AN ACOUSTIC ANALYSIS OF BOUNDARY-SIGNALING DIFFERENCESBETWEEN LANGUAGES WITH CONTRASTIVE AND NON-CONTRASTIVE DURATION

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1. INTRODUCTION

Languages with contrastive duration tend not to utilize duration for additionalgrammatical functions (Engstrand and Krull 1994). It may thus be expectedthat they will behave differently from languages with non-contrastiveduration, with regard to boundary signalling. The acoustic analysis undertaken in the present study aims atproviding further support for this assumption by examining the temporalpatterns apparent within the paragraph. In this paper it is hypothesizedthat, in the above two types of languages, paragraph-boundary signalling differences correlate with differencesevident in the realization of temporal patterns within these speech units.It is argued that, in languages where duration is not contrastive, thedurational increase signalling aboundary co-occurs with a greater degree of durational variation within theparagraph.

The project reported on here is a direct continuation ofa pilot study examining the issue indicated above in six languages: threewith contrastive, and three with non-contrastive duration (McRobbie-Utasi 1999). In that study it wasconcluded that the two observed tendencies -- (i) durational variationsrealized in connection with sentences in different positions as well as inintersentential pauses, and (ii) preboundary lengthening -- are realized differently, depending on the languagetype (i.e., on whether duration is contrastive or non-contrastive).Further, it was hypothesized that languages with contrastive duration tendto maintain durational ratios betweenlong and short segments. Consequently, in languages where duration is notlinguistically significant, a greater degree of variation could be expectedat the segmental level. It is in connection with this latter issue thatthe present study further explores temporal patterns by way of (i) identifying segment durational patterns in both types of languages, and (ii) relating these patterns to the tendencies reported on in McRobbie-Utasi 1999.

2. THE EXPERIMENT

Recordings of six paragraphs by eight speakers wereacoustically analyzed. Each paragraph consisted of three sentences(henceforth A, B and C). The sentences in the six paragraphs were thesame, except in their ordering. Each speaker was asked to translate the same paragraph. In the experimentthere were nine languages in total, five with contrastive, four withnon-contrastive duration. The languages with contrastive duration wereHungarian, Latvian, Hindi, Finnish, and Korean; those with non-contrastive duration were English, Cantonese,Brazilian Portuguese, and Russian. The experiment was designed with the objective of first making thesubjects familiar with the text. They were informed as to the purpose ofthe study only after the recording had taken place. Altogether 108paragraphs were analyzed.

3. RESULTS AND DISCUSSION

3.1 TEMPORAL PATTERNS

The general tendency that was observed insentence duration will be summarized here in relation to the sixconfigurations of sentence ordering. Mean durations and standarddeviations were obtained for each of the three sentences separately in the three positions.These durational values were examined by relating them to the mean sentenceduration (i.e., Ýx of A sentences, Ýxof B sentences, and Ýx of C sentences, in allthree positions). Divergences from the mean, indicating the degree ofvariation associated with the ordering of the sentences within theparagraph, are summarized in Figure 1. It may be observed that (i) it is the third positionin which durational variations are most apparent, and (ii) these variationsare greater for languages with non-contrastive duration.

In connection with the two intersentential pause durations, the patternthat emerges in 69 out of the 108 paragraphs implies the existence of aninteresting tendency: first, it was observed that paragraph durationstend to have relatively small standard deviation values; second, it is in the third sentence position thatthe greatest degree of variation was observed (see Figure1). If we assume that speakers tend to conform to a durational target (the experiment being designedin such a fashion that speakers were familiar with the text), we mayhypothesize that towards the end of the paragraph the durational variationsobserved may function as timing adjustments. Further, the 69 sentences (a number indicating greater thanchance occurrences) confirm the assumption that the duration of the secondintersentential pause also plays a role in this timing adjustment.Keeping to a durational target for theparagraph, as indicated by the degree of variability associated with theparagraph-final sentence and the second intersentential pause duration, isvalid for languages with contrastive and non-contrastive durationalike.

Variations in duration of the last word in the paragraph were examined withthe objective of discovering a possible pattern indicating an increase induration in paragraph-final sentence positions. In comparing thesemeasurement values with those in the first and second sentence positions, the following tendency could be observed: (i) while durationalvariations were manifested in all positions, it is in the paragraph-finalposition that they register mainly as increases in duration; (ii) theseincreases, while apparent in both language types, are of a greater degree in languages with non-contrastiveduration. Subsequently, variations in duration of the last syllablein the paragraph were related to last syllable durations in the threesentences in different positions. The results emerging from the present project are comparable to those reported inMcRobbie-Utasi 1999. Measurements from three additional languages confirmthe existence of a distinct pattern in the two language types. Languageswith contrastive duration havea lesser degree of durational increase in the last syllable than dolanguages with non-contrastive duration.

3.2 SEGMENT DURATIONS

In examining segmental durations, the hypothesistested in this project was that languages with non-contrastive duration will manifest a greater variation in segments than those languages withnon-contrastive duration. The rationale that underlines this assumptionwas that the maintaining of distinctions between short and longsegments -- such distinctions being linguistically significant -- would constrain thevariations in duration in languages with contrastive durations. It wasthus further hypothesized that the durational distance between long andshort segments would have to be

kept preserved -- variations at thesegmental level being constrained by the grammatical function ofduration.

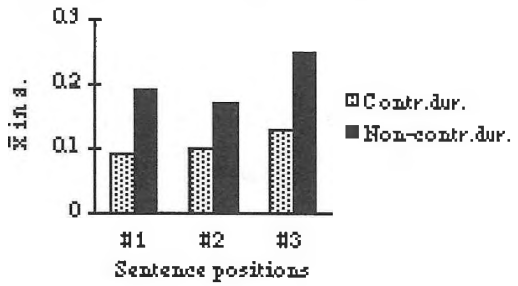

Figure 1. Sentence level durationalvariations

At this stage of the project only vowel segments have been examined. Inlanguages where duration is contrastive, vowels were divided into fourgroups (due to the fact that only three sentences were analyzed, not allthe texts contain representatives of each of these groups for the same vowel): stressed long vowels, unstressedlong vowels, stressed short vowels, andunstressed short vowels. In languages with non-contrastive duration it wasthe stressed vowels (both primary and secondary stressed) that weremeasured.

In connection with durational variation at the segmental level in languageswith contrastive duration the following tendencies were identified: (i)long stressed vowels occur with the greatest degree of durationalvariation, and (ii) the smallest degree of variation occurs in connection with short unstressed vowels. Anexample from Latvian illustrates this tendency: the durational increase or decrease observed forlong stressed vowels is within the range of +/- 41 msec, for longunstressed vowels +/- 26 msec, for short stressed vowels +/- 30 msec, andfor short unstressed vowels +/- 13 msec. In examining the additional three languages, it was observed that themaintenance of durational distance between short and long segments may berealized differently in relation to the degree of the durational variationsobserved. The range of the variation may be similar to that observed in Latvian (see example above); or itmay be larger (such as, for example, in Finnish, where the durational increase or decrease for long stressed vowel is withinthe range of 67 msec, for long unstressed vowels +/- 48msec, for short stressed vowels +/- 60 msec, and for short unstressedvowels +/- 59 msec). It appears that differences in terms of the range ofthese variations are language specific. The manifestation of durational variationimplies the presence of a pattern that assures the keeping of durationaldistance between long and short vowels within values serving thelinguistically significant distinguishingfunction.

Durational measurements of primary stressed vowels in languages whereduration is non-contrastive show a noticeably high degree of variation;measurement values in Brazilian Portuguese indicate an increase or decreasewithin the range of +/- 76 msec, in Cantonese +/- 91 msec, in Russian +/- 103 msec, and in English+/- 80 msec. The degree of variation attested to vowel segments bearingsecondary stress is lesser (in Brazilian Portuguese within the range of+/- 51 msec, in Cantonese +/- 78msec, in Russian +/- 90 msec, and in English +/- 67 msec).

Figure 2 summarizes the differentdurational patterns as described above in connection with the two languagetypes.

In evaluating the tendencies with regard to thedurational variations associated with segments as presented above, it may be stated that

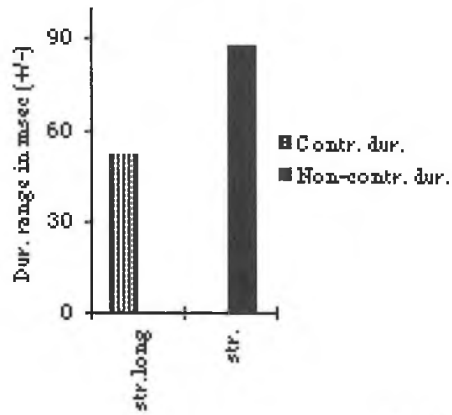

Figure 2 . Differences in vowel durationalvariations between the two types of languages

languages withcontrastive duration behave according to two distinct patterns: (i) thosewhere there is clear evidence of keeping the durational ratios ofthe segment constant, such as in Estonian (Krull and Engstrand 1994, Krull 1999) and in Saami(McRobbie-Utasi 1994), and (ii) those where it is important to maintain aclearly identifiable durational distance between short and long segments(such as in those languages examined in thepresent project).

4. CONCLUSIONS

A comparison of the realization of temporal patterns evident within theparagraph elicited during the course of this controlled experiment showsthat the two language types -- those with contrastive duration, and thosewith non-contrastive duration -- differ in the degree of variation associated with the paragraph constituentsexamined, and that this difference correlates with the degree of durationalincrease signalling boundaries. The apparent tendency for the maintaining of durational differences between long and short segments impliesthat, in languages with contrastive duration, durational increase plays alesser role in signalling the paragraph boundary than in languages withnon-contrastive duration where paragraph-final lengthening is more evident. (Because of the relatively smalldata base these conclusions can be considered as no more than tentative).

5. REFERENCES

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