

DECLINATION LINE AND TONES VARIATIONS IN STANDARD CHINESE

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ABSTRACT

Chinese is a tone language. As a tone language, each lexical item has an inherent tone pattern. In Chinese there are four tones : high, rising, low and falling. Our experiment investigates first the pattern of declination in Standard Chinese broadcasts and TV news speech, secondly the interaction of this effect with the sentence length and finally the evolution of the tones F0 values all through the sentence. Furthermore, we have investigated the prosodic structure of the newscast discourse.

1. INTRODUCTION

Tone languages such as Chinese present an observable F0 patterns as a combination of multiples factors. Both lexical tones (there are four tones in Chinese : high, rising, low, falling) and intonation are primarily realised in pitch. So it is of great interest to characterise the relationship between tone and intonation. Chinese has attracted considerable attention from researchers with such issues as the relationship among the major component of prosody : tone, stress, rhythm, and intonation. There is a great deal of interplay between tone and intonation. Besides, it is fairly well-recognised that, prosodically, all languages organise spoken discourse into intonation units.

During the last decade great attention has been paid to the so-called declination of the fundamental frequency contour and to the lowering of the peaks of accentuated syllables towards the end of the declarative sentence. Declination refers to the fact that the pitch (strictly speaking fundamental frequency) of the voice is lower at the end of a sentence than it is at the beginning. The existence of the declination line and its origins are regularly questioned. There are two assumptions to explain this phenomenon : one of the most common hypothesis is that the declination is due to physical constraints. The drop of F0 is due to the drop of subglottal pressure. The other hypothesis is that declination is a pre-planning strategy of the speaker, conditioned by the length of linguistic units eg. length of sentence. The

declination of F0 is partially planned by the speaker so that speaker often adjusts the rate of declination according to the length and the syntactic structure of the sentence.

Concerning the Chinese language, Shih Chilin (1997) has found for isolated mandarin high level tone sentences that there is a clear declination effect, stronger in magnitude than previously reported, and that declination interacts with sentence length and focus.

Each language articulates its messages according to a particular code. There isn't any language which it uses only monotone. So intonation has its importance in the transmission of the messages, and its various patterns convey for the members of a community precise meanings. Speakers use prosodic means (among other) to communicate to listeners the structure of the message that they wish to impart. Intonational prominence, in particular, is a prosodic device which principally serves as an indicator of the message structure. Moreover, it is a phenomenon of considerable cross-linguistic generality. Concerning the structure of discourse it is fairly well recognised among researchers that, prosodically, the majority of languages organise spoken discourse into intonation units. Previous studies on prosodic structures and discourse organisation (Yang Lichung, 1995) have demonstrated for English that pitch movements shows that discourse is hierarchically organised by intonation. Topic initiations often begin with a high pitch level while endings are marked by a low pitch level or a narrow pitch range. A shift in discourse topic is accompanied by raised F0 (reported for English, Japanese, Scottish English, American English).

Undoubtedly, Mandarin speakers use intonation as a linguistic resource to express various aspects of modality, emotion, attitude and to perform other interactional functions just as speakers of other languages do. It should be noticed that the majority of works studying F0 declination line is based on the analysis of laboratory speech consisting of isolated sentences pronounced out of context and usually read rather than produced naturally. Some claims based on

isolated, controlled sentences have a limited stage of application for natural discourse data. Our experiment try to analyse the declination effect in TV and radio news, and the prosodic structure of such discourse.

II. MATERIAL

The speech materials we used for this experiment are composed of a set of radio and televisual news pronounced by different speakers. The radio newscasts were recorded in Beijing, and the televisual newscasts on CCTV 4 in France via a satellite equipment, and on CCTV in China. Because it is an ongoing research, the speech material which served for this communication consists in a radio newscasts record (pronounced by a male speaker) and a record of televisual national and international news (pronounced by a female speaker).

The radio corpus is composed of two paragraphs and fifteen sentences, each sentence including from 8 to 40 syllables which are grouped from one to two clauses.

The first televisual newscasts corpus which served for this paper is composed of three paragraphs with a total of 15 sentences from 19 to 70 syllables grouped from 1 to 5 clauses. The second one is composed of three paragraphs with a total of 12 sentences. In this corpus there are many enumerations.

III. WHY DID WE CHOOSE A RADIO AND TV NEWSCASTS CORPUS ?

There are several reasons for choosing radio or TV news. Several features are common to radio and TV newscasts all over the world such as monology, reading aloud, standard pronunciation, extremely clear articulation, objective (neutral) but convincing presentation and the absence of immediate listeners. Furthermore, some speech acts, such as questions or exclamations, can't occur in newscasts, which limits the prosodic patterns. Due to their regularity radio and TV news are a very interesting speaking style to overlook the relationship that can exist between syntax and prosody. Furthermore, this kind of corpus is syntactically complex and highly informative.

IV. MEASUREMENTS AND METHODS

After recording, the speech materials were digitalised at a 22 Khz sampling rate and than were analysed, segmented and hand-labelled. In order to describe the phenomenon of declination and the mannerisms in newsreading we have investigated several parameters :

- the global F0 curves
- F0 was measured at three points of the tone, 10 ms after the beginning, at the middle and 10 ms before the end of the tone.
- F0 distribution (mean, standard deviation, minimum and maximum)
- pause length (within and between sentences)
- duration of each word, syllable and tone.

SignalizeTM. speech processing system running on a Macintosh was used for analysis. The corpus registered in Beijing was analyzed using Praat 4.0 (developed by Paul Boersma) running on Macintosh.

V. RESULTS

We have paid attention to the global features of the F0 contour considering newscasts as a textual unit, group of sentences as "paragraph" units, and in relation to their contexts, and finally clauses as units within sentences.

Our analysis reveals the following results :

1) the presence of sentence declination line. In figure 1 a global tendency of sentence declination can be observed. The same results have been observed for both corpuses (radio and TV news corpuses). There is a significant effect of sentence length on the F0 values : the longer the sentence is, the weaker the slope is and vice versa.

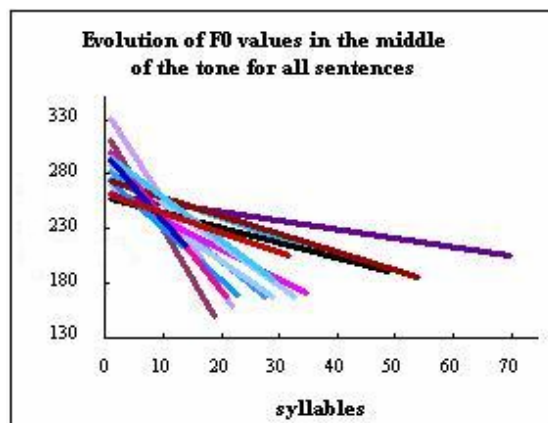


Figure 1 : Example of the evolution of the F0 values for the TV corpus : the longer the sentence is the weaker the slope is.

This result leads us to suppose that there is a programming and a prediction of the length of the sentence. (It seems that the speaker preprograms the length of the sentence). In table 1 below we can see the declining effect in regards to the length of the sentences for radio news corpus. For sentences composed of a few syllables for exemple sentence n°11 composed of 8 syllables the regression coefficient is higher

(-6,93) comparatively of those for sentence n°5 (-0,87) composed of 40 syllables. That is to say that the sentence n°11 declines more abruptly than sentence n°5.

sentence number	regression coefficient	number of syllables
11	-6,93	8
1	-6,39	10
9	-6,69	15
3	-2,91	18
6	-1,52	19
7	-2,56	24
8	-1,95	28
2	-1,96	32
10	-1,03	37
4	-1,13	38
5	-0,87	40

Table 1 : table of regression coefficient of F0 slope in regard to the number of syllables in the sentences.

2) The declination effect for clauses composing sentences. The same results were observed for clauses with the presence of resetting between clauses. (see figure 2). Each clause composed sentence begins with a high F0 value and finishes with a low F0 value, after this decrease the F0 curve is resetting, the following clause begins with a higher F0 value. This result gives us some informations about the syntactic structure.

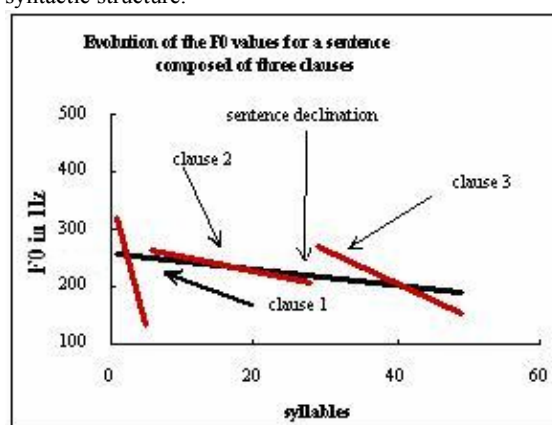


Figure 2 : Example of the evolution of the F0 values for a sentence composed of three clauses

3) The amplitude of resetting of the declination line between sentences is an indicator of the structure of this kind of discourse. Major resetting indicates a change of the subject, which means that a new given information (a new paragraph) is marked by a starting point higher in frequency, as a consequence there is a special structure of the paragraph.

Minor resetting of F0 are observed between sentences. The lowest F0 values were observed at the end of a paragraph ; the last syllable of the paragraph is often pronounced with a creaky phonation, even for a female speaker. The sentence's initial F0 level depends very much on the thematic connection to the previous sentence.

4) The F0 and duration values of the tones evolve according to their position in the sentence. Whatever the tone may be, the F0 value of the tone decreases along the sentence, the low tone varies less than the others.

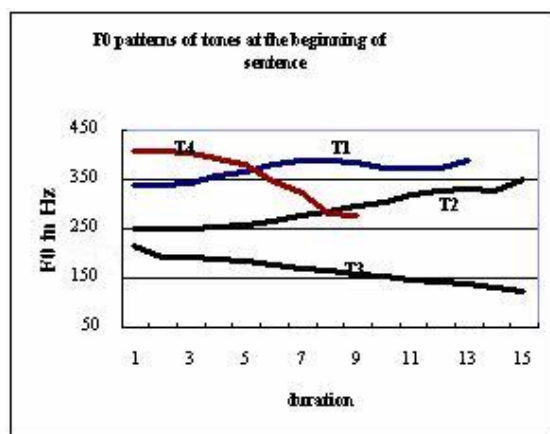


Figure 3 : F0 patterns of tones in the initial position

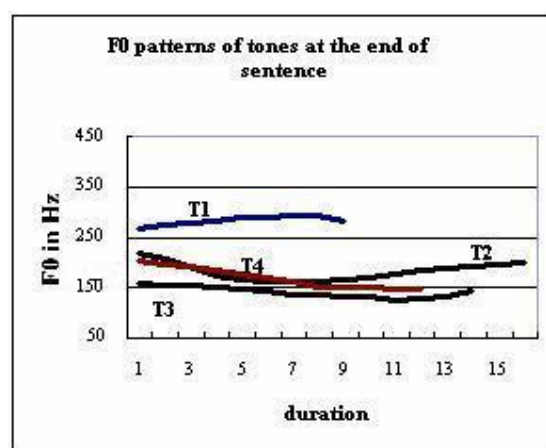


Figure 4 : F0 patterns of tones in the final position

The F0 range of tones is larger at the beginning of a sentence than it is in its end.

In terms of duration. The duration of the tones evolves along the sentence. As in other languages, the syllables are longer at the end of a sentence than in initial position.

Tones are lengthened and F0 values are lowered along the sentence. At the end of a sentence some high tones (T1) have the same F0 values as low tones (T3) at the beginning of the sentence. This result leads us to suppose that the duration of

tones is a relevant clue regarding the syntax structure of such a discourse.

5) The distribution of pauses. Pause duration between and within sentences has also been identified as an indicator of discourse structure. The shortest pauses were observed within the sentences, the longest ones between the sentences. The longest pauses of all were found between the paragraphs. The major pauses between the sentences indicate a change in information.

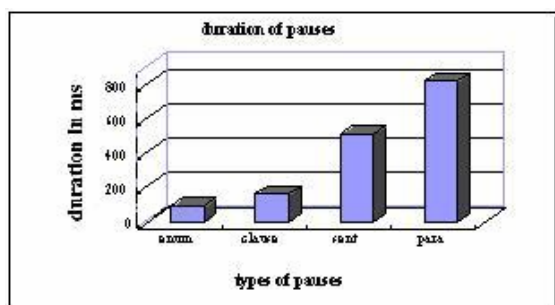


Figure 5: duration of pauses within and between the sentences.

VI. CONCLUSION

To sum up, we can say that in Chinese TV and radio broadcast news as in other languages the discourse is hierarchically organized by intonation. Initiations often begin with a high pitch level or expanded pitch range, while endings are marked by a low pitch level or a narrowed pitch range. The magnitude of the F0 increase corresponds to the hierarchical level of the discourse structure. An increase in F0 range indicates the beginning of a « paragraph » while a final lowering signifies the end of it.

Downstepping between clauses usually occurs when there is a natural elaboration of topic idea which moves towards a settling. The degree of step lowering represents the degree of completeness and finality of the clause relation to the topic hierarchy.

Considering our results, the duration of the syllables preceding boundaries increases as the degree of the prosodic boundaries increase. This effect is more significant on the sentence and the paragraph levels. It is also very close to the syntax structure. Finally pauses between and within sentences give some informations on the syntactic structure. Perception tests are needed to examine which are the more relevant factors to considering the syntax structure in this kind of discourse.

REFERENCES

- [1] BECKMAN M. E. (1995) Local shapes and global trends. *Proceedings of the XIIIth International Congress of Phonetic Sciences*, Stockholm 13-19 August, Sweden, vol. 2, pp. 100-107.
- [2] CAO J. (1995) sandhi tonal and accented/non accented *Zhongguo yuwen*, 4, pp. 312-320 (in Chinese)
- [3] CHAO Yuanren (1933) Tone and Intonation in Chinese. *Bulletin national Institute of History and Philology Academia Sinica*, vol. 4, n°2, 121-134
- [4] FUJISAKI H., HIROSE K., LEI H. (1992) Prosody and syntax in spoken sentences of Standard Chinese. *Proceedings of ICSLP 92*, vol. 1, pp. 433-436.
- [5] GUO J. (1993) *tones and intonation in Chinese, some commentary*. Beijing yuyin xueyuan chubanshe (in Chinese)
- [6] HO A. T. (1976) Mandarin tones in relation to sentence intonation and grammatical structure. *Journal of Chinese linguistics*, 4 (1), pp. 1-13.
- [7] LADD R. D. (1984) Declination : a review and some hypotheses. *Phonology Yearbook*, 1, pp. 53-74
- [8] QIAN Yao & PAN Wuyun (2002) Prosodic word : the lowest constituent in the mandarin prosody processing. *Proceedings of Speech Prosody 2002*, Aix en Provence, 11-13 april 2002
- [9] SHIH C. (1988) Tone and intonation in Mandarin. *Working papers of the Cornell Phonetics Laboratory*, N°3, pp. 83-109.
- [10] SHIH C. (1997) Declination in Mandarin, *Proceeding of ESCA Intonation Workshop*, Athens
- [11] VAISSIERE J. (1983) Language independent Prosodic features. in *Prosody : Models and Measurements*, Cutler A. & Ladd D. eds., Springer-Verlag, pp. 53-66.
- [12] YANG L. C. (1995) Prosodic structures and discourse organization. *Proceedings of ICPHS 95*, Stockholm, p. 274-277
- [13] YANG Yufang & WANG Bei (2002) Acoustic correlates of hierarchical prosodic boundary in Mandarin. *Proceedings of Speech Prosody 2002*, Aix en Provence, 11-13 april 2002
- [14] YUAN Jiahong, SHIH Chilin, KOCHANOSKI Greg P. (2002) Comparison of declarative and interrogative intonation in Chinese. *Proceedings of Speech Prosody 2002*, Aix en Provence, 11-13 april 2002