Remote App-Based Assessment of Memory and Executive Functioning in Aging and Pre-Clinical Alzheimer's Disease in a Diverse Sample of Older Adults

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Introduction

- Mobile, valid and engaging cognitive assessments are essential for detecting and tracking change in research participants and patients at risk for Alzheimer's Disease and Related Dementias (ADRDs).
- This pilot study aims to determine the feasibility and generalizability of at-home, app-based cognitive assessments included in the mobile cognitive app performance platform (mCAPP), to detect cognitive changes associated with aging and preclinical AD.

Methods

Participants

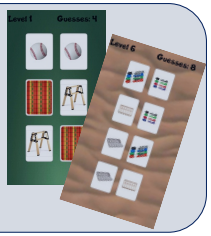
60 cognitively normal older adults (73% female; age=71.9±4.6, years of education=16.6±2.4; 50% White, 48% Black, 2% Multiracial; MoCA=26.3±2.7), were recruited from the Penn Alzheimer's Disease Center Clinical Core. They completed in-lab testing and used the mCAPP games at home for 2 weeks.

Cognitive Measures

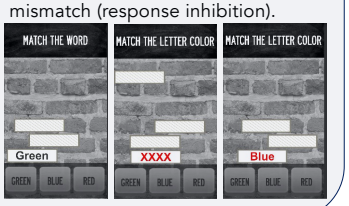
- UDS3: MoCA (global cognition), Craft Story (story learning and memory), Digit Span (attention/working memory), Verbal Fluency (language & executive functioning), Trail Making Test A (attention & processing speed) and TMT B (executive functioning)
- Preclinical Alzheimer's Cognitive Composite (PACC), Stroop Color-Word Test, and Digit Symbol Substitution Test (processing speed and executive function)

mCAPP Games

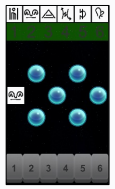
Concentration Memory Game: Cards are shown face-up to reveal the objects and then immediately turned over. Difficulty (load) increases as participants progress to higher levels. Includes learning and then matching hidden card pairs and incorporates increasing memory load, pattern separation features (lure vs. non-lure), and spatial memory (moving target cards).



Brick Drop: Stroop-like task with 3 blocks (1) word matching, (2) color identification, and (3) color identification for color-word mismatch (response inhibition).



Space Imposters: Symbol-number coding task with 3 blocks of increasing target pairs (4, 5 and 6 targets).



Results

Participant Phone Use & mCAPP Experience

- 98% use a smartphone, including for calls (100%), texting (98%), email (83%), games (62%), calendar (77%), and social media (62%)

	Too Easy	Just Right	Too Difficult
Concentration Memory Game	3%	94%	3%
Brick Drop Game	8%	87%	5%
Space Imposters Game	0%	88%	12%

mCAPP Usability

MAUQ scale 6.3±0.8 (1-7 scale)

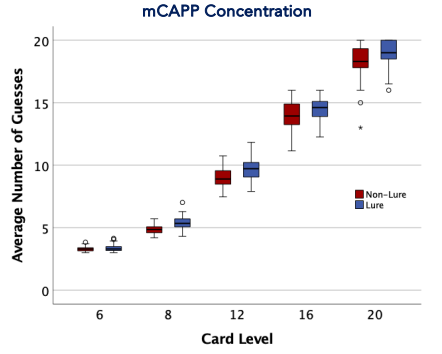
At-home use:

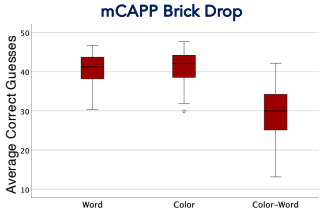
Number of sessions: 12±5.1 sessions over 2 weeks
Average session length: 11.5 ± 2.8 minutes
63% of participants played extra sessions

mCAPP Performance

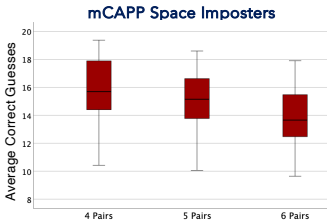
Performance decreased with increasing levels of difficulty.

On Concentration, all lure levels required more guesses than non-lure levels (p<0.001).





All mCAPP tasks showed lower performance with increasing cognitive load (p's<.05).



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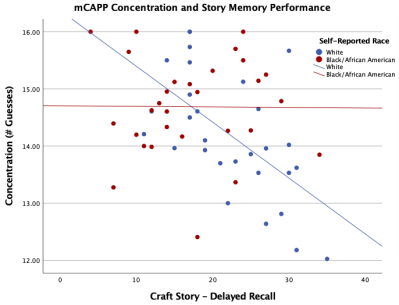
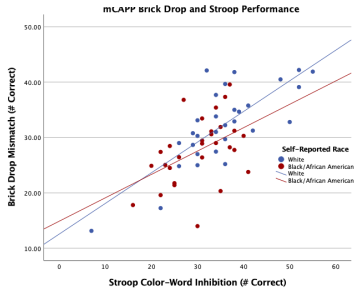
Results (cont.)

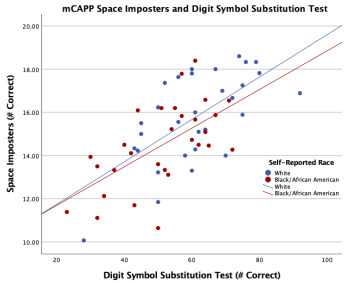
mCAPP & Neuropsychological Test Data



Concentration performance correlated with UDS3 memory measures and the PACC overall (p's<.05). When examined by self-identified racial group, relationships remained significant in White participants, but not in Black/African American participants.

Brick drop performance correlated with the Stroop task (p<.05) and space imposters performance correlated with the DSST (p<.001) within all groups.





Education, but not age, differed between Black (15.8±1.9yrs) and White (17.6±2.3yrs) participants.

ADI rankings indicated lower levels of neighborhood disadvantage in White participants (28±16) than in Black participants (57±30).

Discussion

- This pilot study shows acceptability and usability of the app for at-home use in a diverse cohort of older adults. Performance across measures indicate initial reliability and validity of mCAPP.
- Significant relationships between mCAPP variables and standard neuropsychological measures suggest preliminary evidence of criterion and construct validity. Additional attention is needed to identify, account for, and further probe differences in performance across participants with diverse sociodemographic backgrounds, including the impact of Social and Structural Determinants of Health (SSDoH) on cognitive performance and brain health in aging.
- Future work will include examination of the results of burst testing and the relationship of mCAPP variables with structural and molecular biomarkers.

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