LSVT Global Public Webinar

Title: Expand your Clinical Reach: How to Apply LSVT Treatments Beyond Parkinson's Disease

Panelists: Heather Hodges, MA, CCC-SLP
Laura Gusè, BSPT, MPT

Date Presented: July 20, 2022

Contact Us:
Web: www.lsvtglobal.com Email: info@lsvtglobal.com
Phone: 1-888-438-5788 (toll free), 1-520-867-8838 (direct)

Expand your Clinical Reach:
How to Apply LSVT Treatments Beyond Parkinson's Disease

LSVT GLOBAL Innovation in Science. Integrity in Practice.®

1

Presenters

Heather Hodges
MA, CCC-SLP
LSVT LOUD® Faculty
LSVT Global, Inc.

Laura Gusè, BSPT, MPT
LSVT BIG® Faculty &
Chief Clinical Officer
LSVT Global, Inc.

2

Presenter Biographies

Heather Hodges, MA, CCC-SLP
Ms. Hodges received her master's degree in Speech, Language, and Hearing Sciences from the University of Colorado. She has been part of Dr. Ramig's research team since 2004. Ms. Hodges is a consultant, expert clinician, training and certification faculty and CE Administrator with LSVT Global. She also enjoys her role within LSVT Global collaborating and presenting on Google's Project Euphonia, which aims to improve voice recognition software for those with dysarthria and dysphonia. In addition to specializing in neurogenic voice and speech disorders, Ms. Hodges worked for 13 years at an outpatient hospital specializing in diagnosing and treating dysphagia, dysphonia, and upper airway disorders. She has presented nationally and internationally on LSVT LOUD, Parkinson's disease, PVFM/VCD, cough, and dysphagia. Ms. Hodges has published articles and a book chapter on speech treatments for upper airway disorders. Educating others on the diagnosing and treatment of upper airway disorders remains a focus and passion for her.

Laura Gusè, BSPT, MPT
Ms. Gusé has extensive experience treating people with neurodegenerative disorders in various practice settings. She was LSVT BIG certified in 2009 and now serves as Chief Clinical Officer of LSVT BIG. Ms. Guse' oversees the training, curriculum and product development related to LSVT BIG, and has helped to create many of the current LSVT BIG treatment tools, webinars, and courses. She has spoken at many national and international conferences on topics related to LSVT BIG.

3

Disclosures

- All LSVT faculty have both financial and non-financial relationships with LSVT Global.
- Non-financial relationships include a preference for LSVT LOUD and LSVT BIG as treatment techniques.
- Financial Relationships include:
  - Ms. Hodges is a consultant for LSVT Global and receives lecture honorarium. Ms. Gusé is an employee of and receives lecture honorarium from LSVT Global, Inc.

4

Webinar Logistics

- Microphones muted
- How to ask questions
- Handouts
- Survey
- Continuing Education Units (CEUs)

5

Information to Self-Report CE Activity

- This LSVT Global webinar is NOT ASHA or state registered for CEUs for speech, physical and occupational therapy professionals, but it may be used for self-reported CEU credit as a non-registered/non-preapproved CEU activity.
- If you are a speech, physical, or occupational therapy professional and would like to self-report your activity, e-mail webinars@lsvtglobal.com to request a certificate after completion of the webinar which will include your name, date and duration of the webinar.
- Licensing requirements for CEUs differ by state. Check with your state PT, OT or Speech licensing board to determine if your state accepts non-ASHA registered or non pre-approved CEU activities.
- Attendance for the full hour is required to earn a certificate.

6

Learning Objectives

Upon conclusion of this webinar, participants will be able to:

- Explain the rationale for using LSVT LOUD and LSVT BIG in conditions beyond Parkinson disease.
- Describe six non-PD diagnoses in adults and children where LSVT LOUD and/or LSVT BIG has been used.
- Discuss the outcomes of effectiveness, as self-rated by LSVT therapists in non-PD conditions and challenges associated with applying this treatment beyond PD.
- Outline the process of decision making when applying LSVT LOUD or LSVT BIG beyond PD.

7

Up to 1 billion people globally are living with a neurological disorder.

World Health Organization Report 2007

Parkinson's disease 10+ million	Stroke 101.5 million	Alzheimers and dementias 24.3 million	Atypical Parkinsonisms over 3 million
Multiple Sclerosis 2.8 million	Cerebral Palsy 17 million	Down Syndrome 250,000 (USA)	

Statistics. Parkinson's Foundation.; 2021 Heart Disease & Stroke Statistical Update Fact Sheet Global Burden of Disease; Ferri et al., 2005; Levin et al., 2016; Walton et al., 2020; Alliance, C. P. Facts about cerebral palsy. Cerebral Palsy Alliance; Presson et al., 2013; World Health Organization. Neurological disorders affect millions globally: Who report 2007.

8

Negative Impact of Dysarthria on Communication

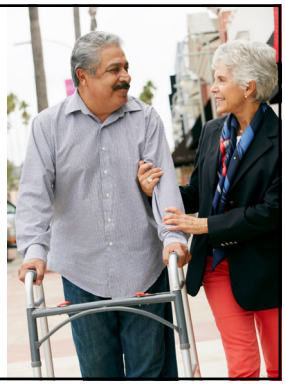
- Decreased intelligibility
- Decreased naturalness
- Encounter negative attitudes or discrimination
- Diminished engagement in communication
- Non-motor symptoms
- Complex – challenging to treat

Dickson et al., 2008. Walshe et al., 2009

9

Negative Impact of Neural Impairment or Aging on Mobility & ADLs

- Balance problems
- Gait and mobility challenges at home and in the community
- Difficulty dressing, feeding, bathing and other ADLs/IADLs
- Fear of falling, falls
- Reduced activity, deconditioning
- Complex – challenging to treat

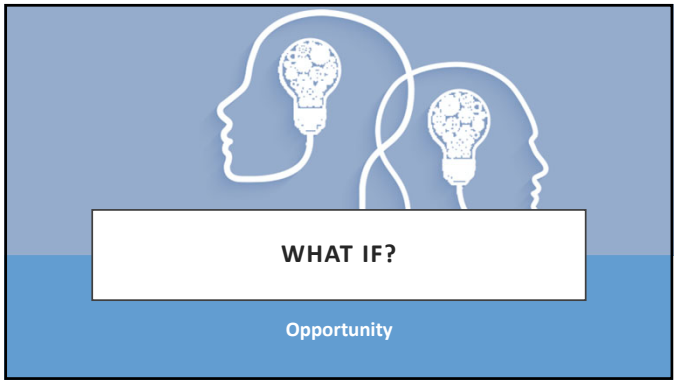


10

Treatment Options

- Restore or improve function
- Promote the use of residual function (compensatory strategies)
- Maximize the external environment for communication and movement
- Incorporate assistive devices for communication and movement

11



12

LSVT Protocols: Speech, Physical and Occupational Therapies Developed for People with Parkinson's Disease

LSVT LOUD - speech therapy

LSVT BIG - occupational or physical therapy

Delivered by LSVT Certified therapists

LSVT = Lee Silverman Voice Treatment

13

Why LSVT LOUD and LSVT BIG Beyond PD?

Established Treatment Approach → LSVT Protocols (30+ years research)

Applied to a different population → Phase 4 research

- LSVT focuses on restoring residual function in damaged or degenerative conditions
- LSVT may help facilitate motor control for communication, gait, and activities of daily living in neurodevelopmental diagnoses

14

Incorporates:

- Principles of neuroplasticity
- Motor learning techniques
- Extrinsic feedback provided via LSVT teaching techniques

Promotes:

- Intrinsic feedback using calibration to help patients "re-set" their internal motor program
- Generalizability to other activities outside of treatment

15

Key Concepts of LSVT LOUD and LSVT BIG Apply to a Range of Neurological Disorders

TARGET: Amplitude (LOUD or BIG)

MODE: Intensive and High Effort

CALIBRATION: Addresses barriers to generalization outside of treatment room

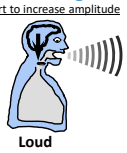
Ramig, 1992; Dromey, Ramig, Johnson, 1995; Sapir et al., 2003; 2007; Fox et al., 2002; Fox et al., 2012

16

TARGET – Amplitude (Loud or Bigness)

Voice too soft/movements too small

Drive effort to increase amplitude



Healthy Vocal Loudness

Single Target - Triggers Activation across motor systems

Healthy Amplitude

Berardelli et al, 1986; Hallett, 2011

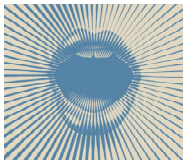
17

Amplitude – Size of Control

In LSVT LOUD and LSVT BIG, the target of amplitude is sometimes to learn control of movement vs. overriding soft voice/small movement

Training stability of normal loudness and bigness or improving strength is the goal:

- Ataxic movements
- Hyperkinetic movements (S/P DBS)
- Impulsivity
- Hyperfunction (voice)
- Weakness



18

Voice as a Source by Dysarthria Type

Dysarthria Type	Example Populations	Voice Component (Voice as "Point of entry")	Rationale for LSVT LOUD
Hypokinetic	Parkinson's disease	Reduced loudness, breathy or hoarse vocal quality, monoloudness	Increase amplitude of output, improve vocal quality
Spastic	Cerebral Palsy, stroke, TBI, tumor, encephalitis	Strain/strangled vocal quality, breathy voice quality, reduced loudness	Improve vocal quality, control over voice
Ataxic	Cerebellar ataxia, Friedrich's ataxia, stroke, TBI - cerebellum, surgical trauma	Variations in loudness (too soft/too loud), harsh vocal quality	Control of vocal loudness, improve vocal quality, stability in vocalization
Flaccid	Down syndrome, stroke, TBI, tumor, surgical trauma	Breathiness, reduced vocal loudness	Improve vocal quality
Hyperkinetic	Chorea, Huntington's disease	Harsh, strained/strangled vocal quality, excess loudness variations	Improve vocal quality, control over voice
Mixed	Multiple Sclerosis, Progressive Supranuclear Palsy, Multi-System Atrophy	Characteristics of multiple dysarthria types	Varies depending on dysarthria types present

19

SLP shapes and models normal LOUDNESS with healthy vocal quality, which can also impact…

Voice as a Trigger

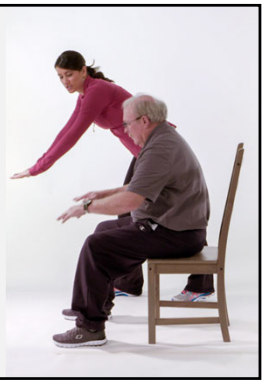
- Deep breath
- Open mouth
- Intonation
- Improved articulation
- Reduced rate
- Naturalness
- And more!

Mahler et al., 2015; Huber et al., 2003; Spielman et al, 2003; El Sharkawi et al., 2002,Sapir et al., 2003; Sapir et al., 2007

20

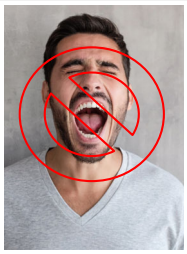
PT and OT shape and model normal BIGNESS with good quality, which can also impact…

- Balance
- Gait
- Endurance
- Posture
- Safety
- Confidence
- Independence with mobility and ADLs
- And more!



21

- Cueing increased loudness does NOT mean you are teaching clients to talk "too loud".
- Cueing increase bigness does NOT mean you are training clients to use exaggerated movements.
- Loudness or bigness is what the client *may feel* in order to have voice or movement that is **WITHIN NORMAL LIMITS**.
- **You are training healthy vocal loudness or health movement amplitude**.



Countryman et al., 1997; Smith et al., 1995; Fox & Boliek, 2012

22

Mode of delivery: Intensive and High Effort

- Important for both healthy and disordered motor systems
- Key to effecting behavioral changes that last over time
- Applicable for adults and children
- Consistent with principles that drive activity-dependent neuroplasticity

23

Goal in therapy: incorporate multiple principles that drive neuroplasticity

- Intensity
- Complexity
- Repetition
- Salience
- Timing
- Specificity

Alexander et al., 1990; Fox et al., 2002; Graybiel 1998; Kleim et al., 2003; Kleim and Jones, 2005; Joneset al. 1999; Saint-Cyr JA, 2003; Tillerson et al., 2002; Vergara-Aragon et al., 2003; Black et al. 1990; Comery 1995; Fisher et al, 2004; Kleim et al., 2002; 1996; Perez et al. 2004; Pisani et al., 2005 Plautz et al., 2000

24

Plasticity principles also apply to children

Plasticity occurs when treatments incorporate:

- Intensive task repetitions
- Progressive challenges to the learner with increasing difficulty
- Presence of motivators and rewards (internally driven)
- Active participation
- Skill acquisition of a functional goal
- Practice must be structured

Shertz & Gordon, 2008

25

MODE – Intensive & High Effort

LSVT LOUD → **LSVT BIG**

Delivery LSVT LOUD

- Certified LSVT LOUD Speech Therapists
  - 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)

Delivery LSVT BIG

- Certified LSVT BIG Physical and Occupational Therapists
  - 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)

26

Calibration in Treatment

Parkinson's Disease	Other Neurological Conditions

• Sensory mismatch
• Problem with internal cueing
• Subtle neuropsychological changes
  • Slower thinking
  • Slower learning
  • Problems shifting cognitive set
	• Sensory disorders
	• Effort required for improved speech or movement
	• Social stigma
	• Cognitive challenges
	  • Language deficits
	  • Difficulty with attention, memory, reasoning, decision making

27

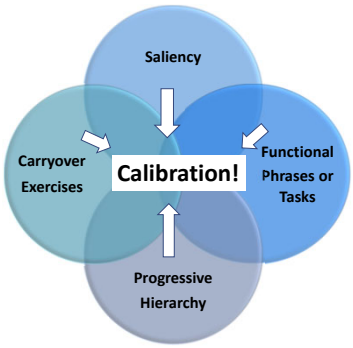
Link to Function and Task Specific Practice Personalized to Each Client is VITAL for Generalization as part of calibration

- Incorporate tasks that are meaningful and salient to person – enhances motivation
- Link program to functional goals
- Hobbies and passions should be incorporated and used to achieve self-realization and improved communication, movement, gait and ADLs

28

Focus on Function in LSVT LOUD and LSVT BIG

Goal: PERSON automatically uses improved voice or movement in daily living and the improvements last over time.



29

The treatment dosage and framework are not changed or modified when delivered beyond PD

LSVT IS LSVT IS LSVT

- LSVT LOUD and LSVT BIG are delivered per protocol
- You do not take "parts" of LSVT LOUD or LSVT BIG and apply them beyond PD; do the entire treatment or none at all
- Core fundamentals of intensity, complexity, repetition, task specificity and saliency apply beyond PD

30

What is the research on the use of LSVT LOUD and LSVT BIG with conditions other than PD?

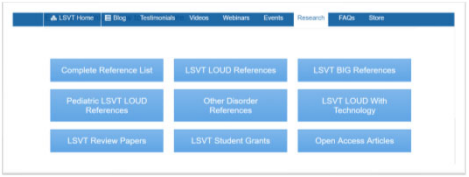
- Parkinson Plus (Countryman et al., 1994)
- Post Surgery, Fetal cell (Countryman, et al., 1993)
- Stroke (Fox et al., 2002; Mahler et al., 2009; Mahler et al., 2012; Proffitt et al., 2018, Metcalfe et al., 2019; Proffitt et al., 2021)
- Idiopathic Normal Pressure Hydrocephalus (Fillmore et al., 2020)
- Multiple Sclerosis (Sapir et al., 2001; Crispiatico et al., 2021)
- Ataxia (Sapir et al., 2003)
- Cerebral palsy (Fox et al., 2012; Boliek et al., 2014; McInerney et al., 2021; Moya-Galé et al., 2021; Ertan et al., 2021)
- Down Syndrome (Boliek et al., 2016; Petska et al., 2006; Mahler et al., 2012; Boliek et al., 2021)
- Aging (Ramig et al., 2001)
- Autism Spectrum Disorder (Galgano et al., 2021)

(Single-subject, case study and small group designs. LSVT LOUD studies in black. LSVT BIG studies in blue.)

31

LSVT References

https://blog.lsvtglobal.com/research/



32

The real-world clinical use of LSVT LOUD in non-Parkinson's conditions

- 13 question online survey sent to LSVT LOUD speech therapists in 6 English speaking countries
- 248 speech therapists representing all six countries responded
- Respondents:
  - 95% professionals
  - 5% students

33

LSVT LOUD

94% of respondents reported providing LSVT LOUD to clients with PD

Beyond PD, 75% of therapists reported using this treatment with adults with non-PD diagnoses

15% of the therapists reported using LSVT LOUD with children

34

Survey Results from LSVT LOUD Clinicians

LSVT LOUD Speech Therapy

	Usage	Effectiveness*
Movement Disorders		
Progressive Supranuclear Palsy	30%	75%
Multi-System Atrophy	24%	79%
Lewy Body Dementia	19%	81%
Ataxia	14%	88%
Other Disorders		
Stroke	34%	96%
Multiple Sclerosis	19%	89%
Vocal Fold Paralysis	20%	92%
Aging Voice	17%	91%

LSVT LOUD Speech Therapy

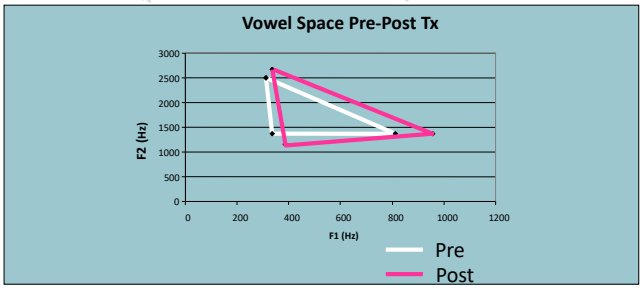
	Usage	Effectiveness*
Children		
Cerebral Palsy	7%	100%
Down Syndrome	5%	100%
Vocal Fold Paralysis/Paresis	2%	80%
Developmental Disorders	2%	50%

*Combined ratings of Very Effective and Somewhat Effective

35

Ataxic Dysarthria – Audio Sample

Pre Post

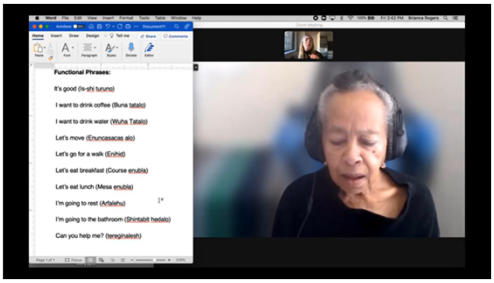


Sapir et al., 2003

36

37

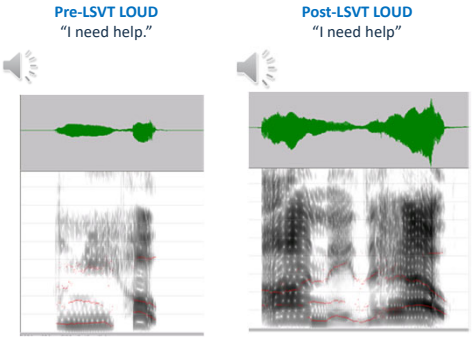
s/p CVA: WEEK 2 LSVT LOUD



38

Phrase Level Play: Countdown to Liftoff

39



40

The real-world clinical use of LSVT BIG in non-Parkinson's conditions

- 13 question online survey sent to LSVT BIG physical and occupational therapists in 6 English speaking countries
- 541 therapists responded
- Respondents:
  - 97% professionals
  - 3% students

41

Survey Results from LSVT BIG Clinicians

Movement Disorder	Usage	Effectiveness
Secondary PD	26%	91%
Lewy Body Dementia	26%	70%
Progressive Supranuclear Palsy	20%	73%
Other Disorder	**Usage**	**Effectiveness**
Stroke	40%	86%
Aging Balance	36%	94%
Multiple Sclerosis	17%	82%

42

Summary of Evidence (Stroke)

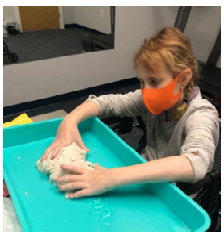
	Proffitt et al. (2018)	Metcalfe et al. 2019	Proffit et al. (2021)
Design Participants	Mixed Methods Case Study 1	Single-Case Experimental Design 2	Randomized, wait-list, cross-over pilot feasibility trail 5
Data Points	Pre; Post; 6-week follow-up	Baseline; intervention; post	Baseline; after 4 weeks; after cross-over
Outcomes	COPM WMFT PASS SS-QOL Tone (MAS) ROM MMT	COPM REACH PQRS-OD CAHAI	Feasibility and Acceptability COPM WMFT PASS NIH PROMIS-43 Active ROM Tone (MAS)
Results	COPM - (1.7 for performance and 2.7 for satisfaction) 45% decrease in WMFT time Elbow flexor tone reduced	Increase performance in trained and untrained goals Improved CAHAI [not clinically significant]	4 of 5 participants rated performance and satisfaction of COPM higher Average task time on WOLF decreased Improved PASS scores PROMIS-43 changes

43

44

Clinical Pediatric Case Example

- 10-year-old female
- Diagnosed with Anaplastic Ependymoma grade 3 brain cancer 5 years prior
- Tumor extended from 4th ventricle into cerebellum
- History of 3 open brain surgeries for tumor removal
- 50 doses of targeted radiation



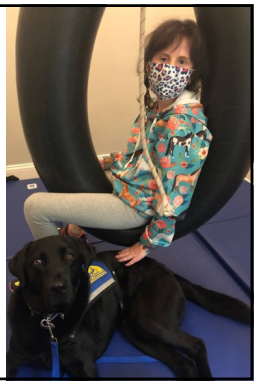
45

Why LSVT BIG?

Traditional therapies had improved strength and ROM, but limited improvements to functional independence or gait independence.

Treatment Parameters

- Pre-assessment
- 4 sessions per week x 4 weeks
- LSVT BIG exercises conducted twice daily
- High parent buy in
- Post-assessment



46

Pre/Post LSVT BIG

30 Second Sit to Stand

15 times *(6 times at eval)*

47

Post LSVT BIG

6 Minute Walk Test using AD-1007 feet
(25.9% improvement from 800 feet at eval)

Bruininks-Oseretsky Test of Motor Development (BOT-2) Scores - 5th percentile for Body Coordination and Strength and Agility *(improved from 1st percentile at eval)*

Single Leg Stance: R:L 3:4 sec *(0 sec at eval)*

Tandem Stance R:L 14:17 sec *(0 sec at eval)*

Gait - Using an anterior ETAC Walker only for long distance ambulation or uneven surfaces

48

Decision Making Process for Applying LSVT LOUD or LSVT BIG Beyond PD

- LSVT LOUD and LSVT BIG are **not** for everyone – It is another tool in the toolbox!
- Medical diagnosis consideration, stimulability testing results, clinical judgment and client/family discussions should guide the decision to progress with treatment or not

49

How to determine if LSVT LOUD or LSVT BIG are appropriate for other disorders?

- Evaluate the clinical diagnosis and rationale for focusing on improving voice or movement.
- Determine if there are medical contraindications (e.g. ALS, myasthenia gravis) by consulting with the patient's medical team.*
- If there is a good clinical rationale, based on the physiology of the communication or movement disorder, then and LSVT Certified therapists can evaluate and do stimulability testing.
- If stimulability testing is successful, LSVT Certified Clinician can do a one-week trial treatment. Assess and proceed accordingly.

50

After a Trial Week of LSVT LOUD or LSVT BIG Treatment

- Can the client understand and approximate instructions?
- Does the client show signs of motivation and engagement?
- Is there compliance with homework and carryover exercises?
- Do you hear or see changes?

51

Give everyone a chance!

Don't discount successful treatment options just because a condition is severe, advanced or complex

The outcomes can be very impressive and greatly improve quality of life for client and family

52

Summary

There is a solid rationale for applying LSVT LOUD & LSVT BIG to conditions with disordered speech beyond Parkinson's

Research evidence exists for select populations (case studies, single-subject designs and small group designs)

The effectiveness, as self-rated by treating therapists, of LSVT LOUD & LSVT BIG in non-PD conditions has been quite high for the conditions reported here

Use stimulability testing, trial treatment and clinical expertise to determine appropriate clients

53

How to ask questions

1. Type in the question box on your control panel
2. Raise your hand! (click on the hand icon in your control panel)
3. Email info@lsvtglobal.com

54

Bonus webinar for PTs and OTs in August!

Let's get moving! Increase your activity level safely with uniquely designed mobility products

Representatives from the U-Step Neuro Walker and Urban Poling will demonstrate how their innovative walking devices, the U-Step Neuro Walker and Activator Walking Poles, are designed to prevent falls, increase mobility and function, and improve participation in life's activities.

Date: Wednesday, August 10, 2022

Time: 2:00 PM – 3:15 PM Eastern Daylight Time (EDT)

Register at https://blog.lsvtglobal.com/events/
Scroll down to August events

55

Join us in September!

Everything you need to know about LSVT LOUD® and LSVT BIG®: A guide for people with PD and those who support them!

Tune in for a general overview of the treatments, recommendations on how to help facilitate homework and carryover exercises outside of the treatment sessions, and suggestions for motivation and encouragement.

Date: Wednesday, September 21, 2022

Time: 2:00 PM - 3:00 PM Eastern Daylight Time (EDT)

Intended Audience: Individuals with PD and their caregivers

Register at https://blog.lsvtglobal.com/events/
Scroll down to September events

56

LSVT Training and Certification Opportunities

GET LSVT CERTIFIED

https://www.lsvtglobal.com/

- LSVT LOUD is open to SLPs, SLPAs and SLP Grad Students and Fellows
- LSVT BIG is open to PTs, PTAs, OTs, OTAs and students in those professions
- **Online and Virtual Live Training Options**
  1. Online (self-paced, asynchronous); 60-day course access
  2. Virtual Live (blend of 3 -4 hours asynchronous + 2 days live instruction and practice via Zoom)
- Virtual Live 2-hour practice lab now offered quarterly for recently certified clinicians
- ****NEW** LSVT LOUD for Kids Course**!
  - ❖Virtual Live on October 21-22, 2022

57

Thank you!

info@lsvtglobal.com
www.lsvtglobal.com

Please complete the survey that will display on your screen after you exit the webinar.
It will take five minutes or less to complete!

58

References for Expand your Clinical Reach: How to Apply LSVT Treatments Beyond Parkinson's Disease

July 20, 2022

- 2021 heart disease and stroke statistical update fact sheet: Global ... (n.d.). Retrieved July 19, 2022, from https://professional.heart.org/-/media/phd-files-2/science-news/2/2021-heart-and-stroke-stat-update/2021_stat_update_factsheet_global_burden_of_disease.pdf?la=en
- Alexander, G. E., & Crutcher, M. D. (1990). Functional architecture of basal ganglia circuits: Neural substrates of parallel processing. Trends in Neurosciences, 13(7), 266-271. https://doi.org/10.1016/0166-2236(90)90107-l
- Alliance, C. P. (n.d.). Facts about cerebral palsy. Cerebral Palsy Alliance. Retrieved July 19, 2022, from https://cerebralpalsy.org.au/our-research/about-cerebral-palsy/what-is-cerebral-palsy/facts-about-cerebral-palsy/
- Bakhtiari, R., Cummine, J., Reed, A., Fox, C.M., Chouinard, B., Cribben, I., Boliek, C.A. (2017) Changes in brain activity following intensive voice treatment in children with cerebral palsy. *Human Brain Mapping*, *38(9):* 4413-4429. doi: 10.1002/hbm.23669.
- Baldanzi, C., Crispiatico, V., Foresti, S., Groppo, E., Rovaris, M., Cattaneo, D., & Vitali, C. (2020). Effects of Intensive Voice Treatment (The Lee Silverman Voice Treatment [LSVT LOUD]) in Subjects with Multiple Sclerosis**:** A Pilot Study. *Journal of voice : official journal of the Voice Foundation*, S0892-1997(20)30275-7. Advance online publication. https://doi.org/10.1016/j.jvoice.2020.07.025
- Black, J. E., Isaacs, K. R., Anderson, B. J., Alcantara, A. A., & Greenough, W. T. (1990). Learning causes synaptogenesis, whereas motor activity causes angiogenesis, in cerebellar cortex of adult rats. Proceedings of the National Academy of Sciences of the USA, 87(14), 5568–5572. https://doi.org/10.1073/pnas.87.14.5568Boliek et al., 2016 (Down syndrome)
- Boliek, C. A., Halpern, A., Hernandez, K., Fox, C. M., & Ramig, L. (2022). Intensive Voice Treatment (Lee Silverman Voice Treatment [LSVT LOUD]) for Children With Down Syndrome: Phase I Outcomes. *Journal of speech, language, and hearing research : JSLHR*, *65*(4), 1228–1262. https://doi.org/10.1044/2021_JSLHR-21-00228
- Boliek, C.A. & Fox, C.M. (2014). Individual and environmental contributions to treatment outcomes following a neuroplasticity-principled speech treatment (LSVT LOUD) in children with dysarthria secondary to cerebral palsy: a case study review. *International Journal of Speech-Language Pathology, 16(4*): 372–385.
- Boliek, C.A. & Fox, C.M. (2016). Therapeutic Effects of Intensive Voice Treatment (LSVT LOUD®) for Children with Spastic Cerebral Palsy and Dysarthria: A Phase I Treatment Validation Study. *International Journal of Speech-Language Pathology*, Oct 5:1-15. DOI:10.1080/17549507.2016.1221451
- Boliek, C.A., Fox, C.M., Norton, J., Gan, L., Archibald, E., Knuttila, E., Rosborough, C., & L'Abbe, A. (2009). Changes in trunk muscle activation and respiratory kinematics during speech following

Intensive voice treatment (LSVT LOUD) for children with spastic cerebral palsy. *Movement Disorders, 24*, S450.

- Comery, T. A., Shah, R., & Greenough, W. T. (1995). Differential rearing alters spine density on mediumsized spiny neurons in the rat corpus striatum: Evidence for association of morphological plasticity with early response gene expression. Neurobiology of Learning and Memory, 63(3), 217-219. https://doi.org/10.1006/nlme.1995.1025
- Countryman, S., Hicks, J., Ramig, L., & Smith, M. (1997). Supraglottal hyperadduction in an individual with Parkinson disease: A clinical treatment note. *American Journal of Speech-Language Pathology, 6*(4), 74–84. https://doi.org/10.1044/1058-0360.0604.74
- Countryman, S., & Ramig, L. (1993). Effects of intensive voice therapy on voice deficits associated with bilateral thalamotomy in Parkinson's disease: A case study. Journal of Medical Speech-Language Pathology, 1, 233–250.
- Countryman, S., Ramig, L., & Pawlas, A. (1994). Speech and voice deficits in Parkinsonian plus syndromes: Can they be treated? *Journal of Medical Speech-Language Pathology, 2*(3), 211-225.
- Crispiatico, V., Baldanzi, C., Napoletano, A., Tomasoni, L., Tedeschi, F., Groppo, E., Rovaris, M., Vitali, C., & Cattaneo, D. (2022). Effects of voice rehabilitation in people with MS: A double-blinded long-term randomized controlled trial. Multiple Sclerosis Journal, 28(7), 1081–1090. https://doi.org/10.1177/13524585211051059
- Dickson, S., Barbour, R.S., Brady, M., Clark, A.M, & Paton, G. (2008) International Journal of Language and Communication Disorders, 2, 135-153.
- Dromey, C., Ramig, L., & Johnson, A. B. (1995). Phonatory and articulatory changes associated with increased vocal intensity in Parkinson disease: A case study. Journal of Speech and Hearing Research, 38(4), 751–764. https://doi.org/10.1044/jshr.3804.751
- El Sharkawi, A., Ramig, L., Logemann, J. A., Pauloski, B. R., Rademaker, A. W., Smith, C. H., Pawlas, A., Baum, S., & Werner, C. (2002). Swallowing and voice effects of Lee Silverman Voice Treatment: A pilot study. Journal of Neurology, Neurosurgery, and Psychiatry, 72(1), 31-36. https://doi.org/10.1136/jnnp.72.1.31 Ertan et al., 2021 (Cerebral Palsy)
- Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., Hall, K., Hasegawa, K., Hendrie, H., Huang, Y., Jorm, A., Mathers, C., Menezes, P. R., Rimmer, E., Scazufca, M., & Alzheimer's Disease International (2005). Global prevalence of dementia: a Delphi consensus study. Lancet (London, England), 366(9503), 2112–2117. https://doi.org/10.1016/S0140-6736(05)67889-0
- Fillmore, S., Cavalier, G., Franke, H., Hajec, M., Thomas, A., & Moriello, G. (2020) Outcomes following LSVT BIG in a person with normal pressure hydrocephalus: A case report. Journal of Neurologic Physical Therapy, 44(3), 220-227. https://doi.org/10.1097/NPT.0000000000000319 Fisher et al, 2004
- Fox, C. M., Morrison, C. E., Ramig, L. O., & Sapir, S. (2002). Current perspectives on the Lee Silverman Voice Treatment (LSVT) for individuals with idiopathic Parkinson disease. American

Journal of SpeechLanguage Pathology, 11(2), 111-123. https://doi.org/10.1044/1058-0360(2002/012) Fox, C.M., & Boliek, C.A. (2012). Intensive voice treatment (LSVT LOUD) for children with spastic cerebral palsy and dysarthria. *Journal of Speech Language Hearing Research, 55*, 930-945.

- Fox, C.M., Boliek C.A. (2015). Technology-enhanced maintenance practice following intensive voice therapy (LSVT LOUD) in children with cerebral palsy and dysarthria. Movement Disorders, Vol. 30, Suppl 1, p. S205.
- Fox, C.M., Boliek, C.A., & Ramig, L. (2005). The impact of intensive voice treatment (LSVT) on speech intelligibility in children with spastic cerebral palsy. *Movement Disorders*, *20*(10), S149.
- Fox, C.M., Boliek, C.A., Namdaran, N., Nickerson, C., Gardner, B., Piccott, C., Histad, J., & Archibald, T. (2008). Intensive voice treatment (LSVT) for children with spastic cerebral palsy. *Movement Disorders*, *23*, S378.
- Galgano, J., Tsang, G., Ramig, L. (2021). Brief Report: Making Intensive Voice Treatment (LSVT LOUD®) accessible for a child with Autism Spectrum Disorder (ASD) and mixed dysarthria using a novel, pre-treatment protocol. *JSM Communication Disorders* 4(1): 1013, 1-7. https://www.jscimedcentral.com/CommunicationDisorders/communicationdisorders-4-1013.pdf
- Graybiel, A. M. (1998). The basal ganglia and chunking of action repertoires. Neurobiology of Learning and Memory, 70(1-2), 119-136. https://doi.org/10.1006/nlme.1998.3843 Huber et al., 2003
- Jones, T. A., Chu, C. J., Grande, L. A., & Gregory, A. D. (1999). Motor skills training enhances lesioninduced structural plasticity in the motor cortex of adult rats. Journal of Neuroscience, 19(22), 10153- 10163. https://dx.doi.org/10.1523%2FJNEUROSCI.19-22-10153.1999 Kleim and Jones, 2005
- Kleim, J. A., Lussnig, E., Schwarz, E. R., Comery, T. A., & Greenough, W. T. (1996). Synaptogenesis and Fos expression in the motor cortex of the adult rat after motor skill learning. Journal of Neuroscience, 16(14), 4529-4535. https://dx.doi.org/10.1523%2FJNEUROSCI.16-14-04529.1996
- Kleim, J. A., Barbay, S., Cooper, N. R., Hogg, T. M., Reidel, C. N., Remple, M. S., & Nudo, R. J. (2002). Motor learning-dependent synaptogenesis is localized to functionally reorganized motor cortex. Neurobiology of learning and memory, 77(1), 63–77. https://doi.org/10.1006/nlme.2000.4004
- Kleim, J. A., Jones, T. A., & Schallert, T. (2003). Motor enrichment and the induction of plasticity before or after brain injury. Neurochemical Research, 28(11), 1757-1769. https://doi.org/10.1023/a:1026025408742 Langlois, C., Tucker, B. V., Sawatzky, A. N., Reed, A., & Boliek, C. A. (2020). Effects of an intensive voice treatment on articulatory function and speech intelligibility in children with motor speech disorders: A phase one study. *Journal of communication disorders*, *86*, 106003. https://doi.org/10.1016/j.jcomdis.2020.106003

- Levin, J., Kurz, A., Arzberger, T., Giese, A., & Höglinger, G. U. (2016). The Differential Diagnosis and Treatment of Atypical Parkinsonism. *Deutsches Arzteblatt international*, *113*(5), 61–69. https://doi.org/10.3238/arztebl.2016.0061
- Levy, E. S., Ramig, L. O., & Camarata, S. M. (2013). The effects of two speech interventions on speech function in pediatric dysarthria. *Journal of Medical Speech-Language Pathology, 20*(4). 82-27.
- Levy, E.S. (2014). Implementing two treatment approaches to childhood dysarthria. *International Journal of Speech-Language Pathology. 16(4):344-54*.
- Lowit, A., Egan, A. & Hadjivassiliou, M. (2020) Feasibility and Acceptability of Lee Silverman Voice Treatment in **Progressive Ataxias**. *Cerebellum*. https://doi.org/10.1007/s12311-020-01153-3
- Lu, F. L., Presley, S., & Lammers, B. (2013). Efficacy of intensive phonatory-respiratory treatment (LSVT) for presbyphonia: Two case reports. *Journal of Voice, 27*(6), 11-23. https://doi.org/10.1016/j.jvoice.2013.06.006
- Mahler, L., & Ramig, L. O. (2012). Intensive treatment of dysarthria secondary to stroke. *Clinical Linguistics and Phonetics, 26*(8)*,* 681–694*.* https://doi.org/10.3109/02699206.2012.696173
- Mahler, L., & Jones, H. N. (2012). Intensive treatment of dysarthria in two adults with Down syndrome. *Developmental Neurorehabilitation, 15*(1)*,* 44–53*.* https://doi.org/10.3109/17518423.2011.632784
- Mahler, L. A., Ramig, L. O., & Fox, C. (2015). Evidence-based treatment of voice and speech disorders in Parkinson disease. *Current Opinion in Otolaryngology & Head and Neck Surgery*, *23*(3), 209–215. https://doi.org/10.1097/moo.0000000000000151
- Mahler, L., & Ramig, L. O. (2012). Intensive treatment of dysarthria secondary to stroke. *Clinical Linguistics and Phonetics, 26*(8)*,* 681-694*.* https://doi.org/10.3109/02699206.2012.696173
- Mahler, L., Ramig, L., & Fox, C. (2009). Intensive voice treatment (LSVT LOUD) for dysarthria secondary to stroke. *Journal of Medical Speech-Language Pathology, 17*(4), 165-182.
- McInerney, M., Imms, C., Carding, P. N., & Reddihough, D. S. (2021). Evaluation of an intensive voice treatment to reduce anterior drooling in children with cerebral palsy: Protocol for a concurrent multiple-baseline, single case experimental design study. Contemporary clinical trials communications, 24, 100872. https://doi.org/10.1016/j.conctc.2021.100872
- Metcalfe, V., Egan, M., & Sauve-Schenk, K. (2019). LSVT BIG in late stroke rehabilitation: A single-case experimental design study. Canadian Journal of Occupational Therapy, 86(2), 87-94. https://doi.org/10.1177%2F0008417419832951
- Moya-Galé, G., Galgano, J., Ferrone, C., Chang, Y. M., & Ramig, L. A. (2021). LSVT LOUD® Applied to an Adult with Cerebral Palsy: Acoustic Findings. Communication Disorders Quarterly. https://doi.org/10.1177/1525740121993802
- Nozaki, S., Fujiu-Kurachi, M., Tanimura, T., Ishizuka, K., Miyata, E., Sugishita, S., Imai, T., Nishiguchi, M., Furuta, M., & Yorifuji, S. (2021). Effects of Lee Silverman Voice Treatment (LSVT

LOUD) on Swallowing in Patients with **Progressive Supranuclear Palsy:** A Pilot Study. *Progress in rehabilitation medicine*, *6*, 20210012. https://doi.org/10.2490/prm.20210012

- Perez, M. A., Lungholt, B. K., Nyborg, K., & Nielsen, J. B. (2004). Motor skill training induces changes in the excitability of the leg cortical area in healthy humans. Experimental Brain Research, 159(2), 197-205. https://doi.org/10.1007/s00221-004-1947-5
- Petska et al., 2006 (Down syndrome)
- Pisani, A., Centonze, D., Bernardi, G., & Calabresi, P. (2005). Striatal synaptic plasticity: Implications for motor learning and Parkinson's disease. Movement Disorders, 20(4), 395-402. https://doi.org/10.1002/mds.20394
- Plautz, E. J., Milliken G. W., & Nudo R. J. (2000). Effects of repetitive motor training on movement representations in adult squirrel monkeys: Role of use versus learning. Neurobiology of Learning and Memory, 74(1), 27-55. https://doi.org/10.1006/nlme.1999.3934
- Presson, A. P., Partyka, G., Jensen, K. M., Devine, O. J., Rasmussen, S. A., McCabe, L. L., & McCabe, E. R. (2013). Current estimate of Down Syndrome population prevalence in the United States. The Journal of pediatrics, 163(4), 1163–1168. https://doi.org/10.1016/j.jpeds.2013.06.013
- Proffitt, R. M., Henderson, W., Scholl, S., & Nettleton, M. (2018). Lee Silverman Voice Treatment BIG® for a person with stroke. American Journal of Occupational Therapy, 72(5), 7205210010p1-7205210010p6. https://doi.org/10.5014/ajot.2018.028217
- Proffitt, R., Henderson, W., Stupps, M., Binder, L., Irlmeier, B., & Knapp, E. (2021). Feasibility of the Lee Silverman Voice Treatment-BIG Intervention in Stroke. OTJR : occupation, participation and health, 41(1), 40–46. https://doi.org/10.1177/1539449220932908
- Ramig, L. O., Sapir, S., Countryman, S., Pawlas, A. A., O'Brien, C., Hoehn, M., & Thompson, L. (2001a). Intensive voice treatment (LSVT) for patients with Parkinson's disease: A 2 year follow up. Journal of Neurology, Neurosurgery, and Psychiatry, 71(4), 493-498. https://doi.org/10.1136/jnnp.71.4.493
- Ramig, L. (1992). The role of phonation in speech intelligibility: A review and preliminary data from patients with Parkinson's disease. In R. D. Kent (Ed.), *Intelligibility in speech disorders: Theory, measurement, and management* (pp. 119–156). John Benjamin. https://doi.org/10.1075/sspcl.1.05ram
- Ramig, L., Gray, S., Baker, K., Corbin-Lewis, K., Buder, E., Luschei, E., Coon, H., & Smith, M. (2001). The aging voice: A review, treatment data and familial and genetic perspectives. *Folia Phoniatrica et Logopaedica, 53*(5), 252-265. https://doi.org/10.1159/000052680
- Reed, A., Cummine, J., Bakhtiari, R., Fox, C.M., Boliek, C. (2017). Changes in white matter integrity following intensive voice treatment (LSVT LOUD®) in children with cerebral palsy and motor speech disorders. *Developmental Neuroscience.* Jul 28. doi: 10.1159/000478724. [Epub ahead of print]

- Saint-Cyr, J. A. (2003). Frontal-striatal circuit functions: Context, sequence, and consequence. Journal of the International Neuropsychological Society, 9(1), 103-127. https://doi.org/10.1017/s1355617703910125
- Sale, P., Castiglioni, D., De Pandis, M. F., Torti, M., Dall'armi, V., Radicati, F. G., & Stocchi, F. (2015). The Lee Silverman Voice Treatment (LSVT®) speech therapy in progressive supranuclear palsy. *European Journal of Physical and Rehabilitation Medicine, 51*(5), 569-74. PMID: 26138088
- Sapir, S., Spielman, J. L., Ramig, L. O., Story, B. H., & Fox, C. (2007). Effects of intensive voice treatment (the Lee Silverman Voice Treatment [LSVT®]) on vowel articulation in dysarthric individuals with idiopathic Parkinson disease: Acoustic and perceptual findings. Journal of Speech, Language, and Hearing Research, 50(4), 899-912. https://doi.org/10.1044/1092-4388(2007/064)
- Sapir, S., Pawlas, A., Ramig, L., Seeley, E., Fox, C., & Corboy, J. (2001). Effects of intensive phonatory-respiratory treatment (LSVT®) on voice in individuals with multiple sclerosis. *Journal of Medical Speech-Language Pathology, 9*(2), 35-45.
- Sapir, S., Spielman, J., Ramig, L., Hinds, S., Countryman, S., Fox, C., & Story, B. (2003). Effects of intensive voice treatment (the Lee Silverman Voice Treatment [LSVT]) on ataxic dysarthria: A case study. *American Journal of Speech-Language Pathology, 12*(4), 387-399. https://doi.org/10.1044/1058-0360(2003/085)
- Schertz, M., & Gordon, A. M. (2009). Changing the model: a call for a re-examination of intervention approaches and translational research in children with developmental disabilities. Developmental medicine and child neurology, 51(1), 6–7. https://doi.org/10.1111/j.1469-8749.2008.03220.x
- Smith, M. E., Ramig, L., Dromey, C., Perez, K. S., & Samandari, R. (1995). Intensive voice treatment in Parkinson disease: Laryngostroboscopic findings. *Journal of Voice, 9*(4), 453–459. https://doi.org/10.1016/s0892-1997(05)80210-3
- Spielman, J. L., Borod, J. C., & Ramig, L. O. (2003). The effects of intensive voice treatment (LSVT) on facial expressiveness in Parkinson disease: Preliminary data. Cognitive and Behavioral Neurology, 16(3), 177-188. https://doi.org/10.1097/00146965-200309000-00005
- Tillerson, J. L., Cohen, A. D., Caudle, W. M., Zigmond, M. J., Schallert, T., & Miller, G. W. (2002). Forced nonuse in unilateral parkinsonian rats exacerbates injury. Journal of Neuroscience, 22(15), 6790-6799. https://doi.org/20026651
- Vergara-Aragon, P., Gonzalez, C. L., & Whishaw, I. Q. (2003). A novel skilled-reaching impairment in paw supination on the "good" side of the hemi-Parkinson rat improved with rehabilitation. Journal of Neuroscience, 23(2), 579-586. https://dx.doi.org/10.1523%2FJNEUROSCI.23-02-00579.2003
- Walshe, M, Peach, R.K., & Miller, N. (2009). Dysarthria impact profile: development of a scale to measure psychosocial effects. International Journal of Communication Disorders, 44, 693-715.

- Walton, C., King, R., Rechtman, L., Kaye, W., Leray, E., Marrie, R. A., Robertson, N., La Rocca, N., Uitdehaag, B., van der Mei, I., Wallin, M., Helme, A., Angood Napier, C., Rijke, N., & Baneke, P. (2020). Rising prevalence of multiple sclerosis worldwide: Insights from the Atlas of MS, third edition. Multiple sclerosis (Houndmills, Basingstoke, England), 26(14), 1816–1821. https://doi.org/10.1177/1352458520970841
- Wenke, R. J., Theodoros, D., & Cornwell, P. (2008). The short- and long-term effectiveness of the LSVT for dysarthria following TBI and **stroke**. *Brain Injury, 22*(4), 339-352. https://doi.org/10.1080/02699050801960987
- World Health Organization. (n.d.). Neurological disorders affect millions globally: Who report. World Health Organization. Retrieved July 19, 2022, from https://www.who.int/news/item/27-02-2007-neurological-disorders-affect-millions-globally-who-report