Remote cognitive evaluation in aging adults: A new software implementation during COVID-19

[1]Praise O. Adesida, [1]Esteban Montenegro-Montenegro, [2]David L. Woods, [1]David K. Johnson

[1]Alzheimer's Disease Center- East Bay, Department of Neurology, University of California, Davis; [2]Neurobehavioral Systems, Inc.

Background

- Remote cognitive testing is a convenient and efficient method to evaluate older adults especially because of the sanitary restrictions due to COVID 19. Our aim was to test the psychometric properties of newly developed versions of two visuospatial attention subtests, Hidden Patterns and Identical Pictures, administered by remote cognitive evaluation platform developed by Neurobehavioral Systems, Inc. We conducted testing in a sample of healthy aging adults.

Objectives

- Our first aim was to examine the psychometric properties of an adapted hidden patterns test and identical picture test, administered by a remote cognitive evaluation platform developed by Neurobehavioral Systems, Inc.

- Our second aim was to explore the best IRT model via Bayesian inference to examine the item difficulty.

Methods

- Participants were recruited in East-Bay, California; 117 aging adults completed the computerized hidden patterns test, and 119 older adults answered the identical picture test. Participants were evaluated twice in one year at home, the software created by Neurobehavioral Systems, Inc allowed a synchronous interaction with the remote evaluator.

- The Bayesian IRT Models were estimated via Markov Chain Monte Carlo. Three chains were estimated.

- R statistical language was used to conduct all the analysis.

- Model fitting and evaluation utilized the brms package (Bürkner, 2017). Model convergence was evaluated as PSR ≤ 1.05, Effective Sample Size ≥ 300.

Table 1. Demographics

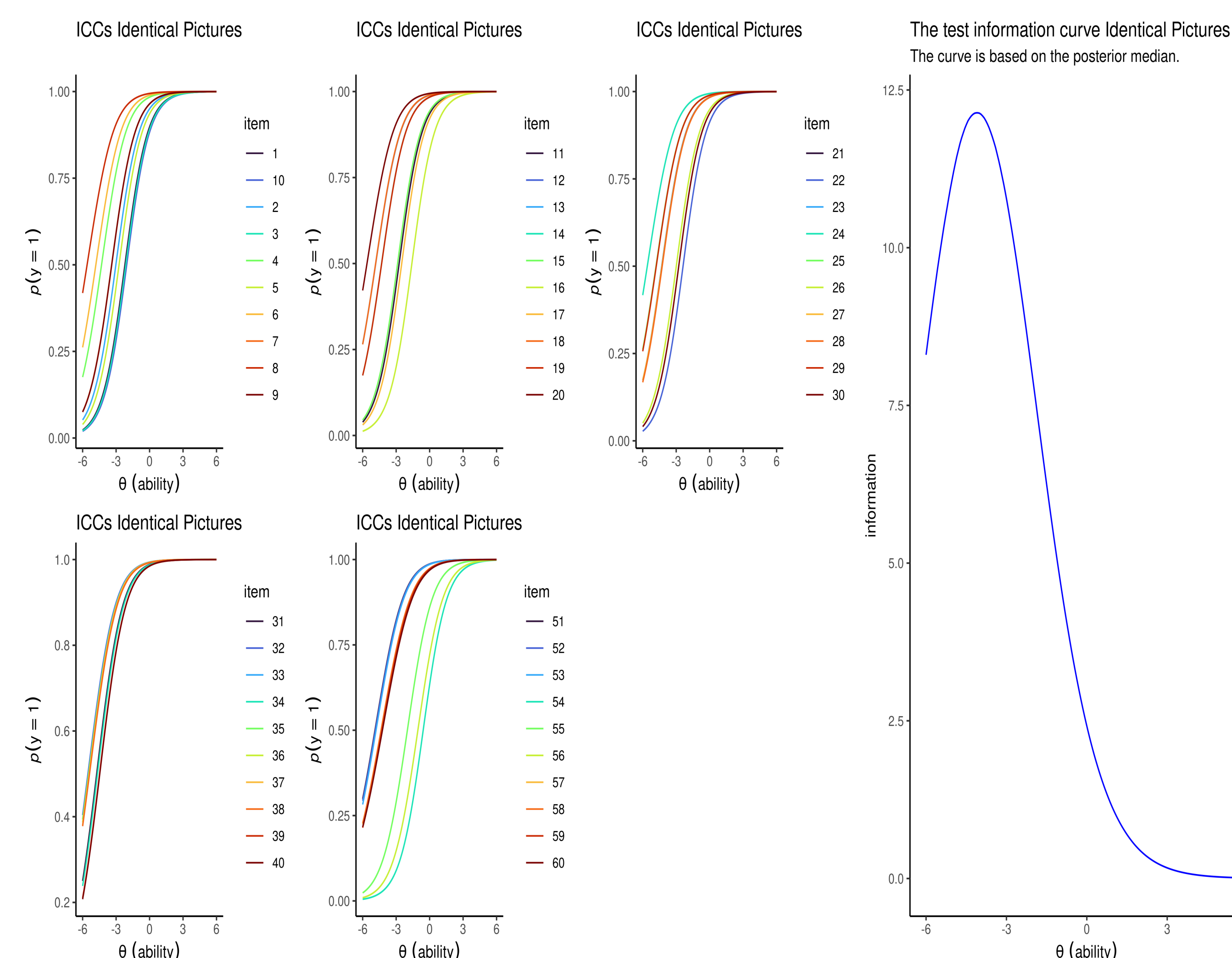| Variable		Mean (SD) or Counts (%)
Age (years)		65.04 (14.50)
Males		260 (59%)
Education	No schooling	2 (0.46%)
	High school completed	54 (12.30%)
	Junior/technical college	33 (7.52%)
	Associate degree	52 (11.85%)
	Bachelor's degree	137 (31.21%)
	Some graduate	18 (4.10%)
	Graduate	143 (32.57%)

Figure 1. Identical Pictures Test: 1 PL Item Information Curve and Test Information Curve.

- A 1PL model fitted the IP data better after comparing the leave-one-out cross-validation information criterion (LOOIC) (Gelman et al, 2013).

- Figure 1 shows that most of the items were easily responded to correctly, which is an expected result in this pilot study with healthy participants.

- The TIC shows that the test captured information mostly for the low ability tail.
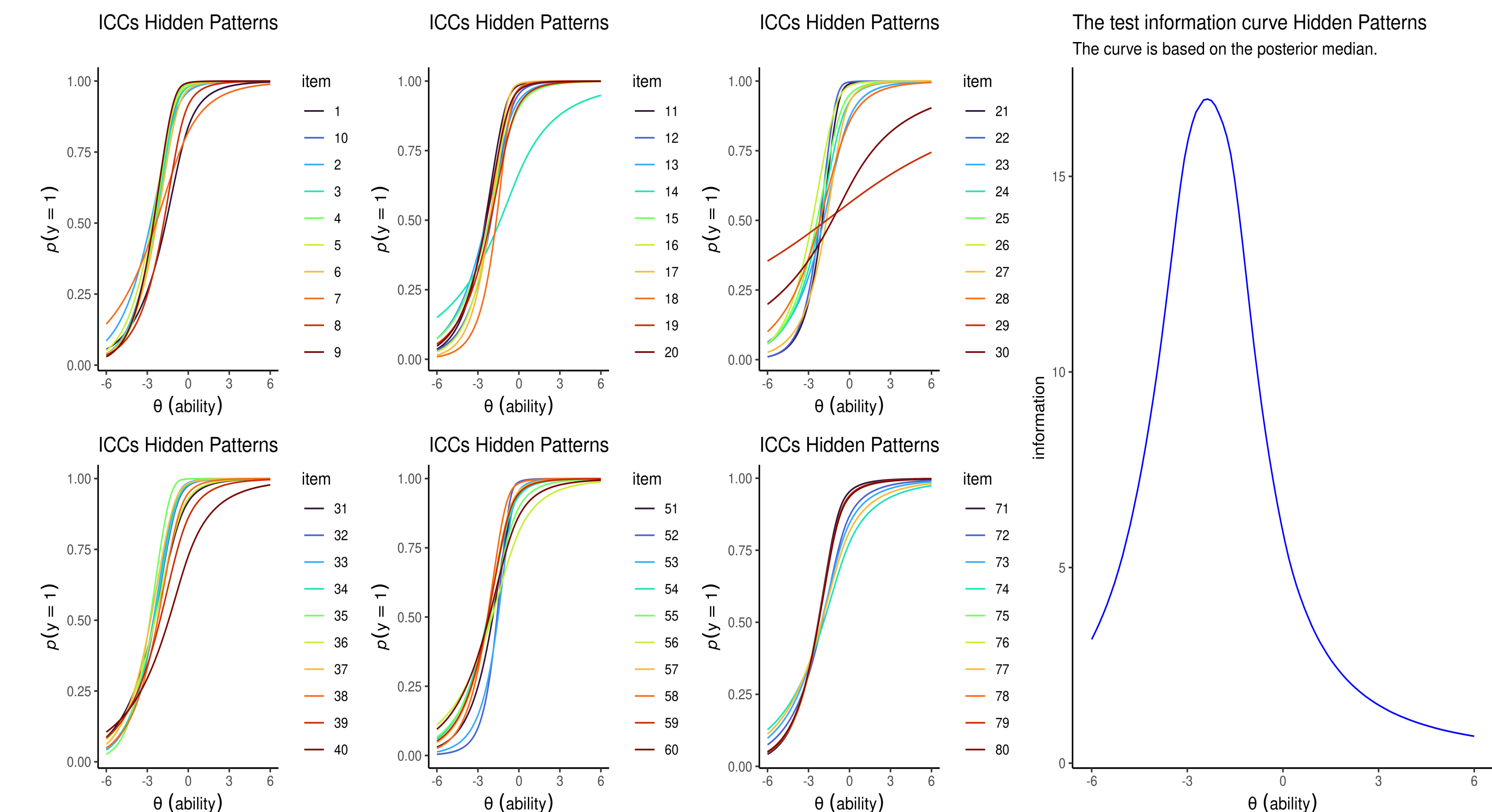
Results

Figure 2. Hidden Pattern Test: 2PL Item Information Curve and Test Information curves.

- A 2 PL model fitted the HP data better according to the LOOIC.

- Figure 2 shows that most of the items were easy to answer, participants with low ability had a high probability of answering the trial correctly.

- Several trials show low discrimination, other items such as trial 29 need revision due to their lack of discrimination.

- The TIC showed that the model accounts for mostly low ability information.

Conclusions

- The IRT models showed that it is necessary to expand the sample to include low educated participants, and participants with lower performance such as mild cognitive impaired aging adults.

- These results will help in the improvement of stimuli, given the lack of discrimination in the HP test and the difficult patterns found in the IP test.

References

Bürkner, P. C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of statistical software*, 80, 1-28.

Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian data analysis* (3rd ed.). CRC Press. https://doi.org/10.1201/b16018