TEMPORAL RATIOS OF SOUND SEGMENTS AND THE PERCEPTION OF ENGLISH DIALECT DIFFERENCES

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In a previous paper (Bush 1967) certain intra-syllabic sound segment duration ratios were reported for speakers of three dialects of English: American, British, and the English spoken in India by native speakers of Hindi. In a country in which English is used as a second language, the teachers of English tend to be speakers who themselves learned English as a second language or even as a foreign language. Over a period of time such a tradition reinforces typical characteristics of language interference. It is not the purpose of the present paper to consider the contrasts between Hindi and English which have influenced the development of this dialect, but rather to compare this dialect of Indian English with other well-known dialects of English. These three dialects have a high degree of mutual intelligibility, yet each is readily identifiable, even under listening conditions in which intelligibility is destroyed.

This study was undertaken in order to specify some of the systematic differences in the temporal sequencing of sound segments for these three dialects. Samples of utterances included three-syllable nonsense words (e.g., *ət'ʃit, ə'katə*), real words in citation form (e.g., *sheeting, shooting*) and sentences read in context (e.g., *the traveler took off his cloak*). These data were collected from four young adult speakers of each dialect: Midwest General American, British Received Pronunciation, and Western Hindi English. Measures of standard deviation showed reasonably high consistency within dialect group.

Spectrographic and oscillographic analyses of the traces from simultaneously recorded air and laryngeal microphones permitted the specification of certain sound segments associated with periodicity and aperiodicity in speech. For example, Figure 1 shows the duration relationships for three sound segments in the stressed syllables of nonsense words: the consonant closure, the release and the vowel. Overall durations are consistently longer for Americans than for British and longer for British than for Indians. However, the most conspicuous differences are apparent in the relative durations of the intra-syllabic segments. Figure 2 shows consonant/vowel ratios for the three dialects. The vertical line which serves as the base for the histogram represents unity, the point at which the duration of the consonant is equal to the duration of the vowel. All values to the right of that line indicate that the

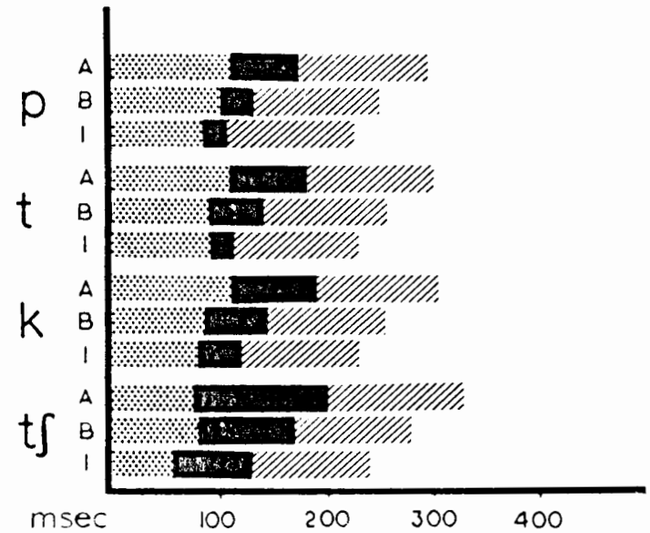

Fig. 1. Sound segment duration relationships in three dialects: consonant closure, release and vowel duration in stressed syllables.

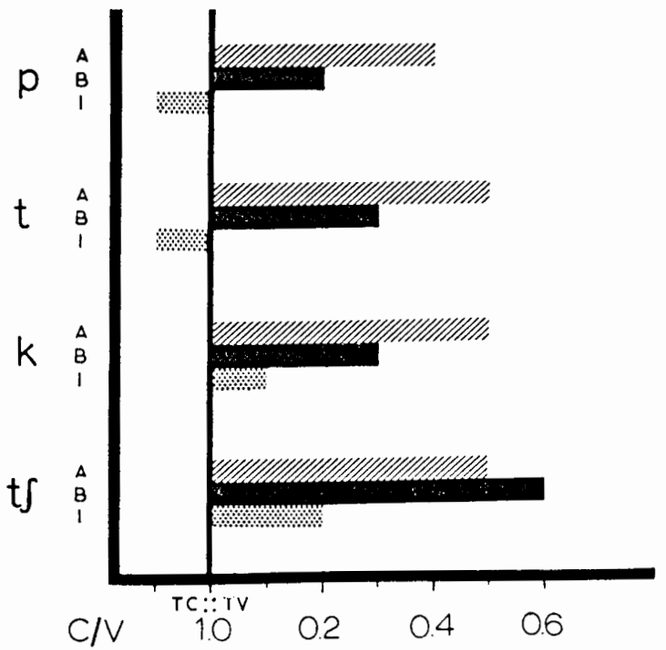

Fig. 2. Consonant/vowel duration ratios in stressed syllables. 1 = Unity.

consonant is proportionately longer than the vowel. Values to the left indicate that the consonant is shorter than the vowel. For the voiceless stops and affricate, these ratios are similar in kind for American and British, but different in degree. For all these consonants, the Indian ratios are conspicuously different in degree and for the labial and apical stops, the Indian ratios are different in kind as well as degree.

Figure 3 shows dialect consonant/vowel ratios for a fricative with two diffuse vowels. The fricative is always longer than the vowel, strikingly so for British and Indian dialects on the syllable /ʃi/, for example. Here, the average C/V ratios for British and Indian are identical, and three times greater than the American ratio. This figure also presents evidence of interesting dialect differences in CV ratios for front (lip-spread) and back (lip-rounded) vowels produced in the phonetic context of a dialectally more-or-less lip-rounded palato-alveolar fricative. This suggests that both the assimilative lip-rounding effect and the durational effects of articulatory distances (Fischer-Jørgensen 1964) may be manifested distinctively in different dialects for certain CV combinations.

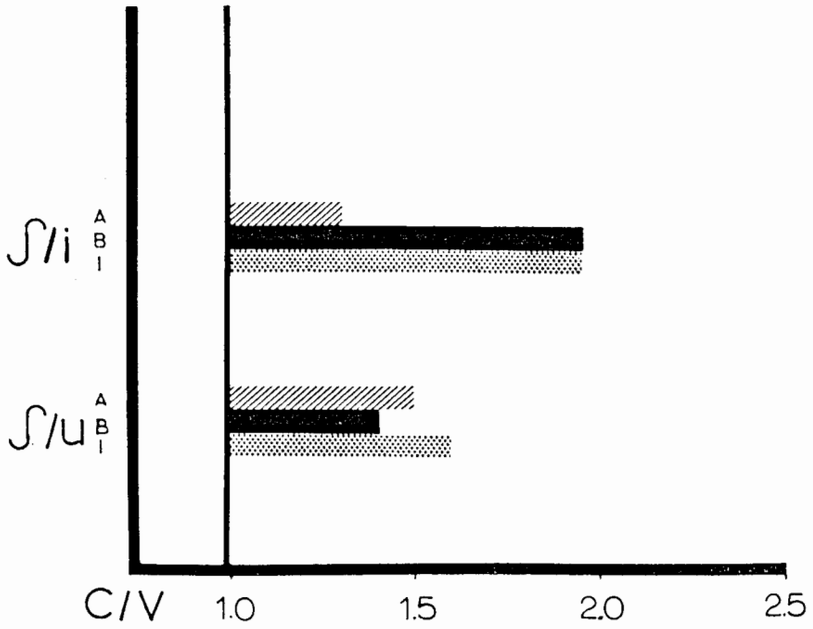

Fig. 3. Connsoant/vowel duration ratios in the stressed syllables of *sheeting* and *shooting*. 1 = Unity.

Figure 4 shows intra-consonant duration ratios for voiceless stops and affricate in nonsense words, the ratio of the closure period to the release. The affricate, as expected, reverses the closure/release ratio. The positive ratio for all the stops is systematically reduced for all dialects as a function of place of articulation antero-

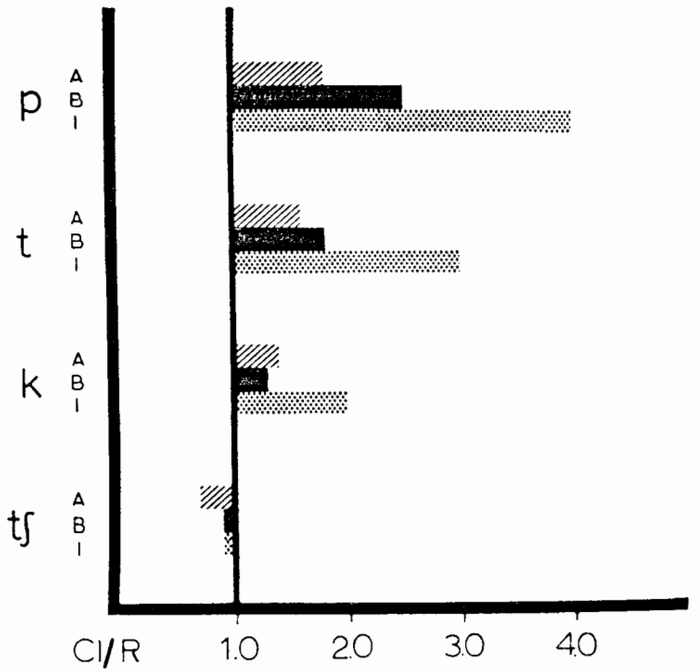

Fig. 4. Closure/release duration ratios in stressed syllables. 1 = Unity.

posterially. With the anterior consonant /p/, where the effect is most striking, the respective dialect ratios are American nearly 2:1, British 2.5:1 and Indian 4:1.

Figure 5 contrasts the information on /t/ and /k/ from the nonsense data (t_1 and k_1 indicate these citation forms) with the /t/ and /k/ data from the stressed words in the sentence *the traveler took off his cloak* (t_2 and k_2). It is clear that a change in phonetic environment, as expected, changes the durational values sufficiently to affect the respective ratios. The interesting point is that, once again, the ratios for American and British differ, if at all, only in degree while the ratios for Indian differ conspicuously in kind as well as degree.

Figure 6 shows duration ratios across dialects for stressed vowels and unstressed vowels in words of two syllables, nonsense words of three syllables and in sentence context. In all three contexts, ratios for the Indian dialect are substantially lower — in effect revealing less temporal distinction made between stressed and unstressed vowels. For all three dialects, the longer the phonetic context, the greater the durational differences between stressed and unstressed vowels. This effect is conspicuously heightened in British dialect, where temporal vowel reduction in unstressed syllables is greatest.

The ratio of total time to phonated time is shown in Figure 7 for words in citation form and for the sentence. The ratios show dialectal differences which remain

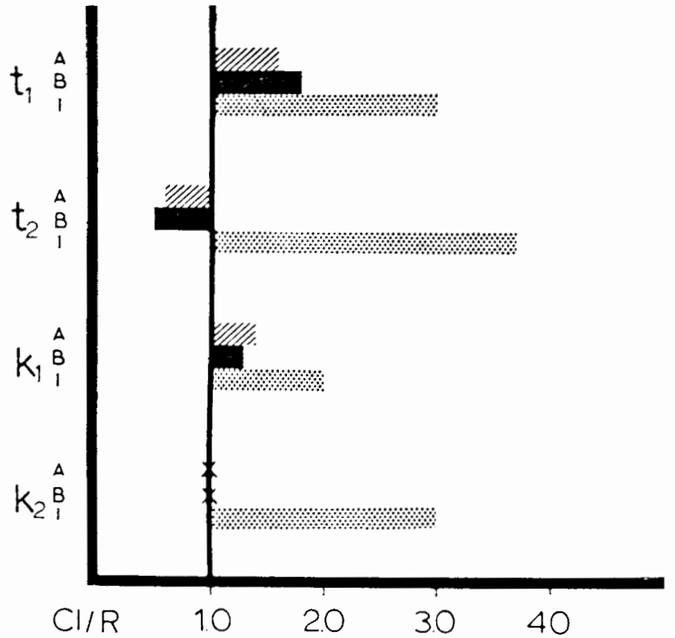

Fig. 5. Closure/release duration ratios in contrasted phonetic environments. 1 = Unity.

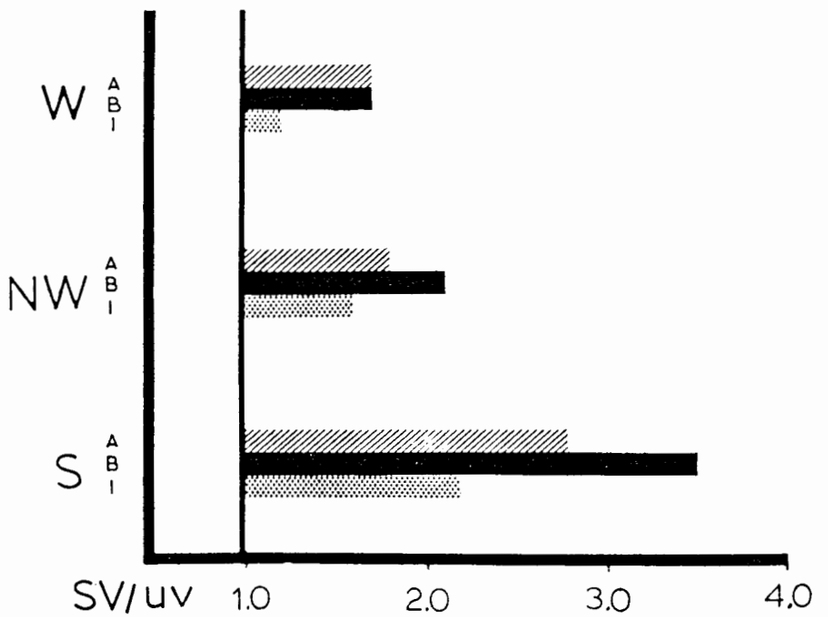

Fig. 6. Stressed vowel/unstressed vowel duration ratios in contrasted phonetic environments. 1 = Unity.

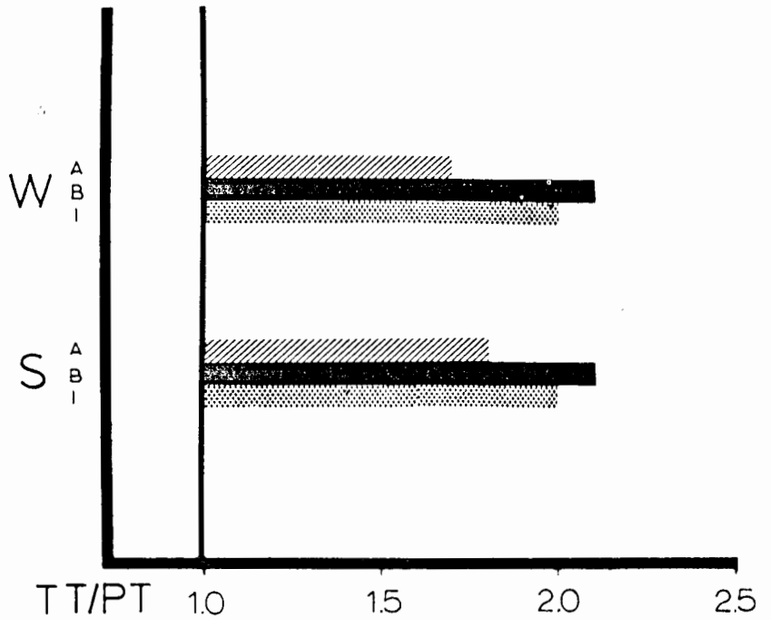

Fig. 7. Total time/phonated time ratios for isolated words and for sentences. 1 = Unity.

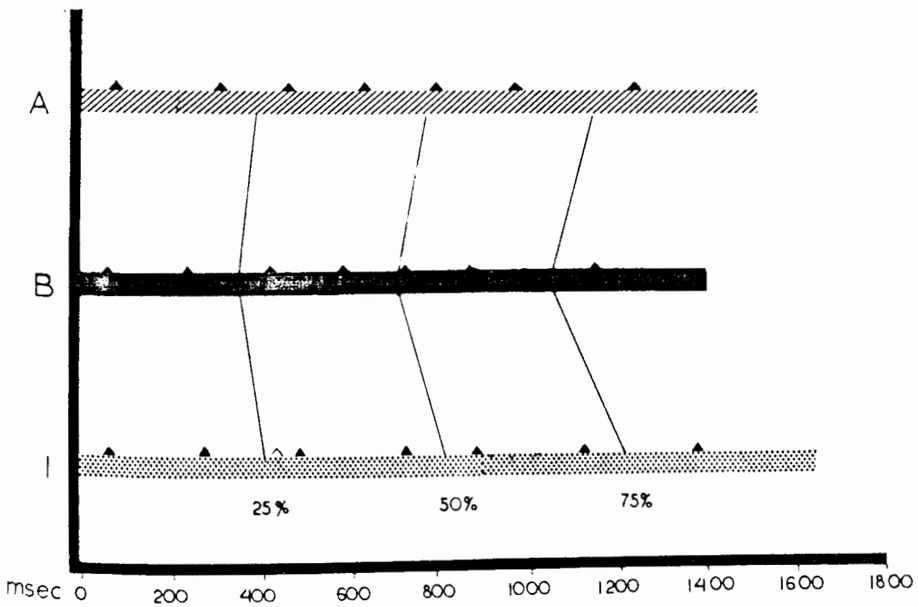

Fig. 8. Relative syllable timing in the sentence *the traveler took off his cloak.*

remarkably stable for these different utterance types. British English shows the highest preponderance of unphonated time per utterance and American English the least, with Indian English ratios intermediate but closer to British than to American values. It has been suggested that the relationship of phonated to unphonated time in speech may be one measure of a legato vs. staccato speech mode (Hanley, Snidecor and Ringel 1966).

The final figure, Figure 8, shows the temporal relationships of the succession of syllables in the utterance *the traveler took off his cloak*. The lengths of the dialect bars reflect the differences in the mean duration of the total utterance. The light vertical lines connect the 25, 50 and 75% points in the utterance. All subjects had reached the 25% point midway in the word *traveler*, the 50% point shortly before uttering the vowel of the word *off* and the 75% point between the vowels of the two words *his* and *cloak*. The relative lag in the Indian timing begins to show up clearly by the 50% point and is conspicuous with respect to the relationship between the 75% point and the final two syllable centers (Bolinger and Gerstman 1957).

In summary, comparative duration data on three dialects of English show systematic differences across dialects in sound segment duration relationships and in syllable timing. These differences are apparent within syllables in the ratios of consonant to vowel and the ratios of consonant closure to release. In words and sentences, differences are also apparent in the temporal ratios of stressed vowel to unstressed vowel, in the ratios of total time to unphonated time and in relative syllable timing.

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DISCUSSION

VON RAFFLER ENGEL (Nashville, Tenn.)
I have observed that dialectal difference in CV ratio correlates with a rhythmic difference and would like to know if your data indicate the same type of correlation?

BUSH
I have not yet had time to look at the overall rhythm effects in these data. I am pleased to learn that your own work has shown comparable effects across other dialects. I would expect similar effects to show up in these data.

GAGE (Washington)
Do you have any feeling as to what are likely to be the most important factors among the things you mention in creating the perceived differences among the dialects?

BUSH
I do not think we have enough information yet to answer that question. It is exciting that there has been such a resurgence of interest in the temporal aspects of speech — and that the hearing sciences are increasingly interested in the temporal resolving power of the ear. JNDs for absolute judgments on non-speech obviously have limited relevance to the question of how a listener perceives speech — let alone identifies a dialect when it has been made unintelligible. That is the reason for concentrating here on relative rather than absolute measurements. The next few years look hopeful for some synthesis of information on temporal processing in speech production and perception.