Critical Review: Does LSVT LOUD Improve Intelligibility in Children with Dysarthria Associated with Cerebral Palsy?

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This critical review examined the research available regarding the efficacy of the Lee Silverman Voice Treatment (LSVT LOUD) on improving intelligibility of children with dysarthria associated with cerebral palsy (CP). The articles included in this review consisted of single subject studies, a systematic review, and a retrospective study. Although the articles included have shown slightly suggestive evidence of improved intelligibility following LSVT LOUD, evidence from enhanced research designs are needed. Recommendations for further research and clinical practice are provided.

Introduction

Approximately 1.5 to 4 in every 1000 live births worldwide are diagnosed with cerebral palsy (CP; Centers for Disease Control and Prevention, 2019). Motor speech disorders (i.e., dysarthria) are commonly associated with CP and can greatly affect a child's ability to produce intelligible speech (Langlois et al., 2020). Characteristics of dysarthric speech can include a "lack of breath support resulting in short phrases and possible rushes of speech, low pitch, hypernasality and problems with articulation" (Pennington et al., 2006, p. 256). Therapy typically follows a systems approach that targets multiple areas (i.e., respiration, phonation, resonance, articulation, and prosody) to improve intelligibility (Pennington et al., 2006). Although the aforementioned approach is well-known and recommended, there is a lack of strong evidence regarding effectiveness (Levy et al., 2012). The Lee Silverman Voice Treatment (LSVT LOUD) is an intensive program that has shown an increase in phonatory function and articulatory subsystems, resulting in improved intelligibility in those with Parkinson's Disease (Langlois et al., 2020). As similar areas need to be addressed in children with CP, LSVT LOUD should be considered as a viable treatment option for this population.

Objectives

The primary objective of this paper was to critically review the literature surrounding the effects of LSVT LOUD on intelligibility (i.e., the ability for spoken output to be understood) in children with dysarthria associated with CP. Factors that affect intelligibility may include "imprecise articulation, low pitch, reduced pitch variation, harsh voice, hypernasality, and/or deficient breath control for speech" (Langlois et al., 2020, p. 2).

Methods

Search Strategy

Articles discussed in this review were found using Scopus, ScienceDirect, ASHA Journals, and Google Scholar. The following keywords were used to search the aforementioned databases: [(Cerebral Palsy) OR (CP) AND (LSVT LOUD) OR (Lee Silverman Voice Treatment) AND (Dysarthria) AND (Intelligib*)].

Selection Criteria

Articles that met inclusion criteria primarily focused on aspects of vocal output that might influence intelligibility, as previously stated, following LSVT LOUD treatment on the desired population. When the aforementioned was not the main objective of the publication, data from previous studies was extracted to analyze related variables.

Data Collection

Papers discussed in this review include 3 single subject studies, 1 informational review of the literature, and 1 retrospective study.

Results

Single Subject Studies

Single subject designs allow researchers to create hypotheses surrounding new treatment methods. However, given the inherently small sample sizes, these studies are typically underpowered and not generalizable. Results should be interpreted with caution.

Fox and Boliek (2012) conducted a phase I, single-subject study replicated across 5 children (ages 5 to 7) with dysarthria associated with spastic CP to determine the effects of LSVT LOUD via vocal output measurements (i.e., auditory-perceptual data, acoustic data, and parent rating forms). Inclusion and exclusion criteria were provided for participants with CP and typically developing controls. Dysarthric characteristics of the participants determined by 2 SLPs varied in terms of severity, type, and observed speech and voice signs (e.g., breathiness, loudness, articulatory imprecision).

Participants were randomly assigned to 1 of 4 predetermined baseline conditions, each of which consisted of at least 4 recordings, upon availability. Recording sessions were outlined in detail and consistent across baseline (BASE), post-treatment (POST), and follow-up (FUP). Multiple repetitions of maximum performance and sentence repetition tasks were obtained by trained data collectors who were blinded to the purpose of the study; baseline data was collected by the first author. The majority of participants participated in all recording sessions. The order of the aforementioned tasks was randomized. 1 parent of each participant completed a visual analog scale consisting of 10 variables related to voice at BASE, POST, and FUP.

LSVT LOUD was administered by Fox, a co-founder of LSVT Global, in the participants' homes. This could result in a bias when administering therapy. The protocols were outlined. 1 of 5 participants did not receive treatment until follow-up measurements were obtained to control for maturation.

7 SLPs with extensive experience in motor speech disorders and voice completed paired listening tasks during which they would rate which sample they preferred depending on 6 variables. Order of recordings was randomized. Intra-rater reliability ranged from 74 to 89%. Visual analyses of 6 acoustic variables obtained via Praat were completed by 3 independent judges who had no contact with the study participants. Intra-rater reliability ranged from 98 to 100% and inter-rater reliability was 94.7%. Inter-rater reliability varied amongst parent rating forms. Statistical analyses were applied to outcome measures according to well-outlined rules using appropriate methods.

A statistically significant preference for POST over BASE was found for all listeners in most variables; this was not consistently maintained at FUP. Statistically significant improvements across acoustic variables occurred in at least one area amongst participants at POST; this was typically maintained at FUP. Parent ratings generally improved from BASE to POST, with the exception of 2 participants (1 of whom did not receive treatment); these results were not consistently maintained at FUP.

This article provides slightly suggestive evidence and suggestive clinical importance in terms of LSVT LOUD improving intelligibility in children with dysarthria associated with CP, as all outcome measures contribute to intelligibility (Langlois et al., 2020).

Boliek and Fox (2017) conducted a phase I, within-subject, repeated measures study comparing 7 children (ages 6 to 10) diagnosed with spastic-quadriplegia CP to determine whether improvements in speech function occurred following LSVT LOUD intervention. Outcome measurements (i.e., auditory-perceptual, parent interviews and rating forms, and speech acoustics) were obtained at BASE, POST, and FUP. Auditory-perceptual judgements were made by expert and naïve listeners.

Inclusion and exclusion criteria were clearly identified for treatment participants and typically developing controls. Participants were gathered from the same facility, reducing generalizability of results. Therapists and therapy assistants were assigned to participants and this remained consistent throughout treatment. Trained data collectors did not administer treatment and were not blind to the phase of intervention. Inter- and intra-measurer reliability amongst measured variables was good.

Appropriate statistical analyses for within-groups comparisons revealed that expert listeners preferred the voice quality and articulatory precision of participants at FUP. Evidence for physiological effects on CP children's voice and mechanical aspects of speech following treatment were shown for both

trained and untrained tasks. Maximum decibel (dB) sound pressure level (SPL) on sustained phonation tasks were maintained at FUP. Average dB SPL for phrases that were not administered in therapy increased at POST. dB SPL approached the level of typical developing peers for sustained phonation and spoken phrases following treatment. Naïve listeners perceived an increase in intelligibility at POST. Parents indicated improvements in their child's speech, voice, and communication skills at POST and FUP.

This article provides slightly suggestive evidence and clinical importance in terms of LSVT LOUD improving intelligibility of children with dysarthria associated with spastic CP.

Levy et al. (2012) conducted a phase I, single-subject study consisting of 3 children (ages 3 to 9) who have dysarthria associated with spastic CP to determine the impact of LSVT LOUD and Traditional speech interventions. This review focused on participants who underwent LSVT LOUD provided by the first author. Inclusion and exclusion criteria were not stated. Children were allocated to intervention type based on availability. The treatment approach was outlined vaguely. Participants differed in terms of age, dysarthric severity, as well as cognitive, expressive, and receptive abilities.

Children were tested twice prior to intervention and once post-intervention on outcomes of interest. Recording procedures were described briefly. Data collectors did not administer treatment.

Functional impact questionnaires completed by caregivers revealed a 2.5 to 3 point increase in "speaks so others can understand." 10 naïve listeners blinded to the purpose of the study were presented with pre- and post- intervention stimuli of contrastive words and spontaneous speech with and without orthographic representation, respectively. Development of the stimuli was described well. The post-treatment data was preferred and easier to understand in both contrastive words and spontaneous speech. The Arizona Articulation Proficiency Scale was scored by an SLP and 2 SLP students blinded to the phase of treatment; articulation scores improved for both participants. Statistical analyses were not completed. Although BASE measurements varied, SPL in both participants increased in word and spontaneous speech.

This article provides equivocal evidence and slightly suggestive clinical importance in terms of LSVT LOUD improving intelligibility in children with dysarthria associated with CP.

Informational Review of Literature

Informational reviews of literature allow expert authors to provide detailed first-hand descriptions of disorder and/or population specific treatment management. Data included is generally descriptive with little information pertaining to the methods employed during extraction and should therefore be interpreted cautiously.

Levy (2014) conducted an informational review of two treatment approaches (LSVT LOUD and Speech Systems Intelligibility Treatment) to utilize as a resource in future research targeting improved spoken output in children with dysarthria associated with CP. The author is an expert in the field, as illustrated through the completion of necessary training in LSVT LOUD protocol and their participation in relevant publications. The specifics of treatment, outcome measurements, and acoustic analyses were provided in detail. This review focused on the acoustic analysis provided for 2 participants that completed LSVT LOUD. Drawing on data from a previous study completed by Levy et al. (2012), the author and a research assistant analyzed vowel mid-points of nonsense words produced by 2 children prior to and following LSVT LOUD. Inter-measurer reliability was 81%. Following treatment, vowel space expanded in 1 of the 2 participants, indicating improved intelligibility.

This article provides equivocal evidence and clinical importance in terms of LSVT LOUD improving intelligibility in children with dysarthria associated with CP.

Retrospective Within Group Study

A retrospective study examines prior data that was obtained for specific outcomes of interest and utilizes that data to examine alternate outcomes for analyses. This type of analysis can provide preliminary evidence

for prospective studies and data for rare populations. Data obtained from prior studies is subject to biases and confounding factors. Results from these studies should be interpreted with caution since the control of variables is removed.

Langlois et al. (2020) conducted a retrospective analysis to determine if there were post-treatment changes in acoustic measures (i.e., vowel duration, acoustic vowel space, and the ratio of F2/i/ to F2/u/) among participants with CP or Down syndrome following LSVT LOUD therapy. This review focused on participants with CP. 17 children (ages 6 to 16 years) with CP were involved in the analysis. Stringent inclusion and exclusion criteria were utilized to limit the effects of extraneous factors on treatment outcomes. CP participants varied in the severity and type of their speech diagnoses, cognition, and presence of comorbid diagnoses.

CP participants were recorded at BASE, POST, and FUP. A single baseline measurement was obtained. Good intra-measurer and moderate inter-measurer reliability were determined for the acoustic vowel space variables. Blinding of participants and/or testers to the purpose of the original study was not indicated. Concurrent controls were not included.

All CP participants completed LSVT LOUD therapy as specified by the treatment protocol along with a maintenance program to be followed until FUP.

Appropriate statistical analyses were utilized to compare the means of data between BASE and POST, as well as BASE and FUP. These analyses revealed significant findings; an increase in vowel durations during sentence productions (BASE to POST), a reduction in the acoustic vowel space during sentence productions (BASE to FUP), and an increase in the acoustic vowel space during single word productions (BASE to FUP) for CP participants. Post hoc comparisons were made without correcting for multiple comparisons, increasing the likelihood of a type I error occurring. Results from this analysis should be interpreted with caution.

This article provides slightly suggestive evidence and suggestive clinical importance for the effects of LSVT LOUD treatment therapy on improving the articulatory system and intelligibility of children with dysarthria secondary to CP.

Discussion

Overall, the articles reviewed in this paper provided slightly suggestive evidence that LSVT LOUD improves the intelligibility of children with dysarthria associated with CP. Changes in acoustic measurements, auditory-perceptual preferences, and parent rating forms throughout the reviewed articles indicate a positive impact on intelligibility.

Based on the critically reviewed studies, LSVT LOUD results in statistically significant listener preferences for POST over BASE data regardless of age or dysarthric severity, implying that intelligibility improves immediately following treatment for all participants (Fox & Boliek, 2012; Levy et al., 2012). Listener preferences for follow-up data generally diminished to BASE or "no preference" amongst all participants, excluding a child with a mild-moderate form of dysarthria, which suggests that it might be difficult to maintain improved intelligibility following treatment for more severe types of dysarthria associated with CP (Fox & Boliek, 2012, 2017; Levy et al., 2012). It should be noted that Fox and Boliek (2017) reported averages rather than individual scores, therefore, it is not possible to interpret data patterns associated with individual performance.

Parent ratings improved for all participants, implying improved intelligibility following treatment, as items such as "speaks so others understand" are scored (Fox & Boliek, 2012, 2017; Levy et al., 2012). These results varied amongst participants at follow-up (Fox & Boliek, 2012; Levy et al., 2012). In the study completed by Boliek and Fox (2017), parent ratings were maintained at FUP, however, data was averaged so it should be interpreted cautiously. Additionally, LSVT LOUD protocol typically requires the completion of a Voice Handicap Index (VHI) by the participant pre- and post-treatment; this information was not reported in the aforementioned studies. The measured variables in the VHI are not necessarily relevant to the purpose of the research studies above, however. Exclusion could be due to age, cognitive abilities, or disorder area of the participants. Future researchers might consider including the participant's perspective regarding perceived intelligibility.

Acoustic analyses of the participants revealed varied results. In a study completed by Levy (2014), one participant's acoustic vowel space increased following LSVT LOUD, whereas the other's decreased. Similar findings occurred in the study completed by Langlois et al. (2020). Acoustic vowel space was decreased in sentence productions but increased in word productions. According to Fox and Boliek (2012), all children improved in at least one acoustic measure immediately following treatment and were able to maintain and improve in other areas at FUP, implying improved intelligibility. However, this does not align with parent ratings or listener preferences. One might infer that the acoustic measures used in these studies does not reflect one's perspective of improved intelligibility, therefore, it is important to consider both in future research.

The retrospective analysis research provided preliminary data on the effects of LSVT LOUD on aspects of intelligibility, such as gains in vowel space and vowel duration. The outcomes measured in this study warrant further investigation to determine if these results can be replicated in research designed to measure the desired outcomes.

LSVT LOUD shows promise in improving speech intelligibility immediately following treatment, however, these results may vary at FUP.

Limitations

Although strengths were present throughout the research (i.e., appropriate statistical analyses to compare results and determine significance, administration of therapy via appropriately trained professionals, the collection of qualitative and quantitative data), a variety of limitations exist.

Among the 5 articles discussed, 3 were authored by co-founders of LSVT LOUD (i.e., Fox and Ramig). Due to their professional affiliation with the program, it is possible that a bias exists, thereby impacting the validity of the research process. Additionally, the 2 articles that did not involve co-founders (i.e., a retrospective study and an informational review) provide lower levels of evidentiary support and utilize data obtained by Fox and Ramig. Furthermore, 3 authors (Levy, Fox, and Boliek) wrote all of the articles appraised in this paper.

Due to the rarity of the target population, small and heterogeneous samples are common in research. This makes it difficult to generalize results and find correlations among variables. Additionally, this makes it difficult to form control groups consisting of children with CP, which would improve the research design.

Future research should focus on improvements in study designs, increasing sample size, increasing the homogeneity of populations, and completing FUP measures. Additionally, diversity of authors within related publications would enhance the validity of findings.

Clinical Implications

The evidence discussed in this review suggests that the implementation of LSVT LOUD may improve intelligibility in children with dysarthria associated with CP shortly following treatment. Further research with increased levels of evidence are required to support the efficacy of this treatment protocol within this population.

References

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