Study of Verbal Working Memory in Patients with Parkinson’s Disease

Gilbert, Belleville, Bherer, & Chouinard, 2005
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Parkinson’s Disease

- 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

http://my.webmd.com/hw/health_guide_atoz/hw78534.asp
PD and WM

- 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
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

- **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
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 (1st half of block) or left button (2nd half)
  - Some in “choice” condition
  - Tested reaction time (psychomotor), movement time (motor), and a slowing score (psychomotor; formula: \{choice RT – simple RT\}/simple RT)
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)

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Please see:

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: (direct score – alphabetical score)/direct score
- Manipulation score correlates positively with slowing score and RT, negatively with DSST (all insignificant)
Conclusions

- 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.
Discussion

- 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
Motor/Psychomotor Tasks

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