Speech, Swallowing, and Cognition in Parkinson Disease: Meeting the Challenge

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Parkinson Disease (PD) symptoms

- Bradykinesia (slowness of movements)
- Rigidity of movements
- Sensory changes/perception of how body is moving
- Impact on speech and swallowing structure: reduced lung power, reduced closure of vocal folds (bowing), reduced range of motion and coordination of lips, tongue etc. that form the sounds and help with swallowing
Voice and Speech

- Specific type of speech disorder typical with PD: hypokinetic dysarthria:
  - **Voice:**
    - reduced in loudness
    - hoarse or breathy voice quality
  - **Speech:**
    - reduced clarity due to imprecise articulation
    - rate changes: bursts of rushed speech, faster rate
  - **Prosody/vocal melody:** monotone, monoloud (lack of expression in the voice)

(Duffy 2005)

What are the consequences?
For some people with PD: Changes in Language (the Message)

- Difficulty with word-finding (tip-of-the-tongue phenomenon)
- Difficulty maintaining train of thought
- Slower rate of formulating ideas
- Difficult to think about how to talk and what you are saying!
Three approaches to treating speech-voice difficulties

- Behavioral therapy (one-to-one speech/voice therapy)
- Compensatory devices: amplifiers
- Biofeedback
World Health Organization:
International Classification of Functioning, Disability, and Health
Contextual factors that influence your participation (positively?)

Your personality

Your environment

Revised Conceptual Framework
Addressing Communication Participation: Speech Language Pathologists

- 50% of SLPs had participation-focused rationales
- However, the goals, activities and outcome measures typically focused more on impairment and skills performance
- 8% of goals specifically referenced participation

- Barriers: time, productivity constraints, limits of clinical settings, and documentation challenges
- Bottom line: share with SLP what you want to do with your communication!

(Torrence, Baylor, Yorkson, & Spencer, 2016)
A few important points

Evidence Based Practice

- Patient preferences, values, satisfaction (what does the patient want?)
- Evidence from research studies
- Expert advice/experience (the clinical expertise of your speech-language pathologist)

Important to balance
Speech versus Speaking (in PD)
(Yorkston, Baylor, & Britton, 2017) Interviewed 24 people with PD

- Theme: *speaking*
  - thinking about speaking, weighing value versus effort, feelings associated with speaking, the environmental context of speaking, the impact of PD on speaking
  - "speaking requires both physical and cognitive effort"

- Theme: *treatment experiences*
  - choosing not to have treatment, the clinician, drills and exercise, and a lack of focus on social aspects of communication
  - "I feel bored" "I feel silly doing these drills" "Activities are irrelevant"

Recommendation: increase focus on cognitive demands of speaking and on psychosocial aspects of communication (again participation!)
Rationale for Speech Therapy

- Approximately 75-90% of people with PD end up with speech/voice problems
- Limited or inconsistent effects w/ meds and/or surgery on speech and voice
- Limited or inconsistent effects of traditional speech therapy focusing on artic and rate
- Success with intensive treatment focused on ramping up effort
Behavioral (speech/voice therapy)

- Effective: yes!
- Side effects: no!
- Long lasting: yes, if you keep it up!

- LSVT (Intensive individual treatments, 4x/week for 4 weeks, 2x/week for 8 weeks, Telepractice/Companion)

- Speak-Out (Individual and Loud Crowd groups)

- Phorte
5 Essential Components of LSVT®LOUD

- VOICE FOCUS
- HIGH EFFORT
- INTENSIVE TREATMENT
- CALIBRATION
- QUANTIFICATION

Rational for above based on the literature in neurology, motor learning theory, muscle training, speech mechanism physiology, and research re: patient compliance.
Lee Silverman Voice Treatment Approach

LSVT®LOUD (Ramig, L., Countryman, S, Thompson, L., & Horri, 1995)

Strengths:
- Years of evidence with patients with PD (and other diagnoses)
- Evidence of improved voice, improved intelligibility, improved loudness
- Evidence of improved swallowing
- Evidence of improved facial expression
- Simple focus: Think Loud (which ramps up amplitude of movement of entire speech mechanism)
- Options for treatment: original 4x/week, 2x/week, or Telepractice
- LSVT Companion (9 in clinic and 7 with device)
SPEAK OUT!® (Levitt, Chitnis, & Walker-Batson, 2015)

- SPEAK OUT!® developed by a nonprofit organization (Parkinson’s Voice Project) specializing in the treatment of individuals with Parkinson’s related disorders.
- Typically consists of 3x/4 weeks; however, the therapy schedule may be modified towards the end of the program as appropriate.
- SLP and patient work through speech, voice, and cognitive exercises laid out in the SPEAK OUT!® Workbook
- Emphasis is on speaking with intent! (like you really mean it!)
- Developed to be effective and efficient. Therapy sessions, including documentation, can be completed in 40-45 minutes.
SPEAK OUT!® and Loud Crowd®

Rationale:

- Individuals with PD can find it challenging to maintain the strength of their voice and often struggle with motivation as a result of the lack of dopamine in the brain.

- Therefore after SPEAK OUT!®, each patient enters the maintenance phase of Parkinson Voice Project’s two-part therapy program. The LOUD Crowd® which consists of speech therapy groups and a singing program to help patients maintain the strength of their voices.

- LOUD Crowd® provides ongoing vocal practice, accountability, support, and encouragement.

- Given both treatment modalities: results for more than five years and counting.

(Watts, 2016)
Phorte: designed for voice changes associated with aging (presbyphonia)

- Phonation resistance training exercises
- 4 times in 4 weeks
- Same concept of intense drills: sustained vowels, glides, functional phrases (loud & high), and phrases with encouragement to use ‘strong’ and low voice
- Improved voice-related quality of life
- Reduced perceived phonatory effort
- High treatment satisfaction
- Alternative for individuals with PD?

(Ziegler, Verdolini Abbot, Klein, Johns, & Hapner, 2014)
Sensory changes lead to faulty information about your speech mechanism (lungs, mouth opening, how loud you actually are)

Requires ramping up to overcome sensory and motor challenges

Typically need guidance/accountability provided through a SLP

Requires some degree of repetitive drill

Must be integrated with real world life: social context of communication!
Speech Amplification Devices

Why??

- Challenging to maintain that loud or intent-filled voice intent'
- Challenging to think about how we talk while thinking about what we want to say (also ties into some changes with word-finding difficulties and cognitive changes)
- Challenging to talk in noisy environments (people with PD don’t tend to ramp up their voice very well in response to noise)
- Use an amplifier!
Recent comparison of available devices  
(Adreetta, Adams, Dykstra, & Jog, 2016)

- Compared effectiveness of seven devices: ADDVox, BoomVox, ChatterVox, Oticon Amigo, SoniVox, Spokeman, & Voicette

- Measured speakers with PD while talking in noisy background

- Measured speech-to-noise ratio, speech intensity, and intelligibility

- Measured the speakers' speech experience ratings using questionnaire: physical comfort, visual presentation, sound quality, perceived amplification power (i.e., how loud the device made their voice), overall preference
Findings of Amplification Study

- BoomVox: Highest Speech-to-Noise Ratio
- BoomVox: Loudest Speech Intensity (loudest)
- BoomVox: Highest Speech Intelligibility (transcription measure)
- BoomVox: Highest Speech Intelligibility (rating scale: visual analogy scale)

However...patient preferences did not exactly line up...

Overall highest rating: Spokeman
Power and Sound quality: ChatterVox
Physical comfort and Visual (looked like): Spokeman

But, BoomVox typically came in 2\textsuperscript{nd} to 3\textsuperscript{rd} out of 7 in these ratings
Tactile Biofeedback by a Portable Voice Accumulator (Schalling, Gustafson, Ternström, Wilen, & Södersten, 2013)

- Six participants with PD received tactile biofeedback (vibration) when their voice fell below a certain level of loudness

- Significant increase in voice sound level (loudness)

- Participants found it to be a positive experience

- Wanted to keep the device
Benefits of Singing

- Study by Elefant and colleagues (2012) investigated a singing and music program with ten individuals with mild cognitive problems associated with PD.
- Showed significant changes in terms of a variety of singing measures including voice quality and vocal range.
- Also, improved on the Voice Handicap Index-physical subset (felt less affected by their voice problems).
- Speaking quality did not decline during the treatment period.
Swallowing

- Structures involved in swallowing are used for food, liquids, and breathing
- Swallowing mechanism is critical for nutrition and hydration
- Eating and drinking are also important part of our social connections and activities
- Three phases: oral, pharyngeal and esophageal
Introduction

- Deglutition is the act of swallowing, through which a food or liquid bolus is transported from the mouth through the pharynx and esophagus into the stomach.
Swallowing disorders aka: dysphagia

- Some or all phases can be affected in dysphagia
- Degree of disability can vary for each phase
- Successful swallow: quick, comfortable, and no pieces of food left in the mouth, throat or airway/lungs
- Numerous factors influencing dysphagia: aging, disease itself, medications
Aging

- Changes in physiology, anatomy, neuro motor and sensory changes
- Declining muscle strength: reduced tongue and lingual pressure (slower movement of food to back of mouth and trigger of swallow reflex)
- Loss of muscle tissue (i.e., tongue)
- Delays in transit time
- Reduced elevation of voice box (larynx)
- Loss of synchronization of the sequenced events of swallowing
- Increased reflux
- Decline in saliva production/increase in dry mouth
- Change in composition of saliva
Common age-related conditions that can affect swallowing

- **Hypertension** and **osteoarthritis**: longer times to move through the mouth to the throat (oropharyngeal transit) and through the throat (pharyngeal transit) (as compared to healthy elders)

- Prolonged oropharyngeal/pharyngeal transit times in individuals with **hypothyroidism**, reflux, **high cholesterol levels**, and **depression** (Kendall, 2004)
Medication and Swallowing Difficulties

- Individuals with PD are typically on a lot of medications
- Dry mouth (xerostomia): certain types of medications affect this such as: antihistamines, antidepressants, antianxiety agents, anti-hypertensives (for high blood pressure), anti-parkinsonian agents
- Side effects of antipsychotics, some anti-depressants etc. can influence tone of the throat muscles
- Some medications “erode” the lining of the esophagus (e.g., NSAIDs)
Typical complaints/things to watch for:

- Weight loss
- Start to make dietary changes (not ones recommended but made by individual with PD)
- Heartburn
- Nausea
- Difficulty swallowing solid foods
- Food stuck in the throat
- Change of voice when eating (gurgly voice quality)
- May not always notice typical things like coughing, choking etc. even when a problem exists
- In one study 38% of patients with PD denied having swallowing difficulties when they did
Oral phase

- Oral: food is chewed and mixed with saliva to form a bolus (wad of food), pushed to back of mouth to trigger the start of swallow
- Oral phase is voluntary and affected by appetite, taste, texture, ambience

Some of the issues that might affect this stage:

Problems with teeth,
Dry mouth/lack of saliva,
Difficulty with tongue movement,
Coordination of tongue movement/initiation of swallow reflex (due to neurological problems)
Not hungry/nausea (i.e., don’t want to eat)
Pharyngeal and Esophageal phases

Pharyngeal phase: starts the swallowing response (coordinated muscle activity sequence)
- Actually need to stop breathing briefly (close your vocal folds)
- Raise the larynx (voice box) so food can go to stomach
- Squeezing movements of the throat (pharynx), to move food through the tube

Esophageal:
- Squeezing movements continue to drive the food downwards towards stomach
- Process is controlled by sensory receptors that analyze size, temperature, taste etc.
- Not under voluntary control (autonomic system)
- Extremely quick process: duration of swallow response in healthy adults is less than 740 milliseconds
What goes wrong

Normal swallowing: epiglottis closed to protect airways

Dysphasia: epiglottis unable to protect airways

Epiglottis

Esophagus entrance

To the stomach

To the lungs
Specifics for people with PD

- Most of the difficulty early in the disease process is in pharyngeal and esophageal phases
- **Rigidity/slowness** of movements likely influences this
- **Delayed swallowing reflex** related to impairment of dopamine metabolism (medication helps this somewhat) (similar to freezing behavior)
- **Longer transit times**
- **Discoordination** of squeezing action
Swallowing difficulties specific to PD continued

- Reduced sensation part of the problem (don’t have obvious symptoms when may be having problems in esophageal phase)
- Can lead to laryngeal penetration (food entering voice box) or aspiration (food passing through the vocal folds and entering airway/lungs)
- Difficulty with oral phase (i.e., chewing, forming the wad of food, transportation to back of mouth), was noted later in disease process
- Sensory problems related to oral phase
Complaints of drooling

- Sialorrhea: increased amount of accumulating saliva in the oral cavity,
  - likely due to reduced frequency of swallowing/clearing the saliva out of the mouth
  - often leads to daytime drooling
  - leads to psychosocial issues, chapped skin, and reduced quality of life
- Correlated with swallowing disorders (increase in drooling and worsening of dysphagia in people with PD)
Treatment for drooling

- Remember to swallow saliva and do it frequently (maybe add in to exercise routine!)
- Physician may recommend: botulinum toxin type-B. Reported to be safe and efficacious for treating PD-related drooling, "ensuring a long-lasting waning of this disabling symptom." (Lagalla et al., 2009)
Silent aspiration
(Nobrega, Rodrigues, & Melo, 2008)

- Aspiration: when food goes into airway (usually leads to immediate coughing reaction)
- Given sensation changes in PD, patients may not get this reaction
- “Silent aspiration” or “silent (laryngeal) penetration”
- Significant risk for respiratory infections

Bottom line:
- Recommend talking to doctor regularly about swallowing
- Consider videoswallow studies (aka modified barium swallow studies) to observe swallowing
Anxiety, depression, and swallowing disorders in PD (Manor, Balas, Giladi, Mootanah, & Cohen, 2008)

- More anxious and more depressed patients reported the most swallowing difficulty
- Chicken-egg issue (not sure about causality)
- More anxious patients complained more about swallowing problems or did swallowing problems lead to more anxiety and depression?
- Some patients complained but didn’t actually have difficulty with moving the food through their system)

Bottom line:
- Monitor and manage both for greatest success
Medication: Solid Oral Dosage Form (SODF)

- Challenging for many populations (kids, older adults, people who are frail or have swallowing difficulties)

--modifications (crushing, opening capsules, mixing with applesauce etc.) can alter the effectiveness, high risk for drug instability, and is not typically authorized by manufacturer regulatory agencies (FDA).

-may lead to serious adverse effects, affect the drug’s performance or even cause severe intoxication of patients

Bottom line: don’t modify medications without talking to doctor or pharmacist!
Challenge of taking oral medications

- Easiest (not horse pills!) are small, oval or oblong and coated
- Capsules can be easier for some people as well
- Need: design better methods to transfer active ingredients than pills
Bottom Line: Suggestions and Strategies

- Although “protective” swallowing strategies can be taught/adopted, you need **personalized recommendations** based on a swallowing evaluation.
- Generally, a double swallow may be helpful.
- Aim for the smallest pills (coated, oblong etc).
- Talk to physician/pharmacist about strategies for pills.
- Focus on the task when eating/drinking.
- Eat several smaller/highly nutritious meals.
- Take your time.
- Don’t underestimate a swallowing problem…they are underdiagnosed (especially in early PD) and respiratory infections are serious.
Attention disturbances
- Slower processing of information
- Difficulty with multi-tasking

- Mild Cognitive Impairment (MCI)-notice changes but don’t interrupt daily functioning
- In some: may see dementia, thinking and memory difficulties that interfere with daily activities
  (e.g., bill paying, remembering medications, visual changes)
Evidence that cognitive retraining is beneficial in PD (Paris et al., 2011)

- Study: Provided intensive cognitive training (4 weeks of 3x/week 45 minute sessions) to a group of individuals with PD (without dementia)
- Paper and pencil cognitive exercises and multimedia software program
- Compared to a group that received speech therapy alone, they found:
  - improved attention
  - improved speed of information processing
  - improved memory
  - improved visuo-spatial and visuo-constructive abilities
  - improved executive functioning
Cognitive training and influence on dopamine

- Backman & colleagues (2011) provided 5 weeks of working memory cognitive training to 10 healthy young adults.
- As compared to those who didn’t get the training, they saw enhanced dopamine release after cognitive training.
Spaced Retrieval

- **Spaced retrieval** is an evidence-based memory technique that uses procedural memory to help people recall information over progressively longer intervals of time.
- Can be used for a variety of things that would be important to remember and can be used even when a person has significant memory difficulties.
- Spaced retrieval has been used to teach/train compensatory strategies for eating safely (swallowing strategies) (Benigas & Bourgeois, 2016).
Evidence that exercise is beneficial too! (way to go PWR! members!)

- **Executive functioning**: a set of processes that help one manage oneself and one’s resources to achieve a goal

- Duchesne and colleagues (2015) conducted a study with individuals with PD: three month aerobic exercise training led to increased physical fitness AND better cognitive and procedural functioning (i.e., executive functioning)

- Tanaka et al. (2009) provided a 6 month multi-modal exercise program to older persons with PD and showed improved executive functioning
Cognitive-Communication Therapy for Functional Success

- Focus on strategies to succeed in daily activities

- Develop “external” executive functioning aids/memory aids (e.g., appointment books, journaling, to do lists)

- Develop and practice strategies for word-finding difficulties and difficulty maintaining train of thought