



Information Processing Speed Influences the Component Processes of Verbal Working Memory in Parkinson's Disease Patients

York, M.K., Levin, H.S., Soety, E.M., Lai, E.S., Jankovic, J., Grossman, R.G.
Baylor College of Medicine, Departments of Neurology and Neurosurgery

Introduction

Parkinson's disease is purported to disrupt frontostriatal neural circuitry which may be responsible for successful performance of working memory. Working memory is a prospective, on-line, limited capacity process which temporarily stores and processes information, associates this information with incoming stimuli, and facilitates response selection. A three-component model of working memory has been proposed, including two slave systems and a central executive component that is responsible for monitoring and manipulation of material. Researchers have also suggested that declines in working memory may be the result of general slowing of processing speed. This is a cardinal symptom of Parkinson's disease.

OBJECTIVE

To investigate the dissociation between the component processes of verbal working memory in Parkinson's disease patients and to explore the role information processing speed plays in verbal working memory performance.

Methods

Subjects

We examined the differences in performance in 18 mild Parkinson's disease (H&Y Stages 1 & 2), 24 moderately severe Parkinson's disease (H&Y Stage 2.5 to 4), and 21 elderly control subjects.

| | Mild PD (n=19) | Moderate PD (n=28) | Elderly Control (n=21) |
|-----------------|----------------|--------------------|------------------------|
| Gender | | | |
| Male/Female (%) | 63/34 | 79/21 | 48/52 |
| Age | 61.5 (9.7) | 65.3 (11.2) | 62.8 (12.9) |
| Education | 15.4 (2.1) | 15.6 (3.7) | 16.3 (2.3) |
| Age of Onset | 56.5 (11.6) | 57.0 (13.3) | N/A |
| Duration | 4.9 (5.2) | 8.3 (5.8) | N/A |

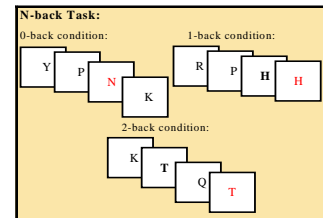
Methods (cont.)

Procedure

The N-back working memory task is a computerized test of working memory maintenance that consists of 4 conditions with increasing memory load (0- to 2-back). The measures of analysis are Hits (correct responses) and False Alarms (incorrect guesses).

Task Conditions:

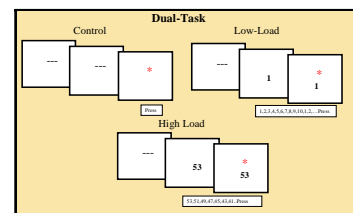
- 0-back: One letter search
- 1-back: Same as previous
- 2-back: Same as 2 before



The Dual-Task is a computerized test of working memory monitoring and manipulation that consists of 3 conditions which increase in memory load. Reaction Time (RT) is measured.

Task Conditions:

- Control: RT to prompt
- Low-load: RT + counting from 1 to 10
- High-load: RT + counting backwards by 2's from the number presented



Statistical Methods

We ran a series of one-way ANOVAs to examine the differences between the mild PD, moderately severe PD, and elderly control groups with N-back memory load Hits and False Alarms and average reaction time for the Low and High Load conditions on the Dual-Task measure as dependent measures. We then ran a series of ANCOVAs covarying Symbol Digit Modality Test-Oral as a measure of processing speed.

Results

Figure 1: Non-Adjusted and Adjusted Means for 2-back Hits

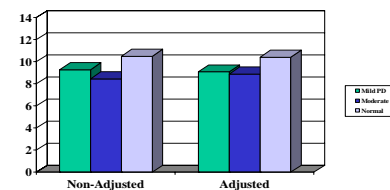


Figure 2: Non-Adjusted and Adjusted Means for 2-back False Alarms

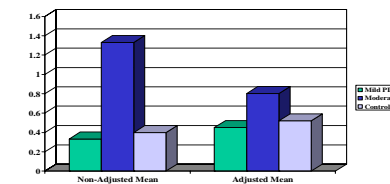


Figure 3: Non-Adjusted and Adjusted Means for Dual-Task Low Load Reaction Time

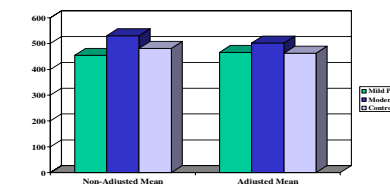
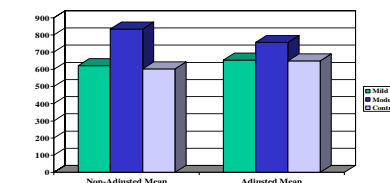


Figure 4: Non-Adjusted and Adjusted Means for Dual-Task High Load Reaction Time



Results (cont.)

1. Moderately severe Parkinson's disease patients demonstrated a deficit compared to mild Parkinson's disease and elderly controls on the 2-back condition of the N-back test.
2. No significant differences were found for the 0-back Hits or False Alarms or the 1-back Hits or False Alarms.
3. Mild and moderately severe Parkinson's disease patients demonstrated a deficit compared to elderly controls on both the low and high-load conditions of the Dual-Task.
4. No significant differences were found for the control condition of the Dual-Task.
5. When information processing speed was entered as a covariate, stage of disease progression did not account for any additional variance in the N-back and Dual-Task performances.

Conclusions

Our results suggest that the maintenance and manipulation processes of working memory can be dissociated in Parkinson's disease patients, with decline in working memory associated with disease progression. However, slowed information processing speed, rather than a change in the specific cognitive domain, accounts for the decline in these component processes of working memory.

ACKNOWLEDGMENTS

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