

PRODUCTION AND PERCEPTUAL CORRELATES OF SPANISH-ACCENTED ENGLISH

Amee P. Shah

School of Communication Sciences and Disorders, McGill University,
Montreal, Quebec, Canada
amee.shah@mail.mcgill.ca

ABSTRACT

This study attempted to identify the acoustic deviations in the speech of Spanish-accented speakers of English and their influence on the native perception of accentedness. Recordings of eight multisyllabic target words spoken in sentences by 22 Spanish speakers of English and five native speakers of American English were analyzed for temporal acoustic differences. Acoustic deviations in Spanish-accented speech included overall word duration, unstressed vowel duration, stressed-unstressed (S/U) vowel duration ratios, Voice Onset Time (VOT) and closure duration in intervocalic flaps/stops. Native listeners listened to the nonnative samples and assigned a range of ratings of accentedness. Results showed that the accentedness ratings were correlated to varying degrees with each of overall word duration, S/U vowel duration ratios, VOT duration, and closure duration of intervocalic /t/. Overall, results suggest that Spanish-accented English is characterized by systematic temporal differences from native American English, and that these temporal differences are related to the perception of accentedness as judged by native AE listeners.

BACKGROUND

Relative to the long-standing research in normal speech perception and production, the study of foreign-accented speech is a recent, but fertile area of interest. The speech of non-native speakers of a language or “foreign-accented” speech is usually characterized by presence of acoustic-phonetic and phonological deviations from the norm. Research in this field has attempted to tap these deviations in order to characterize different accents, study the effect of these deviations on listeners’ perception and intelligibility, understand the process of second language learning as it shapes in ways different from the first language, and ultimately, to understand the processes of speech perception and production.

The present work adds to, and extends this body of research through an attempt to isolate those nonnative speech deviations that cue listeners’ perception of accentedness, using the case of Spanish-accented English. Previous studies have typically described nonnative speech in terms of phonological characteristics (e.g., MacDonald, 1989; Ortega-Llebaria, 1997, Stockwell & Bowen, 1965) with only a few studies addressing the acoustic characteristics of those productions (e.g. Flege & Port, 1981; Munro, 1993; Magen, 1998; Backman, 1978; Flege & Eefting, 1987; Flege, Munro & Skelton, 1992). Moreover, these acoustic studies were mainly restricted to studying single parameters of English, such as vowel duration differences in voicing contrasts, acoustic vowel spaces, voice onset time of stop consonants, changes in fundamental frequency as related to intonation, or some measure of rate of speech (e.g. Flege & Port, 1981; Elsendoorn, 1985; Flege, 1993; Backman, 1978; Flege, 1991; Schmidt and Flege, 1996). Multiple acoustic parameters as they relate to perceived accentedness have not yet been

studied in a correlational design. Thus, the present study attempted to address the distinct speech characteristics of Spanish-accented speakers as they influence native listeners' perception of accentedness. Previous acoustic-phonetic and phonological findings led to the hypotheses motivating the present work, in that Spanish-accented speech is characterized by deviations in temporal patterns, and that these deviations account, at least in part, for the perception of "foreign-accentedness".

Two studies were designed to test the hypotheses: 1) a perception study to obtain accentedness ratings from native listeners as they listened to multisyllabic words (and sentences) produced by native as well as the non-native (Spanish-accented) speakers, and 2) a production study to measure the temporal parameters of the multisyllabic productions of nonnative speakers as they differ from those of native English speakers. A third part, a set of analyses testing the correlation of the range in segmental durations of the Spanish-accented speakers and the range in accentedness ratings assigned by the native listeners, was attempted to test the hypothesis that the temporal deviations in the nonnative (Spanish-accented) speech are related to the perception of foreign-accentedness

PERCEPTION STUDY

In this perception study, the objectives were: a) to establish the relative global accentedness of the nonnative speakers in this study, and b) to determine the correlation between ratings of accentedness in multisyllabic word and overall sentence condition in order to test whether the accentedness on the multisyllabic words were representative of the global accentedness across the nonnative speakers.

Subjects

The listeners in the accent-rating tasks comprised ten native speakers of American English, who were in the ages between 18-45 years, had a minimum of high-school education, were born and raised in the Greater New York metropolitan area and reportedly, presented an unremarkable history of any speech, hearing or language problems. Additionally, a questionnaire was used to rule out any formal training in Spanish and/or any extensive experience listening to Spanish-accented English. All listeners also passed an audiometric screening test (PTA <25 dB at 500Hz, 1KHz, 2Kz, and 4Khz).

The speakers who recorded the stimuli were 22 nonnative Spanish-accented speakers and five native, monolingual speakers of American English. The nonnative speakers were between the ages of 18-45 years, born in the Dominican Republic and were residing in the United States since 12 years of age, with a continuous length of residence of at least two years in the United States. Pilot testing determined that they were fluent speakers of English with a substantial degree of Spanish accent. The native speakers were monolingual speakers of English as their first language with no spoken knowledge of any other languages. They were between the ages of 26-50 years and were born and raised in the Greater New York metropolitan area.

Stimuli and Procedure

The nonnative and native speakers read eight sentences, each containing a high-frequency multisyllabic target word. Recordings were made of these sentences, which then served as the stimuli in the sentence-rating task. The target multisyllabic words were spliced from these sentences, thus forming the stimuli in the word-rating task.

These stimuli were presented to the listeners for judgment of accentedness, wherein the listeners rated eight blocks of sentences (as a measure of global accentedness) and eight blocks of the spliced multisyllabic words. Within each block, the sentence/word was the same utterance, produced by all 27 speakers. The sentence-rating task preceded the word-rating task in order to ensure that listeners would not guess or over-attend to the target words in the sentence-rating task. Listeners were asked to listen to, and rate the relative accentedness of the speakers on a nine-point rating scale presented on a computer screen, where 1=least-foreign accented, and 9=most-foreign accented. The stimuli were presented through headphones in a sound-treated listening booth

Results

The ratings of listeners on each of the eight words were pooled and the typical (median) native listener ratings of accentedness on each word were used as the speakers' scores in the correlational analyses with the production measures as described later. Additionally, results indicated a strong correlation ($\rho=0.82$) of accentedness ratings on sentences and multisyllabic words. Thus, these multisyllabic words were good predictors of global accentedness, i.e they appear to have properties that contribute significantly to overall sentence accentedness. Inferences can, therefore, be made from productions of these multisyllabic words for the importance of lexical stress and segmental deviations in judgments of accentedness. The acoustic properties of multisyllabic words need to be studied to identify those that relate to the perception of accentedness by native listeners, which are the objectives in the following production study and the correlational analyses.

PRODUCTION STUDY

In the production/acoustic study, the above-mentioned eight multisyllabic (3, 4, and 5 syllable) target words, as recorded by 22 nonnative and the five native speakers of American English were analyzed for temporal acoustic differences. The segments measured included overall word duration, unstressed vowel duration, ratios of stressed to unstressed (S/U) vowel duration as a measure of lexical stress, Voice Onset Time (VOT) of word-initial, voiceless stop consonants and closure duration in intervocalic flaps/stops. Based on phonological descriptions of Spanish-accented English and Spanish phonological rules (MacDonald, 1989; Ortega-Llebaria, 1997), predictions were made for each of the acoustic segments measured. The Spanish-speakers of English (nonnative group) were expected to produce longer overall word durations due to an expected slower rate of speech. Voiceless stop VOT values were expected to be smaller in the nonnative group since voiceless stops in Spanish are unaspirated. Flap/closure duration of intervocalic /t/ was expected to be greater in the nonnative group, approximating durations for stops. Vocalic segmental durations were expected to be approximately equal for stressed and unstressed syllables; thus S/U ratios were expected to be equal to 1 in the nonnative group, as predicted by the syllable-timed stress pattern of Spanish phonology.

Procedure

The above-mentioned acoustic segments were measured using the Multispeech waveform editing software, Model 3700, 2.3 (Kay Elemetrics Corp., 1999). Displays of waveforms and wideband spectrograms were used in combination to arrive at decisions regarding the onset, offset and durations of the acoustic segments. Following the segmentation of words and the measurement of durations of each acoustic segment within the words, group differences in segmental durations were compared.

Results

Due to unequal group sizes (5 native speakers and 22 nonnative speakers), and differences in variances, group differences were compared using Welch t' -tests that corrected for unequal variances. Results of the group differences in acoustic measures confirm the predictions made from previous phonological findings. As expected, results showed that the nonnative speakers' productions were, on average, significantly longer than the native productions [$t(56)=-2.15$, $p<0.04$]. The unstressed vowel durations were, on average, proportionately longer for the nonnative group compared to the native group. Unlike the native group, the nonnative group failed to make a sufficient temporal distinction between stressed and unstressed vowels, with S/U ratios, on average, varying from 1.00 to 2.05. VOT, on average was shorter in the nonnative group, on average, compared to the native group. Flap/closure durations were, on average, longer in the nonnative group, compared to the native group.

As expected, the nonnative speakers, as a group, showed greater variability in each of the measured segmental durations as compared to the native group. This variability in word duration lent itself well to test its correlation with the range in accentedness ratings by the native listeners (as obtained from the Perception Study).

CORRELATION ANALYSES

Each of the above segmental measures were rank-ordered and correlated with ranked median ratings of accentedness on words, using a Spearman rank-order correlation. The objective of this analysis was to determine the relationship of the temporal deviations in the nonnative group with the perceived accentedness, as judged by the native speakers.

Findings indicated that overall word duration was correlated with perceived accentedness with low to moderate strength ($\rho=0.04$ to 0.56), although only one word, "committee", yielded a statistically significant relation. Stressed to unstressed vowel ratio, a measure of lexical stress, correlated positively with perceived accentedness for all but one word, although, only the correlation for the word "economic" was significant ($\rho=0.80$). Deviations in VOT also correlated positively with accentedness ($\rho=0.26$ to 0.36) and so did deviations in flap/closure durations ($\rho=0.29$ to 0.59). While none of the VOT-accentedness correlations was statistically significant, three of the five correlations of flapped /t/ and accentedness were highly significant.

DISCUSSION

The overarching goal of this research was to examine the temporal speech characteristics of native Spanish speakers of English-as-a-second-language that relate to the native English-speaking listeners' perception of accentedness. Previous studies were restricted to either describing the phonological characteristics or analyzing a select few acoustic measures of this nonnative group. Multiple acoustic parameters as they relate to perceived accentedness have not yet been studied in a correlational design. The present study tapped several temporal characteristics of multisyllabic words, selected on the basis of previous phonological descriptions of Spanish-accented speech, as they relate to a measure of perceived accentedness. Two studies were designed to test the hypotheses that temporal deviations characterize Spanish-accented speech, and that these deviations are related to the perception of accentedness as judged by native speakers of English. The multisyllabic words used in the two studies had been found to be good predictors of global accentedness, i.e. accentedness on overall sentences. Results showed systematic temporal deviations in the nonnative group

compared to the native group for each of overall word duration, unstressed vocalic duration, stressed to unstressed vowel ratios, VOT for voiceless, word-initial stops as well as for closure duration in intervocalic stops/flaps. However, overall group differences were small. Moreover, correlations tested with each of these segmental deviations with accentedness ratings showed only low to moderate strength of relationship. It is hypothesized that, while each of the measures alone does not strongly predict accentedness, some combination of these temporal deviations may account, at least in part, for native listeners' judgments of perceived accentedness.

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