The effects of two speech interventions on functional intelligibility in pediatric dysarthria

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Introduction

Reduced functional speech intelligibility is a primary disability in children with cerebral palsy (CP) who have the motor speech disorder of dysarthria (Kennes et al., 2002). Interventions for pediatric dysarthria with evidence of efficacy are greatly needed (Pennington, Miller, & Robson, 2009). The present exploratory study examined the effects of two intervention methods on children with CP: 1) TRADITIONAL intervention, representing "treatment as usual," consisting of instruction on breath control, positioning, articulation, and other behaviors (Pennington, Miller, Robson, & Steen, 2010), 2) Lee Silverman Voice Treatment (LSVT®LOUD), an intensive intervention protocol that increases intelligibility and vowel space in adults with dysarthria due to Parkinson Disease (e.g., Sapir, Spielman, Ramig, Story, & Fox, 2007) and has recent evidence suggesting effectiveness for children with CP (Fox & Boliek, 2012). Descriptive results are presented.

Question

Do TRADITIONAL and LSVT LOUD interventions increase functional intelligibility of children with dysarthria due to CP, as judged by:

1. Caretakers' responses regarding functional impact?
2. (Arizona) Articulation scores (pre- and post-intervention)?
3. Blinded listener preference (pre- and post-intervention) of children's words and spontaneous speech?

Method

Participants

Three native American-English speaking females with spastic dysarthria:
P3: 8;10 year-old, mild dysarthria
P4: 3;3 year-old, moderate dysarthria
P2: 9;7 year-old, moderate dysarthria, severe apraxia
Formal language/phonology/cognition assessment revealed P3/P4's language/cognition within-normal-limits, although P4 had delayed phonological acquisition. P2 revealed language/phonology/cognition deficits.

Design

Pre-intervention: Children were tested twice before intervention.
Intervention: P3/P4 received LSVT LOUD, P2 received TRADITIONAL.
Post-intervention: Children were tested immediately after last intervention session.

Schedule

LSVT LOUD took place 4 times weekly 50-60 minutes, plus 10 minutes of homework and one carryover assignment daily. TRADITIONAL was twice weekly 50 minutes with homework. Both took place over four weeks.

Testing

1. Questionnaires on functional impact completed by caregivers.
2. Children were recorded:
a. Naming pictures in Arizona Articulation Proficiency Scale (AAPS, Fudala, 2001)
b. Naming photographs of contrastive words (contrasting in vowels)"meat-mitt-knot-nut-soap-soup-pan-pen-chip-ship" (Levy et al., 2010; see Ansel & Kent, 1992)
c. Producing spontaneous speech.

A Shure headset-microphone was 8 cm from child's lips. Calibration involved tone played adjacent to the microphone. The experimenter noted the sound-pressure level (SPL) on a Galaxy CM140 SPL meter 30 cm from the microphone. This was repeated at end of sessions. Data collectors post-intervention differed from intervention providers.

Results

1. Functional impact as reported on questionnaires:
Caregivers reported positive functional impact for all children. E.g., for "Speaks so others can understand," ratings increased median of 3 points (P4), 2.5 points (P3), 1.5 points (P2), where 1 = never, 9 = always. Comments included "More eager to engage other children."

2. Arizona Articulation Proficiency Scale (Fudala, 2001)
A speech-language-pathologist and a master's student scored coded sound files. Articulatory-proficiency score increased post-intervention for all children, indicating increased intelligibility. Voice-onset-time errors, in particular, decreased.

Arizona Articulatory-proficiency score	Pre-intervention	Post-intervention
P3 LSVT LOUD	85	98
P4 LSVT LOUD	60	79
P2 TRADITIONAL	35	44

3. Blinded Listener Preference
Ten naïve listeners were presented with pre- and post-intervention stimuli in contrastive-words and spontaneous-speech and indicated overall preference. Half of the pre-intervention stimuli presented were from Baseline 1, the other half from Baseline 2. Immediate post-test was preferred for all children and both conditions, especially for spontaneous speech.

	Pre-Intervention			Post-intervention
% Words Preferred	B1	B2	B1 and B2	
P3 LSVT LOUD	27%	15%	42%	58%
P4 LSVT LOUD	12%	29%	41%	59%
P2 TRADITIONAL	29%	17%	46%	54%
% Spontaneous Speech Preferred				
P3 LSVT LOUD	10%	11%	21%	79%
P4 LSVT LOUD	15%	10%	25%	75%
P2 TRADITIONAL	10%	15%	25%	75%

SPL Analysis

Actual SPL was determined for each stimulus. For children who received LSVT LOUD intervention, at post-test, SPL had increased overall for contrastive words, although baselines were not stable. For P3, increase took place at word level, but did not carry over to spontaneous speech. For P4, SPL increase was greater in spontaneous speech. SPL of child receiving TRADITIONAL intervention did not increase.

SPL (dB) Contrastive Words	Mn-B1	Mn-B2	Mn-B1 and B2	Mn-Post-intervention
P3 LSVT LOUD	63	59	61	70
P4 LSVT LOUD	51	69	60	63
P2 TRADITIONAL	46	67	57	58
SPL(dB) Spont. Speech	Mn-B1	Mn-B2	Mn-B1 and B2	Mn-Post-tx
P3 LSVT LOUD	67	63	65	66
P4 LSVT LOUD	55	65	60	70
P2 TRADITIONAL	53	80	67	62

Preliminary Summary and Discussion

1. Greater functional intelligibility post-intervention as perceived by children's caregivers.
2. Greater post-intervention intelligibility according to the AAPS.
3. Blinded listeners' preference for post-intervention speech.
4. Increased SPL for LSVT LOUD in most conditions, but not for TRADITIONAL.
5. LSVT LOUD and TRADITIONAL interventions show promise for yielding increased functional intelligibility in children with dysarthria, although success may vary across linguistic levels and children. LOUD speech led to increases not only in volume, but also in intelligibility. TRADITIONAL intervention also led to increases in intelligibility—without increasing volume. The 3-year-old child may have shown greater SPL increases and preferred speech at spontaneous-language level than at word level because her intervention addressed spontaneous productions more than word-level activities due to her young age.

Future Directions

1. Analysis of performance on the specific vowel contrasts, speech in verbal sequencing, sentence-repetition, reading, stimulability for "loud" and "clear", and other listener data collected.
2. Analysis of follow-up tests and acoustic analysis.
3. Examination of adults' perception of dysarthric speech in noise.
4. Examination of perception of American English dysarthric speech by adult listeners who are non-native speakers of English.
5. Analysis of children with dysarthria's speech perception. In our preliminary perception study, discrimination of non-words by P2 and P3 was less accurate than of real words (69% vs. 83%). Further study of discrimination and identification by children with and without CP and of their perception-production relationship (Levy & Law, 2010) is needed to determine whether perceptual intervention may be indicated.

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