



# Study of Verbal Working Memory in Patients with Parkinson's Disease

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Gilbert, Belleville, Bherer, &  
Chouinard, 2005

presented by  
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# Parkinson's Disease

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- Symptoms: resting tremors, rigidity, bradykinesia, postural instability
- Loss of nerve cells in the substantia nigra, and subsequent depletion of DA levels in the striatum (heavily connected with the frontal cortex)
- Severity levels (Hoehn and Yhr):
  - Stage 1: Mild; symptoms only on one side of body
  - Stage 2: Both sides of the body, but normal posture
  - Stage 3: Moderate; mild imbalance during standing or walking
  - Stage 4: Advanced; person requires substantial help in standing and walking
  - Stage 5: Severe; person is restricted to a bed

# PD and WM

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- WM involves PFC: executive, attentional control functions
  - Functional organization of WM in PFC:
    - Distinct regions for different types of info
    - Separations by the nature of processing
      - Manipulation, monitoring (DLPFC); maintenance (VLPFC)
  - Prior Studies
    - PD patients poor on verbal WM, but specifics unclear
    - Wide range of patient types (severity, depression, cognitive status) and WM components
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# Theories and Study Population

- Impaired executive component in DLPFC
  - Patients with PD perform similarly to frontal lobe patients on classical executive tasks
  - Impairment shown a wide number of tasks, but not with a few others
- Reduced storage capacities
- DA-related deficit caused reduction of psychomotor speed
  - PD patients' performance on sentence and arithmetic spans positively correlate with scores on symbol digit modalities test
- 14 patients (9 female, 5 male) with idiopathic PD
  - 3 in stage 1, 6 in stage 2, 5 in stage 3
  - 1 patient no meds, 11 L-dopa (+), 2 anticholinergic drugs
- Age/education/sex matched controls

# Tasks

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- Storage Task (Forward Digit Span from WAIS)
    - Orally report sequences of digits drawn at random from 1-9; 2+ in sequence, at least 2/4 correct per sequence
  - Executive Tasks
    - Alphabetical recall test: frequent, imaginable, substantive monosyllabic words in sequences
      - Word order test, direct or alphabetical, based on individual's word span
    - Updating memory task: forming sequences with monosyllabic consonants
      - Sequences of 0, 2, 4, and 6 consonants more than individual's consonant span
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# Tasks, cont.

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## ■ Motor and Psychomotor Tasks

- Purdue Pegboard test: manual speed and dexterity (pegs into holes)
  - Digit Symbol Substitution test: digits paired with geometric symbols, have to draw as many symbols as possible with given set of numbers in 90 sec
  - Reaction time task: 3-button box, keep hitting home key in center till black circle appears, then hit right button (1<sup>st</sup> half of block) or left button (2<sup>nd</sup> half)
    - Some in “choice” condition
    - Tested reaction time (psychomotor), movement time (motor), and a slowing score (psychomotor; formula:  $\{\text{choice RT} - \text{simple RT}\} / \text{simple RT}$ )
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# Results:

## Storage and Executive Tasks

- Average digit span: 6.86 in PD, 7.00 in control (insignificant)
- Average word span: 4.36 in PD, 4.64 in control (insignificant)
- Consonant span: 5.46 in PD, 5.38 in control (insignificant)

Figures removed due to copyright considerations.

Please see:

Figures from Gilbert, B., S. Belleville, L. Bherer, and S. Chouinard. "Study of verbal working memory in patients with Parkinson's disease." *Neuropsychology* 19 (2005): 106-14.

No differences  
between groups  
(ANOVA)

ANOVA: effect of recall,  
interaction between  
group and recall

# Results:

## Motor/Psychomotor Tasks

### Motor

- PD patients slower on Purdue test
- PD patients slower on MT (both conditions); effect of condition

### Psychomotor

- PD patients worse on digit symbol substitution test (insignificant;  $p = .07$ )
- PD patients slower on RT (both conditions); effect of condition
- No differences when using slowing score (perhaps initiation deficit then?)
- No Differences when factoring in disease severity, age, or medication type
- Psychomotor slowing and PD reduced verbal WM?
  - Manipulation score:  $(\text{direct score} - \text{alphabetical score}) / \text{direct score}$
  - Manipulation score correlates positively with slowing score and RT, negatively with DSST (all insignificant)

# Conclusions

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- PD patients have intact verbal (consonants, words) and digit short term storage
  - Executive deficit in performance (controlling for storage capacity)
  - Decrease in performance on a task requiring manipulation processes, but normal performance on an updating test
  - Psychomotor and motor speed decrease in PD
  - No effects of dementia, depression, age, education level, disease severity, or medication type.
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# Discussion

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- Possibly general factors (i.e. speed) coexisting with specific factors (i.e. executive processes)?
  - Executive component impairment hypothesis is supported
    - Manipulation vs. updating tasks reveal dissociation of executive processes
      - Physical basis: bilateral-prefrontal-dorsolateral cortex in manipulation (alphabetical recall task), left frontopolar cortex in updating (updating activity task)
  - Medications: what are the effects of PD without medications?
  - GDS issue: PD patients with high depression scores, but this did not affect results when taken as a covariant
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# Motor/Psychomotor Tasks



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