LSVT BIG Amplify
Your Life…
think BIG, move BIG, be BIG

Presenter: Sandy Fini, PT
Objectives of Presentation

• Discuss the pathophysiology of Parkinson’s disease
• Discuss principles of neuroplasticity
• Discuss development and data on efficacious speech treatment LSVT LOUD
• Describe the Fundamental Treatment Principles that underlie LSVT (Lee Silverman Voice Treatment) BIG
• Describe development and key aspect of limb motor treatment LSVT BIG
• Discuss treatment implications using amplitude based treatment principles in practice
PD Statistics

• Parkinson’s Disease is 2nd most common neurodegenerative disease, after Alzheimer’s
• Approximately 1 million Americans live with Parkinson’s Disease (PD) (2010, NPF.Org)
• It is estimated that the number of Parkinson’s disease cases will double by the year 2030
  – Average onset is in 6th decade, mean is 55 years
  – 10% below are below age of 40.3 (NPF, 2011)
  – 2% are >80 years old, 10% are in SNF’s
Pathophysiology of PD

- Parkinson’s disease is a loss of dopaminergic neurons in the substantia nigra
  - 50 – 60% of cell death at diagnosis
  - 70-80% loss of dopamine terminals
  - Proceeds diagnosis ~ 5-6 years
- Causes of PD remain unknown
- Genetic mutations may contribute to one’s susceptibility and most cases of PD are thought to be caused by an interplay of environment and genetics.
MULTIPLE SITES OF PD NEURODEGENERATION: ACCOUNT FOR MOTOR AND NONMOTOR SYMPTOMS

- **Dopamine (DA)** - Associated with motor symptoms bradykinesia/hypokinesias, tremor, rigidity
- **Norepinephrine** – May precede loss of DA: Associated with brain functions such as: sleep, memory, learning and mood
- **Serotonin** – May precede loss of DA: Associated with mood, anxiety, appetite, GI function and pain
- **Acetylcholine** – Associated with memory and learning
Clinical Diagnosis of PD

• Early Motor Symptoms (2/3)
  • Bradykinesia, tremor, rigidity
• Insidious onset: nonspecific non-motor and motor symptoms
• Asymmetrical distribution
• Positive response to dopamine replacement
• Differential diagnosis
Motor Signs of PD

- Resting Tremor
- Cogwheel Rigidity
- Bradykinesia/ Akinesia
- Hypokinesia
- Postural Instability
Non-motor Signs of PD

• Depression (pre-motor clinical finding)
• Anxiety (pre-motor)
• REM Sleep behavior disorder (pre-motor)
• Constipation (pre-motor)
• Impaired olfaction (pre-motor)
• Autonomic abnormalities
• Sensory Changes
• Loss of Higher Cognitive Function
• Dementia
Standard “Early” PD Patient (Hoehn and Yahr staging 0-2.5)

• Motor: resting tremor and bradykinesia with mild cogwheel rigidity predominantly on one side, micrographia, hypophonia, hypomimia, no falls, mild motor complaints if at all

• Non-motor: Constipation, some with depressed mood or anxiety, +RBD, anosognosia, impaired olfaction, cognitive decline
“Midstage” PD Patient (Hoehn and Yahr scale 3)

• MOTOR: bilateral cardinal features in PD, motor complications including wearing off and dyskinesias, some hunched posture and perhaps shuffling gait, more help with ADL’s (buttons, etc), increase in falls, loss of righting reflexes, narrow base of support

• NON-MOTOR: some cognitive decline (executive/visuospatial), maybe bradyphrenia, sensory disturbance, orthostatic hypotension, maybe rare hallucinosis, mood disorders, drooling, mild chronic dehydration

• OTHER: considering support group, caregiver stress and strain may be apparent
“Advanced” PD Patient
(Hoehn and Yahr Stage 4,5)

• MOTOR: bradykinesia, akinesia, freezing, impaired balance and postural control, dyskinesia, tremor, rigidity, weakness, decreased activity tolerance

• NON-MOTOR: severe cognitive decline, possible psychosis, visual changes (contrast sensitivity, visual attention, spatial perception, coarse object recognition)

• Other: care partners training and education; transfer training, QOL, financial factors, remedial vs. compensatory approaches
Clinical implications

GET READY signal too weak
Bradykinesia/Hypokinesia

GO signal too weak
Freezing/Start hesitation

NO GO signal too weak
Festination/Sequential movements more difficult/run together
It is a “Stunning Time” to be in rehabilitation today

- Basic science evidence for the value of exercise in PD (classically drugs and surgery)
- Identified key principles of exercise that drive activity-dependent neural plasticity
- Demonstrated that exercise can improve brain functioning (neural plasticity) and may slow disease progression
- Exercise is Medicine!

Kliem & Jones, 2008; Ludlow et al, 2008
In studies rats injected with 6-OHDA (dopamine depleting toxin) causing unilateral Parkinsonism
- Non affect UE was casted -> forced use of affected side
  - Early exercise no behavioral impairment and attenuated dopamine loss
- Affected UE cast -> inactivity
  - Behavioral asymmetry and additional dopamine loss
- Inactivity = pro degeneration
PRINCIPLES OF NEUROPLASTICITY

• Exercise as a physiological tool to promote brain change from the inside

• Intensity - important for maximal plasticity (frequency, effort, force/resistance and accuracy)

• Complexity- promote greater structural plasticity

• Repetition – acquisition not sufficient, continued performance of skill for long-term structural plasticity

• Salience - practice rewarding tasks, activates basal ganglia circuitry

• Timing - slow progression to non-impaired side

• Specificity - train deficits
Legitimate Therapeutic Options
To provide symptomatic relief; improve function

Pharmacological (L-dopa)

Neurosurgical (DBS-STN)

Voice and Body Exercise

Zigmond et al, 2009

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“If only we can hear and understand her”
Family of Mrs. Lee Silverman 1987
History LSVT (Lee Silverman Voice Treatment)

- **LOUD:** Initial development 1987-89 by Lorraine Ramig, PhD, CCC-SLP at Lee Silverman Center for Parkinson's Disease in Scottsdale, AZ
- **BIG:** 2004-2005 by Becky Farley PT, PhD and Cynthia Fox PhD, CCC-SLP at University of Arizona
What are the fundamentals of LSVT LOUD™?

Standardized, research-based, specific protocol

TARGET: vocal loudness - amplitude

MODE: Intensive and High Effort

CALIBRATION: Generalization
Train one variable to make changes across speech system. Focused on a single goal “speak LOUD!” – the treatment improves respiratory, laryngeal and articulatory function to maximize speech intelligibility.
What are the LSVT LOUD exercises?

**Daily tasks**
First half of treatment session
Rescale amplitude of motor output through CORE Loud
- Sustained “ah” (minimum 15 reps)
- High/Low “ah” (minimum 15 reps)
- Functional phrases (minimum 50 reps)

**Hierarchical speech tasks**
Second half of session
Train amplitude from CORE exercises into in context specific and variable speaking activities
- Week 1 – words, phrases
- Week 2 – sentences
- Week 3 – reading
- Week 4 - conversation

MODE
Shorter, simple
Longer, more complex
Video Example:

- 59 year old female
- 2.5 years post-diagnosis
- On-meds pre and post video

Pre/post LSVT
(Lee Silverman Voice Treatment)
Intensive physical exercise of speech mechanism
Ramig et al., 2001; JNNP
Level 1 Evidence Goetz, 2003

SPL Rainbow (50 cm)

Months

N=45
RESP & VOICE (LSVT® LOUD)
RESP

Blinded, no med change
Same time med
Strobe (Smith)
EMG

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(Farley & Koshland, 2005; Farley, Fox, et al., 2008; Farley & Koshland, in revision)
LSVT BIG Fundamental Treatment Principles

- Hypothesis-based/PD-specific
- Neuroplasticity-based
- Research-based
- Standardized Protocol
HYPOTHESIS – PD SPECIFIC

• *Intensive amplitude-based exercise program for the limb motor*
  – *BIG* reeducation of sensorimotor system

• Treatment of One Target - Amplitude
  – may enhance many levels of movement, improve efficiency and simplify treatment
SINGLE TARGET AMPLITUDE

BIG - The largest range of motion that can be performed with the highest effort with the maximally efficient biomechanics every trial/everyday!
CALIBRATION

• Sensory problem - movements that are within normal are perceived by individual with PD as too BIG
  • sensory-motor mismatch
• Internal cueing problem - decrease self-initiation due to under activation of Supplementary Motor Area
  • "If I don't specifically think about it, I move too small"
• Neuropsychological Sensory Re-Calibration
  • slow thinking, slow learning
  • problems sustaining attention
  • problems shifting cognitive set
  • problems in procedural memory
Sensory Re-Calibration

The process of teaching the patient to self-monitor and accept that what feels too BIG is WNL!

Patient uses bigger movements "automatically" in daily living and is able to maintain bigger movements over time.
When an individual with Parkinson disease moves in their everyday way, out comes small/slow movement.
When they increase their effort level by +1, out comes normal size/speed movement.
The amount of effort needed for an individual with PD to reach a normal movement level feels similar to the amount of effort a healthy individual would feel to perform a big movement.
LSVT BIG Protocol

Administered in an intensive manner to challenge the impaired system.

Techniques specific to PD-specific deficits!

- bradykinesia/hypokinesia
- kinesthetic awareness (sensory deficit)

Does not treat Dyskinesias
PRE-TREATMENT

Problem in self perception/awareness do not recognize movements are small or slow

Self-cueing deficits - continue scaling reduced amplitude of movement patterns

Small, slow movements

Reduced amplitude of motor output
POST-TREATMENT

Mode
Intensive, High effort
(consistent with principles of neural plasticity)

Calibration
Self-perception,
Internal cue,
Simple, Redundant

Target
Increase Bigness

increase
amplitude of output

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What are the fundamentals of LSVT BIG™?

Standardized, research-based, specific protocol

**TARGET:** Bigness (amplitude)

**MODE:** Intensive and High Effort

**CALIBRATION:** Generalization
   - Sensory
   - Internal cueing
   - Neuropsychological changes
TARGET

BIG (Large amplitude whole body movement)
Single Target - Triggers Activation across motor systems

NORMAL “BIGNESS”
MODE

Delivery

– Certified LSVT BIG™ Physical/Occupational Therapist
  • 1:1 intervention

Time of Practice

– 4 consecutive days per week for 4 weeks
– 16 sessions in one month
– 60 minute sessions
– Daily carryover assignments (30 days/entire month)
– Daily homework (30 days/entire month)
CALIBRATION

MIS MATCH between perception of output and how patient believes others perceive it

“I can’t move *like this*, people will think I am crazy!!”

Teach patient to recognize and accept the relationship between increased movement effort and NORMAL motor output.
Learning vs Performance = Successful Calibration

Self monitoring = sign of success
Reports functional impact outside treatment
"Ah-ha" moments
  • "My poker buddies don't ignore me anymore"
  • "I can pick up my granddaughter now"
Retrain sensory calibration and learn new internal cue for WNL movement effort and bigness
Daily Components

**Modeling** - do what I do "BIG"

**Shape** - optimize alignment first with minimal cognitive load/cues

**Drive "BIG Effort"** - increase motor output, maximally stimulated nervous system so they are maximally engaged

**Stabilize** - repetitions/reinforce/motivate

**Calibrate** - provide feedback as doing exercise/teach self monitoring
Comparing Exercise in Parkinson’s Disease — The Berlin BIG Study (2010, Movement Disorders)
Georg Ebersbach, *Almut Ebersbach, Daniela Edler, Olaf Kaufhold, Matthias Kusch, Andreas Kupsch, and Joerg Wissel

EXERCISE IN PARKINSON'S DISEASE

Allocation
- 20 BIG
- 20 Walk
- 20 Home

Post-intervention
- BIG, HOME: 4 weeks
- Walk: 8 weeks

- 20 completed
- 19 completed, 1 withdrawal of consent
- 19 completed, 1 withdrawn due to psychosis

16 weeks follow-up
- 20 completed
- 19 completed
- 19 completed

FIG. 1. Disposition of patients.
Comparing Exercise in Parkinson’s Disease —
The Berlin LSVT BIG Study (2010, Movement Disorders)
Georg Ebersbach, *Almut Ebersbach, Daniela Edler, Olaf Kaufhold, Matthias Kusch,
Andreas Kupsch, and Jörg Wissel

FIG. 2. UPDRS motor score (blinded rating), mean change from baseline (vertical bars 
5 standard deviations). Change between 
baseline and follow up at week 16 was superior in BIG (interrupted line) compared to 
WALK (dotted line) and HOME (solid line), 
P <0.001. ANCOVA did not disclose significant differences between in intermediate and 
final assessments.
Randomized Comparative Pilot Study

Matched Frequency/Duration
4X/week for 4 weeks; 1-hour individual sessions
N=42
Hoehn & Yahr 1-3

Intention to treat analysis
Walking Improvements

Improvements occurred in both groups and lasted 3 months.

Farley & Koshland, in preparation (Unpublished data)
Trunk Rotation

Only improved for LSVT BIG™
Farley & Koshland, in preparation (Unpublished data)
Conclusions:

- **Activity** Matters

- LSVT BIG™ may be especially important for trunk rotation/balance - everyday movements
LSVT BIG adheres to principle of neuroplasticity

Retrain normal use/forced use
• Single focus to target impaired system

Intensive practice (dosage)
• Total time practiced 16 - 1 hour individual sessions
• Energy expenditure - high effort

Repetition
• Daily task, over learned

Complexity/Challenging
• Progressive hierarchies, carryover assignment/homework, promote continuous use in everyday activities

Feedback/Motivation
• Empower/Reinforce/Instruct
Treatment Session

**Daily Exercises**
1. Floor to Ceiling
2. Side to Side
3. Forward step
4. Sideways step
5. Backward step
6. Forward Rock and Reach
7. Sideways Rock and Reach

**Functional Component Tasks**
5 EVERYDAY TASKS – 5 reps each
For Example:
- Sit-to-Stand "an always"
- Pulling keys out of pocket
- Opening refrigerator door

**Walking BIG** distance/time may vary

**Hierarchy Tasks**
Patient identified tasks:
- Getting out of bed
- Playing golf
- In and out of a car

Build complexity across 4 weeks of treatment towards long term goals
Daily Whole-body Maximal Amplitude Exercises
Multidirectional Sustained Movements
Multidirectional Sustained Movements

Purpose - retraining effort needed for SUSTAINED MUSCLE ACTIVATION

1. Floor to ceiling
2. Side to side
Daily Whole-body Maximal Amplitude Exercises

Multidirectional Repetitive Movements
Step and Reach

Forwards

Sideways

Backwards

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Daily Whole-body Maximal Amplitude Exercises

Multidirectional Repetitive Movements
Rock and Reach

Forward                             Sideways

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Multidirectional Repetitive Movements

Purpose:
• Completeness (stop/start)
• Changing directions
• Endurance
• Balance
• Strength

• Daily Exercises 3 - 7
Functional Component Tasks

Functional Components – Patient DRIVEN!

- Never changes
- Simple movements
- Sit to stand
- Rolling, supine to sit
- Sit & reach
- Stand & reach
- Walk & reach
- Put on shoes, brush hair
- Can be component of larger task

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Functional Components Movements

Purpose:
• Over learn familiar commonly used and salient everyday movements!
• Reminds them of BIG movements at home!
• Encourages compliance and carryover!

Goal is to "hook" or "cue" patients into thinking about their BIG movements and BIG effort in daily living.
BIG Walking

• Should feel awkward at first, if it doesn't, it isn't BIG enough.
• Normalize amplitude, stride length, posture and arm swing overtime
• Do not about which arm to start with, doesn't matter!
• Work towards normal reciprocal gait pattern
• Vary environment, time, distance
• Combine BIG turns, obstacles, dual tasks
Daily Hierarchical Tasks
“Real-World” BIG Tasks – Patient DRIVEN!

- Bed to Bathroom
- In/Out of Car
- Walk and Talk
- Tennis
- Chores
- Golf
- Hiking
- Gardening
Hierarchy task- working towards complex LTGs

- Amplitude rescaling into everyday living!
- Complex multi-step functional activities
- Task Analysis
  - Break it down into manageable sub-tasks
  - Remove complexity and environmental/cognitive distractors
  - Identify the "problem" - where behavior breaks down and why?
- Gradually increase complexity
Carryover Task

- Designed to convince patient movements are WNL outside of therapy and positively impact daily function
- Address sensory problem
  - Specific task with specific feedback
- Functional/feasible/achievable
- Accountability
Protocol - Homework

• 15-20 minutes 1-2x/day
• Daily Exercises 1-7
• 5 Functional Component Tasks
• BIG Walking
• Carryover Task
Patient case: Bernie

• 71 year-old, diagnosed with Parkinson’s disease in 1994

• Reason for referral: slowness and difficulty walking, history of falls, freezing

• Optimized on PD medications

• Hoehn & Yahr 3
Bernie’s Goals

• To improve his walking
• To go to the movies
• To play with his grandchildren
• To go out to dinner with friends and family
## Objective Outcomes:

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<th><strong>PRE</strong></th>
<th><strong>POST</strong></th>
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<td>Falls</td>
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<tr>
<td>Assistive device</td>
<td>Cane</td>
<td>None</td>
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<tr>
<td>Confidence</td>
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<td>Gait Velocity</td>
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<td>% of age matched norm</td>
<td>29.6 %</td>
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<tr>
<td>Endurance</td>
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<td>1200 ft</td>
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Summary

• Advances in neuroscience have provided neurobiological and behavioral evidence supporting the positive impact of exercise-based protocols in people with PD

• There is a rapidly growing literature in physical and speech therapy/exercise protocols in humans with PD

• LSVT Protocols have been developed and studied over the past 20 years

• LSVT BIG and LOUD are one type of physical/speech therapy programs that has potential to offer improvements in movement and quality of life for people with PD
QUESTIONS?