Stimulability Testing in Parkinson Disease: Impact on Predicting Treatment Outcomes
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BACKGROUND AND RATIONALE:
Nearly 90% of individuals with Parkinson disease (PD) develop some form of disordered communication (Lohmann et al., 1978; Ho et al., 1998). Diminished vocal loudness and imprecise articulation are commonly associated with PD (Polet et al., 1989; Fox & Ramig, 1997; Ho et al., 1998; Sapir et al., 2007, 2010) and are often targeted in treatment. Prior to treating dysarthria in PD, stimulability testing is frequently utilized to predict whether an individual may benefit from a particular behavioral therapy. However, stimulability testing can only be effective in predicting treatment outcomes if changes following stimulability are comparable to changes post-treatment. Previous research has evaluated the effects of stimulated rate reduction, increased loudness, and cue clear speech on articulation in PD (Mccrea et al., 2002; Tjaden & Wilding, 2004; Tjaden et al., 2010), but it is unclear whether these stimulated conditions differ from trained conditions.

PURPOSE: This study compared changes in vocal intensity and vowel articulation under three speaking conditions: 1) habitual voice and speech, 2) stimulated loudness, and 3) trained loudness (LSVT®LOUD) or trained articulation (LSVT-ARTIC) in 10 subjects, to begin to examine relationships between stimulability testing and treatment outcomes for individuals with PD.

SUBJECT CHARACTERISTICS:
- Voice and artic severity rated by 2 SLPs, 0=normal, 5=severe

<table>
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<tr>
<th>Subject</th>
<th>Age</th>
<th>Gender</th>
<th>Years Since Diagnosis</th>
<th>Voice Severity</th>
<th>Artic Severity</th>
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<tr>
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<tr>
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DATA COLLECTION:
Acoustic data were collected in a sound treated booth via head mounted AKG-420 microphone placed 8 cm from subjects' lips. Subjects were then asked to read the sentence, "The stetpew is packed with peas," pre- and post-treatment. During pre-treatment this sentence was read 10 times at habitual loudness and another 10 times at the cue to speak at twice habitual loudness. A dB SPL increase was considered to be twice habitual loudness. After treatment, subjects read the same sentence 10 times without loudness instructions.

Centralization of formant frequencies and reduction of vowel space area are frequently reported abnormalities of vowel articulation in dysarthria (Ferguson & Kewley-Port, 2007; Kent et al., 1999; Sapir et al., 2003, 2007). Therefore, vowel space area (VSA) and formant centralization ratios (FCR) were used to measure changes between habitual voice and speech, stimulated loudness, and trained loudness/articulation. Since an increase in VSA and a decrease in FCR indicate an improvement in vowel articulation as a result of less centralization, it is hypothesized that these changes will be evident in the stimulated and trained conditions.

DATA ANALYSIS:
Vocal intensity, in terms of average dB SPL, was extracted from the calibrated microphone signal using a reference of 30 cm from the subject's lips. First and second formant frequencies (F1, F2) were measured for vowels /æ/ and /i/. And to obtain VSA and FCR measures, F1 and F2 were extracted from a 30 msec window in the temporal center of the vowels /æ/ and /i/ and last at 30 msec for the vowel /æ/ using TF32 software.

RESULTS:

DISCUSSION:
Changes in vowel acoustics in the stimulated loudness condition were not consistent with changes following intensive treatment in either group, indicating that intensive motor training may be necessary to achieve more permanent changes in motor speech patterns.
Eight of ten subjects increased VSA and nine of ten subjects decreased FCR from habitual to trained conditions, with an equal subject distribution across both groups, suggesting an improvement in articulatory movement for vowels as a result of intensively training vocal loudness or articulation.
All subjects who received intensive vocal loudness training, LSVT-LOUD, increased SPL from habitual to trained conditions and four of five showed improvements in vowel acoustics, possibly reflecting a generalization of motor speech effects across the entire speech production system from intensively training vocal loudness.
Four of five subjects increased VSA and all five decreased FCR post intensive articulation training, LSVT-ARTIC, demonstrating improvements in vowel acoustics from habitual to trained conditions, but only one subject showed improvements in SPL, suggesting that the intensive training target of articulation may not result in more widespread changes in speech production.

While the current study provides insight into the relation of stimulability testing and intensive training outcomes, interpretation of the data must be made cautiously until more subject data have been analyzed in these treatment groups, untreated PD subjects, and healthy controls. Further research incorporating listener perceptual ratings of overall intelligibility is also needed to better understand if improvements in vowel acoustic measures translate into improved functional communication.

Acknowledgment: This study was made possible with funding from NIH grant RO1DC001150
See handout for select references.
References:


Link to select references on voice in Parkinson disease and other neurological disorders: