

Introduction

Conventional neuropsychological assessments of cognitive impairment are constrained by infrequent administration, susceptibility to practice effect, ceiling/floor effects, and ‘white-coat’ biases due to in-clinic execution^{1,2}.

Smartphone-based assessments represent an alternative enabling unsupervised and more ecologically valid cognitive monitoring with an increased temporal resolution^{3,4}.

CoGames is a battery of six smartphone-based user-adaptive assessments (Figure 1) targeting cognitive domains, including visuospatial memory (Treasure Hunt), working memory (Match One, Match More), processing speed and attention (Numbers, Think Fast, Match One), executive functions and cognitive flexibility (Mixer, Match More). CoGames user-adaptivity is driven by a **Dynamic Difficulty Adjustment (DDA) system**⁵, which tailors the task difficulty to individual performance on a session-by-session basis prior to the target study baseline (Figure 2), thereby mitigating practice and ceiling/floor effects.

Preliminary findings from the first 25 participants enrolled in the ADAPT-MCI-01 study (NCT07174869) are reported here.

Conclusions

The CoGames battery of user-adaptive assessments of cognition demonstrated **usability, likability** and preliminary evidence of **construct validity** in participants with mild cognitive impairment (MCI), with an efficient mitigation of practice effects.

Materials and Methods

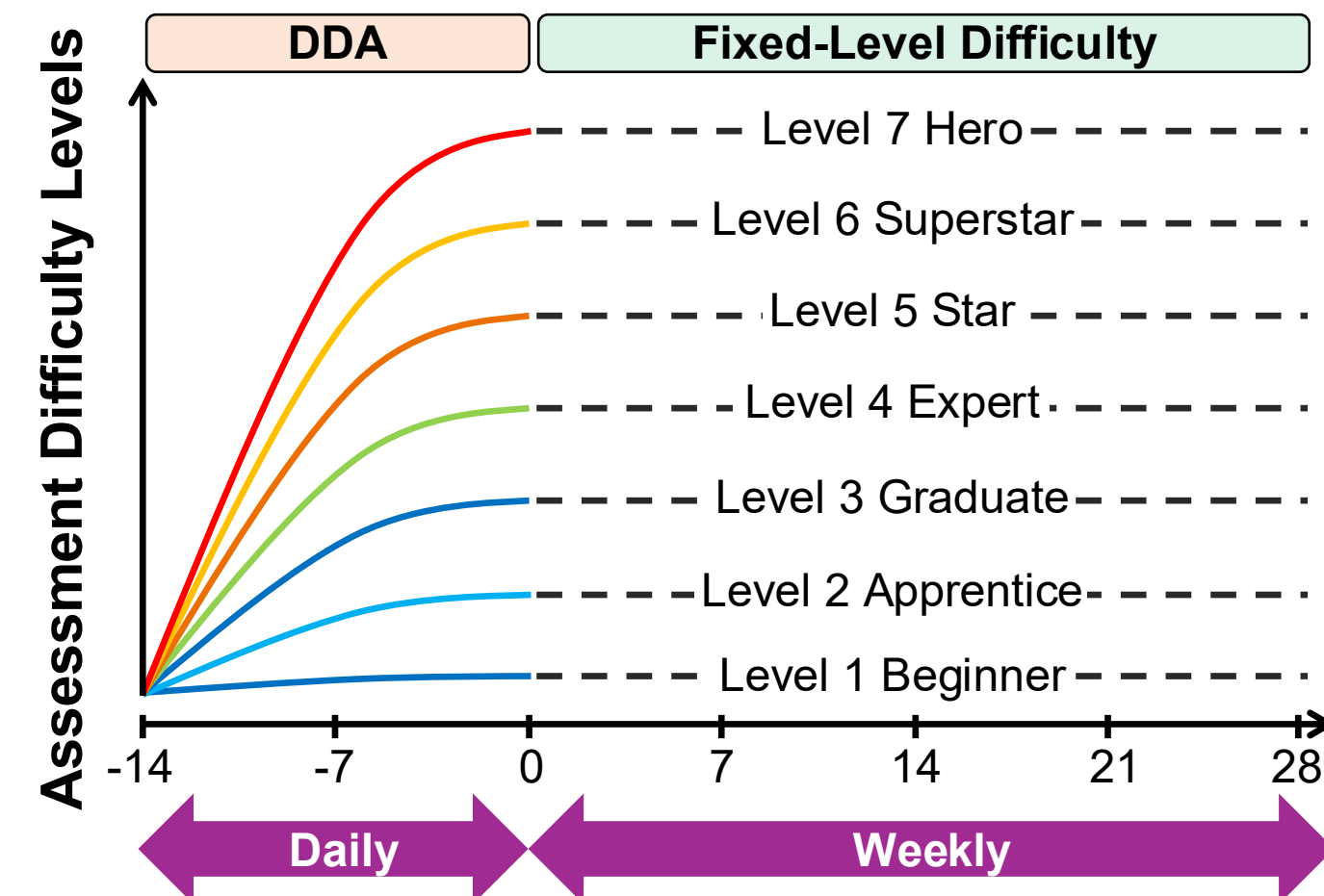
Design Prospective, single-centre feasibility study.

Participants Aged 50–90; HV (global CDR = 0) or PwMCI (global CDR = 0.5), performing the CoGames remotely on their personal smartphones.

Schedule The study spans six weeks. During a first adaptive phase (Day -14 to Day 0), participants complete CoGames assessments daily; the DDA system iteratively adjusts task difficulty from Day -12 until Day 0, when the level is then fixed for the rest of the study. During a subsequent fixed phase (Day 1–28), participants complete CoGames assessments weekly. In-app usability and likability questionnaires are administered at Day 1 and 28 (Figure 2).

Feasibility and performance of the DDA were evaluated by the distribution of difficulty levels reached by PwMCI and HV at the end of the adaptive phase and the number of sessions required to reach a steady-state plateau of difficulty level.

Figure 2: Study Schedule of Assessments



Cognitive performance stability across the fixed-difficulty phase was evaluated descriptively and using linear longitudinal models with random intercept and slope.

Construct validity was evaluated through known-group discrimination (HV vs PwMCI) and convergent correlation with MoCA total score.

Results

Baseline Disposition

By 21 May 2026, 23 participants had completed the study; 2 subjects were lost to follow-up and excluded from the analysis. Baseline characteristics were well balanced between HV and PwMCI (Table 1).

Table 1.	HV (N=11)	MCI (N=12)	All Subjects (N=23)
Sex			
Female	7 (63.6%)	6 (50.0%)	13 (56.5%)
Male	4 (36.4%)	6 (50.0%)	10 (43.5%)
Age, years			
Median	67.0	69.5	69.0
[Min, Max]	[51.0, 78.0]	[53.0, 85.0]	[51.0, 85.0]
Years of education			
Median	16.0	16.0	16.0
[Min, Max]	[14.0, 18.0]	[13.0, 20.0]	[13.0, 20.0]
Global CDR			
Median	0	0.50	0.50
[Min, Max]	[0, 0]	[0.50, 0.50]	[0.00, 0.50]
CDR Sum of Boxes			
Median	0	0.50	0.50
[Min, Max]	[0, 0]	[0.50, 1.00]	[0.00, 1.00]
CDR Memory Box			
Median	0	0.50	0.50
[Min, Max]	[0, 0]	[0.50, 0.50]	[0.00, 0.50]
MoCA Total Score			
Median	29.5	26.0	28.0
[Min, Max]	[26.0, 30.0]	[21.0, 30.0]	[21.0, 30.0]
Missing, n	3 (27.3%)	3 (25.0%)	6 (26.1%)

Adherence

Across all CoGames assessments, participants completed **87% and 78%** of scheduled assessments during the adaptive phase (daily) and the fixed-difficulty phase (weekly), respectively. Adherence was consistent among the assessments.

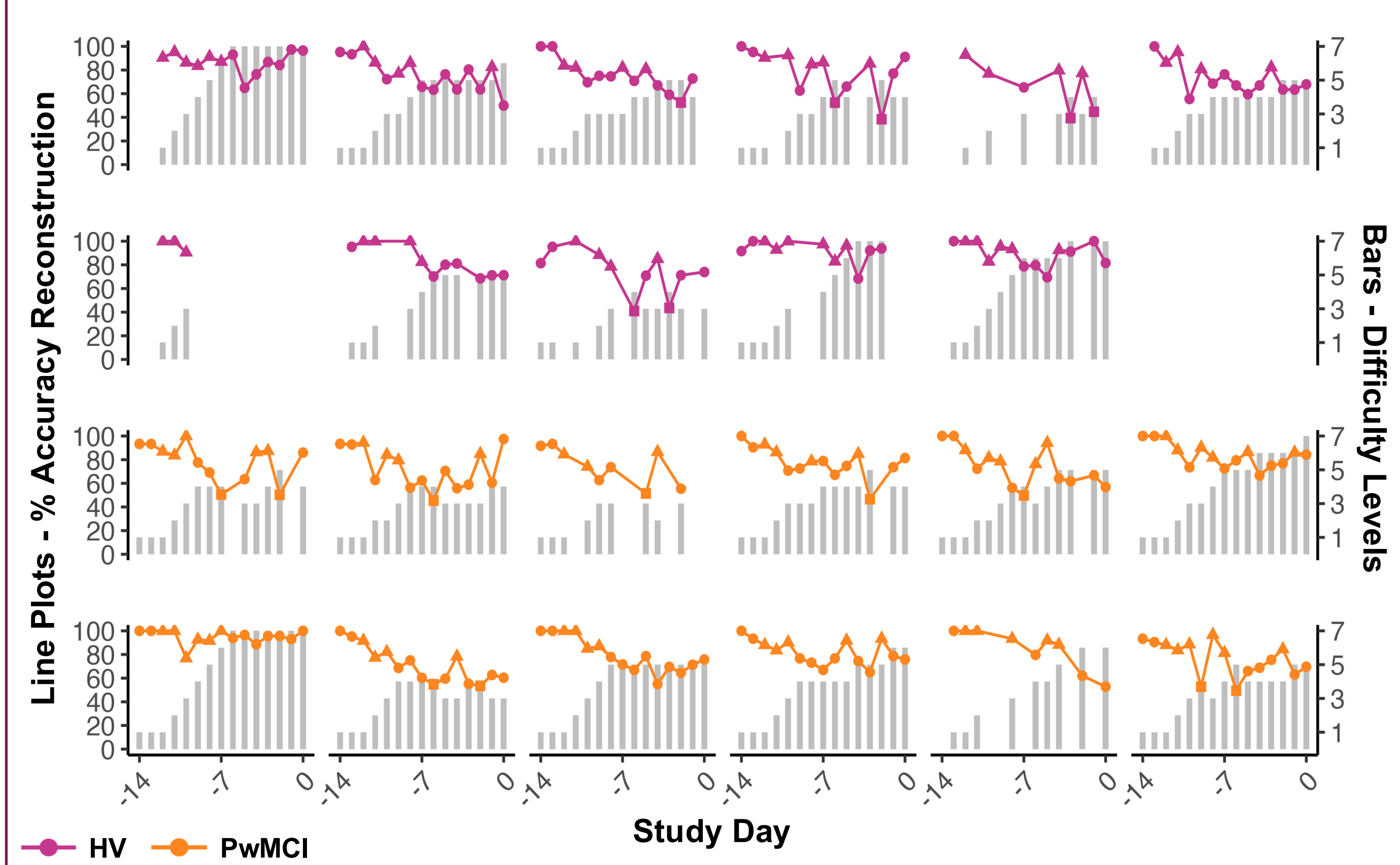
Usability and Likability

Participants in both groups rated the app likability (median **4.0/5.0**, range: 3.0–5.0) and usability per System Usability Scale⁶ (score **75.0/100.0**, range: 67.5–91.3) as good.

Dynamic Difficulty Adjustment (DDA) - Feasibility and Performance

During the 14-day adaptive phase, participants were able to increase the difficulty across a wide range of levels for all CoGames assessments. On average, final difficulty levels were reached after **9 days** of daily assessments (range: 7–11 days) (Figure 3). Similar plots for all CoGames assessments can be found in the test online poster appendix.

Figure 3: Subject Reconstruction Accuracy in Treasure Hunt and Difficulty Levels



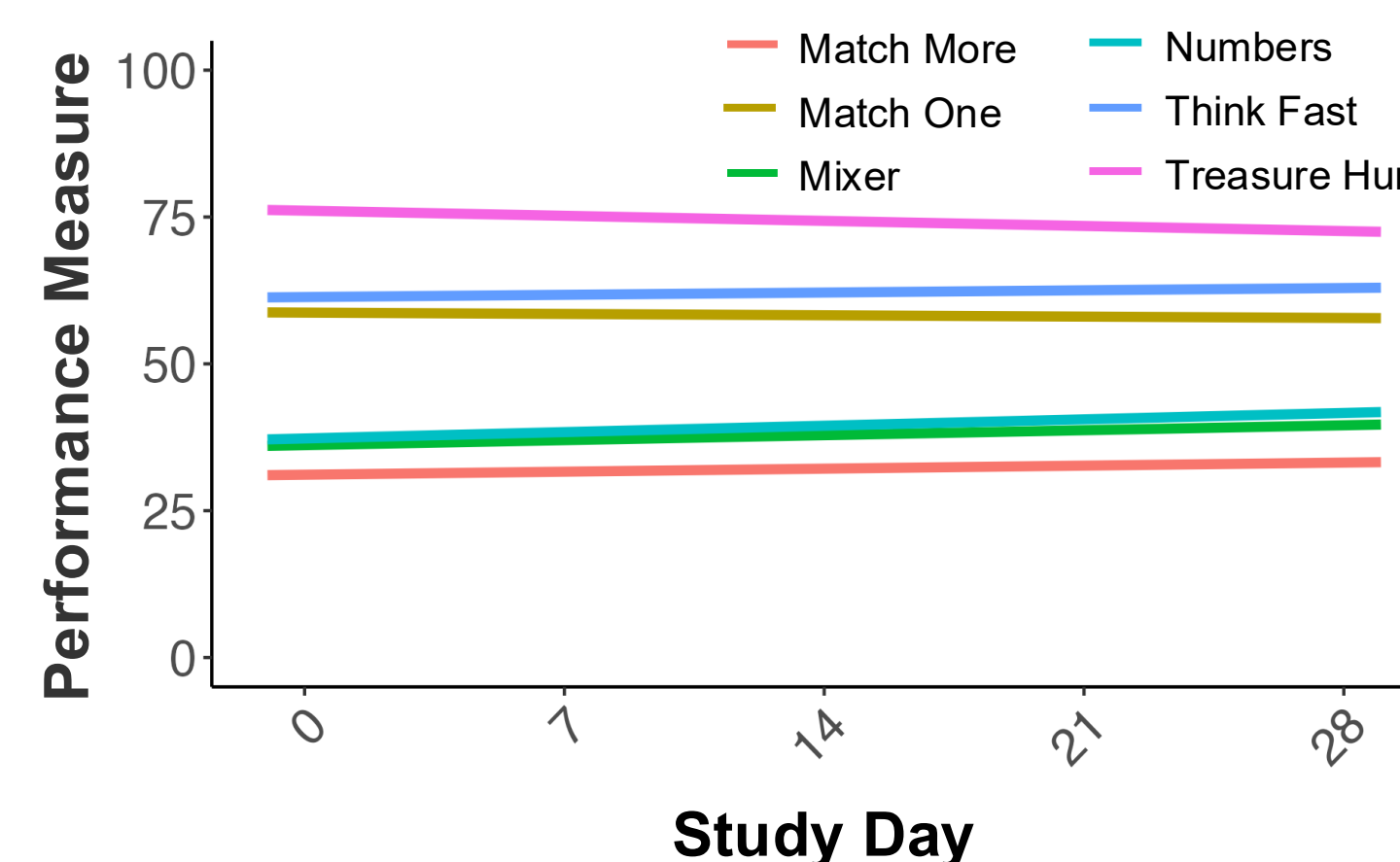
Ceiling effect mitigation

Although the difficulty level changed over time due to the DDA, the performance measure tended to decrease from an initial ceiling of 100% to a similar range across subjects (Figure 3).

Cognitive performance stability

In the fixed-difficulty phase, the absolute median performance fluctuations around the mean of both groups over four weeks were lower than **10%** for the performance measures used for DDA. Linear random coefficients models (one for each assessment) did not identify any trends over time (Figure 4).

Figure 4: Cognitive Performance Stability



Construct Validity

Performance measures during the first three days (all subjects at the lowest level of difficulty for each assessment) across the CoGames battery were higher in the HV group compared to the PwMCI group (Figure 5).

Convergent validity of CoGames assessments was evaluated by the Spearman correlation of mean three first day performance measure with MoCA total score at last in-clinic visit (Table 2).

Figure 5: Known-Group Discrimination

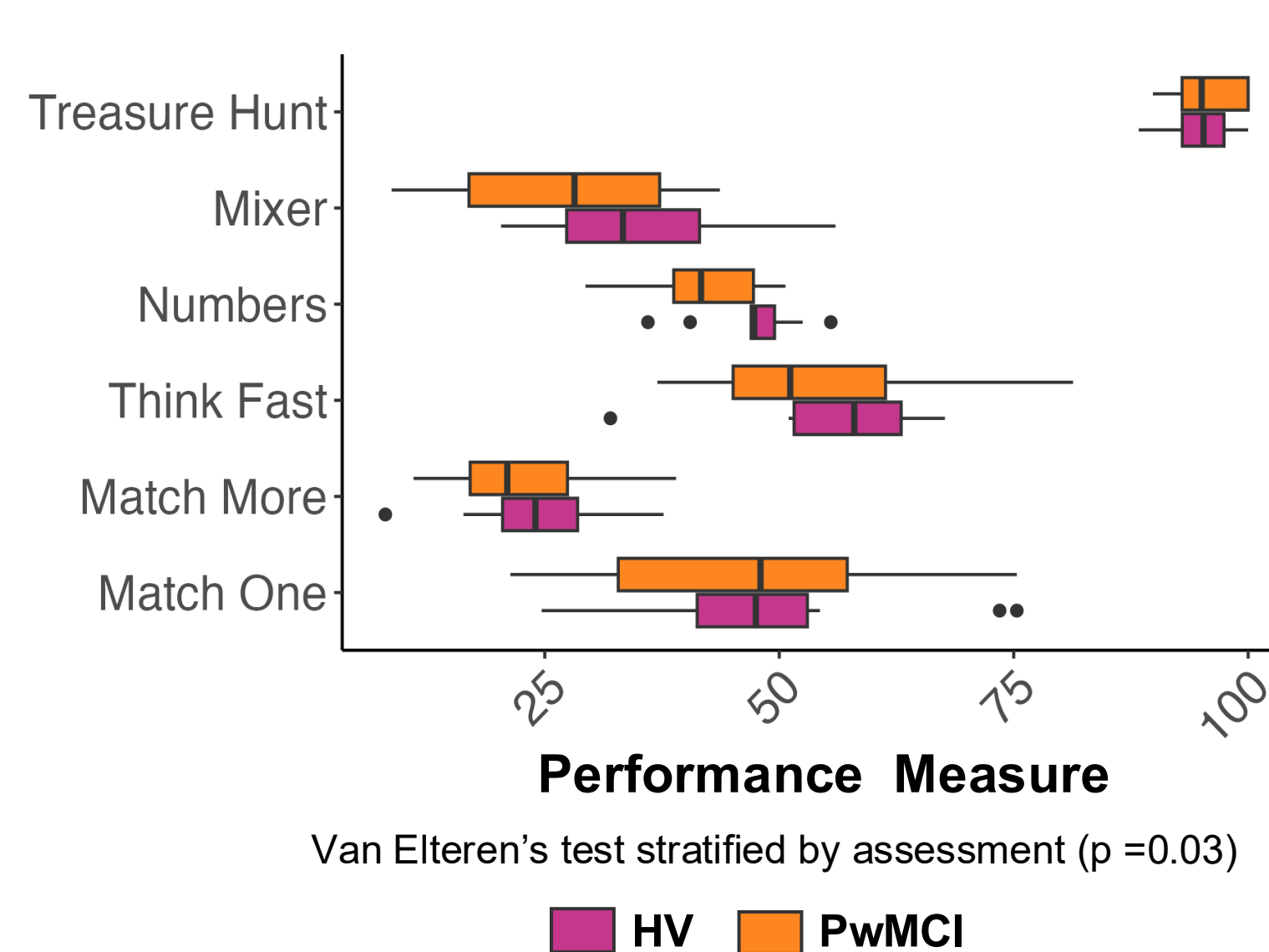


Table 2: Convergent Validity vs MoCA Total Score

Assessment	Mixer	Numbers	Think Fast	Treasure Hunt	Match More	Match One
Spearman's rho	0.587*	0.558*	0.472*	0.411	0.321	0.309

* P-value < 0.05

References and Credits