

Summary of Proposal

Studies examining lexical stress differences produced by normal speakers have revealed that stressed syllables are greater in amplitude, have longer durations and higher F0 compared to unstressed syllables (e.g. Sluijter et al., 1997). Further, vowel quality changes have been consistently identified as an acoustic cue in denoting stress in English (e.g., Zhang et al., 2008).

Walker, Pelletier & Reif (2004) found that RHD subjects performed like control subjects in producing similar acoustic cues (higher F0, increased duration, greater amplitude) to denote lexical stress and listeners were able to identify those differences. However, a more recent study (Walker, Joseph & Goodman, 2009) indicated that LHD subjects differed from control subjects in producing fewer prosodic cues and listeners had difficulty differentiating nouns and verbs that were produced by the LHD subjects. These studies did not investigate the degree to which vowel quality changes within stressed and unstressed syllables of nouns and verbs contributed to the perception of the different meanings.

Studies investigating the vowel quality in the lexical stress productions of LHD subjects have demonstrated distortions in vowel quality in words with varying numbers of syllables. For example, Odell, McNeil, Rosenbeck and Hunter (1991) asked subjects with apraxia of speech (AOS), conduction aphasia (CA) or ataxic dysarthria (AD) to produce thirty monosyllabic, disyllabic and trisyllabic words (e.g., please-pleasing-pleasingly). A phonetic transcription of the vowel quality indicated that subjects with AOS and AD produced distortions of low, tense and back vowels primarily in the initial position of monosyllables. Whereas, the CA subjects made more substitution errors in polysyllabic words in non-initial locations. Haley, Ohde, & Wertz (2001) found errors

that involved tongue height deviations in the vowels of monosyllable words “hid” and “head” of LHD subjects with aphasia or with aphasia and a co-existing apraxia of speech. An acoustic analysis of the formant frequencies of the vowels for both groups deviated from control subjects. These studies did not include RHD subjects.

The purpose of this study was to examine the vowel quality in stressed and unstressed syllables of nouns and verbs produced by LHD and RHD subjects through perceptual judgments and acoustic analyses of the F1 and F2 formant frequencies of the vowels.

Method

Nine RHD, Nine LHD subjects and ten control subjects with no history of neurological damage participated in this study. Ten pairs of two syllable words containing stress on either the first syllable (e.g., COMbine) to convey a noun or the second syllable (e.g., comBINE) to convey a verb were utilized in this experiment. Subjects were presented with individual written words and corresponding pictures depicting the correct meanings and told to read each word aloud. The words were recorded and digitized at a sampling rate of 20kHz using the Kay CSL. The digitized recordings were presented in a random order over speakers to two graduate students in Communication Sciences and Disorders who phonetically transcribed the vowels in each syllable of the words. Error rates according to vowel type and according to stressed and unstressed syllables were recorded. Inter-rater reliability was 100%.

Preliminary results

The preliminary results of the perceptual judgments of the error rates of the vowels in stressed and unstressed syllables for all three groups can be seen in Figure 1. The total error rates of the control subjects (19/200 or 9%) were less than those of the RHD (41/180 or 22%) and LHD (55/180 or 30%) subjects. The majority of errors occurred in unstressed syllables for all three groups (control <1% stressed, 9% unstressed; RHD 4% stressed, 17% unstressed; LHD 5% unstressed, 25% stressed). All three groups had greater difficulty producing the appropriate lax, unrounded, mid-central vowels in unstressed syllables by substituting the full vowel in the same tongue position or a lax, unrounded low-back vowel. However, the LHD group had a proportionally greater number of errors than the other two groups especially in substituting the lax, low-back vowels. To a lesser degree both RHD and LHD subjects produced the reverse pattern in stressed syllables. The LHD subjects also demonstrated additional error types in substitutions of lax unrounded high-front vowels for tense unrounded high-front vowels in unstressed syllables. The RHD group produced a few error types in substitutions of tense, rounded, high-mid, back vowels for lax, unrounded, mid-central vowels.

Discussion

The pattern of errors in both the LHD and RHD groups indicated that substitutions were close to the target sounds with a greater proportion of errors produced by the LHD group. Errors were present in articulatory positioning relative to vowel height and to a lesser degree

fronting. However, substitutions between tense and lax vowels also suggest that a speech timing deficit may be present where variations in vowel length influenced the perception of the vowels. Acoustic analyses of the F1 and F2 formant frequencies will be performed to determine if there is a relationship between deviant F1 and F2 frequencies and perceived vowel substitutions. A discussion of the influences of vowel quality in the production and perception of lexical stress differences in RHD and LHD subjects will follow.

References

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