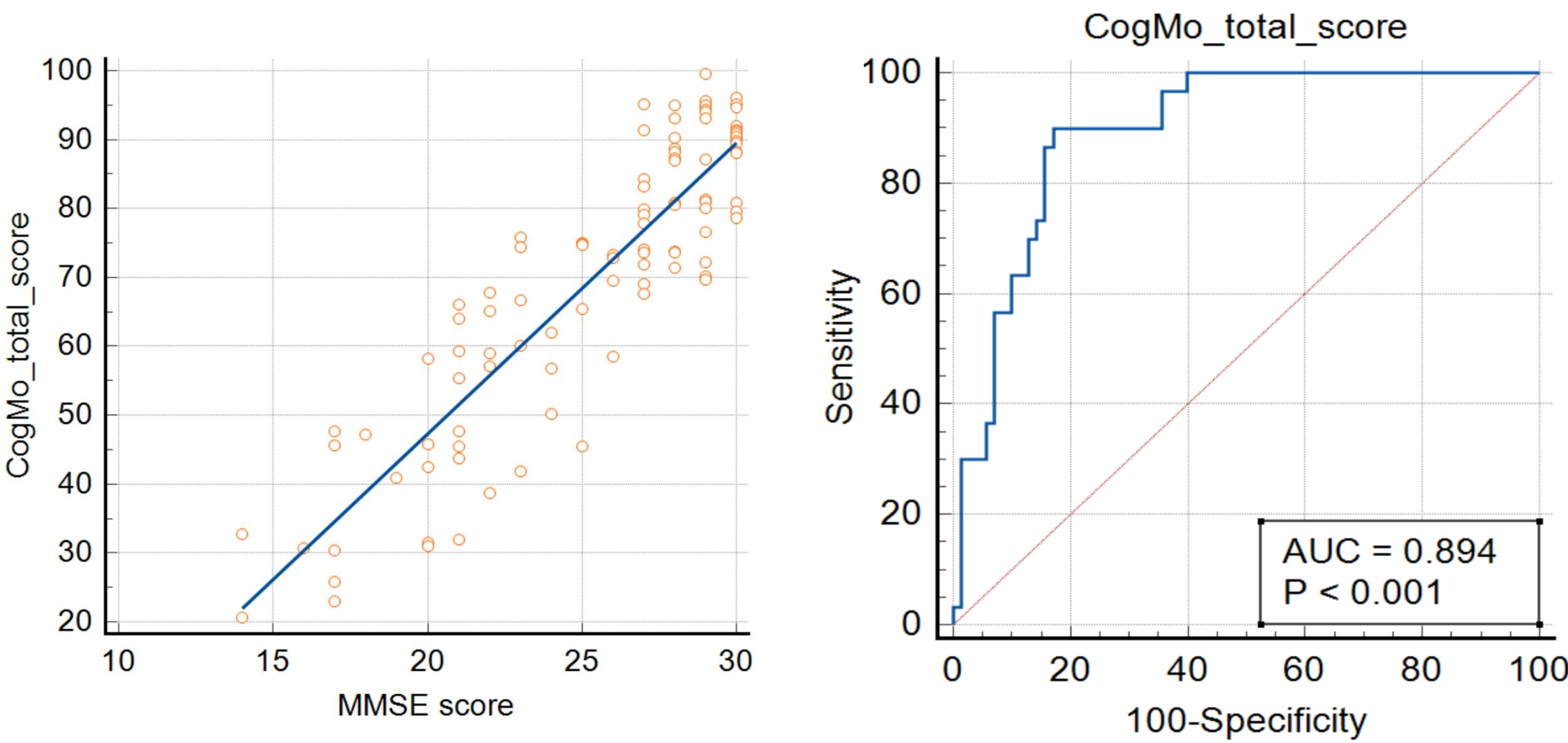


Fig 2. Scatterplot & ROC curve analysis

- ✓ **AUC = 0.89**,
- ✓ Cut-off = 68.8 point (sensitivity = 90.0%, specificity = 82.9%)

Conclusion

- CogMo showed sufficient **validity** and **reliability** to discriminate cognitive impairment in community-dwelling older adults in this study
- CogMo can be used for the **continuous monitoring** of **multi-domain cognitive functions** including **language** in community-dwelling older adults

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