Usability of a Remote App-Based Assessment of Cognition to Analyze the Effects of Parkinson's Medication

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Introduction

- The What: A mobile cognitive app performance platform whose goal is to deliver valid and engaging cognitive assessments to those at risk for developing a neurodegenerative disease as a means to detect associated cognitive changes.
- The How: The mCAPP mobile app contains three minigames aimed to assess memory and executive functioning skills, one of which is the Brick Drop Game.
- The Specific: This study explores the ways in which mCAPP data collected from a participant with Parkinson's disease can be used to test the cognitive impact of the on and off Parkinson's medication (ie. L-dopa) states.

Methods

Participant

Male older adult individual diagnosed with Parkinson's Disease.

Data Collection

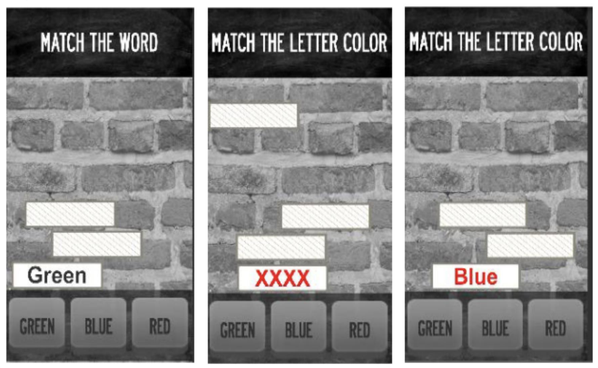
The mCAPP memory application consists of 3 games:

- **Concentration Memory Game:** Cards are turned over immediately after they've been displayed face-up to display the items. As participants go to higher levels, difficulty (load) rises. Combines pattern separation skills (lure vs. non-lure) and spatial memory (moving target cards), as well as learning and matching disguised card pairs.
- **Brick Drop:** Stroop-like task with 3 blocks: speed word, color identification, and 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).

** The data was collected both in the office and at home over the span of 8 days. The participant completed a total of 12 sessions at home: 6 of which was in the "on medication state" and the other 6 in the "off medication state." The states were self-reported by the participant. The states had varying degrees (very OFF, somewhat OFF, neither, very ON, somewhat ON). Even though the participant played all three games in each session, this specific study only uses data from the Brick Drop Game.

Brick Drop

Speed word | Color identification | Color identification for color-word mismatch

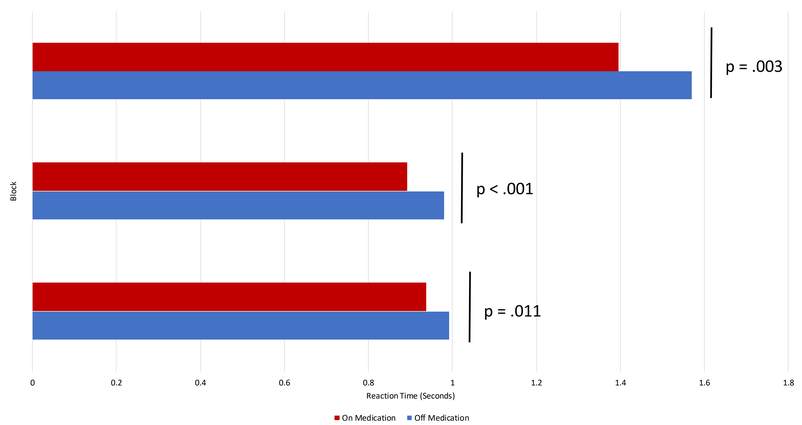


Scan for Background Information!

Cognitive Effects of Parkinson's and Parkinson's Medication

Results

Effect of Medication on Average Reaction Time For All Blocks



Effects of Parkinson's medication on the mean reaction time are statistically significant throughout all blocks. Difference of means is greatest for the color naming block.

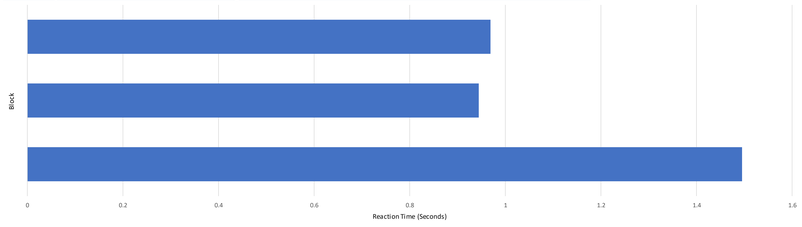
Average Reaction Time On Medication VS Off Medication

Medication (On = 1, Off = 0)	Average Reaction Time (Seconds)
1	1.041986014
0	1.137209063

Collapsing data from all three blocks, average reaction time for on medication is significantly lower.

Does reaction time on Brick Drop reflect differences in performance across blocks?

Comparison of Average Reaction Times For Each Block

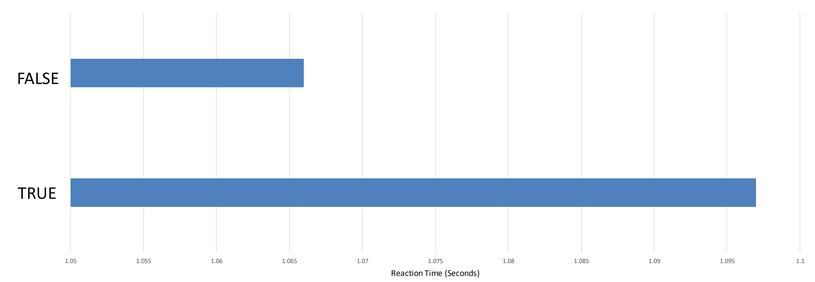


Reaction time significantly increases for the color-word mismatch block (2) which reflects the participant's ability to inhibit cognitive interference. Hence, shorter reaction time would be a valid indicator of improved cognitive function.

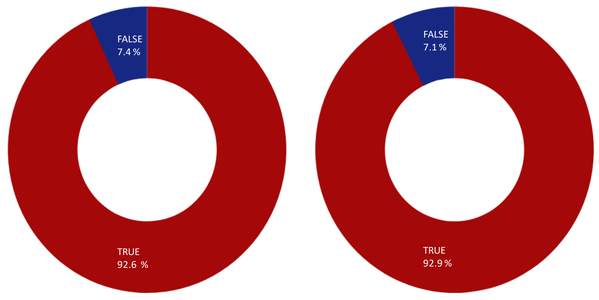
Results cont.

Is the participant fast because of the medication or is the reaction time being influenced by the distribution of correct guesses?

Average Reaction Time for TRUE vs FALSE Guesses



Distribution of TRUE vs FALSE Guesses for Color-Word Mismatch Block



For a clearer understanding of this distribution, only the color-word mismatch block is examined since this block is where the majority of the mistakes are made. Even though reaction time is heavily influenced by the nature of the participant's guess, there is very little difference between the distribution of correct guesses on medication vs off medication. The performance accuracy is not the driver of the reactions time difference in the on and off medication states.

Discussion

- **Feasibility:** Remote testing was successfully implemented both within the clinic and at the home environment. The participant consistently engaged in all testing procedures and submitted self-reports. Remote data collection eliminated the hindrance of clinic visits, enhancing data acquisition.
- **Usability:** participant's adeptness in learning the assessment protocol after a single training session highlighted the tool's user-friendly nature. The participant effectively performed assessments at home, showcasing the practicality of the approach.
- **Clinical Applicability:** mCAPP's potential in detecting variations linked to medication on and off states was underscored by the participant's data. Promising implications for optimizing medication usage and mitigating cognitive impacts of medication emerged.
- **Future Implications:** mCAPP's adaptability suggests its potential application in monitoring participants after sensitive procedures (ie. invasive brain stimulation surgery) and help refine parameter settings to mitigate cognitive risks and potential side effects.

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