Dual-Task Functioning in Mild and Moderately Severe Parkinson's Disease Patients

Michele K. York, Ph.D.[1,2], Eugene C. Lai, M.D., Ph.D.[1,2], Harvey S. Levin, Ph.D.[1], Robert G. Grossman, M.D.[1]

[1]Baylor College of Medicine, Department of Neurosurgery or Neurology; [2]Parkinson's Disease Research, Education, and Clinical Center (PADRECC) Houston Veterans Affairs Medical Center; Houston, Texas USA

PADRECC
Houston VAMC

INTRODUCTION

Working memory is a prospective, on-line, limited capacity process which temporarily stores and processes information. The Central Executive is responsible for the monitoring and manipulation of information in working memory. Neuroimaging studies have revealed activation in the prefrontal and parietal lobes during working memory tasks. Parkinson's disease is purported to disrupt frontostriatal neural circuitry which may be responsible for successful performance of working memory. We hypothesized that later stage Parkinson's disease patients will show impairments in the Central Executive component of working memory.

OBJECTIVE

To investigate the relationship between the stage of Parkinson's disease and frontostriatal functioning using a computerized task that taps the Central Executive (monitoring and manipulation processes) of working memory.

METHODS

Subjects

We examined the differences in performance in 14 mild PD (H&Y Stages 1 & 2), 12 moderately severe PD (H&Y Stage 3), and 15 elderly control subjects.

|	Mild PD (n=14)	Moderate PD (n=12)	Elderly Control (n=15)
Gender Male/Female (%)	64/36	75/25	33/67
Age	63.9 (7.3)	62.8 (12.8)	64.1 (14.2)
Education	15.8 (1.1)	15.9 (3.0)	16.3 (1.7)
Age of Onset	60.5 (9.4)	54.2 (12.9)	N/A
Duration	3.3 (4.3)	8.6 (4.4)	N/A

Procedure

The Dual-Task is a computerized test that consists of 3 conditions which increase in memory load. Reaction Time (RT) is measured. Each task is presented at varying interstimulus intervals (ISIs; 2000-5000 msec).

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
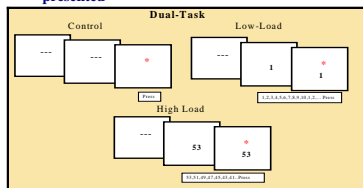
METHODS (cont.)

Statistical Methods

Outliers were identified and trimmed to 2 SD above the mean using frequency plots and boxplots. We used one-way ANOVAs with RT for the Control, Low-load, and High-load conditions as the dependent measures to examine the differences between the mild PD, moderately severe PD, and elderly control groups.

RESULTS

Figure 1: Dual-Task RT for Mild PD, Moderately Severe PD, and Elderly Control Subjects
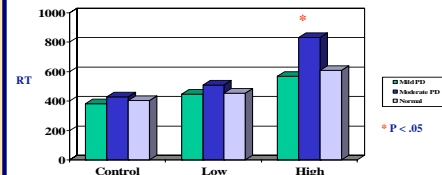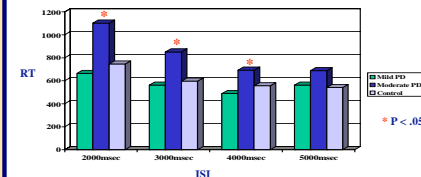

Figure 2: High Load RT at Varying ISIs for Mild PD, Moderate PD, & Control Subjects

RESULTS (cont.)

1. Moderately severe PD patients demonstrated a deficit compared to mild PD and elderly controls on the high-load condition of the dual-task working memory measure.

2. In the high load condition, the 2000, 3000, & 4000 msec ISIs accounted for the significant difference among the groups, suggesting that the initial period of the dual-task condition is more sensitive to Central Executive dysfunction.

CONCLUSIONS

Our results suggest that the monitoring and manipulation components of working memory are adversely affected in later stages of Parkinson's disease. There is likely a greater amount of disruption in the frontostriatal neural circuitry. The causes and characteristics of this deficit should be further investigated.