Broadening clinical perspectives: The dynamic nature of communication challenges in Parkinson’s disease

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Learning Objectives

1. Summarize the core features and incidence/prevalence data for Parkinson’s disease

2. Define the core speech, voice, cognitive, language, and spontaneous spoken language impairments in Parkinson’s disease

3. Summarize the current gaps in clinical care relative to communication interventions in Parkinson’s disease

4. Identify opportunities for expanding clinical assessment and interventions in Parkinson’s disease by considering combined impairment and social-based approaches
Disclosures

• Dr. Roberts receives honoraria for speaking/teaching from Parkinson Society Canada

• Dr. Roberts received travel support for today’s conference from Travel Northwestern University
Parkinson’s Disease

Parkinson’s Disease with Mild Cognitive Impairment

Lewy Body Spectrum Disorders

Lewy Body Dementia

Parkinson’s Disease Dementia

Lippa et al., 2007
Parkinson’s Disease

- 100-250/100,000 North America
- Expected to double by 2030
- Average age of onset 62.4 years
- 10% of cases diagnosed by age of 40
- Rarely diagnosed under the age of 30
- 85% of cases are idiopathic
UK Brain Bank Criteria

Bradykinesia (slowness)

PLUS **ONE** OF THE FOLLOWING

- Muscular rigidity
- 4–6 Hz resting tremor
- Postural instability not caused by primary visual, vestibular, cerebellar or proprioceptive dysfunction
Non-motor Symptoms In PD

- Swallowing
- Speech and voice
- Mood
- **Cognitive decline**
- **Language**
- Bowel/bladder
- Digestion/gastric
- Blood pressure regulation
- Pain
- Reduced Levodopa effectiveness (for some individuals)
Speech/Voice Changes in PD

- Reduced loudness (i.e., hypophonia)
- Reduced pitch variability
- Reduced stress patterns
- Breathy, hoarse voice
- Imprecise speech sounds
- Changes in rate of speech
- Reduced amplitude/peak velocity of jaw movements

(Darley et al., 1969, 1975; Ramig et al., 2008)
Cognitive Changes in PD

• 30% of newly diagnosed cases may have cognitive changes (Elgh et al., 2009)

• Begin early and progresses with disease duration and age (Troster 2008)


• Possible relationship with type of motor symptoms

• 6-fold higher increase for developing dementia (Aarsland & Kurz, 2010)

• Conservative estimates suggest dementia rates of 20-40% of cases after 10 years of disease (Aarsland & Kurz, 2010)
Early Cognitive Changes

- **Visuospatial/visuoconstructional skills** (Pagonabarraga et al, 2012)
- **Attention** (Elgh et al., 2009; Muslimovic et al., 2005)
- **Executive functions** (Pagonabarraga et al; 2012; Muslimovic et al., 2005)
- **Memory (retrieval)** (Elgh et al., 2005; Green et al., 2002; Muslimovic et al., 2005)
- **Language**
  - **Word retrieval** (Cotelli et al., 2007; Herrera et al., 2012; Troster, 2008; Rodriguez-Ferreiro, et al. 2011)
  - **Syntax processing/production** (Colman et al., 2009; Grossman, et al. 1993, 2000, 2002; Troche et al., 2012)
  - **Emotional processing/production** (Jaywant & Pell, 2010; Monetta et al., 2008; Pell, et al., 2006)
Communication in PD: Client Perspectives

“I just can’t follow what he is saying. It’s there but something is missing. The words and the way he communicates just isn’t him. He was always so articulate.” (Caregiver, 2010)

“It wasn’t my speech or movement but I would be in front of the class not able to find my words like ‘allomer’ that I have used for years teaching.” (M.L., 2013)

“By the time I put together what I want to say the conversation moved on so I just choose to sit quietly and not engage as much.” (J.V., 2009)
Monologic Spoken Discourse

Language “beyond the boundaries of isolated sentences” (Ulatowska & Olness, 2004, p. 300)

- Provide experimental control

- Reveal deficits not readily discernable with standardized language and cognitive tests (Fleming & Harris, 2008; Mayer & Murray, 2003; Shadden, 1998)

- Integrate motor speech, language and cognitive processes of communication (Shadden, 1998; Ulatowska et al., 1994)

- Reflect conversation abilities in every day contexts (Doyle et al., 1995)
Participants (all)

• Participants (N = 38)
  – 19 PD and 19 healthy controls

• Age
  – PD = 70.74 (7.92); Control = 68.16 (7.14), n.s.

• Education
  – PD = 15.47 (2.91); Control = 15.21 (3.36), n.s.

• Handedness
  – 37 right hand dominant; 1 left hand dominant (control)

• Sex
  – PD Men = 15; Control Men = 7

• Language(s)
  – English monolingual speakers; 1 bilingual speaker using English exclusively > 40 years
Participants (all)

No baseline differences between PD and Controls:

• Speech intelligibility
• Speaking rate
• Cognitive measures
  – Memory, executive function, attention, global measure of dementia
• Language measures
  – Battery of language measures including naming of nouns, syntax production, semantic, verbal fluency (categories)
  – Exceptions: Verb naming (TAWF), Action verbal fluency
**Method**

**Picture Sequence** *(Nicholas and Brookshire, 1992)*

- Participants listened to a pre-recorded telling of a story
- Asked to re-tell the story
- 2 – stimuli from the Discourse Comprehension Test
  - “Glass of Water” & “Out of Gas”

**Story Retelling** *(Brookshire and Nicholas, 1997)*
Multi-level Discourse Analyses

**Productivity**
- Total Words (Nicholas & Brookshire, 1993)
- Words per C-unit (SALT, 2014)
- Words per minute (WPM)

**Lexical**
- % Open class words (Saffran et al., 1989)
- % Verbs

**Grammar**
- % Grammatical utterances (Quirk & Greenbaum, 1973)
- % Complex (Ash et al., 2009)

**Informativeness**
- Total Correct Information Units (CIUs) (Nicholas & Brookshire, 1993)
- % CIUs (Nicholas & Brookshire, 1993)
- CIUs per minute (Nicholas & Brookshire, 1993)

**Verbal Fragmentation**
- Total verbal disruptions (Illes, 1988; MacWhinney, 2000)
- Verbal disruptions per 100 words
@Time start: 0:00:02

*25: See a husband # uh being # uh # lectured by his wife.
*25: And uh # <she threatens <to>> [/] <to> [/] uh doesn’t smarten up she is going to leave him.
*25: <Sh> [/] -she’s going towards the door.
*25: And she’s got a <suitc()> [/] suitcase.
*25: <And> [/] <and> [/] and he’s wondering [“] What have I done?” +”/
*25: [“] What have I done?”
*25: And then <she comes> [/] the next picture is she’s come back out through the door again.
*25: She may have changed her mind <about> [# 4.0] [/] about what she said.
*25: And he welcomes her back.
*25: And they hug and kiss.
*25: I [# 3.0] make up.

@Time end: 0:00:46.8

Pause < 2 seconds
Phrase retracing with correction. A retracing without correction appears within the corrected phrase.
4-second pause followed by a word retracing without correction

Roberts et al., 2015
### Individual Variables Differing Significantly (PD vs. Control)

<table>
<thead>
<tr>
<th>Productivity</th>
<th>$p$-values</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total words</td>
<td>$p = .057, \eta^2_p = 0.097$</td>
<td>Ctrl &gt; PD</td>
</tr>
<tr>
<td>Words/Minute</td>
<td>$p = .009, \eta^2_p = 0.177$</td>
<td>Ctrl &gt; PD</td>
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</table>

<table>
<thead>
<tr>
<th>Grammar</th>
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<tbody>
<tr>
<td>% Grammatical</td>
<td>$p &lt; .001, \eta^2_p = 0.249$</td>
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</table>

<table>
<thead>
<tr>
<th>Informativeness</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CIUs</td>
<td>$p &lt; .001, \eta^2_p = 0.270$</td>
</tr>
<tr>
<td>% CIUs</td>
<td>$p = 0.004, \eta^2_p = 0.206$</td>
</tr>
<tr>
<td>CIUs/Minute</td>
<td>$p &lt; .001, \eta^2_p = 0.281$</td>
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<table>
<thead>
<tr>
<th>Verbal Fragmentation</th>
<th></th>
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<tbody>
<tr>
<td>Disruptions/100 words</td>
<td>$p = .057, \eta^2_p = 0.097$</td>
</tr>
</tbody>
</table>

$\alpha = 0.10$, Univariate tests post significant multivariate effects
Spoken discourse in PD is disrupted in select discourse domains

Could a single composite discourse score distinguish the spoken language of individuals with PD from healthy older adults?
Developing a Single Discourse Score

Discourse Score =

(-.004 \times \text{WPM}) + (.021 \times \% \text{CIUs}) + (.023 \times \text{CIUs/Minute}) + (.055 \times \text{Disrupt/100 Words}) + (.044 \times \% \text{Grammatical}) + (.014 \times \text{CIUs}) + (-9.463)
**Sensitivity and Specificity of Discourse Score**

Discourse score .788

<table>
<thead>
<tr>
<th>Group</th>
<th>PD</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td>31</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>Control</td>
<td>5</td>
<td>33</td>
<td>38</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td>81.60</td>
<td>18.40</td>
<td>100.00</td>
</tr>
<tr>
<td>Control</td>
<td>13.20</td>
<td>86.80</td>
<td>100.00</td>
</tr>
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</table>

Discourse score -.788
## Summary of Findings

<table>
<thead>
<tr>
<th>Discourse Measures</th>
<th>Affected</th>
<th>Not affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced productivity (Total words, WPM)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced proportion of well-formed sentences</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced informativeness at lexical level</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced content, main themes/ideas (Roberts, 2015)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Increased verbal disruptions (pauses – Roberts, 2015)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced productivity (utterance length)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced syntax complexity</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Reduced lexical diversity (% open class, % verbs)</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Reframing Clinical Interventions in PD

- Voice intensity
- Intelligibility
- Communication Focused
- Language
- Cognition
- Spontaneous language
Monologic discourse Tasks

• Picture Sequences or more complex single pictures
  – Nicholas and Brookshire stimuli (Nicholas and Brookshire, 1992)
  – Picnic picture Western Aphasia Battery

• Minimum of two tasks to obtain sample of sufficient size for analysis

• Key measures
  – Speech intelligibility/intensity
  – Correct Information Units (Nicholas and Brookshire, 1993)
  – Main ideas (Capilouto et al., 2005; Nicholas and Brookshire, 1995)
  – Grammatical form/correctness
  – Verbal disruptions (pauses)
  – Output rate measures
Conversation Analysis

• Focuses on “what participants do” in conversation (Whitworth, 2003)
• “Interactional consequences” (Whitworth, 2003)
• Conversation level – naturally occurring
• Evaluate the ‘success’ or ‘failure’ of a conversational turn
• 10-minute conversation sample usually sufficient
• Published tools
  – Quantification of conversation behaviors (Crockford and Lesser, 1994)
  – Conversation Analysis Profile for People with Cognitive Impairment (Perkins, Whitworth & Lesser; 1998)
Using Conversation Analysis In PD
(adapted from Whitworth, 2003)

- **Sources of breakdown**
  - Voice intensity/speech intelligibility
  - Linguistic errors (e.g., word choice, content, or grammar errors)
  - Verbal disruptions
  - Environment
    - Partner’s hearing abilities
    - Environmental distractions, noise
  - Turn taking rule violations
    - Delays in initiating language (e.g., linguistic, cognitive, motor)
    - Within/between utterance pauses (e.g., linguistic, cognitive, motor)
    - Reduced non-verbal language (e.g., reduced eye contact, facial expression)
Pragmatic changes

- Impaired topic management (Hall et al., 2010; McNamara and Durso, 2003; Whitworth et al., 1999)
- Impaired initiation (Hall et al., 2010; McNamara and Durso, 2003; Whitworth et al., 1999)
- Impaired turn-taking (Hall et al., 2010; McNamara and Durso, 2003; Whitworth et al., 1999)
- Impaired nonverbal language (Hall et al., 2010; McNamara and Durso, 2003)
Using Conversation Analysis In PD (cont.)

• **Conversation breakdown repairs** (Crockford and Lesser, 1994)
  – Identify which partner initiates repair of breakdowns
    • Collaborative repairs vs. one partner doing all of the work
  – Non-actualized repairs
    • # of repair sequences vs. breakdowns
  – Duration of time/# of turns required to repair the breakdown
    • # of turns within collaborative repair sequences is a sensitive measure of communication effectiveness (Lubinski, 1980)
  – Repair success
Using Conversation Analysis In PD (cont.)

• **Conversational Loading** *(Crockford and Lesser, 1994)*
  
  • Respective burden that each partner carries in conversation
  
  • Conversation propelling turns (e.g., elaboration of a previous point, addition of new information, requests for more information, etc.) *lessen burden*
  
  • Minimal response turns (e.g., uhm, uh huh, I don’t know) *increase burden*
Combining Impairment and Social Approaches for Optimizing Communication in PD

**Impairment**
- Voice intensity training
- Speech intelligibility training

**Activity**
- Conversation strategies
- Voice amplification
- Rate reducing strategies
- AAC
  - Lombard Effect-based devices

**Participation**
- Conversation partner training
- Communication environment modifications
- Communication QOL and participation outcomes
Future Research Directions in PD Communication Interventions

• PD-specific assessments of cognitive-communication
  – Cognitive and language influences on communication
  – Communication-driven outcome measures
  – Discourse analyses (automatic and manual)

• Conversation-based therapies in PD
  – Integrate motor speech and cognitive-communication goals

• Cognitive and language training programs
  – Target specific language processes that support communication effectiveness and efficiency

• PD-specific communication partner education/training programs
  – Target strategies that focus on relationships and conversation at the level of the dyad
Take Home Messages…

• Communication challenges in PD are multifactorial

• Discourse and Conversation tasks are valuable tools for understanding the interactions among cognitive, language, and motor processes in PD

• Expanding our view of PD to include the assessment and treatment of communication in a broader context is important

• Value in developing PD-specific assessment and intervention approaches
Research funding
• Parkinson Society Canada
• Canadian Institutes of Health Research
• Ontario Brain Institute
• Behavioural Supports Ontario
• Ontario Neurodegeneration Research Initiative
• Parkwood Foundation

Research support
• London Health Research Institutes
• Aging and Geriatric Research Center
• Western University
• Movement Disorders Program (NPF Center of Excellence) – London Health Sciences Centre
• Cognitive Neurology Program – St. Joseph’s Healthcare/Parkwood Institute

Collaborators
Dr. JB Orange, Dr. Michael Strong, Dr. Ken McRae, Dr. Elizabeth Finger, Dr. Mandar Jog, Dr. Scott Adams, Dr. Jack Scott, Dr. Andrew Johnson, ONDRI Neuropsychology platform and Executive Committee

Graduate Students and Research Support Staff
Shalane Basque, Katie Findlater, Kelsey Santerre, Peter Nguyen, Thea Knowles
Participants (all)

- **Depression/Psychiatric illness/Neurological history**
  - No history of untreated depression
  - No history of major psychiatric disorders
  - No history of neurological disorders/surgery (other than PD)
  - No history of learning challenges

- **Global cognitive performance (Dementia Rating Scale -2)**
  - DRS-2 MOANS Score: PD = 14.25/18 (1.32); Control = 15.42/18 (2.19)
  - $t(29.47) = -2.063, p = .050$
  - All PD participants scored above mean score for PD-specific normative data (Llebaria et al., 2008)
Participants (all)

• **Speech Intelligibility: Sentence Intelligibility Test** (Yorkston et al., 1996)
  – PD = 94.51 (9.55); Controls = 97.51 (2.77)
  – $F(1, 36) = 1.73, p = .181$

• **Speaking Rate**
  – PD = 15.47 (2.91); Control = 15.21 (3.36)
  – $F(1, 36) = 1.87, p = .189$

• **Hearing Screening (Pure-tone, ASHA guidelines)**
  – 6 participants failed screening, fitted with personal amplifier

• **Vision Screening** (Bayles, 1993)
  – 38/38 passed
Participants (PD only)

- Unified Parkinson Disease Rating Scale-III ( /108)
  - $M = 30.26$ ($SD = 12.13$), 95% CI [24.42, 36.11]
- Hoehn and Yahr ( /5)
  - $M = 2.45$ ($SD = .797$), 95% CI [2.06, 2.83]
- Duration of PD symptoms
  - $M = 9.34$ years ($SD = 3.63$), 95% CI [7.59, 11.09]
- Levodopa Equivalent Dose (LED)
  - $M = 984.37$ mg. ($SD = 539.95$), 95% CI [724.12, 1244.62]
## Group Differences: Cognition & Language

<table>
<thead>
<tr>
<th>Domain</th>
<th>F test</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trail Making Test</td>
<td>$F(1, 36) = 1.37, p = .249$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Stroop</td>
<td>$F(1, 36) = 0.02, p = .891$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Verbal Learning/Memory</td>
<td>$F(1, 36) = 2.74, p = .107$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Phonemic fluency</td>
<td>$F(1, 36) = 2.44, p = .127$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Semantic fluency</td>
<td>$F(1, 36) = 3.21, p = .081$</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

$\alpha = 0.01, 0.10/10$ corrected for multiple comparisons; ANOVA

Tombaugh, 2004; Golden, 2002; Bayles, 1993; Strauss et al., 2006
## Group Differences: Cognition & Language

<table>
<thead>
<tr>
<th>Domain</th>
<th>$F$ test</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action fluency</td>
<td>$F(1, 36) = 8.17, p = .004, \eta^2_p = 0.159$</td>
<td>✓</td>
</tr>
<tr>
<td>Boston Naming Test</td>
<td>$F(1, 36) = 3.26, p = .080$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Verb naming - TAWF</td>
<td>$F(1, 36) = 15.71, p = &lt; .001, \eta^2_p = 0.279$</td>
<td>✓</td>
</tr>
<tr>
<td>Pyramids and Palm Trees</td>
<td>$F(1, 36) = 4.27, p = .046$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Sentence Production</td>
<td>$F(1, 36) = 2.31, p = .138$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Priming Test - NAVS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\alpha = 0.01, 0.10/10$ corrected for multiple comparisons; ANOVA

Woods et al., 2005; Kaplan et al., 2001; Graves et al., 2004; German, 1989; Howard & Patterson, 1992; Thompson, 2011
Main Events\(^1\) Analysis

<table>
<thead>
<tr>
<th></th>
<th>PD (n = 18)</th>
<th>Control (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Main Events</td>
<td>65.44</td>
<td>77.32</td>
</tr>
</tbody>
</table>

% Main Events \((p = .017)\)

Informativeness of Discourse: PD vs. Controls

- Proportion of informative words (CIUs) \((\text{Roberts, 2014; Murray, 2000})\)
- Completeness of information \((\text{Bayles, 1990; Murray, 2000; Roberts, 2014})\)

ANOVA; \(\alpha = 0.025\) (0.05/2 multiple comparisons correction)

\(^1\text{Capilouto et al., 2005;}\)
# Verbal Fragmentation by Subtype

<table>
<thead>
<tr>
<th>Disruption Sub-type</th>
<th>$F$ test</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pauses &gt; 2 seconds</td>
<td>$F(1, 74) = 6.29, p = .014, n^2_p = .078$</td>
<td>✓</td>
</tr>
<tr>
<td>Abandoned Utterances</td>
<td>$F(1, 74) = 4.47, p = .038$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Revision/retracing with correction</td>
<td>$F(1, 74) = .387, p = .536$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Repetitions/retracing without correction</td>
<td>$F(1, 74) = .278, p = .600$</td>
<td>n.s.</td>
</tr>
<tr>
<td>Interjections</td>
<td>$F(1, 74) = 488, p = .487$</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

$\alpha = 0.02 (0.10/5)$ for multiple comparisons correction

Consistent with previous literature (Illes et al., 1988; Illes, 1989; Griffiths et al., 2012)
Main Events\(^1\) vs. CIUs\(^2\)

<table>
<thead>
<tr>
<th></th>
<th>PD (n = 18)</th>
<th>Control (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Main Events</td>
<td>65.44</td>
<td>77.32</td>
</tr>
<tr>
<td>% CIUs</td>
<td>72.26</td>
<td>82.75</td>
</tr>
</tbody>
</table>

- % CIUs \((p = 0.004)\)
- % Main Events \((p = 0.017)\)
- Correlation between % CIUs and % Main Events not significant for PD or Controls

Informativeness of Discourse: PD vs. Controls

- Proportion of informative words (Murray, 2000)
- Efficiency of conveying information
- Completeness of information (Bayles, 1990; Murray, 2000)

ANOVA; \(\alpha = 0.025\) (0.05/2 multiple comparisons correction)

\(^1\)Capilouto et al., 2005; \(^2\)Nicholas & Brookshire, 1993