



# LSVT LOUD Applied to Adults with Cerebral Palsy: Two Single-Subject Studies



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## Introduction

- **Cerebral palsy** is a group of developmental disorders that affects movement and posture. In children, cerebral palsy (CP) constitutes the most common motor disability and it is estimated to occur at 1.5-4 per 1,000 live births worldwide (Centers for Disease Control and Prevention, 2018).
- **Dysarthria** is the motor speech disorder most frequently associated with CP (Schölderle et al., 2016), with variable prevalence data (Nordberg et al., 2013; Mei et al., 2014).
- Despite the increased life expectancy observed in CP, and the early onset of dysarthria in this population, sparse attention has been paid in the literature to the speech of adults with this neurological condition or to the effect of speech treatment on their vocal function and overall communication (Haak et al., 2009).

## Existing literature

- Sparse attention has been paid in the literature to the speech of adults with this neurological condition or to the effect of speech treatment on their vocal function and overall communication (Haak et al., 2009).
- Few studies have focused on the clinical representation of dysarthric speech in adults with CP (Schölderle et al., 2016).
- To the authors' knowledge, no experimental study has yet examined treatment effects of an intensive voice-focused approach on the speech acoustics and perceptual characteristics of this population.

## Current Study

- To preliminarily examine the effects of LSVT LOUD® on two adult speakers with CP. In particular, this study focused on pre-to-post treatment changes in selected acoustic and perceptual measures of dysarthric speech.

## Methods

**Speakers:** A 36-year-old female and a 24-year-old male with severe spastic dysarthria secondary to CP participated in the study.



Male speaker pictured above.

Speakers' medical and speech characteristics are listed below:

	Medical dx	Deviant speech characteristics	Received former speech therapy?
<b>Female</b>	Spastic quadriplegia s/t CP	Strained-strangled voice quality, hoarseness, imprecise articulation, poor intelligibility	YES
<b>Male</b>	Athetoid CP	Strained-strangled voice quality, hoarseness, imprecise articulation, slow speech rate, uneven stress, dysfluencies, fair intelligibility	YES

## Procedure

**Recordings:** Baseline data were collected three times within the week before treatment started. Post-treatment data were collected immediately after treatment. The Experimenter noted sound-pressure level (SPL) on Galaxy SP-meter adjacent to microphone. Microphone-to-mouth distance was 5cm for the female speaker and 8cm for the male speaker.

**Treatment:** Both speakers received four 1-hour sessions of the intensive voice-based treatment LSVT LOUD (Ramig et al., 2001) for four weeks (total number of sessions = 16). Treatment incorporated principles of motor learning and was structured as follows (Ramig et al., 2018):

Daily Exercises (minutes 1-30)	
Maximum sustained movements	
Directional movements	
Functional movements (i.e., self-generated phrases)	
Hierarchy Exercises (minutes 31-55)	
Purpose	Generalize vocal exercises into context-specific and functional speaking activities
Method	Multiple repetitions of reading & conversation tasks
Tasks	Increase in complexity across weeks & tailored to speakers' interests

## Results: Acoustic data

### Female speaker

Acoustic Variable	Baseline 1 (SD)	Baseline 2 (SD)	Baseline 3 (SD)	Post-Treatment (SD)
SPL (dB)	75.9 (3.57)	79.01 (1.73)	79.68 (2.04)	74.48 (1.61) **
Mean F0 (Hz)	178 (17.07)	168.98 (21.26)	175.89 (15.24)	245.79 (13.3) **
MPT (s)	9.53 (4.48)	4.6 (0.81)	4.45 (0.74)	20.17 (6.51) *
Jitter (%)	0.71 (0.52)	1.12 (0.5)	0.89 (0.46)	0.23 (0.08) *
Shimmer (%)	3.82 (1.87)	4.35 (1.9)	2.56 (0.9)	2.53 (0.49)
NHR	0.07 (0.09)	0.11 (0.08)	0.07 (0.05)	0.01 (0.01) *
MPFR (Hz)	226.17 (10.10)	208.46 (11.8)	221.86 (5.82)	263.54 (11.45)**

**Note: Asterisks (\*) indicate significant differences post-treatment. \*p < .05; \*\*p < 0.001**

### Male speaker

Acoustic Variable	Baseline 1 (SD)	Baseline 2 (SD)	Baseline 3 (SD)	Post-Treatment (SD)
SPL (dB)	61.66 (2.20)	59.67 (2.31)	63.1 (1.46)	65.5 (1.03) *
Mean F0 (Hz)	142.36 (2.85)	129.56 (5.16)	129.72 (2.84)	141.45 (3.56) *
MPT (s)	3.11 (2.23)	2 (0.94)	1.89 (0.77)	4.02 (2.45)
Jitter (%)	.69 (0.11)	1.03 (0.36)	.96 (0.3)	.71 (0.06)
Shimmer (%)	3.28 (0.47)	4.25 (0.6)	4.05 (1)	4.44 (0.56) *
NHR	0.04 (0.01)	0.07 (0.04)	0.06 (0.03)	0.05 (0.03)
MPFR (Hz)				

**Note: Asterisks indicate significant differences post-treatment \*p < .05**

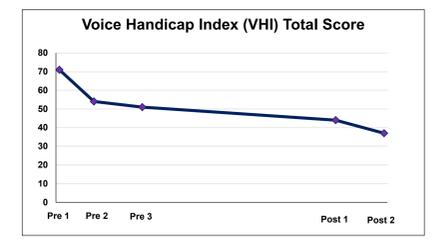
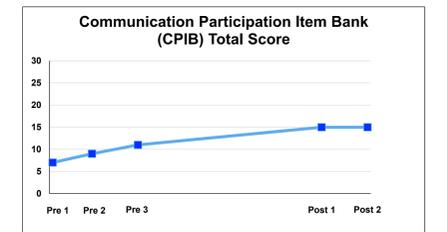
## Results: Perceptual data

### Female speaker

“ I didn't say I was receiving intensive voice therapy to my family and friends and they noted a change. ”

“ People could understand me more clearly. ”

### Male speaker



## Discussion

- The motor speech disorder of dysarthria has a lifelong impact on the communicative function of individuals with CP.
- Despite the early onset of the speech disorder and its reported severity across the lifespan, adults with CP have been traditionally neglected in the literature (Schölderle et al., 2016), as most research on this neurological condition has targeted children.
- Our study aimed to provide preliminary evidence on the effects of an intensive speech treatment targeting voice (LSVT LOUD) on selected acoustic and perceptual variables.
- Results from the current study focus on two adults with spastic dysarthria secondary to CP.
- The significant post-treatment changes in the majority of the acoustic measures analyzed for the female speaker and the results for the male speaker suggest LSVT LOUD has the potential to improve vocal function in adults with dysarthria secondary to CP.
- Together with the perceptual data and previous positive outcomes of LSVT LOUD applied to CP (Boliek & Fox, 2017; Fox & Boliek, 2012), these findings motivate continued research in this area.

## References

Boliek, C. A., & Fox, C. M. (2017). 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*, 19, 601-615.

Fox, C. M., & Boliek, C. A. (2012). Intensive Voice Treatment (LSVT LOUD) for children with spastic cerebral palsy and dysarthria. *Journal of Speech, Language, and Hearing Research*, 55, 930-945.

Centers for Disease Control and Prevention (CDC). (2019). *Cerebral Palsy (CP)*. [online] (available at: <http://www.cdc.gov/ncbddd/cp/data.html>)

Haak, P., Lenski, M., Cooley Hidecker, M. J., Li, M., & Paneth, N. (2009). Cerebral palsy and aging. *Developmental Medicine & Child Neurology*, 51, 16-23.

Nordberg, A., Miniscalco, C., Lohmander, A., & Himmelmann, K. (2013). Speech problems affect more than one in two children with cerebral palsy: Swedish population-based study. *Acta Paediatrica*, 102, 161-166.

Mei, C., Reilly, S., Reddihough, D., Mensah, F., & Morgan, A. (2014). Motor speech impairment, activity, and participation in children with cerebral palsy. *International Journal of Speech-Language Pathology*, 16, 427-435.

Ramig, L., Halpern, A., Spielman, J., Fox, C., & Freeman, K. (2018). Speech treatment in Parkinson's disease: randomized controlled trial (RCT). *Movement Disorders*, 33, 1777-1791.

Ramig, L. O., Sapir, S., Countryman, S., Pawlas, A. A., O'Brien, C., Hoehn, M., & Thompson, L. L. (2001). Intensive voice treatment (LSVT) for patients with Parkinson's disease: a 2 year follow up. *Journal of Neurology, Neurosurgery & Psychiatry*, 71, 493-498.

Schölderle, T., Staiger, A., Lampe, E., Strecker, K., & Ziegler, W. (2016). Dysarthria in adults with cerebral palsy: Clinical presentation and impacts on communication. *Journal of Speech, Language, and Hearing Research*, 59, 216-229.

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