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The Role of Pitch Range Reset in Korean Sentence Processing

Kong, Eun Jong[1)]

ABSTRACT

This study investigates the effect of pitch range reset in Korean listeners' processing of syntactically ambiguous participle structures. Unlike Japanese and English,in Korean, the downtrend or the reset of pitch range does not consistently differentiate Accentual Phrases (AP), a lower level of phrasing, from Intonational Phrases (IP), a higher level of phrasing. Therefore, we explore Korean listeners' comprehension patterns for syntactically ambiguous speech strings varying in 1) the relative height of F0 peaks across prosodic units, and 2) the types of prosodic phrasing, to see whether pitch range reset informs the recovery of syntactic structure even though it is not reflected in the intonational hierarchy in Korean. The results show that the hierarchical level of prosodic phrasing affects the parsing pattern of syntactic ambiguity. The pitch range reset also cued the location of syntactic boundaries, but this effect was confined to phrases across AP.

Keywords: Pitch range reset, prosodic hierarchy, intonation phonology, sentence processing, syntactic ambiguity

1. Introduction

When a sentence is syntactically ambiguous, the way the string is prosodically phrased can provide information useful for its disambiguation. Sentence processing experiments have shown evidence from many languages that the phonetic cues to the location and the hierarchical status of prosodic boundaries play an important role in listeners' parsingof spoken languages by informing the listener of likely syntactic boundary locations (Kjelgaard & Speer, 1999; Misono, Mazuka, Kondo & Kiritani, 1997; Kang & Speer, 2002; Schafer & Jun, 2004).

Pitch range variation, represented by the peak F0, is one ofthe common cues that have been adapted in the Japanese and English sentence processing literatures as indicative of a prosodic phrase boundary. This is because in both languages, pitch range variations consistently cue a higher level of prosodic phrase boundary, due to the phonological behavior of pitch accents in a particular level of the prosodic domain. The lexically defined pitch accent in Japanese (H*+L)[2)] and the post-lexically assigned pitch accent in English (H*, L* and so on) trigger downstepping within Intonational Phrase (IP) and intermediate phrase (ip), respectively (Beckman & Pierrehumbert, 1983). For this reason, the reset of pitch range necessarily indicates the presence of a prosodic phrase boundary, eventually affecting the parsing of the syntactic structure.

Kjelgaard & Speer (1999) found English listeners'early utilization of prosodic representation in processing syntactic structure of sentences. In the cross-modal naming task, the location of the prosodic phrasal boundary was set tovary by manipulating the pitch ranges either to cooperate or to conflict with that of the syntactic boundary in an identical string of words. In the cooperating prosody condition as in (1)a, the pitch range of the disambiguating word "is" was set lower than NP "the house", while the pitch range of "is"was higher in the conflicting prosody condition as in (1)b. The finding was that English listeners performed the naming task sensitively to the manipulated phonetic cues such as F0 range variations.

1) Univ. of Wisconsin at Madison ekong@wisc.edu

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2) Japanese intonational structure is comprised of two intonational units, where the lexical pitch accent (H*+L) or the phrasal accent (H-) forms Accentual Phrase (AP) and APs are phrased into a prosodically higher unit, Intonational Phrase (Venditti 1997).

(1) When Roger leaves the house is dark

a. Cooperating prosody: When Roger leaves] **Iph** [the house is dark.

b. Conflicting prosody: When Roger leaves the house] **Iph** [is dark.

Likewise, Misono, Mazuka, Kondo & Kiritani (1997) adapted the phonetic variable of pitch range reset by way of altering the pattern of prosodic phrasing in order to investigate the role of prosody in syntactic ambiguity resolution. The study tested whether the prosodic phrasing alternations would influence Japanese listeners' interpretation of sentences despite the existence of semantic bias in the string. The presence/absence of pitch range differences between two units (NP1 and Pred1 in sentence (2), for example) was manipulated to cue the existence of the prosodic phrase boundary; F0 at Pred1 was lower than F0 at NP1 within the prosodic phrase while F0 at Pred1 was higher than F0 at NP1 across the prosodic phrase. The result of auditory comprehension test for Japanese listeners suggested that phonetic cues to the prosodic phrasing that favors each of possible interpretations lead listeners to the interpretation that the prosody favors, little affected by the semantic bias in the string.

(2) Shoonen-wa zubunure-ni natte kakemawaru koinu-o oikaketa.

NP1-Top	Pred.1	Pred.2	No2-Acc	Pred.3
Boy	drenched become	run around	puppy	ran after.

a. main clause interpretation

[Shoonen-wa zubunure-ni natte [kakemawaru koinu]-o oikaketa.]

"the boy, becoming drenched, ran after the running puppy."

b. embedded clause interpretation

[Shoonen-wa [[zubunure-ni natte kakemawaru] koinu]-o oikaketa.]

"the boy ran after the puppy that was drenched and running around."

Although the function of pitch range variations in recovering the syntactic structure was evident in English and Japanese, it cannot be generalized across languages. It is because the prosodic phrases are defined by different linguistic elements in different languages and therefore the type of phonetic cues useful for detecting the syntactic phrasing needs to depend on which phonetic elements are associated with the prosodic phrasing. As observed above, the pitch range reset/downtrend alters the parsing pattern of the syntactic structure in English and Japanese where pitch range variations are phonologically mediated through the downstepping of pitch accents. However, it is questionable whether the pitch range reset would work as a phonetic cue to syntactic boundary location in a language such as Seoul Korean, where the prosodic phrasing is not necessarily encoded with pitch range reset or downtrend.

The phonological relationship between pitch range and prosodic phrasing in Korean has been discussed in few studies since the intonation structure was modeled in Jun (1993). According to the study, Korean intonation structure posits two hierarchical levels of prosodic phrases, that is, Accentual Phrase(AP) and Intonational Phrase(IP), neither of which is defined in terms of pitch accents[3].

Given the lack of pitch accent in the prosody of Seoul Korean, Kong (2004) investigated whether the hierarchy of the intonational structure affects the pitch range reset and downtrend without being mediated by pitch accents. In that study, each location of AP and IP boundaries in 3 female Seoul speakers'narratives was labeled by phoneticians according to K-ToBI convention. The highest F0 (HiF0), extracted from each labeled prosodic unit, was subtracted from that of the following unit to obtain HiF0 differences across two prosodic units. The histogram in <Figure 1> shows one typical pattern of those F0 subtraction distributions across AP and IP respectively. Almost overlapping two peaks of IP (solid) and AP (dotted) lines suggest that the pitch range, represented as peak F0 in a prosodic unit, does not vary across AP boundaries in a distinctive way from across IP boundaries; the pitch range does not consistently reset across IP nor downtrend within IP. These different implications of pitch range reset in Korean and Japanese intonational structure are schematized at <Figure 2>, where the pitch range reset in Korean never consistently reflects the presence of a higher level of prosodic phrase, whereas it does in Japanese.

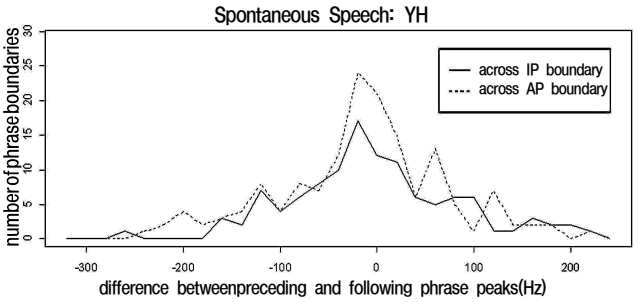

Figure 1. The histogram of HiF0 differences between two adjacent prosodic units. Solid line indicates the F0 differences across IP, while the dotted line does so across AP. The similar pattern of HiF0 subtraction across AP and IP implies that the pitch range in Korean does not necessarily reset across IP.

3) Accentual Phrase in Seoul Korean is defined by a tonal pattern of "LHLH" or "HHLH" and Intonation Phrase is marked by pause and final syllable lengthening as well as by final boundary tones L%, H%, etc (Jun, 1993; Jun, 2000).

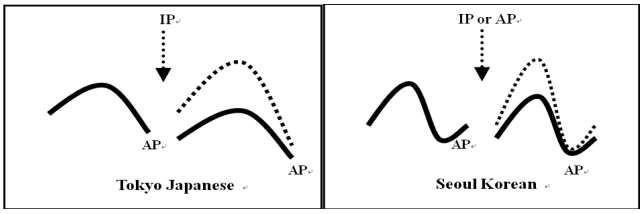

Figure 2. The schematic configurations of pitch range reset (indicated by the dotted lines) that differ in their role in marking the prosodic hierarchy between two languages; Tokyo Japanese (left) and Seoul Korean (right).

The lack of association between the pitch range reset and the hierarchy of prosodic phrasing in Korean leads us to the question as to whether the pitch range reset would affect in resolving the syntactic ambiguity in a speech regardless of nullimplication of pitch range variationson the level of prosodic phrasing. In the current study, two experiments were conducted to explore the role of pitch range reset in the syntactic ambiguity resolution: a written questionnaire survey and an auditory comprehension test. The written questionnaire task is performed to prepare for the sentences without semantic biases in visual presentation. In the follow-up auditory comprehension task, listeners' parsing pattern of semantically neutral stimuli is examined by providing speech phonetically manipulated in termsof three prosodic factors. Finally, based on the results from these experiments, we will discuss the dimension of linguistic constraints that governs the pitch range variations in Korean.

2. Experiment

2.1. Syntactic structure: a participle construction

Sentence processing patterns are examined by adapting the participle constructions, which are globally ambiguous when linearly structured as in (3). Depending on which constituent is the agent of the participle phrase, the sentence (3) results in two possible readings. The participle phrase can modify the main subject 'Miran', leading to the (a) reading, or the main object, 'Youngman', leading to the (b) reading.

(3) Miran-ika untongha-myense nolayhakoiss-nun
Miran-NOM exercise-PARI sing-PROG

Yengman-ilul parapa-sse
Youngman-ACC watch-PAST

a. "Miran, while exercising, watched Youngman who was singing."
b. "Miran looked at Youngman, who was singing while exercising."

A total of 160 test sentences were devised for the study, in half of which a participle phrase is followed by a tense/aspirated obstruent initial phrase and in the other half of which it is followed by a lax obstruent or liquid initial phrase as shown in (4). This phonation type contrast in phrase initial consonant was made to control the pitch range differences inherited in the phonation type of the AP initial segment.

(4) Phonation type contrast in test sentences.
a) Tense/Aspirated obstruent initial phrase
uncengika nwunulhulkimyense] [**hwalulnekoissnun**
Unceng-NOM stare at-PARI be angry-PROG
yehaksayngul yatanchesse.
female-student-ACC scold-PAST

b) Lax obstruent/ liquid initial phrase
uncengika nwunulhulkimyense] [**papulmekkoissnun**
Unceng-NOM stare at-PARI eat-PROG
yehaksayngul yatanchesse.
female-student-ACC scold-PAST

2.2. Written questionnaire survey

The written comprehension task was performed to ascertain that the 160 test sentences are syntactically ambiguous when visually presented. Twenty one native Koreans in their 20s or 30s participated in the task, and each was given 80 test sentences with 90 filler sentences to examine. Filler sentences comprised 58 syntactically unambiguous strings and 32 ambiguous strings whose syntactic structure was different from that of the test sentence. In the task, they were instructed to read the sentences written in a paper and to answer who could be the possible agent of participle phrase by choosing one out of three given answers ('*subject*', '*object*' and '*either*').

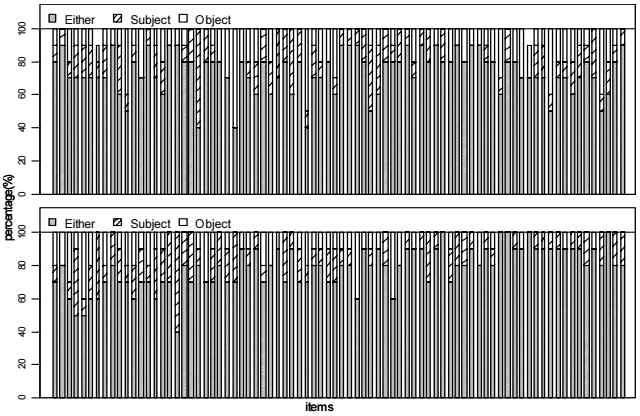

Figure 3. The distributions of responses (‘*subject*’, ‘*object*’ and ‘*either*’) over each item (80 written items in total). The mean percentage is 76%, for ‘*either*’, 13% for ‘*subject*’, and 10.8% for ‘*object*’.

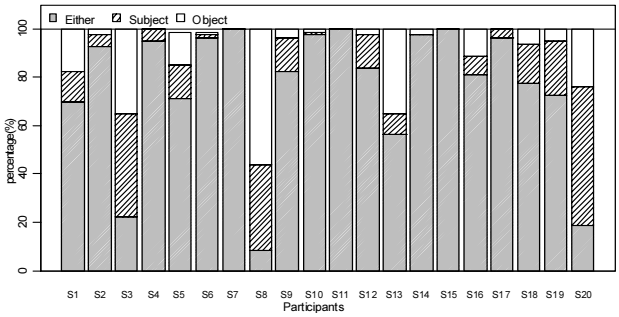

Figure 4. The distributions of responses for each participant.

2.3. Auditory comprehension task

2.3.1. Auditory stimuli

Auditory stimuli were created for the test sentences by recording a native speaker’s productions and then cross-splicing. The native speaker (the author) produced each sentence four times producing all four testing conditions of prosodic levels and pitch ranges, so that three prosodic factors were varied to test the effect of pitch range reset independent of the level of prosodic phrasing and the type of unit initial segments; 1) unit initial tone types (**H-initial unit** vs. **L-initial unit**) 2) prosodic phrasing level (**AP** vs. **IP**), and 3) pitch range reset (**Reset** vs. **NoReset**).

The unit initial tone type was contrastive between **H-initial** and **L-initial** depending on the phonation type of the phrase initial segment. 80 sentences whose participle phrase is followed by the prosodic unit beginning with an aspirate/tense obstruent segment as in (2)a belongs to **H-initial** units, whereas 80 sentences whose participle phrase is followed by the unit beginning with lax obstruent or liquid consonant such as (2)b belongs to **L-initial** units. The prosodic phrasing type of participle phrase was manipulated either to end with a small F0 rise that indicates the presence of Accentual Phrase (**AP**), or to end with a high F0 rise followed by a lowering that cues the presence of Intonational Phrase (**IP**). <Figure 5> illustrates this contrast by overlaying F0 configurations of each prosodic phrasing condition. Finally, the height of the F0 peak has been varied at the unit after the participle phrase. **Reset**is defined as the condition where the F0 peak at the prosodic phrase is higher than that of the preceding phrase, whereas **NoReset** is the condition where the F0 peak is not higher than the preceding one. The overlaid F0 configurations in <Figure 6> show this pitch range reset contrast.

Three independent prosodic factors were combined into 8 conditions; 2(**H-/L-initial** units * 2(**AP/IP**) * 2(**Reset/NoReset**) = 8. 160 test sentences (80 **H-initial** and 80 **L-initial** units) were read by a trained phonetician and cross-spliced at the critical region to vary the prosodic phrasing and the pitch range.

(5) H-initial phrase/ L-initial phrase

uncengika	nwunulhulkimyense]	[**hwalulnekoissnun**
Unceng-NOM	stare at-PARI	be angry-PROG
		H-initial Phrase
		[**papulmekkoissnun**
		eat-PROG
		L-initial Phrase
yehaksayngul	yatanchesse.	
female-student-ACC	scold-PAST	

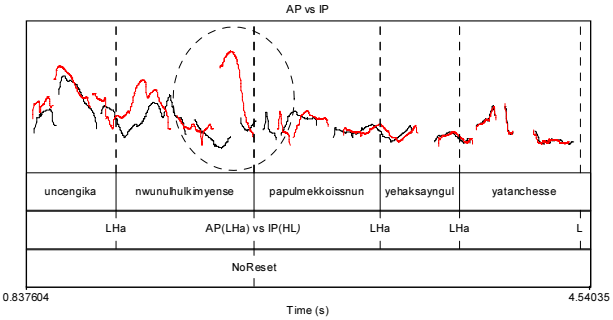

Figure 5. Overlaid F0 contours of cross-spliced stimuli showing the contrast between **AP** and **IP**. **IP**, in red line, is represented by a big F0 rise and fall at the right edge of the unit, whereas **AP**, in black line, is indicated by a small F0 rise on the final syllable.

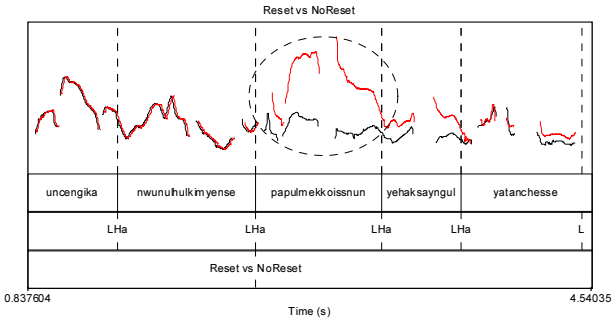

Figure 6. Overlaid F0 contours of cross-spliced stimuli showing the contrast between **Reset** and **NoReset.**Reset (dotted line), has the HiF0 higher relative to that of the preceding unit, whereas NoReset (solid line), has the HiF0 lower than that of the preceding unit at the circled region.

2.3.2. Task

Eighty native Korean speakers participated in the auditory comprehension test. The test took place in a silent experimental setting. Subjects listened to speech stimuli played through headphones. Immediately after each sentence played, they saw the question on the screen written in Hangul, and were asked to answer who can be a possible agent of the participle phrase by selecting one of three given choices (‘*subject*’, ‘*object*’ and ‘*either*’) using a response button. Each subject listened to 80 test stimuli along with 80 filler sentences. The 80 fillers contains 32 syntactically unambiguous sentences and 48 ambiguous ones whose syntactic ambiguities are to be resolved by the prosodic phrasing. Participants were in their 20s or 30s and paid.

2.3.3. Results

The distribution of answers across 8 prosodic conditions is presented in <Figure 7>. A first thing to note is that the pattern is very different from the responses in the written task, showing that the prosody does disambiguate what is an inherently ambiguous constriction when the form is read. <Figure 7> shows that the initial tone type made no significant difference in listeners’comprehension pattern of syntactically ambiguous sentences, indicated by similar response patterns between **H-initial** and **L-initial**conditions (labeled as H and L in parenthesis) in the graph. When two other prosodic factors, unit hierarchy and pitch range reset, were controlled to be equal, the pitch range differences caused by the phonation type of segment showed a null effect in the pattern of sentence processing, suggesting that the unit initial tone type is paradigmatically contrastive in Korean listeners’ perception of pitch range variations.

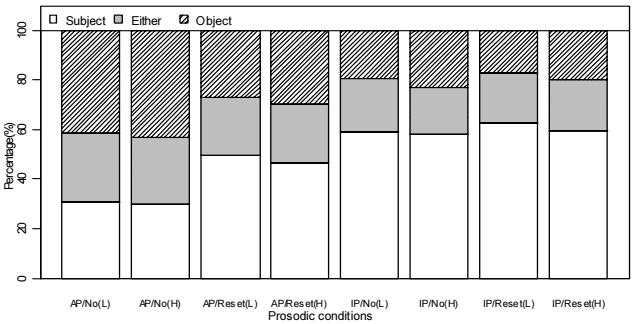

Figure 7. Distributions of responses across the 8 prosodic conditions collected from 80 participants.

Both the level of prosodic phrasing and the reset of pitch range were important prosodic factors that alter the comprehension pattern of spoken sentences. The participle phrase was more likely to be interpreted as a subject modifier when it was separated from the following unit by IP versus AP, indicated by a higher percentage of ‘*subject*’ responses in **IP** conditions than **AP** conditions in <Figure 7>. At the same prosodic phrasing condition, the reset of pitch range alters listeners’ comprehension pattern of the participle phrase. The percentage of ‘*subject*’ responses in **Reset**turned out to be higher than that in **NoReset** across **AP**. However, this effect of pitch range reset in sentence comprehension exists only when the reset was across **AP** but not across **IP**. <Figure 7> shows that the rate of ‘*subject*’ response is almost identical between **Reset** and **NoReset** across IP conditions.

Those results are statistically significant when a repeated measure two-way ANOVA has been performed over subjects and items respectively, taking ‘*subject*’responses across 4 conditions as an indicator of perceptual pattern. There was a main effect of phrasing level (**AP, IP**) in both subject and item analysis [$F1(1, 79) = 220.98$, $p<0.0001$; $F2(1, 79) = 58.439$, $p<0.0001$]. Also, the main effect of reset (**Reset**, **NoReset**) has been found both in subject and item analysis [$F1(1, 79) = 42.085$, $p<0.0001$; $F2(1, 79) = 79.454$, $p<0.0001$]. The interaction between phrasing level and reset were also significant [$F1(1, 79) = 43.553$, $p <0.0001$; $F2(1, 79) = 33.344$, $p <0.0001$]. Planned comparisons confirmed that every prosodic condition show significant differences in their percent ‘*subject*’ responses except one pair, **Reset** and **NoReset** in **IP**condition. This indicates that the pitch range is an influential factor on interpreting the syntactic structure of speech, only conditionally to the type of prosodic phrasing.

The percentage of ‘*subject*’ responses are presented as scatter-plots in <Figure 8>, where two figures at the top plot the data of **NoReset** against that of **Reset** over items while two at the bottom plot over subjects. It is observed that the two left figures

(**AP**) pattern differently from the two right ones (**IP**), in that the data points in **AP** are densely clustered at the bottom left while those in **IP** are clustered at the top right. This suggests the effect of prosodic phrasing level on sentence parsing: listeners favored the '*subject*' responses when the stimuli were provided with **IP** condition. Figures at the left are also contrastive with figures at the right in terms of the distribution of data points along the diagonal line. The filled circles in **AP** are mostly scattered above the diagonal line, suggesting that **Reset** after **AP**edge leads listeners more to '*subject*'responses than **NoReset**. The null effect of reset factor across **IP**is observed by open triangles distributed evenly above and below the diagonal line. Both subject and item analyses provide almost identical pictures of scattered-plots despite a more loosely clustered pattern for subject analysis.

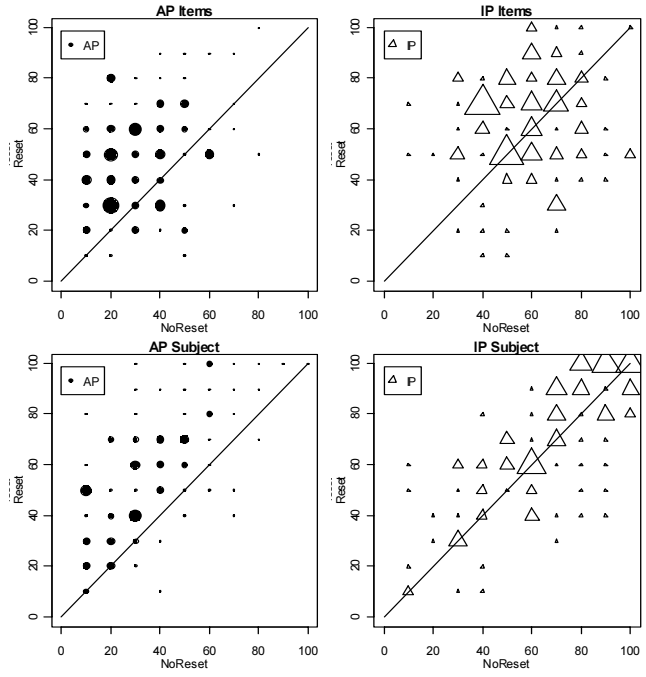

Figure 8. The percentage distributions of 'subject'responses plotted over the plane of Reset/Noreset conditions. Filled circles represent '*subject*' response when a participle phrase is followed by AP, whereas blank triangles represent '*subject*'response when followed by IP. The size of each symbol indicates the response weighed by the number of items or participants.

3. Discussions and Conclusion

We explored the effect of pitch range reset in processing an ambiguous syntactic construction in Seoul Korean, where the pitch range does not consistently encode the hierarchy of prosodic phrasing. The role of pitch range variations in participle phrase ambiguity resolution was tested by conducting an auditory comprehension task of sentences judged semantically neutral in a written questionnaire survey.

The auditory comprehension task confirmed the prior finding of Korean listeners' use of IP boundary cues in syntactic ambiguity resolution, in that IP provides a perceptual boundary across prosodic phrases, which is prominent enough to indicate the syntactic clause boundary (Kang & Speer, 2002).

The present study also reveals that pitch range reset plays a role as a prosodic prominence marker in speech processing and is used by Korean listeners to disambiguate the location of a syntactic clause boundary. However, this effect was limited to the condition of pitch range reset across AP, a prosodically lower level of phrase. This conditional effect of pitch range reset by the hierarchical level of prosodic phrase suggests that Korean listeners employ the phonetic cue of pitch range reset in detecting the location of syntactic phrase boundary in the absence of the prosodic phrase boundary information of IP. <Figure 9> illustrates the function that pitch range reset indicates the syntactic clause boundary among APs.

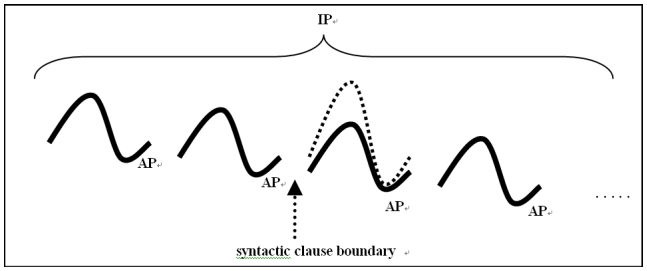

Figure9. The schematic configuration of pitch range variations among APs, which illustrates the prominent effect of pitch range reset (dotted curve) for cueing the location of syntactic clause boundaries in Korean.

It is known that pitch range is registered in a gradient manner despite the categorical interpretation of pitch range expansion, in that, for example, English listeners could not discriminate the specific range for the emphasized pitch but could identify whether the speech is emphasized or not (Ladd & Morton, 2002). Still, this gradient component in speech is constrained by different dimensions of linguistic structure, such as a phonological mediation through pitch accent downstep in Japanese and English (Beckman & Pierrehumbert, 1986), a hierarchical structure of discourse intentions in English, Japanese, Mandarin Chinese and Korean (Ayers, 1997; Yoneyama, Koiso & Fon, 2003; Fon, 2002; Kong, 2004), and a syntactic clause boundary as a location of metrical boost in Japanese (Kubozono, 1991).

Speaking of the role of pitch range reset as a linguistic

structure marker in Korean, the phonological prosodic hierarchy does not determine the pitch range register but the discourse intentional hierarchy consistently varies the pitch range in Korean. According to Kong (2004), F0 range at each discourse segment consistently resets across a discourse segment boundaries and the degree of reset is determined by the discourse segment hierarchy.

The present study provides the evidence that syntactic structure is another linguistic structure that accounts for the gradient fluctuations of pitch range in Korean. The auditory processing pattern of syntactically ambiguous sentence suggests that the syntactic clause boundary can be cued by the pitch range reset, which is comparable to "metrical boost"found in Japanese production study (Kubozono, 1991) in a sense that the syntactic structure contributes to the pitch range variations.

We conclude that even though the intonation structure does not employ the pitch range variations as a reliable phonetic cue to mark the structural unit hierarchy, the pitch range reset is prosodically prominent in Korean, existing as an additional cue to syntactic structure when prosodic phrasings is not informative enough for parsing speech.

Reference

Ayers, G. M. (1994). "Discourse functions of pitch range in spontaneous and read speech", *OSU Working Papers in Linguistics*, Vol. 44, pp. 1-49.

Beckman, M. E. & Pierrehumbert, J. B. (1986). "Intonational structure in Japanese and English", *Phonology Yearbook*, Vol. 3, pp. 255-309.

Beckman, M. E. & Ayers, G. M. (1997). Guidelines for ToBI labelling, version 3.0. Manuscript and accompanying speech materials, Ohio State University.

Fon, Y-J.J. (2002). *A cross linguistic study on syntactic and discourse boundary cues in spontaneous speech*, Doctoral dissertation, The Ohio State University, Columbus, Ohio, USA.

Grosz, B. G. & Sidner, C.L. (1986). "Attention, intentions and the structure of discourse", *Computational Linguistics*, Vol. 12, pp. 175-204.

Jun, S. (1993). *The phonetics and phonology of Korean prosody*, Doctoral dissertation. The Ohio State University, Columbus, Ohio, USA.

Jun, S. (2000). "K-ToBI (Korean ToBI) labeling conventions", http://www.humnet.ucla.edu/humnet/linguistics/people/jun/ktobi/K-tobi.html.

Jun, S. (2003). "Phrasing and attachment preferences", *Journal of Psycholinguistic Research*, Vol. 32, No. 2, pp. 219-249.

Kang, S. Y. & Speer, R. S. (2002). "Effects of prosodic boundaries on syntactic disambiguation", *Proceedings of GLOW*.

Kawamori, M., Kawabata, T. & Shimazu, A. (1998). "Discourse markers in spontaneous dialogue: A corpus based study of Japanese and English", *Proceedings of the ACL-COLING Workshop on Discourse Relations and Discourse Markesr*: pp. 93-99.

Kjelgaard, M. & Speer, S. (1999). "Prosodic facilitation and interference in the resolution of temporary syntactic closure ambiguity", *Journal of Memory and Language*, Vol. 40, pp. 153-194.

Kong, E. (2004). "The role of pitch range variation in the discourse structure and intonation structure of Korean", *Proceedings of ICSLP*.

Kubozono, H. (1991). "Modeling syntactic effects on downstep in Japanese", *Papers in Laboratory Phonology II*, pp. 368-387.

Ladd, D. R. & Morton, R. (1997). "The perception of intonational emphasis: continuous or categorical?", *Journal of Phonetics*, Vol. 25, pp. 313-342.

Misono, Y., Mazuka, R., Kondo, T., Kiritani, S. (1997). "Effects and limitations of Prosodic and Semantic Biases on Syntactic Disambiguation", *Journal of Psycholinguist Research*, Vol. 26, No. 2, pp. 229-245.

Schafer, A. & Jun, S. (2005). "Effects of Accentual Phrasing on Adjective Interpretation in Korean", M. Nakayame (ed.), *East Asian Language Processing,* Stanford, CSLI.

Yoneyama, K., Koiso, H. & Fon, J. (2003) "A corpus-based analysis on prosody and discourse structure in Japanese spontaneous monologues", *Proceedings of the ISCA & IEEE Workshop on Spontaneous Speech Processing and Recognition (SSPR2003)*, Tokyo.

Venditti, J. J. (1997). "Japanese ToBI Labelling Guidelines", *OSU Working Papers in Linguistics*, Vol. 50, pp. 127-162.

• **Kong, Eun Jong**
University of Wisconsin at Madison
1500 Highland Avenue
Waisman Center #493
Madison, WI 53705, USA
Tel: 1-614-493-7370
Email: ekong@wisc.edu
Area of interest: Phonetics
2009~present Post-doctoral research associate
Ph.D., Dept. of Linguistics, The Ohio State University, 2009