Rehabilitation in Parkinson Disease: BIG, LOUD, and RHYTHMIC

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March 24, 2018

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Disclosures

- I have no relevant financial interest or affiliation with any entity producing, marketing, re-selling, or distributing healthcare goods or services consumed by, or used on, patients
- Co-Director, Johns Hopkins Center for Music & Medicine

Objectives

1. Understand the current thinking regarding the theoretical basis for rehabilitation interventions in PD
2. Understand why, when and how often patients with PD should be referred for rehabilitation
3. Name several types of music/rhythm-based interventions for PD

Outline

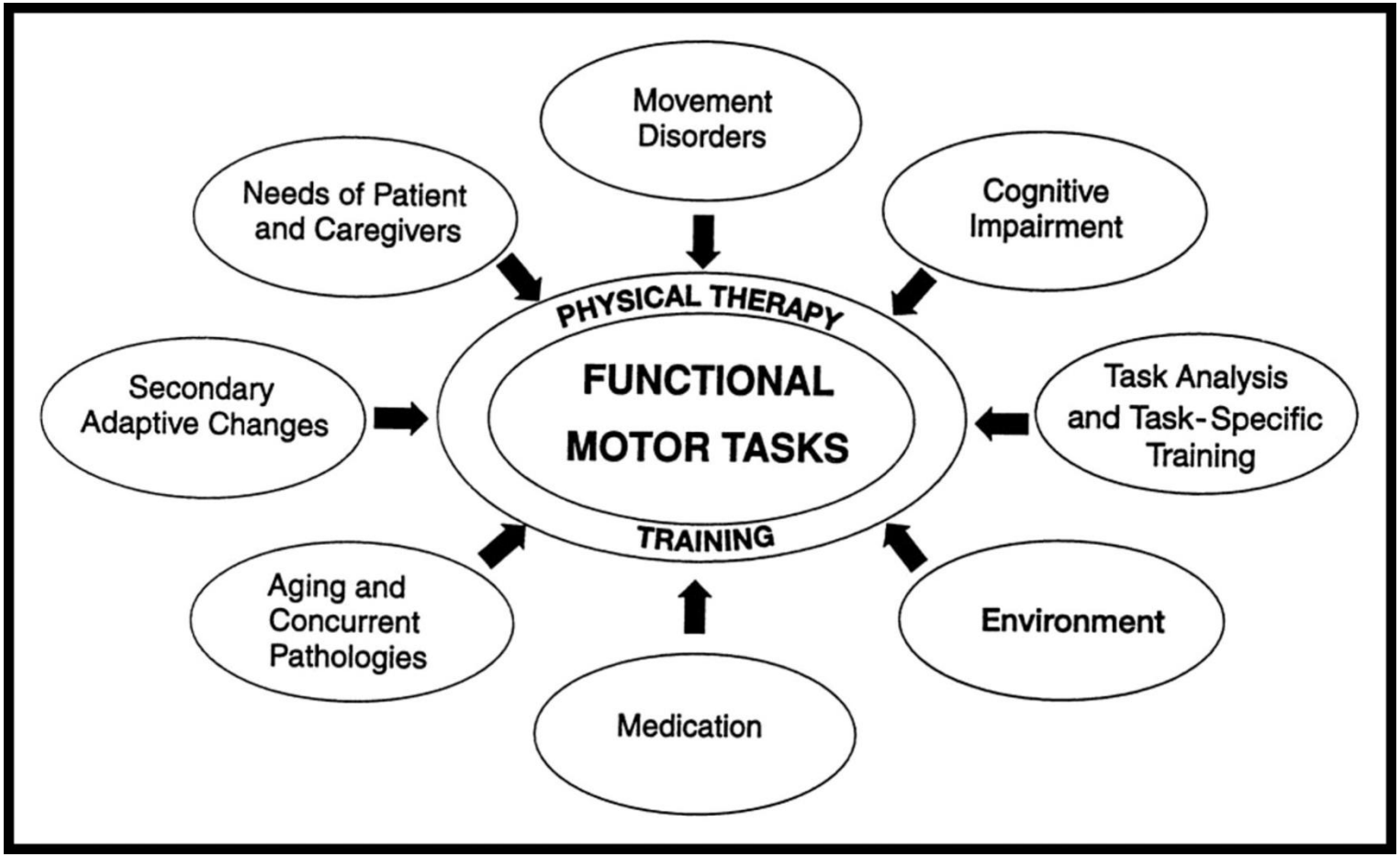
- Theoretical basis for rehabilitation interventions (physical/speech therapy) in PD
- Referral issues/alternatives
- Music/rhythm-based interventions for PD
- Conclusion and questions

PD Background

- Wu and Hallett (2005) and others: patients with PD require more (cortical) brain activity in performing *automatic* movements to compensate for basal ganglia dysfunction
- Rhythm processing is impaired
- A problem with *activation*
- **How to overcome this loss of automaticity? →By repetitive exercise training!**

Wu T, Hallett M. Brain. 2005;128:2250–2259.
Morris ME, et al. Brain. 1996;119(Pt 2):551–568.
Morris ME. *Physical Therapy* 2000;80(6):578–597.

Physical Therapy Theoretical Model



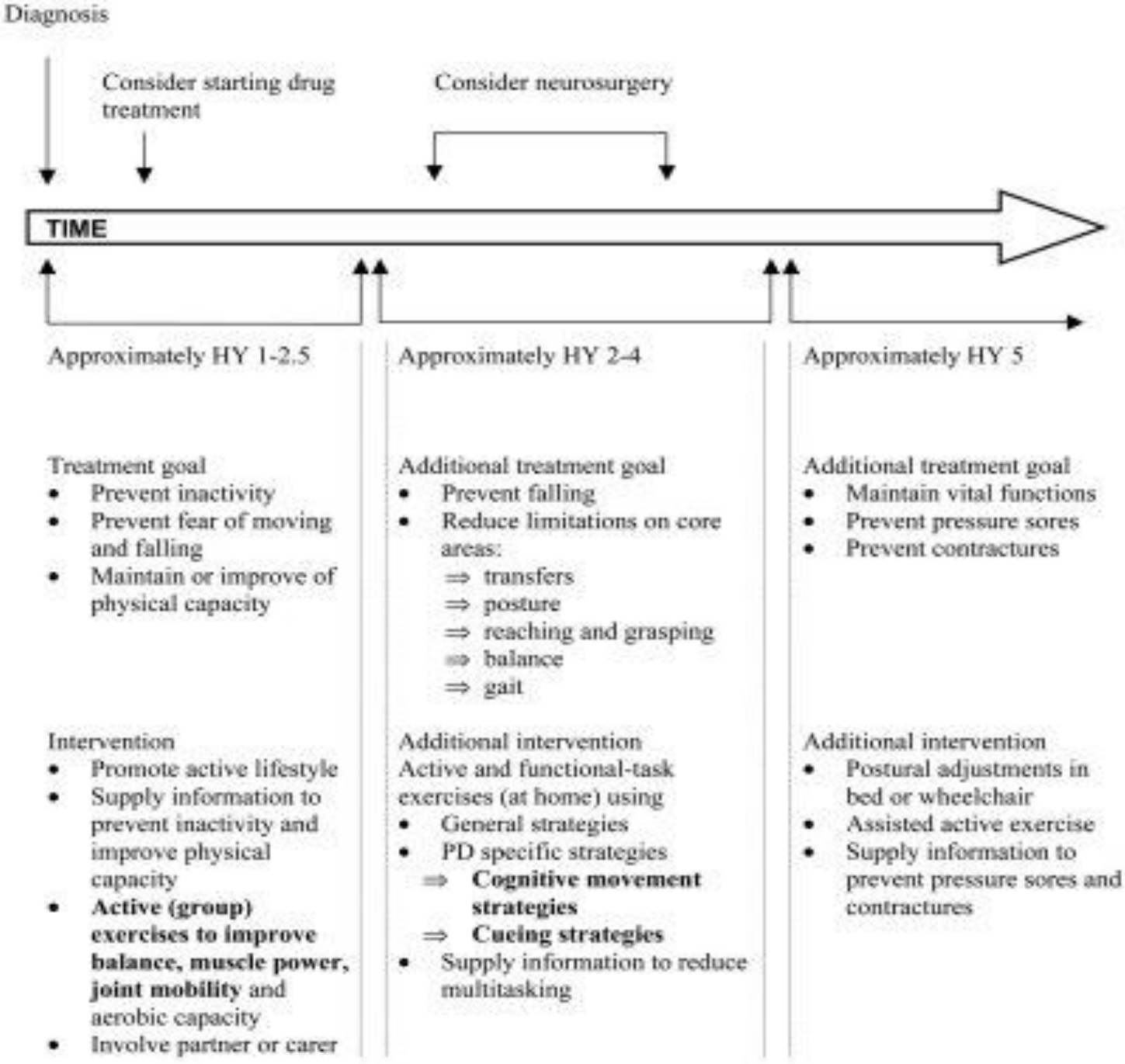
From: Movement Disorders in People With Parkinson Disease: A Model for Physical Therapy

Phys Ther. 2000;80(6):578-597. doi:10.1093/ptj/80.6.578

PT in PD: Key Elements

- Teaching patient how to move more easily and maintain postural stability by using *cognitive strategies (strategy training)*
  - (1) compensatory strategies to bypass defective basal ganglia (external cueing, action sequencing)
  - 2) learning strategies to improve performance through practice
- Management of musculoskeletal and cardiorespiratory system difficulties that occur as a result of deconditioning, reduced physical activity, advanced age, and comorbid conditions
- Promotion of physical activities that assist the person in making *lifelong changes* in exercise and physical activity habits as well as preventing falls

Morris ME, et al. *Physical Therapy* 2010;90(2):280–288.



Movement Disorders Volume 22, Issue 4, pages 451-460, 28 NOV 2006 DOI: 10.1002/mds.21244
http://onlinelibrary.wiley.com/doi/10.1002/mds.21244/full#fig1

Physical Therapy in PD

- Physical therapy can improve motor function in patients with PD short-term
  - Gait, postural stability (small overall effects)
  - *Benefit typically wanes within 6 weeks of stopping therapy*
  - No high quality evidence favoring particular PT types

Tomlinson CL, et al. Cochrane Database Syst Rev. 2012;7:CD002817.
Tomlinson CL, et al. Cochrane Database Syst Rev. 2014;6:CD002815.
Klamroth S, et al. Journal of Neurologic Physical Therapy.2016;40(1):3–14.

Speech Therapy in PD: Background

- Perception of own loudness may be impaired in PD
- Impaired perception of prosody may be related to working memory impairment
- Speech networks are altered in PD patients *before* they develop speech symptoms

Kwan LC, Whitehill TL. *Parkinson's Disease*, vol. 2011, Article ID 389767 doi:10.4061/2011/389767
Arnold C., et al. *NeuroImage: Clinical.* 2014;4:82-97.

Speech Therapy—Continued

- Hypophonia relates to reduced “energization” (motor drive) due to reduced striato-prefrontal coupling
  - May be partially levodopa-responsive
- PD patients show signatures of reduced monitoring of auditory feedback

- Dysarthria may result from imprecise shaping of motor representations by feedback

- External therapeutic models (speech therapy) may help normalize above speech-related neural anomalies even in advanced PD

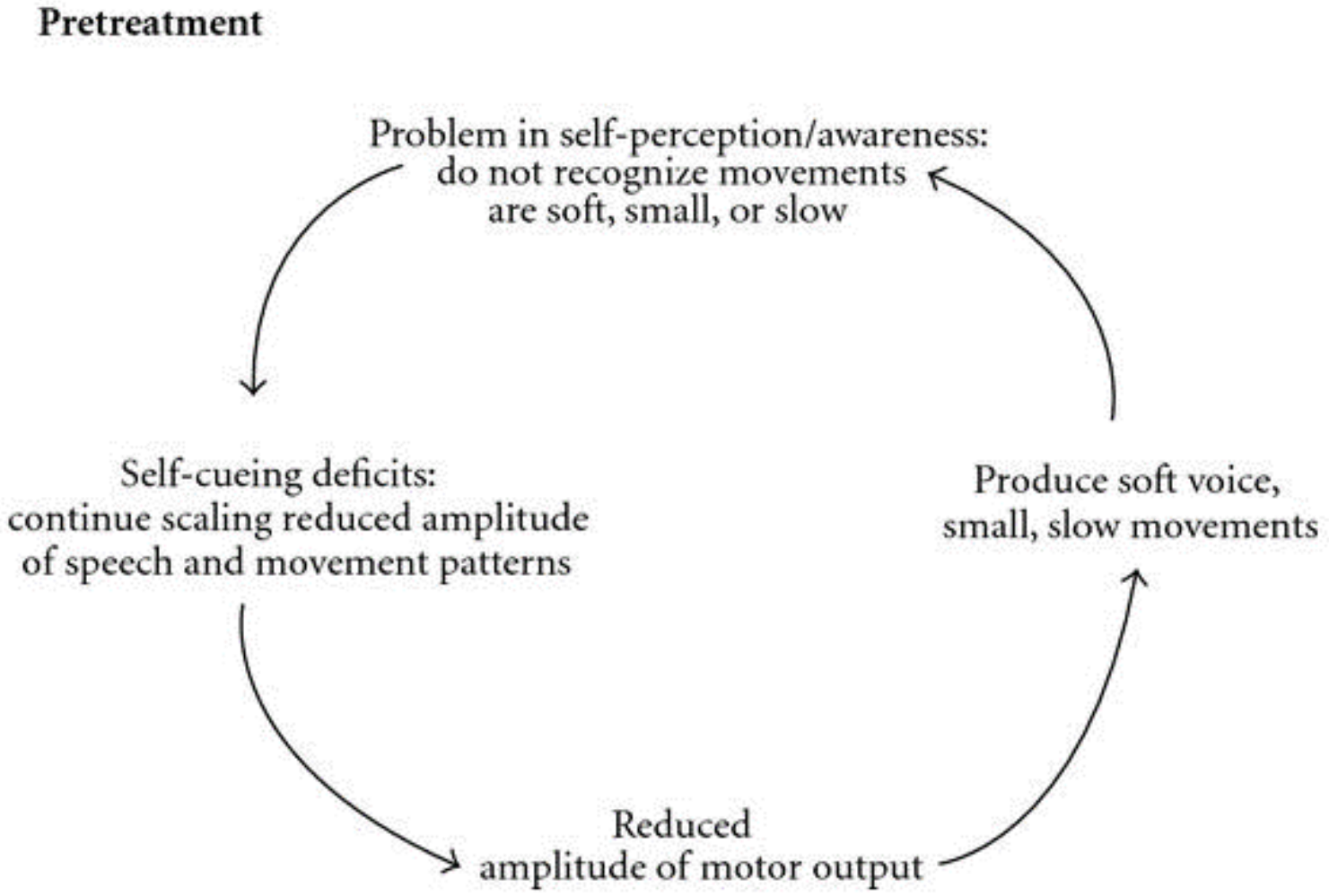
Arnold C., et al. *NeuroImage: Clinical.* 2014;4:82-97.

Lee Silverman Voice Treatment (LSVT®)

- LSVT focuses on training **loudness**
- Effects generalize to improvements of speech modulation (prosody), articulation, and facial expression
- Increasing amplitude of speech and non-speech movements by external therapeutic models is efficient in reducing hypokinesia in general
- In LSVT BIG® and LOUD®, patients learn to overcome their hesitation to move and speak in a way they often describe as *exaggerated*
- Patients initially (mostly) depend on external feedback given by the therapist before they automatize the newly learned motor routines
- This adequately *circumvents* dysfunctional auditory self-monitoring systems of PD patients

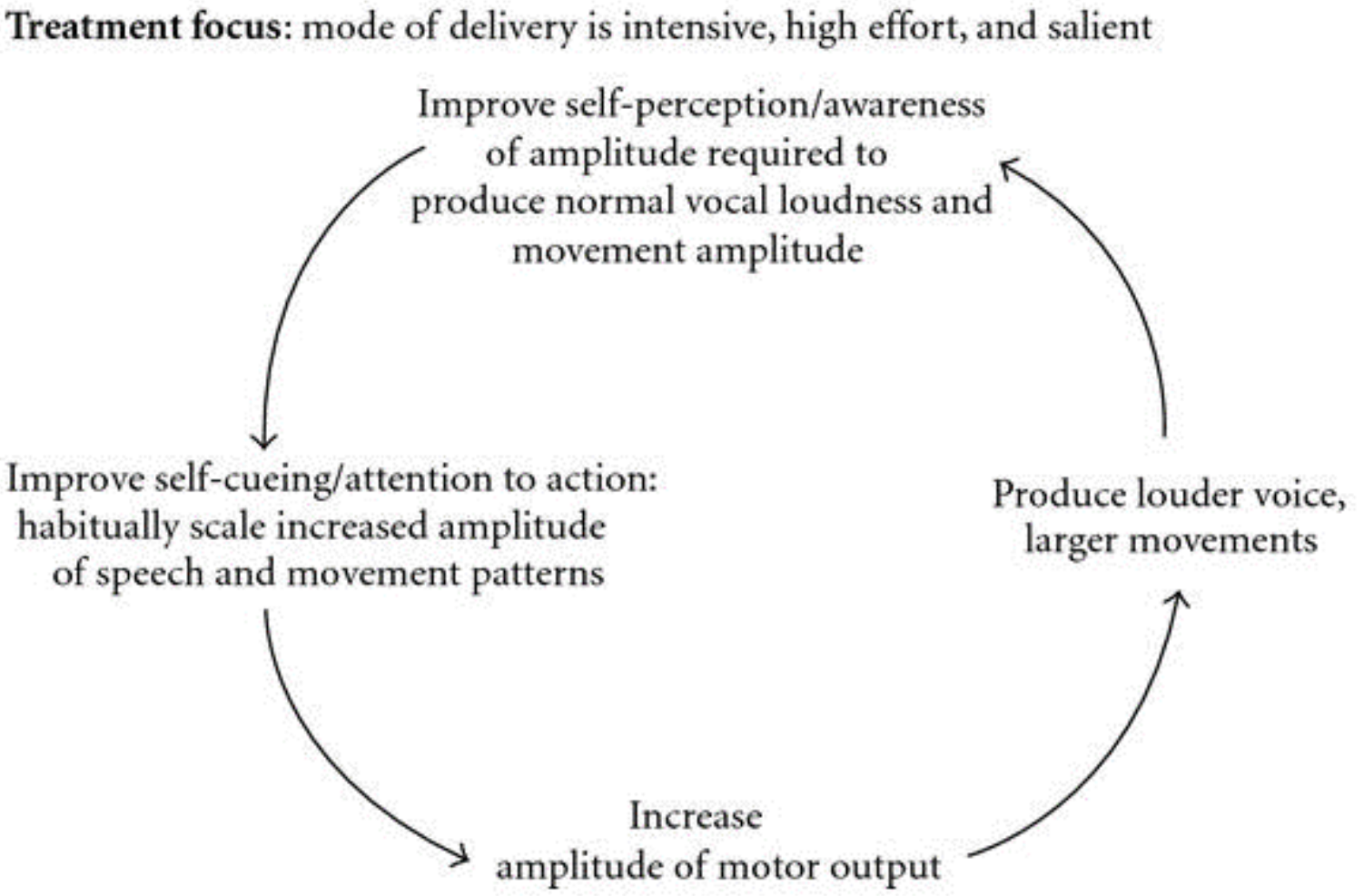
Fox CM, et al. *Am. J. Speech-Lang. Pathol.* 2002;11(2):111-123.
Fox CM, et al. *Parkinson's Disease* 2012. Article ID 391946. doi:10.1155/2012/391946

LSVT BIG and LOUD: Pretreatment



Fox CM, et al. *Parkinson's Disease* 2012. Article ID 391946. doi:10.1155/2012/391946

LSVT BIG and LOUD: Treatment Goals



Fox CM, et al. *Parkinson's Disease* 2012. Article ID 391946. doi:10.1155/2012/391946

Rehabilitation in PD: Why, When and How Often?

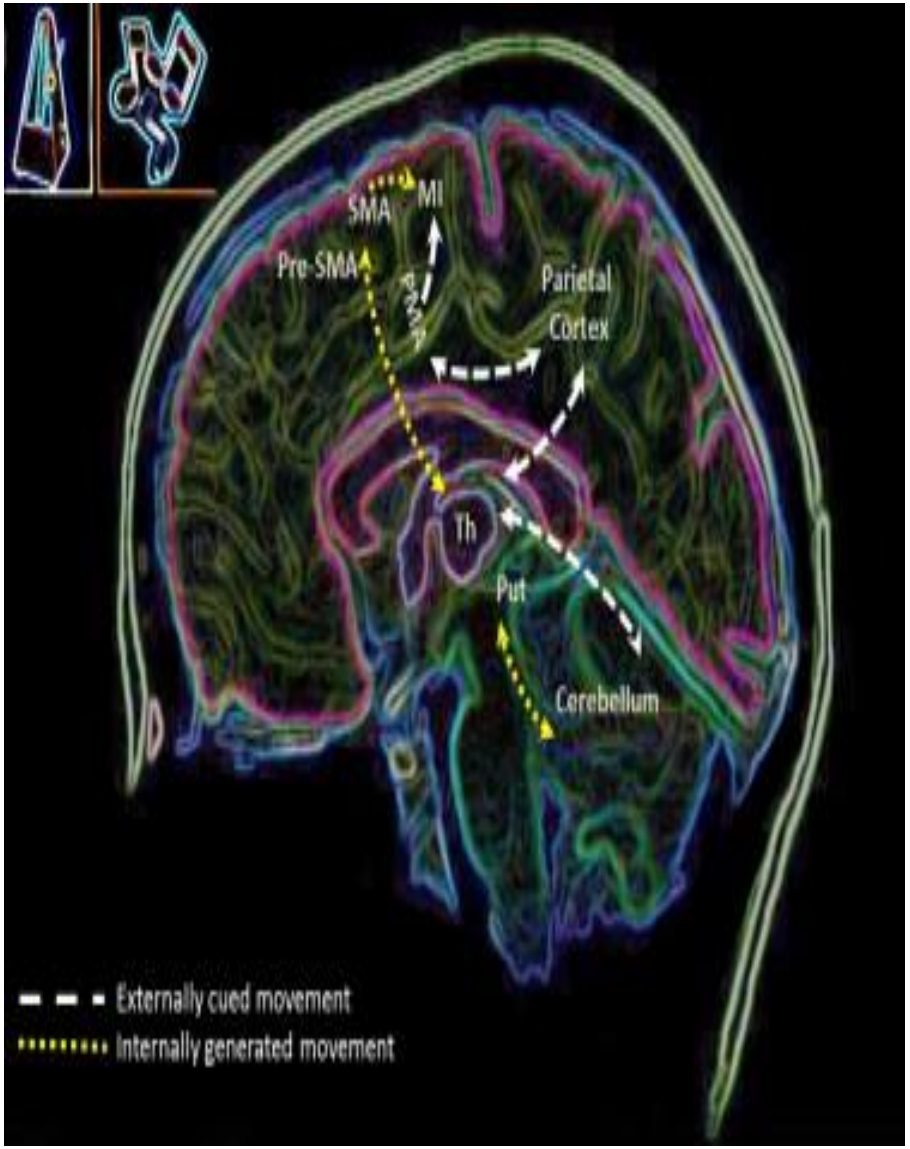
- As early as possible (an ounce of prevention):
  - Maintaining good posture
  - Preventing falls
  - Maintaining/improving normal communication
- Sustained benefit requires ongoing training
  - If you don't use it, you lose it
- **As of 01/01/2018, Medicare beneficiaries meeting certain requirements are eligible to receive unlimited PT/OT/SLP as long as their physician certifies need**

https://www.cms.gov/Center/Provider-Type/All-Fee-For-Service-Providers/Downloads/Medicare-Expired-Legislative-Provisions-Extended.pdf

Rehabilitation in PD: Alternatives

- Tai Chi
- Yoga
- Rock Steady Boxing
- Aquatic exercise
- More below…

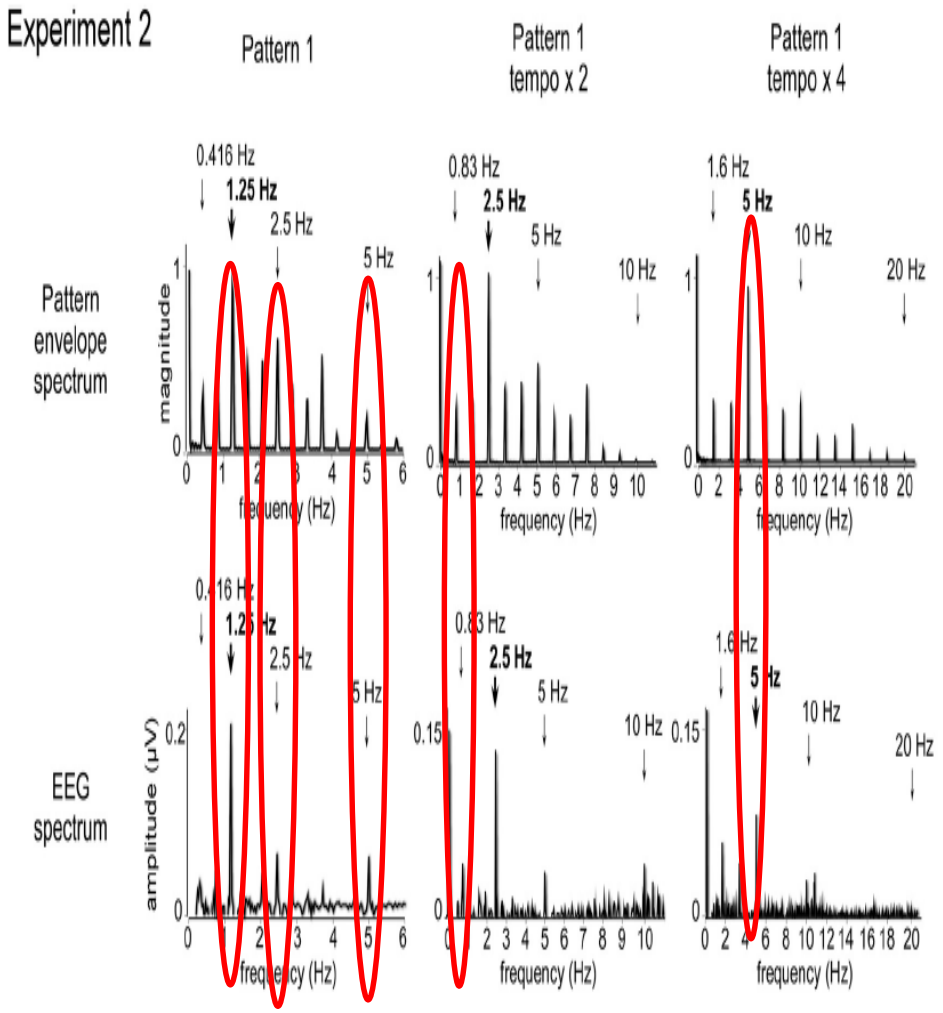
How might rhythm help PD ?



- Therapeutic music performance may be used to improve gross/fine motor skills by ***rhythmic entrainment*** (Thaut 1996; McIntosh 1997; Rochester 2010; Nozaradan 2012)
- *Bypassing and/or facilitating faulty pathways*

Nombela C., et al.
Neurosci& Biobehav Rev.
2013;37(10):2564–2570.

Rhythmic Entrainment



Nozaradan, S., Peretz, I. & Mouraux, A. Selective Neuronal Entrainment to the Beat and Meter Embedded in a Musical Rhythm. *Journal of Neuroscience* 2012;32:17572–17581.

Rhythmic Auditory Stimulation (RAS)

- Typically used for gait rehabilitation
- Rhythm is external timekeeper
- Cueing provided by a metronome or recorded/live music with strong rhythm
- Allows to anticipate next step
- Verbalizing a cadence (beat), counting, singing, playing music (eg, march)

Thaut, M. 1999. *Training Manual for Neurologic Music Therapy.*

RAS—Continued

- May help with start hesitation, freezing, gait stability (*decreasing fall risk*), walking speed, stride length, step coordination
- Increasing speed of sound cue may decrease variability in patients' stride length and step time
- For "freezers," *slower* sound cues may help with festination and allow for more time to target longer strides

Thaut et al. 1996. Mov Disord 11:193-200.
Hausdorff et al. 2007. Eur J Neurosci 26: 2369-2375.

RAS—Continued

- Length of training determined by patient needs
- In one study, improvement after 3 weeks of training sustained for 3 weeks; by 5 weeks performance declined to baseline values
- Can be done with a trained physical therapist or music therapist, as outpatient or at home

McIntosh et al. Mov Disord 1998;13:212.

RAS Benefits in PD

- Lim et al. systematic review (2005):
  - 1 RCT showing benefit of auditory cueing for gait velocity
- Harro et al. RCT 2014: Auditory cueing vs. treadmill training (n=20) for 6 weeks
  - Both interventions produced balance, velocity and endurance improvements at 6 and 12 weeks
  - No improvement in QOL or self-reported falls over 6 months

Lim I, et al. Clin Rehabil. 2005;19(7):695-713.
Harro CC, et al. NeuroRehabilitation. 2014;34(3):557-572.

Dance in PD

- Several studies demonstrated benefits of dance on motor outcomes in PD (Heilberger 2011; Duncan 2012, 2014)
- Literature Review/Meta Analysis (Shanahan 2015):
  - Two 1-hour dance classes per week over 10-13 weeks may have beneficial effects on endurance, motor impairment, and balance
  - Higher-quality multicenter studies needed to determine effect of other dance genres, optimal therapy volume and intensity

www.danceforparkinsons.org

Dance in PD-2

- Duncan et al. 2014:
  - 10 individuals with PD randomly assigned to the Argentine tango (AT) group (*n*=5 [4 men]) or non-intervention control group (*n*=5 [4 men])
  - Blinded assessments at baseline, 12 and 24 months
  - Significant effects at 12 and 24 months for MDS-UPDRS III, Mini-BESTest, MDS-UPDRS II and I, and 6MWT

Duncan RP, Earhart GM. J Altern Complement Med. 2014;20(10):757-763.

Tango vs. Dance*for*PD

- 12 weeks of 2x/week classes; assessments performed off medication; 8 per group (1:1 M:W)
- Measures of balance, repeated sit-to-stand performance and endurance (mini-balance evaluation systems test, four square step test, five times sit to stand, 6-min walk time) improved from pre- to post-intervention similarly in both groups
- *Motor sign severity (MDS-UPDRS-Motor) and functional mobility (Timed Up and Go) improved in the Tango group and worsened in the D4PD group*
- Gait velocity not affected by either intervention

McNeely ME, et al. Front Aging Neurosci. 2015;7:239.

Music Therapy for Voice

- Therapeutic singing: focus on deeper breathing to counteract soft/fading volume and monotone, improving intelligibility
- With practice, may help with **speech initiation**
  - demonstrated clearly in stroke patients with speech deficits
- Verbal cues of remembering how it feels to sing a phrase can often be enough to replicate phrasing in normal speech

Cohen and Masse 1993. J Mus Ther 30: 81-99.
Holten S. 2013. *Neurologic Music Therapy* in Parkinson's Disease, 2nd ed. 990.

Conclusions

- There is a growing theoretical basis for rehabilitation in PD, but more work is needed to clarify mechanisms
  - If you don't use it, you lose it!
- Earlier PT/SLP may be better, and sustained rehabilitation exercises are necessary (and now possible for most) to maintain benefit
- Music and rhythm-based interventions in PD may be an effective and sustainable mode of rehabilitation
  - Rhythmic auditory stimulation
  - Dance
  - Singing?
  - Playing a musical instrument?

Thank You!

- Questions?

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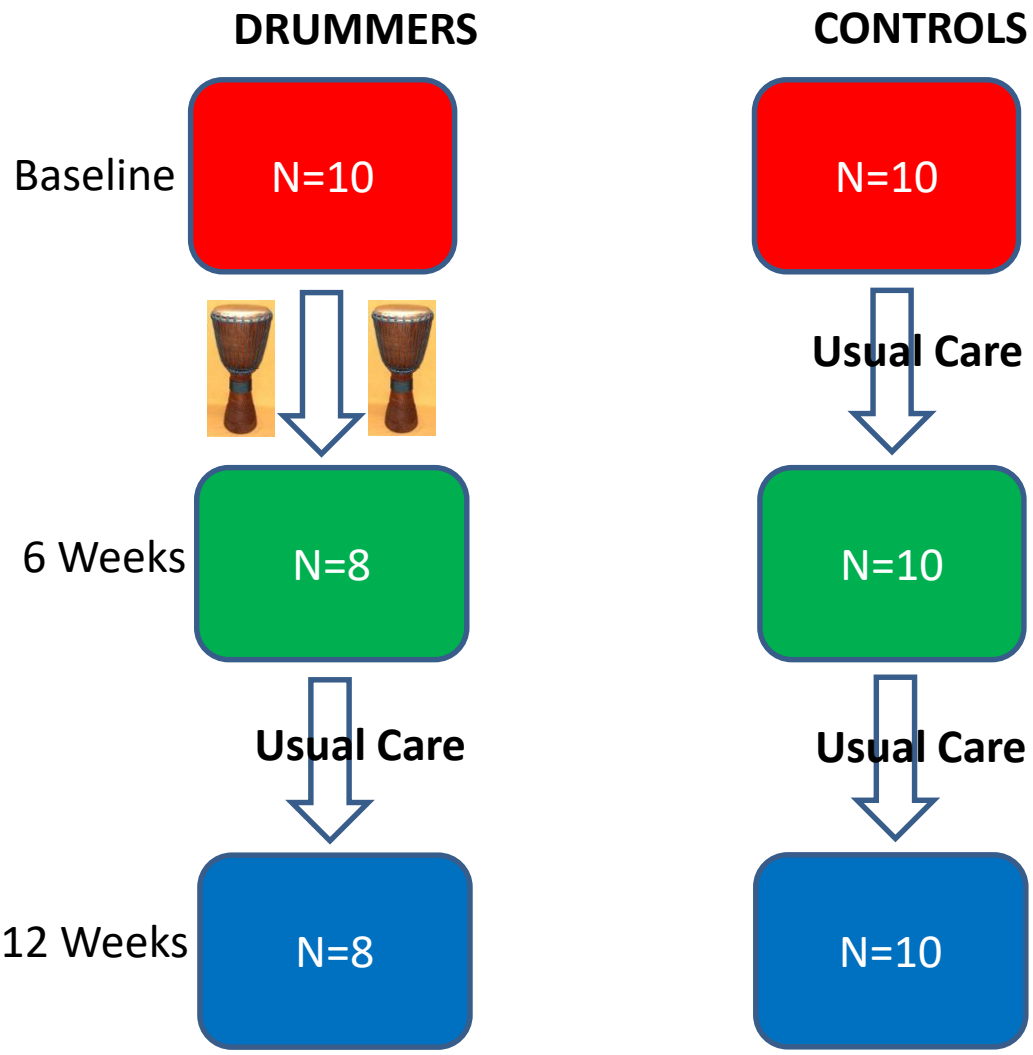
How can we harness rhythmic entrainment in a pleasurable way?

Drumming

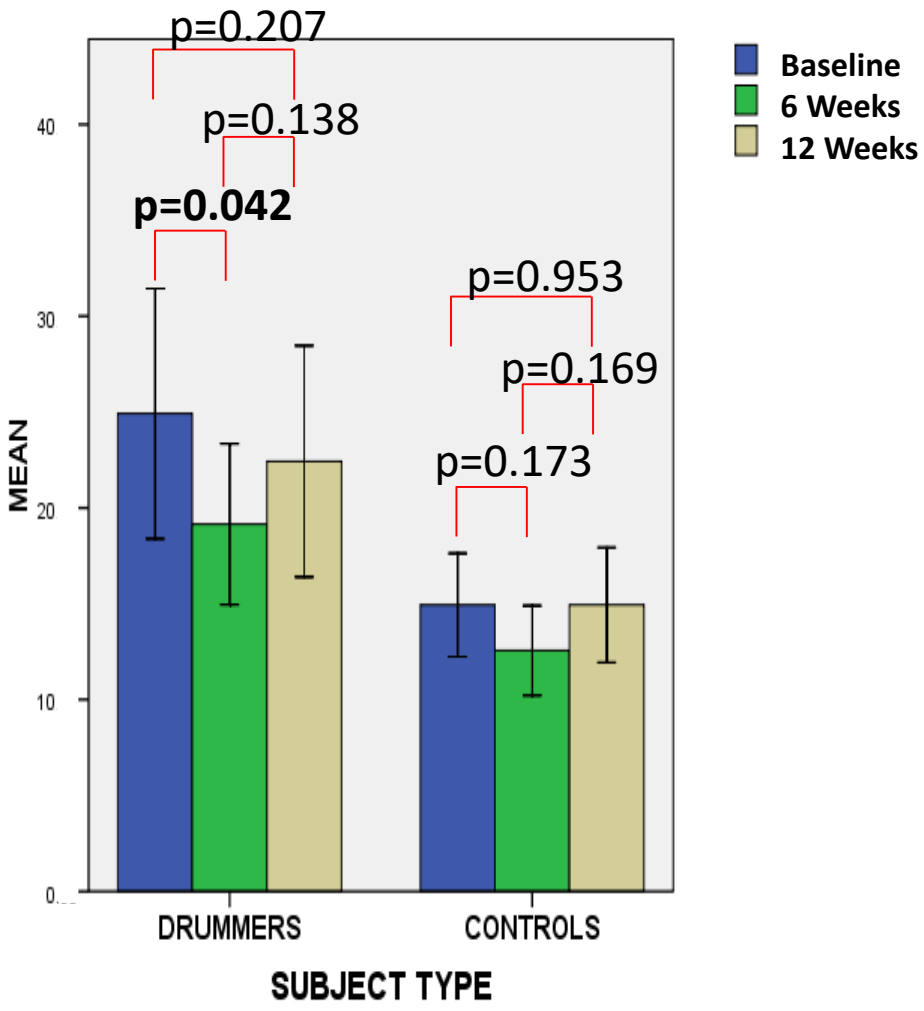
- Drumming has long been a part of traditional healing rituals in many cultures worldwide
- A group of patients with PD at UPenn reported a significantly improved sense of well-being after a single West African drum circle class for 45 minutes

Can drumming improve well-being and motor function in PD?

Study Design



PDQ-39 Results



Participant Reflections

- **“Talk about putting dyskinesias to work!”**
- **“I found that I was able to coordinate my hands even when I was ‘off’.”**
- **“I learned the importance of connecting to the group in a joyful way.”**
- **“It was great being in a drumming circle instead of a drooling circle…being anchored in the present.”**
- **“PD can be isolating, and I realized that I never had a chance to socialize with men who had the disease.”**
- **“Was a welcome challenge to get up, dressed and out of the house in the morning. I took two buses, and enjoyed being amongst those who had a purpose.”**

DRUM-PD Conclusions

- 6 weeks of twice-weekly West African drum circle classes significantly improved self-reported quality of life in patients with PD
  - Improvement waned within 6 weeks of completion of classes, suggesting that continued drumming is necessary to sustain demonstrated short-term benefits
  - iTUG performance trended toward improvement in drummers, but not controls over 12 weeks
- Mood in drumming group worse than control group at baseline
  - Difference decreased at 6 weeks
  - Became non-significant at 12 weeks

Pantelyat et al. *Mov Disord Clin Prac.* 2016

DRUM-PD Conclusions-2

- Findings underscore importance of pursuing non-traditional therapeutic interventions in PD
- Larger controlled investigations comparing drumming classes to established treatments

Pantelyat et al. *Mov Disord Clin Prac.*2016

Parkinsonics Study

- 32 participants with PD (20 men)
- Random assignment to weekly choir vs. weekly facilitated PD support group for 12 weeks
  - Tracked diary of home singing exercises
- **Crossover after 12 weeks**
- Motor, cognitive, mood, patient-reported QOL and objective voice outcomes (loudness in dB, spectral voice analysis) every 6 weeks for 30 weeks
- Blinded assessments

Parkinsonics Study Results

- 26/32 patients (16M/10F; Hoehn&Yahr stage 2.3(2-3); Age 68.6 (55-89)) completed study
- Significant improvement from baseline in average loudness on Cookie theft picture description(2.06 dB) at 24 weeks
  - Improved minimal reading volumes at 24 weeks (4.4 dB) and 30 weeks (8.1dB)
- Increased minimal loudness on Rainbow passage reading at 24 (4.3dB) and 30 weeks (7.2dB)

Parkinsonics Results—2

- Participants also improved on the MDS-UPDRS Motor scale between baseline and 24 (5.9 points) and 30-week visits (8.4 points), regardless of intervention order
- Quality of life improvements (communication, body discomfort) attributable to singing
- Weekly group singing is a feasible intervention that may improve some aspects of conversational voice volume in PD
  - Some improvements were sustained at least 6 weeks after interventions ended

Parkinsonics—What's Next?

- Program (ParkinSonics) continues weekly in the same location under the same leadership; open to all parkinsonian disorders
- Co-funded by Hopkins PD and Movement Disorders Center and the Maryland Association for PD Support (MAPS)
- Planning follow up assessments of voice, motor function, and quality of life