TEST-RETEST RELIABILITY AND VALIDITY OF THE DIGITAL DIGIT-SYMBOL SUBSTITUTION TASK IN PARKINSON'S AND HUNTINGTON'S DISEASE

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CAMBRIDGE COGNITION

Objectives

The CogKit digit-symbol substitution task (DSST; see Figure 1) assesses processing speed, sustained attention, and visuomotor coordination, with demonstrated sensitivity to cognitive impairments in neurodegenerative disorders. This study evaluated: 1) the test-retest reliability and validity of digital DSST for remote cognitive assessments in clinical populations with Parkinson's disease (PD) and Huntington's disease (HD) across three timepoints, and 2) its clinical validity against the Montreal Cognitive Assessment (MoCA).

Methods

Data were collected from the IDEA-FAST Clinical Observation Study, which measures fatigue across multiple disease cohorts.

Participants with PD (n=258; ages 40-82) and HD (n=41; ages 29-67) completed the DSST daily for one week. Only those completing assessments at days 1 and 7 were analyzed. DSST outcomes included number of correct drawings in 90 seconds, response time and drawing time (expressed in milliseconds).

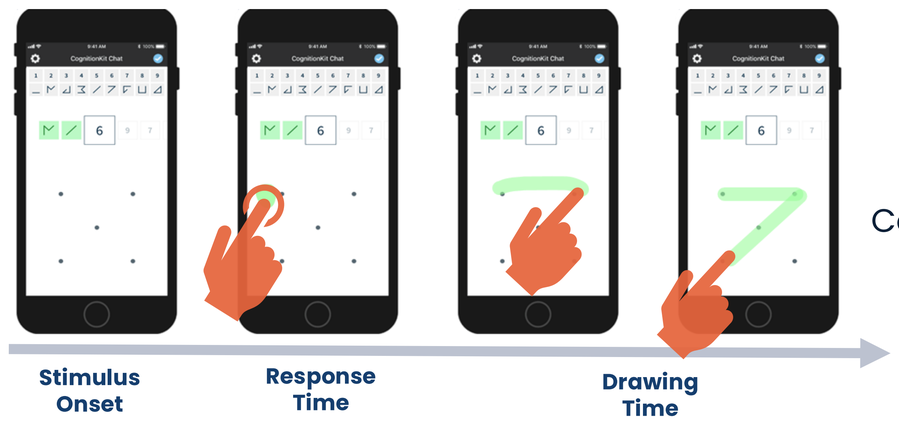

Figure 1: Components of the Digital DSST

Analysis

Table 1 reports summary of statistics by disease group and per each day. Test-retest reliability was assessed using Intraclass Correlation Coefficients (ICC) for Day 1 versus Day 2, and Day 1 versus Day 7. Figure 2 reports ICC values and 95% Confidence Interval (CI).

To address whether different DSST outcomes relate with MoCA global scores and its subscales, a correlation analysis was performed controlling for age and sex. Figure 3 reports partial correlation values.

Table 1: Summary of statistics by Disease Group and Day

DST outcomes	Parkinson's disease			Huntington's disease		
	Day1	Day2	Day7	Day1	Day2	Day7
Total correct	20.6	19.1	21.7	24.3	24.3	25.4
Response Time (m)	2327.8	2699.8	2281.0	2230.6	2334.1	2289.2
Response Time (sd)	684.9	1028.2	760.7	670.2	737.4	869.8
Drawing Time (m)	1634.9	1697.2	1524.1	1331.2	1332.8	1327.1
Drawing Time (sd)	717.7	776.8	686.0	651.0	669.5	626.7

Notes: m=mean; sd=(standard deviation)

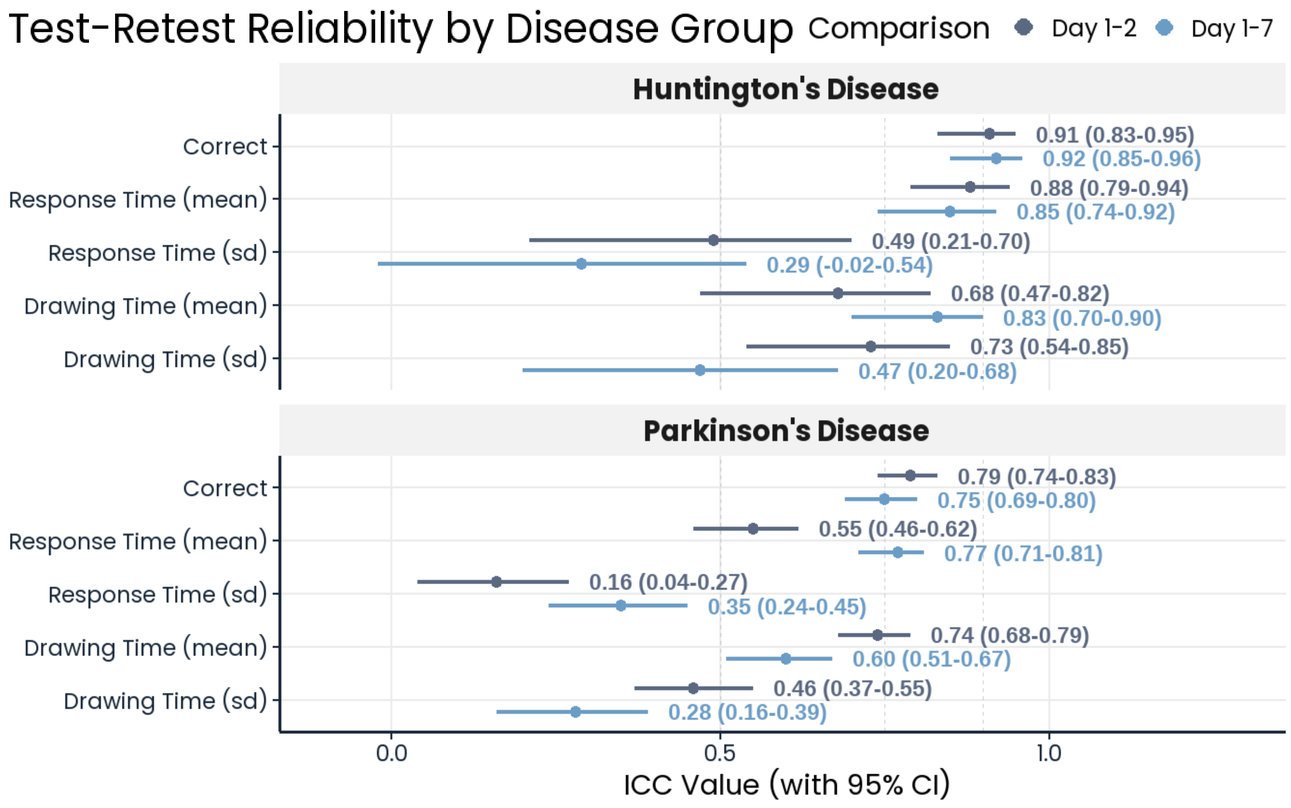

Figure 2: Forest plots showing ICC - 95% CI by Disease Group and Comparison

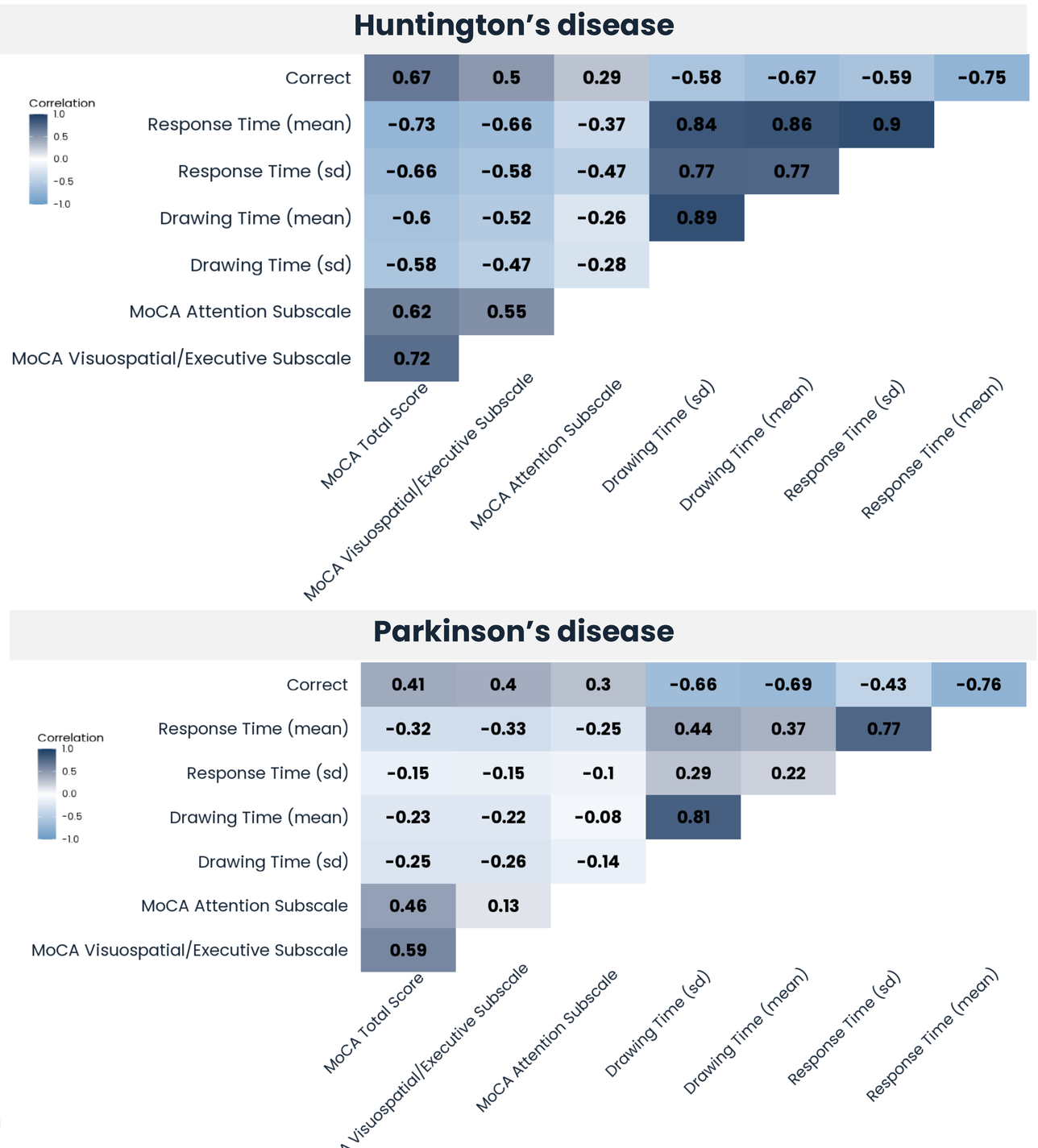

Figure 3: Partial correlation for DSST outcomes and MoCA in HD and PD

Discussion

- Digital DSST shows good-to-excellent test-retest reliability in HD (ICC=0.91-0.92 for accuracy) and good reliability in PD (ICC=0.75-0.79), supporting its use for longitudinal cognitive monitoring
- Mean performance metrics (accuracy, response/drawing time) demonstrate stronger reliability than variability measures (SD), suggesting clinicians should prioritize mean scores for tracking cognitive change
- Response time variability showed poor reliability in PD (ICC=0.16-0.46), likely reflecting motor fluctuations and medication effects characteristic of the condition
- Strong correlations between DSST accuracy and MoCA global scores validate the digital DSST as an efficient screening tool in both populations. Its validation against MoCA suggests it can be adopted as an efficient, low-burden digital solution for screening and frequent monitoring across different clinical settings, including remote assessments
- HD patients demonstrated stronger cognitive-motor associations than PD, with faster, more consistent performance linked to better visuospatial and executive function, however larger samples are needed to confirm HD findings in future research

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