

Stressed and unstressed morphemes in Korean spontaneous speech

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Abstract

This paper proposes a pilot experiment on Korean spontaneous speech. Based on a corpus recorded from a television debate show in which we have clear speech expressions with grammatically correct utterances, and less disfluency, like hesitations or emotional expression. Phonosyntactic approach is adopted for a global prosodic form. 4 grammatical morphemes were collected and measured in F0 variation and duration, and finally they are classified ‘stressed’ or ‘unstressed’.

Index Terms: intonation, spontaneous prosody, prosodic structure, grammatical morpheme, stress

1. Introduction

Korean prosody has been analyzed according to an Autosegmental-Metric framework point of view (Jun, 2006) or boundary pause perception (Cho, 2009). Despite the number of studies, there are few works concerning a framework to analyze Korean spontaneous speech. In this study, a phonosyntactic approach (Martin, 2006a) will be adopted for the analysis.

Martin’s model is a contrastive prosodic structure framework proposed for French intonation (Martin, 2006), and extended to romance languages. The model assumes that a French prosodic structure is presented through final syllables which are stressed according to French phonology. As French has neither lexical accent, compared to a language like English, nor has a lexical tone, compared to Chinese, for example, French final accents measured through fundamental frequency (F0) show a clear example for a hierarchical structure in intonation. This hierarchy is represented by contrastive F0 movements (rising and falling) which makes the contrastively marked prosodic units “in pair”. This ‘paired prosodic units’ constitute a level in the hierarchy. Each unit can also contain a paired unit, which makes lower level of the hierarchy, and so on.

In Martin (2006a), the prosodic structure analyzed by phonosyntactic approach is compared to the annotation resulting from the Autosegmental-Metric approach.

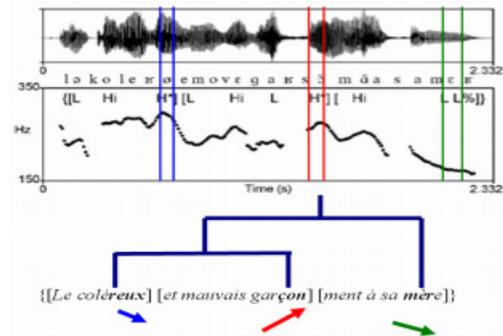


Figure 1: Comparison of two approaches (Martin 2006a)

In Figure 1, a French utterance ‘Le coléreux et mauvais garçon ment à sa mère’ is presented with the signal, annotated by ToBI (Jun, 2002); beneath, is Martin’s phonosyntactic structure.

According to the Autosegmental-Metric framework, there are two APs (Accental Phrase) marked by two accentuated syllables at the right boundary of the domain. ‘-reux’ from ‘coléreux’ and ‘-çon’ from ‘garçon’ are both annotated H*, indicating AP boundary. According to the phonosyntactic approach, these two prosodic units are called PW (Prosodic Word) which might have distinctive prosodic features to show the relation between the two units which are at equal levels of the prosodic hierarchical structure. In Figure 1, the intonation form, ‘-reux’ with descending F0, ‘-çon’ with ascending F0, shows a contrastive F0 movement, and it indicates that these two prosodic units are in a pair.

Korean is a language which can be compared to French concerning the phonosyntactic approach framework; Korean has neither lexical accent nor lexical tones, but is said to have final accents. At first glance, Korean spontaneous speech has prosodic units in an utterance which are marked on grammatical morphemes (so called ‘chosa’ in Korean grammar). This is a first pilot experimental study to discover stressed and unstressed morphemes within a phonosyntactic approach to a prosodic model for Korean. The contrastive F0 feature will be for a forthcoming study; as this is a pilot experimental study concerning the model proposed: measuring the acoustic features in duration and F0 variation of the selected grammatical morphemes, and seeing how the grammatical morpheme behaves as acoustically stressed or unstressed within the assumed global form of the intonation.

1.1. Prosodic model for the analysis

The model proposed for Korean prosody is:

- An utterance is composed by ‘thematic prosodic proposition’ and ‘rhematic prosodic proposition’

- Prosodic units in ‘thematic prosodic proposition’ have a rising F0 form.
- Prosodic units in ‘rhematic prosodic proposition’ have a falling F0 form.
- Within any prosodic unit, there can be a ‘parenthetic prosodic proposition’.

The model proposes 2 propositions that constitute an utterance: thematic proposition, rhematic proposition. These 2 propositions are marked by a global F0 form, rising F0 and falling F0 respectively. A parenthetical proposition might either have an utterance prosodic form or a simple plain F0 form.

The prosodic unit is often ‘*ecel*’ (Nam, 2005) in Korean grammar; it is the smallest unit of a written utterance that can form a phrasal constituent. To make a constituent, a lexical word combines with a grammatical morpheme which is attached at the right end, and it makes one *ecel*. In this study, 4 grammatical morphemes are chosen and they mark nominative and accusative case.

1.2. Hypothesis

The hypothesis for this experiment is:

- Grammatical morphemes are stressed in the thematic prosodic proposition;
- The morphemes become unstressed (‘neutralized’ in Martin’s term) in rhematic prosodic proposition.

For acoustic measurement, stressed morphemes are long in duration and have higher variation in F0.

2. Methods

2.1. Corpus

The corpus is recorded from a television debate program, defused through MBC in 2007, which runs 100 minutes. Two speakers (one male, one female) are chosen in order to gain maximum of the utterances with no superimposed voice, better articulation and no dialect accent, and no emotional expression, but with argumentative attitude expressed, as a whole, in grammatically correct expression. The selection is made according to good articulation in phrases and clear pauses.

The final corpus contains 107 utterances in total, 51 utterances for the female voice, 56 utterances for the male voice. One utterance could be either a sentence which does not finish the utterance or several sentences, including adnominal (namely ‘relative’) phrases, nominalized phrases, embedded phrases, etc. Even though the utterance is not finished perceptively with the predicate ending (i.e., intonation which shows that the speaker has no intention to give the floor to the other speaker), it is treated as a complete utterance if it formed a rhematic descending on the morphological ending.

Among the 107 utterances, the morphemes, -i/lil (namely, accusative particle), -i/ka (namely, nominative particle), are categorized as either stressed or unstressed, then measured in fundamental frequency and in duration, and the results will be compared.

2.2. Utterance analysis

For the first step, each of the 107 utterances were analyzed through global form of F0, visualized through WinpitchPro program. In Figure 2, we can see an example of a Korean utterance ‘*Precisely, the disputed point was the public opinion*

problem’ visualized in F0. The utterance is clearly divided in two parts: ‘A’ and ‘B’. ‘A’ shows a clear global rising F0, and ‘B’ shows a falling F0. We will call the first part marked by ‘A’ as the thematic prosodic proposition and the second part marked by ‘B’ as the rhematic prosodic proposition.

The adnominal phrases, nominalized phrases, and the embedded phrases were considered as separate prosodic utterances or parenthetical prosodic propositions according to their intonation form.

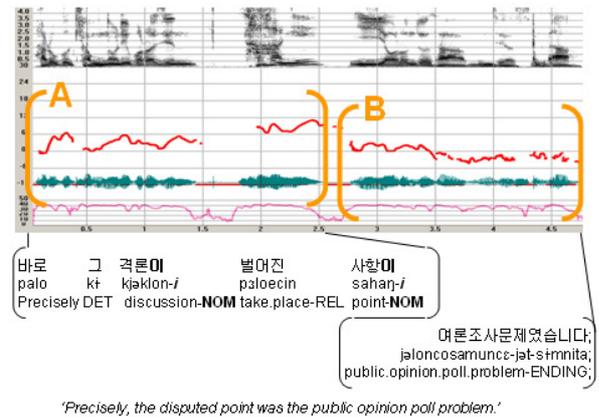


Figure 2: An utterance divided in two prosodic propositions

2.3. Thematic Prosodic Proposition

In the Figure 3, the ‘-i’ nominative morpheme marked ‘A’ with highlight on the image is analyzed as a stressed morpheme; it has the highest F0 pitch with a relatively long duration compared to the other syllables in the prosodic unit.

The ‘-i’ nominative morpheme marked ‘B’ with highlight on the image is also regarded as a stressed morpheme, since it also shows relatively high pitch within the rising F0 form inside the thematic proposition, and it especially shows high pitch within the prosodic unit.

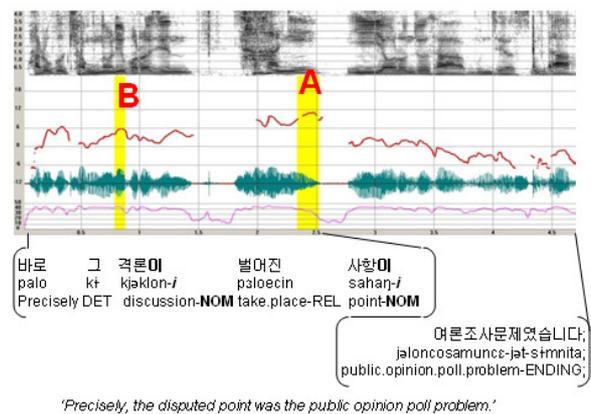


Figure 3: Morphemes in thematic prosodic proposition

2.4. Rhematic Prosodic Proposition

In Figure 4, the highlighted morpheme ‘-i’ in the ‘A’ part is another example of stressed morpheme. Even though it follows a falling F0 of its prosodic proposition, it marks the thematic prosodic proposition by this rising F0 on the right end of the proposition. The second highlighted morpheme in

the rhematic prosodic proposition, 'B' part, is an accusative morpheme, which might be long in duration compared to the preceding syllables, but it is analyzed as unstressed because it has a flat F0 form inside the falling F0 of the rhematic prosodic proposition.

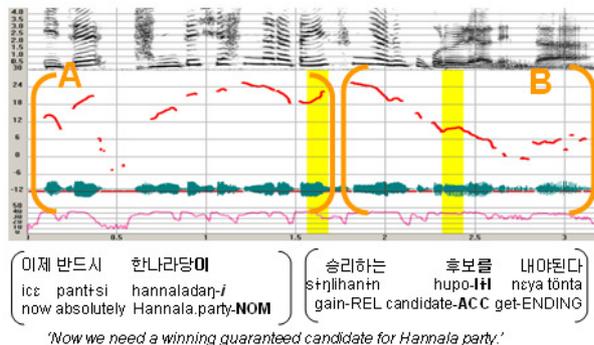


Figure 4: Stressed morpheme in the end of thematic prosodic proposition

The Figure 5 is another example of the unstressed morpheme in the rhematic prosodic proposition. Again this example shows a clear example of an utterance which is marked by a rising F0 as a thematic prosodic proposition and a global falling F0 form for rhematic prosodic proposition. Inside the rhematic proposition, we see an accusative morpheme, neutralized in stress without pause.

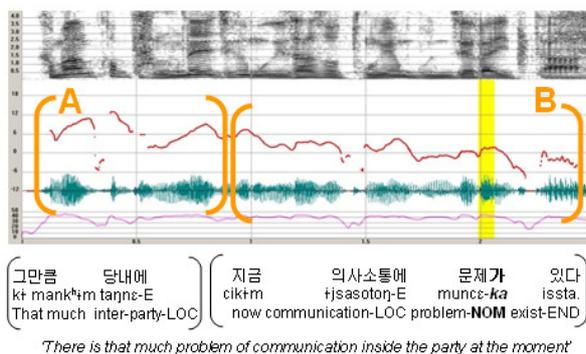


Figure 5: Unstressed morphemes in rhematic prosodic proposition

3. Results

3.1. General results

The total number of grammatical morphemes in question is found to be 305 as the Table 1 shows.

	Stressed morpheme	Unstressed morpheme
-ɪl	35	83
-lɪl	19	37
-i	30	38
-ka	28	35
Total number	112	193

Table 1. Total number of morpheme from the corpus

The 2 types of morphemes are distinguished exclusively according to Korean phonology. The nominative case is marked by morpheme '-i' and the accusative case by '-il' after a consonant; the nominative case is marked by morpheme '-ka' and the accusative case by '-lɪl' after a vowel. The duration and the maximum and the minimum F0 were measured by hand, verified on the spectrogram.

Generally, stressed morphemes were found at the boundary of thematic prosodic propositions. Theoretically, this is the point where the F0 shows the highest pitch; from the measurement, the highest variation of F0 within the syllable seems to be found at the same position.

The unstressed morphemes were found to be inside the rhematic prosodic proposition. Generally, they are short in length and show flat F0.

3.2. Results in duration

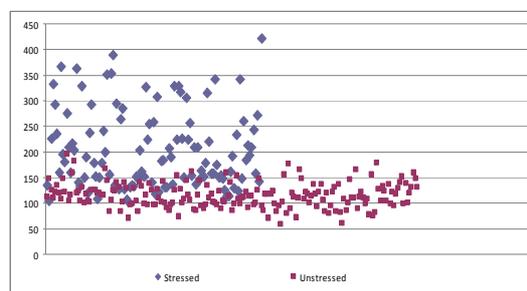


Figure 6: Distribution of the morphemes in duration (morpheme: x-axis; millisecond: y-axis)

The Figure 6 shows a large dispersion of stressed morphemes duration distribution between 100ms to 400ms. For the unstressed morphemes, the distribution stays between 50ms to 200ms.

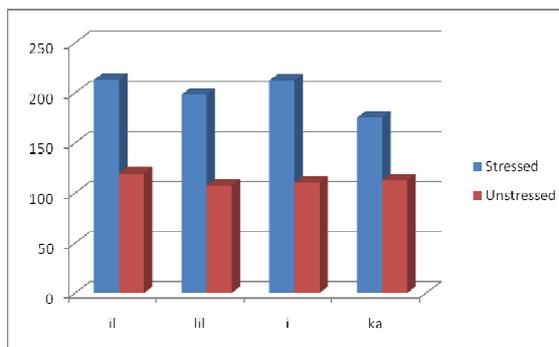


Figure 7: Mean duration of each morpheme (millisecond)

The Figure 7 shows the average duration per morpheme type. This shows that there is no difference between the different morphemes. The average of the stressed morpheme (199.8ms) is 2 times longer than the unstressed morpheme (112.3ms).

3.3. Results in F0 difference

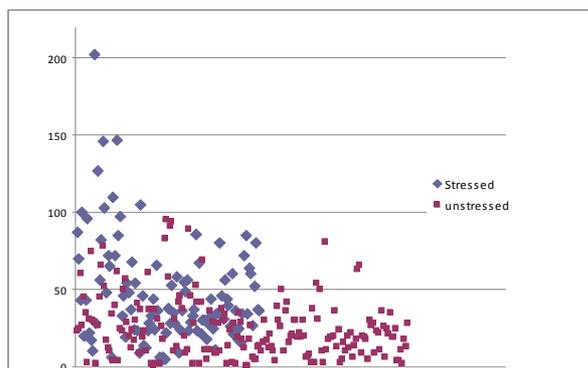


Figure 8: Distribution of F0 difference within each morpheme (morpheme: x-axis; Hz: y-axis)

The Figure 8 shows the distribution of the variation in F0 within each morpheme. For measuring this F0 variation, the difference between the maximum F0 and the minimum F0 are measured. The stressed morphemes show a large range going up to 200(Hz); for the unstressed ones, it goes up to 100(Hz).

3.4. Conclusion

The stressed morphemes are more marked by duration than the F0 register variation. There is not very much correlation in the F0 variation and the duration ($r=0.28$ for the stressed, $r=0.18$ for the unstressed). The covariance of the stressed syllables is remarkably high. We suppose that despite the less number of stressed morphemes than the unstressed ones, the acoustic parameter for analyzing stressed morphemes needs to be defined accurately.

	Stressed morpheme	Unstressed morpheme
Covariance	743,214604	84,53850037
Correlation	0,28929376	0,17781371

Table 2. Correlation between duration and the F0 variance

4. Discussion

The prosodic model in this study proposes a global framework for prosodic analysis in Korean spontaneous speech. The framework proposed is based on global intonation form which gives an observation framework to distinguish the prosodic proposition (thematic and rhematic) as a paired prosodic unit at an utterance level.

The hypothesis is that it is the thematic prosodic proposition having a rising F0 form that makes the condition for the stressed morpheme. This seems to be due to the fact that if the F0 intonation rises and if the morpheme is at the right boundary, then it should have high pitch with long duration. Therefore morphemes in the rhematic prosodic proposition with the F0 falling should be unstressed and probably of short duration.

The duration and the F0 measurements were very problematic for the stressed and unstressed morphemic syllables. The duration of the stressed morphemes is clearly longer than the unstressed ones. Despite the correlation r results, we expect to obtain better results when the direction (+/-) of the F0 variation is considered. The F0 variation needs more strategic methods of measuring; it needs to be measured in relation to the neighboring syllables and the rising and falling movement needs to be considered in the 'stressed' and 'unstressed' measurement.

5. References

- [1] Cho, H., 2009. *Etude des propriétés acoustiques de la structure prosodique du coréen*, Dissertation, L'Université Aix-Marseille I
- [2] Jun, S-A., 2005. "Korean Intonation Phonology and Prosodic Transcription" in Sun-Ah Jun (ed.) *Prosodic Typology: The Phonology of Intonation and Phrasing*, pp201-229, Oxford University Press
- [3] Jun,S-A, and Fougeron, C., 2002. "Realizations of Accentual Phrase in French Intonation", *Probu* 14, pp147-172
- [4] Martin, P., 2006a "Phonologies and Phonetics of French Prosody", in proceedings of Speech Prosody 2006
- [5] Martin, P., 2006b "Intonation du français: parole spontanée et parole lue", *Estudios de fonética experimental*, Vol. 15, pp.133-162
- [6] Nam, K., 2005. *Modern Korean Syntax*, Taehaksa