

MULTILINGUAL PROSODIC RULES
-Introducing a new project-

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ABSTRACT – A new project on typologically motivated prosodic analysis is described. It uses three prototypical languages - Japanese, Eskimo and Yoruba – which are chosen on the grounds of how they use duration and F0 for signalling lexical properties.

INTRODUCTION

In this paper, I would like to present the main concept and some preliminary findings regarding our new project 'MULTILINGUAL PROSODIC RULES – with specific reference to Eskimo, Japanese and Yoruba'. The project has received financial support from the Swedish Council for Research in the Humanities and Social Sciences (HSFR). It started in July 1992 and is planned to run for three years.

The study of prosody has attracted a considerable amount of attention in the past few decades. At home in Sweden, models of prosody which were originally proposed for Swedish had considerable influence in deepening knowledge of prosody in general. These are models of segment duration (Lindblom & Rapp 1973, Carlson & Granström 1986) as well as models of intonation (Öhman 1965, Bruce & Gårding 1978, Bruce & Granström 1989).

Prosodic research in Lund is characterised by its coverage of a wide range of languages and a wide range of applications. Languages whose prosodic aspects have been studied in Lund include English, Arabic, German, Chinese, French, Greek, Hausa, Japanese, Eskimo, Yoruba, and various Swedish dialects. Some of these languages were studied/are being studied in connection with such areas as (1) speech technology (automatic speech recognition and text-to-speech), (2) hearing disorders, and (3) comparative studies and foreign language acquisition. Many of the studies have focussed on not only one, but two dimensions of prosody, namely intonation and rhythm. Some of the recent work has described the variation in the use of the two dimensions more systematically (Bruce et al. 1991). Lund has also carried out a project in collaboration with UCLA on the 'Phonetic analyses of some non-European languages (LUCLA)' sponsored by HSFR (Gårding et al. 1986). The project MULTILINGUAL PROSODIC RULES is the continuation of the Lund tradition in prosody with some new aspects, its essential characteristics are found in the forthcoming dissertation by Nagano-Madsen (in press).

The first aspect of the project is the integration of the temporal and tonal dimensions. In the study of prosody, it has been more common to study one of the dimensions of prosody as an isolated phenomenon. Most of the studies are either on intonation or on rhythm. More recently, several researchers have paid attention to both temporal and tonal structures from different perspectives (cf. Bruce 1991, Nagano-Madsen in press). The prosodic integration presented in the project is based on the assumption that certain aspects of prosodic patterns, both at linguistic and acoustic levels, are related to and constrained by the structural property of the language, such as syllable structure and whether it uses pitch or duration for contrastive purposes.

The integration of the temporal and tonal dimensions allows us to approach the second aspect of the project. It introduces a prosodic typology across intonational and rhythmic categories based on the use of pitch and duration in a language. Following these criteria, prototype languages are selected as duration-oriented (Eskimo), pitch-oriented (Yoruba), and duration/pitch oriented (Japanese). Although contrastive studies are numerous in the area of prosody, many of these studies have chosen languages on a random or expedient basis rather than on a strictly typological or theoretical basis. Studies which are based on typological considerations deal typically with the durational (rhythmic) aspects of spoken languages following a traditional classification such as stress-timing and syllable-timing (Dauer 1983, Strangert 1985, Fant et al. 1991). Typological studies on the tonal aspects of speech are less common and studies which involve both durational and tonal dimensions simultaneously are even rarer.

The third aspect of the project is that it deals with prosodically interesting, but hitherto less commonly studied languages in the phonetic literature. The three languages representing prototypical non-stress languages are Eskimo, Japanese, and Yoruba. They differ in the use of prosodic dimensions as

follows: Eskimo is a typical quantity language in which all the segments have durational contrast, whereas pitch is not used contrastively. Yoruba, on the other hand, is a typical tone language with three lexical tones, where duration is not used contrastively. Japanese comes somewhere in between. These languages are grouped together as non-stress languages as opposed to stress languages such as many Germanic ones (English, Swedish etc.).

PURPOSE AND PROBLEM

The project MULTILINGUAL PROSODIC RULES expands the approach introduced in Nagano-Madsen (in press). Its ultimate goal is to contribute to the theory of prosody. Specifically, it promotes the theory which views a prosodic pattern of a given language as partly a predictable phenomenon on the basis of typology. This view specifies that certain prosodic categories and their acoustic patternings are related to and therefore determined by the phonological and lexical properties of the language.

Because our knowledge in prosody is obtained mostly from European languages - Germanic languages, and stress languages such as English, Swedish, and Dutch - and because the relationship between temporal and tonal dimensions are more complicated in these languages, partly because of the category stress, our understanding of the integrated aspects of prosody leaves many unsolved questions. The choice of the three languages presented in the project gives us an advantage in this respect since in these languages the use of pitch and duration are more clearly defined and related.

In taking such a typological approach, the main problem is to state exactly what aspects of prosodic patterns are likely to be a consequence of structural properties and what aspects are not. An affiliated question is, to what extent the isolated parameters and rules can vary quantitatively and how much of it has to be stated purely as a language specific rule.

In comparing the temporal pattern of a typical quantity language and a non-quantity language, we may expect that the durational variability in the former is smaller than in the latter since the segment durations are used contrastively in the former. However, we do not know exactly in what way this difference in variability arises, e.g. if the variability is scattered over the entire utterance or if it concentrates on some selected points. Our preliminary results favour the latter possibility. In the material, it is shown that in utterance medial position, both the absolute value and the variability in syllable duration were found to be extremely similar for the two types of languages. A large difference was found in utterance final, prepausal position and a significant difference was found in utterance initial position.

In Nagano-Madsen's dissertation, three basic ways by which temporal and tonal dimensions of prosody can be coordinated are identified - synchronization, quantum relation, and dependence and independence of the prosodic features. As for the durational patterns, the location in the utterance where the typological effect may be concentrated and the degree of variation are discussed.

The proposed project extends the lines of this work by first supplementing the information on durational aspects and completing the durational parameters and rules. Later in the project, intonational aspects will be investigated using a parallel approach. At the final stage, the obtained parameters for the three non-stress languages will be compared with those for stress languages like English and Swedish, thereby bringing in the tentative parameters and rules which characterize prototypical typological differences found in the prosodic structures among languages.

PRELIMINARY RESULTS ON THE SYNCHRONIZATION PARAMETER

'Synchronization parameter' refers to the way temporal and tonal dimensions are timed at certain critical points. In autosegmental phonology, this concept is expressed by the association of tone with a specific vowel (Goldsmith 1976). In phonetic terms, this notion must be stated more explicitly. At the physiological level it can be regarded as the synchronization of phonatory control with articulatory control at a number of specific points. At the acoustic level it is identified as the synchronization of F0 reference points, usually F0 maxima, with continuously changing spectra.

Timing of F0 relative to articulatory events has been recognized as a keynote in the phonetic analyses of word accent. In the model of intonation developed in Lund (Bruce & Gårding 1978), the F0 maxima and minima are extracted as acoustic reference points and termed turning points. This is based on

earlier observations that certain F0 maxima and minima are well fixed to segments across different environments. Turning points determine the timing and range of local F0 rises and falls connected with tones and accents. Broad success in applying this notion to languages of different prosodic types implies that turning point parameters can provide certain clues as to the prosodic typology, in particular as to the phonetic manifestation of pitch accent and tone.

In a study of Hausa intonation within the framework of the Lund Model of Intonation Lindau (1986) writes

"...the maxima and minima of the F0 contour do not generally coincide with the middle of the vowel, as one might expect. Instead, there is a strong tendency for the turning points in sentences with alternating highs and lows to occur at, and around, the syllable."

This situation, however, is not peculiar to Hausa. Whether it is a syllable or mora boundary is less critical here since what Lindau refers to is CV-CV boundary. These phenomena have been recognized for Japanese for some time (Fujisaki et al. 1976, Nagano-Madsen and Eriksson 1989, Masaki et al. 1990) and also found for Eskimo (Nagano-Madsen 1988). Figure 1 shows a Japanese utterance *sorewa komadori desu* 'it's a komadori (a kind of bird)' where the synchronization point is indicated by a vertical line.

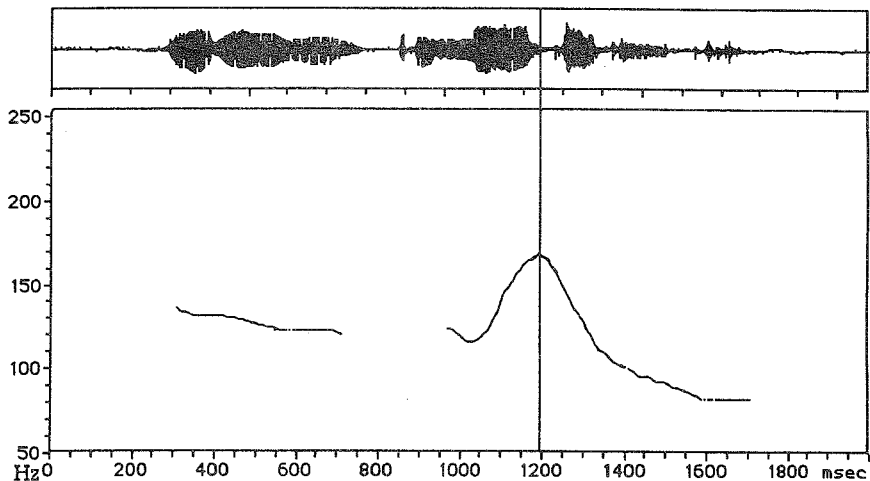


Figure 1 Synchronization between a F0 turning point and segments in Japanese.

In a language like English, the location of F0 turning points is likely to occur in a vowel with some systematic variation for different factors. For example, Steele (1987) found that the location of the F0 peak is varied differently depending on whether the lengthening was induced by change in vowel quality and speaking rate or by final lengthening. With the former, the F0 peak relative to vowel onset varied systematically as a function of the vowel's overall duration. With the latter, the F0 peak did not show systematic variation but rather occurred constantly early in the vowel. Similar results were found in for the timing of pre-nuclear high accents in English with respect to the following nuclear accent (Silverman & Pierrehumbert 1990). The relationship between peak delay and vowel length was found to be a function of the length of the syllable rhyme when a vowel is lengthened by speaking rate.

These differences between languages like Japanese and English are in good agreement with Hockett's (1958), who defined the Japanese mora (syllable in his term) in terms of duration rather than in terms of onset and peak. They also agree with findings that Japanese speakers, in contrast to speakers of English, are not aware of the onset rhyme boundary (Kubozono 1985). What is common to these languages in which turning points occur at and around the CV-CV boundary is that they are mora-counting languages and that they use a register tone to mark linguistic function, be that free accent as in Japanese, phrase final intonation in Eskimo, or distinctive tone as in Hausa.

In languages like English and Swedish, stressed syllables (which are typically heavy syllables) can be associated with contour tone as part of the phonological shape of tonal accent or as part of an intonational morpheme. The entire contour tone, e.g. HL, LH etc., is timed with the entire rhyme of the heavy syllable and this can not be split further. In Japanese, each H and L is timed with the first and the second mora in a heavy syllable as shown in the second experiment in this chapter. Heavy syllables in Japanese are clearly the sum of two independent units. It follows, then – although Japanese has also been analysed as having heavy and light syllables (cf. Abe 1986) – that their nature is quite different from that in a language like English.

If we assume that the synchronization parameter correctly describes and predicts certain prosodic features in a given language (cf. Nagano-Madsen in press, for possible relations between prosodic features), this single parameter may be used as a convenient acoustic parameter for a typologically motivated study of prosody.

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REFERENCES

- Abe, Y. (1986) *Metrical structure and compounds in Japanese*. In T. Imai and M. Saito (eds.), *Issues in Japanese Linguistics*, 5-52. (Foris Publications: Dordrecht).
- Bruce, G. (1991) *Alignment and composition of tonal accents: comments on Silverman and Pierrehumbert's paper*. In J. Kingston and M.E. Beckman (eds.), *Papers in Laboratory Phonology I*, 107-114. (Cambridge University Press:Cambridge).
- Bruce G. and E. Gårding. (1978) *Prosodic Typology for Swedish Dialects*. In E. Gårding, G. Bruce, and R. Bannert (eds.) *Nordic Prosody I*, 219-228. (Gleerups: Lund).
- Bruce, G. and B. Granström. (1986) *Modelling Swedish intonation in a text-to-speech system*. In proc. of Fonetik-89, Speech Transmission Laboratory Quarterly Progress and Status Report 1/1989, 17-21. Department of Speech Communication & Music Acoustics, Royal Institute of Technology, Stockholm.
- Bruce, G. and B. Grandström, and D. House. (1991) *Strategies for prosodic phrasing in Swedish*. In Proceedings of the XIIIth International Congress of Phonetic Sciences, vol.4, 182-185. Aix-en-provence.
- Bruce, G., P. Touati, A. Botinis and U. Willstedt. (1988) *Preliminary Report from the KIPROS project*. Working Papers 33, 23-50. Department of Linguistics and Phonetics, Lund University.
- Carlson, R. and B. Granström. (1986) *A search for durational rules in a real-speech data base*. *Phonetica* 43, 140-154.
- Dauer, R.M. (1983) *Stress-timing and syllable-timing reanalyzed*. *Journal of Phonetics* 11, 51-62.
- Fant, G., A. Kruckenberg, and L. Nord. (1991) *Language specific patterns of prosodic and segmental structures in Swedish, French and English*. In Proceedings of the XIIIth International Congress of Phonetic Sciences, vol 4, 118-121. Aix-en-provence.
- Fujisaki, H., H. Morikawa and M. Sugito. (1976) *Temporal organization of articulatory and phonatory controls in realization of Japanese word accent*. Annual Bulletin of Research Institute of Logopedics and Phoniatrics 10, 177-190. Faculty of Medicine, University of Tokyo.
- Gårding, E., M. Lindau, K. Norlin and J-O. Svantesson. (1986) *Final report: phonetic analyses of some non-European languages*. Working Papers 29, 115-138. Department of Linguistics and Phonetics, Lund University.
- Goldsmith, J. (1976) *An overview of autosegmental phonology*. *Linguistic Analysis* 2, 23-68.

- Hockett, C.F. (1958) *A Course in Modern Linguistics*. (The MacMillan Company: New York).
- Kubozono, H. (1985) Speech errors and syllable structure. *Linguistics and Philology*, no.6, 220-243.
- Lindau, M. (1986) *Testing a model of intonation in a tone language*. *Journal of the Acoustical Society of America* 80, (3), 757-764.
- Lindblom, B. and K. Rapp. (1973) *Some temporal regularities of spoken Swedish*. *Papers from the Institute of Linguistics* 21. University of Stockholm.
- Masaki, S., F. I. Tatsumi, and S. Sasanuma. (1990) *Analysis of temporal coordination between articulatory movements and pitch control in the realization of Japanese word accent by a patient with apraxia of speech*. In *Proceedings of the 1990 International Conference on Spoken Language Processing*, vol. 1, 597-600. Kobe.
- Nagano-Madsen, Y. (1988) *Phonetic reality of the mora in Eskimo*. *Working Papers* 36, 123-132. Department of Linguistics and Phonetics, Lund University.
- Nagano-Madsen, Y. (In press) *Mora and Prosodic Coordination. A phonetic study of Japanese, Eskimo and Yoruba*. (Lund University Press: Lund).
- Nagano-Madsen, Y. and L. Eriksson. (1989) *The location of the F0 turning point as a cue to mora boundary*. Paper from the Third Swedish Phonetics Conference, Speech Transmission Laboratory Quarterly Progress and Status Report 1:41-45, Department of Speech Communication & Music Acoustics, Royal Institute of Technology, Stockholm.
- Öhman, S. (1965) *On the coordination of articulatory and phonatory activity in the production of Swedish tonal accents*. *Speech Transmission Laboratory Quarterly Progress and Status Report* 2/1965, 14-19. Department of Speech Communication & Music Acoustics, Royal Institute of Technology, Stockholm.
- Silverman, K.E.A. and J.B. Pierrehumbert. (1990) *The timing of prenuclear high accents in English*. In J. Kingston and M.E. Beckman (eds.). *Papers in Laboratory Phonology* 1, 72-106. (Cambridge University Press: Cambridge).
- Steel, S. (1987) *Nuclear accent F0 peak location: effects of rate, vowel, and number of following syllables*. *Journal of the Acoustical Society of America* 80, 51.
- Strangert, E. (1985) *Swedish Speech Rhythm in a Cross-Language Perspective*. *Umeå Studies in Humanities* 69. (Almqvist & Wiksell International: Stockholm).