The Role of H Tone of an AP in Korean: The Relation Between Prosody and Morphology*

Hyunsook Kang**

ABSTRACT

This paper investigates tonal patterns of the prosodic constituents of an AP and a PWD in Korean and their relation with the morphological/syntactic structure. Specifically, this paper asks the following questions: First, if there are more than one PWD in an AP, how is each PWD specified in terms of tones? Secondly, in case that there is only one PWD in an AP that consists of several morphemes, is there any preference of the association between tones and the morphemes that constitute that PWD? Thirdly, if an AP dominates a PWD and if a PWD contains at least one morpheme of the lexical category, it follows that an AP should contain at least one morpheme of the lexical category. Can this be verified with the experimental data? In order to answer these questions, Experiment I and II were conducted with the target material consisting of a stem and suffixes that varied in length. The results of this preliminary test show that as the number of syllables in the target material increases, the more number of an AP tonal pattern occurs in it and as a result, in some cases, an AP consisting of suffixes only may occur.

Keywords: prosodic constituents in Korean, morphological/syntactic structure, AP, PWD

1. Introduction

Prosodic structures have been proposed by two different approaches in phonology: Intonational Phonology (cf. Pierrehumbert & Beckman, 1986, etc.) and Prosodic Phonology (cf. Nespor & Vogel, 1986; Selkirk, 1986, 1990, etc.). In both approaches, similar prosodic constituents are motivated, namely, a prosodic word, a prosodic phrase (cf. a phonological phrase in Prosodic Phonology or an accentual phrase (=AP) in Intonational Phonology), etc. This paper examines these two approaches and considers the relationship among tones, prosodic structures, and morphological structures in Korean.

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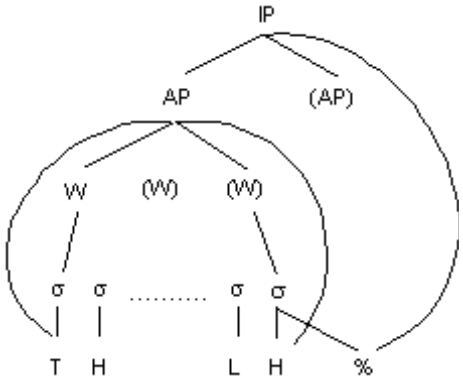
** Hanyang University

Let us first discuss the prosodic structures of Intonational Phonology proposed for Korean by Jun (1993) given in <Figure 1>. These are an intonational phrase (IP), an accentual phrase (AP), or a prosodic word (PWD) from the largest to the smallest constituent. <Figure 1> is from Jun (2000).



IP: Intonation Phrase, AP: Accentual Phrase
w: phonological word, σ: syllable
T= H, when the syllable initial segment is aspirated/tense, otherwise, T= L
%: Intonation phrase boundary tone

Figure 1. Intonational Structure of Seoul Korean

There are two aspects of an AP in <Figure 1> that are important: one is that an AP is defined solely with prosodic melody, namely, as a sequence of four tones, $[T_1H_2..L_{n-1}H_n]$. The other is that an AP respects the constraints of prosodic domination suggested in Selkirk (1995, etc.). Let us discuss the implications of these assumptions in detail.

Prosodic structure in Intonational Phonology claims that the F0 characteristics of vowels in Korean are held to depend on their position within the AP, except the first syllable. Jun (1993) suggests that AP consists of a sequence of four tones, $[T_1H_2..L_{n-1}H_n]$[1]. The first tone, T_1, is associated with the AP initial syllable. If the first segment of an AP is aspirated or tense, the first AP syllable will have a high tone. If not, it will have a low tone. The F0 of vowels in other positions is assumed not to be affected by the type of segment (cf. Kang & Dilley, 2007a, b). Thus, the second tone H is associated to the second syllable in the phrase regardless of its composition. The third tone L is assigned to the penultimate syllable in the phrase. The fourth tone High is assigned to the final syllable in the phrase. Any syllables that may occur between

1) Other than this typical tonal pattern, $[T_1H_2..L_{n-1}H_n]$, is shown to occur for an AP. Kim (2004) reported 14 different tonal patterns for an AP: Half of them begins with a H tone (HHLH, HH, HLH, HL, HHL, HLL, HHLL) and the other half begins with a L tone (LHLH, LHHH, LLLH, LH, LHL, LHLL, LL).

the High tone on the second syllable and the Low tone on the penultimate syllable are assumed to show phonetic interpolation between the High and the Low.

<Figure 1> also shows that the prosodic structure in Korean respects prosodic domination suggested in Selkirk (1995): an AP consists of PWD's only and the PWD's are fully contained within an AP. The prosodic structure in <Figure 1> thus respects Headedness and Exhaustivity in (1) from Selkirk (1995).

(1) Headedness: Any Ci must dominate a Ci-1 (except if Ci = syllable)
e.g. A PWD must dominate a Ft.
Exhaustivity: No Ci immediately dominates a constituent Cj, j<i-1
e.g. No PWD immediately dominates a syllable.

Therefore, the following can be said about <Figure 1>: If a tonal pattern $[T_1H_2..L_{n-1}H_n]$ follows another tonal pattern $[T_1H_2..L_{n-1}H_n]$ in the segmental string, the beginning point of $[T_1H_2..L_{n-1}H_n]$ is the beginning of each AP and also, it is the beginning of a PWD. As for PWD, Jun (1993) simply assumes that its definition is the same as that in Prosodic Phonology. To investigate the relationship between a PWD and an AP in detail, it is therefore necessary to review the definition of a PWD in Prosodic Phonology.

In contrast to Intonational Phonology, Prosodic Phonology emphasizes the syntactic structure in deriving prosodic constituents (Selkirk, 1986; Selkirk & Shen, 1990, etc.) as is shown in (2).

(2) The Syntax-Phonology Mapping (from Selkirk & Shen, 1990)
For each category C^n of the prosodic structure of a language there is a two-part parameter of the form C^n: {Right/left; X^m}
Where X^m is a category type in the X-bar hierarchy.

A syntactic structure-prosodic structure pair satisfies the set of syntax-phonology parameters for a language iff the right (or left) end of each constituent of the type X^m in syntactic structure coincides with the edge of constituent(s) of type in prosodic structure.

In Korean, it has been proposed (cf. Kang, 1992) that the left edge of a syntactic word that belongs to the categories "Noun, Verb, Adjective and Adverb" is the left edge of a PWD. This means that Korean grammar has a Syntax-Prosody Mapping Rule with the following parameter setting in (3) (cf. Kang, 1992).

(3) Korean Prosodic Word Rule:
Prosodic Word: {Left, Lex^0}
Where Lex^0 stands for word belonging to the lexical categories, N, V, A, Adv.

The prosodic structure in (3) is very clear about the domain of a PWD. In accordance with (3), a PWD will extend from the left edge of one lexical item to the left edge of the next, incorporating the suffixes that lie between. If no PWD follows, then the end of the phrase will be the right edge of a PWD.

Motivation for the mapping rule in (3) comes from a phonological rule in Korean, coda neutralization, which applies within the prosodic word boundary: if a vowel initial suffix follows a stem, the stem final consonant appears as an onset of the following syllable with no application of neutralization to it ($_N$/ius/+/i/: [iusi] 'neighbor+subject marker') whereas if the final consonant of the first stem is followed by a vowel-initial stem, coda neutralization first applies to the final consonant of the first stem and then it is re-associated as an onset of the following stem ($_N$/ius/+$_N$/əlin/: [iutəlin] 'neighbor+senior'). Thus, in order to prevent neutralization from applying to the final consonant of a stem before a vowel-initial suffix, one has to assume that suffixes belong to the same domain as the stem ($_N$/ius/+/i/ → $_{PWD}$(iusi): [iusi]) while different stems belong to different prosodic domains ($_N$/ius/+$_N$/əlin/ → $_{PWD}$(ius)+ $_{PWD}$(əlin) → neutralization → $_{PWD}$(iut)+ $_{PWD}$(əlin): [iutəlin]). Therefore, the definition of the PWD in Prosodic Phonology is based on the syntactic structure and has nothing to do with tones. The phonological phrases are built on top of them based on the structures of PWD's and other phonological rules.

Kang (1992) also notes that the prefix in Korean does not belong to the lexical category but it should form its own prosodic word due to coda neutralization. Thus, she suggests Prosodic Structure Wellformedness Constraint shown in (4).

(4) $_N$[Prefix $_N$[Stem]] → [PWD][PWD]
This rule will make the prefix become a PWD.

With the definition of the PWD above, the following questions now can be asked regarding the relationship of tones, prosodic structures and morphological structures of constituents in Intonational Phonology: First, if there is only one PWD in an AP, and if several morphemes constitute that PWD, will there be any preference of association between some specific tones of a PWD ($[T_1H_2..L_{n-1}H_n]$) and the morphological boundaries of morphemes that constitute that single PWD? Secondly, if an AP dominates a PWD, and if a PWD must dominate at least one morpheme that belongs to the lexical category, it is expected for an AP to dominate at least one morpheme that belongs to a lexical category. Kim (2004) showed that most AP's in her

experiment contained 3-4 syllables and the longest AP had 7 syllables. Thus, the question arises on what the prosodic structures of the target material will be if it contains only one lexical category and more than 7 syllables. These questions will be answered with experimental data.

2. Experiment I

In order to answer the questions we raised above, we constructed target materials that are long enough to contain multiple AP's. Specifically, we constructed target materials with a content word and some suffixes to test whether an AP can be formulated without a content word. The content word was either morphologically simple or complex.

2.1 Methods

Stimuli. Stimuli were constructed for the production test. In order to investigate the characteristics of prosodic constituents such as a PWD and an AP in Intonational Phonology, we created long phrases that consisted of one or two content words with one or more suffixes. Specifically, two sets of sentences were created which differed in (1) the number and length of the content words as well as (2) the number and length of suffixes, in order to elicit different numbers of prosodic units (such as PWD's and AP's) in a single syntactic phrase produced by talkers. By examining characteristics of AP's and the morphological constituents that make up a PWD and an AP in the target material, we may be able to observe the relationship among tones, prosodic structure and morphological structure. The list is given in Appendix.

Subjects. Six native speakers of Seoul Korean (all males) participated in the production study. All of them were undergraduate students at Hanyang University at the time of recording. They were naïve to the purposes of the study and paid for the participation. None reported hearing or speaking problem.

Procedure. Talkers were recorded in a sound attenuated booth at Hanyang University. The speech was digitized on a PC running Praat software (Boersma & Weenink, 2002) using a 22.05 kHz sampling rate. Subjects were asked to read the sentences at a normal speech rate. They did not express any difficulty in producing the sentences.

Talkers read the list twice. After the first recording, they were asked to read the list second time and the second rendition of each sentence served as the basis for the analysis. In total, 108 sentences (18 sentences * 6 speakers) were analyzed.

Analysis. Subjects' productions of target materials were examined for the intonational structures. In particular, we determined how many AP's are assigned for the target materials. For all sentences, two trained phoneticians transcribed the intonational pattern of target

materials, which the third phonetician (the author) re-examined. There were not many responses which the first two phoneticians disagreed with and for those that were differently transcribed, the author made a final decision, asking the transcribers for the reconsideration of those materials. All agreed with these minor changes.

The expectation was that by varying the number of syllables of the target material with content words and suffixes would the tonal patterns of that target material be affected, which may result in different numbers of AP's and PWD's for the same syntactical phrase.

2.2 Results

For Type A material, the content words were *atɨl*, *apəʤi*, *minsok-maɨl* and *tæhan-minkuk*, and the suffixes were 2-syllable long ones, *-mank^{h}ɨm*, and *-ina*. The suffix *-ina* was added only when *-mank^{h}ɨm* was present. Each target material included one or two content words and one or two suffixes. The results are given in <Table 1>. Six tokens were produced for each sentence.

Table 1. Type A Material

stimuli	1 AP	2 APs
atɨl-mank^{h}ɨm	atɨlmank^{h}ɨm(6)	----------(0)
apəʤi-mank^{h}ɨm	apəʤimank^{h}ɨm(6)	----------(0)
minsok-maɨl-mank^{h}ɨm	minsokmaɨlmank^{h}ɨm(5)	minsokmaɨl & mank^{h}ɨm(1)
tæhan-minkuk-mank^{h}ɨm	tæhanminkukmank^{h}ɨm(5)	tæhanminkuk & mank^{h}ɨm(1)
atɨl-mank^{h}ɨm-ina	atɨlmank^{h}ɨmina(5)	atɨl & mank^{h}ɨmina(1)
apəʤi-mank^{h}ɨm-ina	apəʤimank^{h}ɨmina(2)	apəʤi & mank^{h}ɨmina(4)
minsok-maɨl-mank^{h}ɨm-ina	minsokmaɨlmank^{h}ɨm(2)	minsokmaɨl & mank^{h}ɨmina(4)
tæhan-minkuk-mank^{h}ɨm-ina	tæhanminkukmank^{h}ɨm(2)	tæhanminkuk &mank^{h}ɨmina(4)

The symbol & indicates an AP boundary and the number shown in the parenthesis represents the number of tokens spoken with that number of AP's.

For Type B material, the content words were *na*, *əmma*, *apəʤi*, *minsok-maɨl* and *tæhan-minkuk*, and the suffixes were *-pota*, and *-nɨn*. The second suffix was added only when the first affix was present. For Type B material, we selected one mono-syllable suffix to investigate the effect of length of the target material on tone assignment. The results are given in <Table 2>.

Table 2. Type B Material

Stimuli	1 AP	2 AP's
na-pota	napota(6)	----(0)
əmma-pota	əmmapota(6)	----(0)
apədʒi-pota	apədʒipota(6)	----(0)
minsok-maːil-pota	minsokmaːilpota(6)	----(0)
tæhan-minkuk-pota	tæhanminkukpota(6)	----(0)
na-pota - nːin	napotanːin(6)	----(0)
əmma-pota - nːin	əmmapotanːin(6)	----(0)
apədʒi-pota - nːin	apədʒipotanːin(4)	apədʒi & potanːin(2)
minsok-maːil-pota - nːin	minsokmaːilpotanːin(2)	minsokmaːil & potanːin(4)
tæhan-minkuk-pota - nːin	tæhanminkukpotanːin(4)	tæhanminkuk & potanːin(2)

The symbol & indicates an AP boundary and the number shown in the parenthesis represents the number of tokens spoken with that number of AP's.

2.3 Discussion

The results reported here are based on 108 sentences and thus, should be interpreted as preliminary. Even so, the results in <Table 1 and 2> clearly show that (1) as the target material gets longer, it tends to be split into two AP's: if the total number of syllables of the target material was 5 syllables or less, all the talkers produced it as one AP. When the number of syllables was 6, three tokens out of eighteen in Type A and two tokens out of eighteen in Type B were produced as 2 AP's. When the target material was 7 syllables long or longer, twelve tokens out of eighteen in Type A material and six tokens out of twelve in Type B material were produced as 2 AP's. This shows that an AP structure has a tendency to depend on the number of syllables of the target material.

(2) The long target material thus resulted in two AP's, as in *tæhan-minkuk & mank^{h}ːin-ina*, or *tæhan-minkuk & pota - nːin*. Interestingly, in these cases, the second AP consisted of suffixes only like *mank^{h}ːin-ina* or *pota - nːin*. One example, *tæhan-minkuk & mank^{h}ːin-ina* is shown in <Figure 2>. The tonal pattern of the target material in <Figure 2> shows that [$T_1H_2..L_{n-1}H_n$] is repeated and thus, two AP's are assigned for it. Since an AP should consist of PWD's, *mank^{h}ːin-ina* and *pota - nːin* should contain a PWD. However, either of them does not contain a morpheme that belongs to the lexical category as is expected from rules in (3), and thus, the definition of the PWD in Prosodic Phonology (cf. (3)) cannot be maintained in Intonational Phonology: Second AP's in the target material, *-mank^{h}ːin-ina* and *-pota - nːin,* are not stems of lexical category.

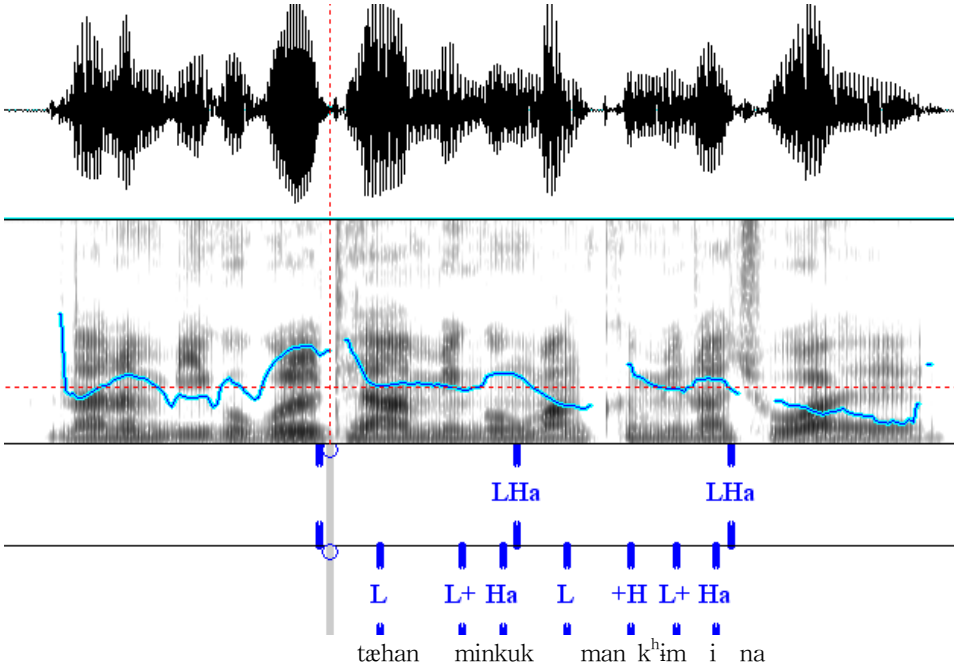


Figure 2. The tonal pattern of the sentence /nanin mikukil tæhanminkukmank^{h}imina ʤoahæ/.

Interestingly, some linguists (e.g., Lim, 2004) argue that *-mank^{h}im* and *-pota* historically come from lexical categories such as nouns, though they may show some differences with other typical nouns currently. If we accept the argument, and treat *-mank^{h}im* and *-pota* as a kind of noun, then the problem we raised here seems to disappear. These morphemes, *mank^{h}im* and *pota,* may build their own PWD's as lexical items and depending on the length of the segmental strings of a sentence, these PWD's may become the second one of the first AP or the first one of the following AP.

(3) The results also show that the AP respects the morphological integrity of morphemes. In test material A, it is shown that the speakers preferred to place the AP boundary after 3-syllable long *apəʤi* and before 4-syllable long suffix *mank^{h}im-ina,* if there are multiple AP's for *apəʤi-mank^{h}im-ina.* However, when the content word was 4-syllable long *minsok-mail* and the suffix was 3-syllable long *pota - nin* in Type B material, all the tokens that were produced as 2 AP's have the AP boundary placed between the 4-syllable long content word, *minsok-mail* and the 3-syllable long suffix, *pota - nin.* This shows that there should be some constraints that align morphemes with an AP or a PWD. We will discuss how to incorporate this as constraints in Conclusion.

(4) Among Type B material, four tokens out of six 5-syllable long target material, *apəʤi-pota,* showed the AP internal H tone to occur on the final syllable of a content word

apəji as is shown in <Figure 3>. For the remaining two tokens, an AP internal H tone occurred on the second syllable of *apəʤi-pota*. For another type of 5-syllable long tokens consisting of 2-syllable long content word *əmma* and the following three syllable long suffixes *pota-nɨn,* all the tokens showed the AP internal H tone on the second syllable, not on the third syllable as is shown in <Figure 4>.

Jun (1993) notes that an AP internal H tone may occur on the second or the third syllable in target material, but interestingly in the data above, an AP internal H tone never occurred on the third syllable if the content word is 2-syllable long and the following suffixes are 3 syllable long (2 syllable long suffix + 1 syllable long suffix). That is, an AP internal H tone does not break the integrity of a morpheme of a suffix *pota-* by being associated with the first syllable of the suffix if the number of syllables of the target material is five. However, if the number of syllables of the target material is four as in *na-potanɨn*, the AP-internal H tone occurred on the second syllable for all the tokens. This shows that the satisfaction of the tones to their anchor syllables has priority to the tendency of keeping the morpheme integrity intact. Whether the tendency of the association of an AP-internal H tone to the third syllable in *apəʤi-pota* is due to the respect for the morpheme integrity or due to the function of *pota-nɨn*, which contrastively emphasizes the noun to which it is attached is yet to be investigated.

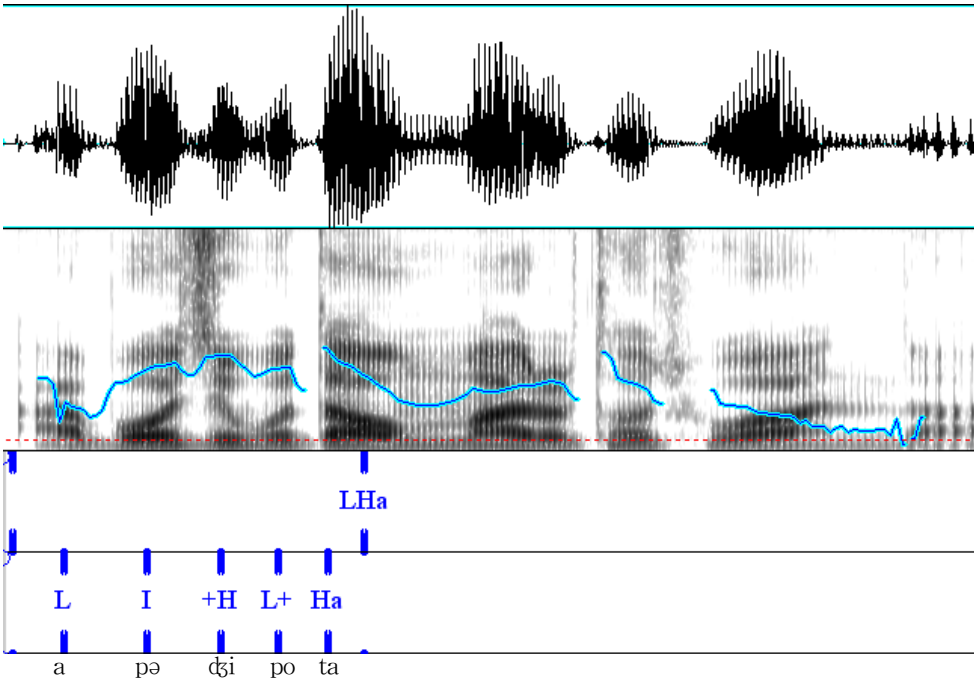


Figure 3. The tonal pattern of the sentence /apəʤipota əmmalɨl tə ʤoahanta/.

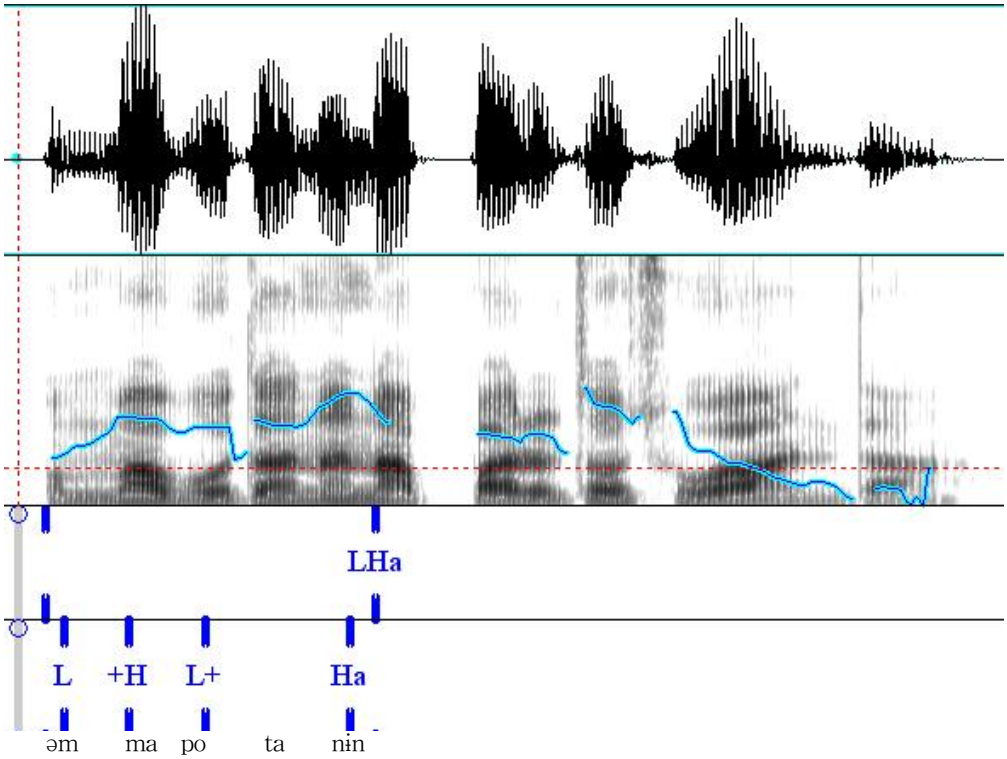


Figure 4. The tonal pattern of the sentence /əmmapotanɨn aPalɨl tə coahanta/.

3. Experiment II

The data in Type A and B raised a question on whether an AP may consist of morphemes that do not belong to lexical categories. Therefore, we needed to test this question with a target material in which the second AP may consist of non-lexical items only. Test material for Experiment 2 was constructed for this purpose.

3.1 Methods

Stimuli. Stimuli were constructed for the production test. For test material in Experiment 2, the content words were *to*ŋ*s*œŋ, *pumonim* and *halapənim*, and the suffixes are *-eke*, *-pota*, and *-nɨn*. Three suffixes were added to the stem in this order. The suffix *-eke* was added before the morpheme *-pota* to make certain that the content word of the target material is immediately followed by a suffix, not by a suspicious noun/suffix. The suffixes that were added to the stem iwere *-eke*, *-eke-nɨn*, *-eke-pota*, *-eke-pota-nɨn*. The list is given in Appendix.

Subjects, Procedure and Analysis. The same subjects were recorded in a sound attenuated

booth at Hanyang University, using the same procedure. In total, 72 sentences (12 sentences * 6 speakers) were analyzed. For all sentences, the same phoneticians who transcribed the intonational pattern of target materials in Experiment 1 transcribed them. Again, there were not many responses which the first two phoneticians disagreed with and for those that were differently transcribed, the author made a final decision, asking the transcribers for the reconsideration of those materials. All agreed with these minor changes.

3.2 Results

The results of Experiment 2 are shown in <Table 3>.

Table 3. Type C Material

Stimuli	1 AP	2 AP's
toŋsæŋ-eke	toŋsæŋeke(6)	
pumonim-eke	pumonimekeni̇n(2)	pumonim & eke ni̇n(4)
halapənim-eke	halapənimekeni̇n(2)	halapənim & eke ni̇n(4)
toŋsæŋ-ekeni̇n	toŋsæŋekeni̇n	
pumonim-eke ni̇n	pumonimekeni̇n(2)	pumonim & eke ni̇n(4)
halapənim-eke ni̇n	halapənimekeni̇n(2)	halapənim & eke ni̇n(4)
toŋsæŋ-ekepota	toŋsæŋekepota(4)	toŋsæŋ & ekepota(1)
		toŋsæŋeke & pota(1)
pumonim-ekepota	pumonimekepota(2)	pumonim & ekepota(4)
halapənim-ekepota	halapənimekepota(1)	halapənim & ekepota(5)
toŋsæŋ-ekepotani̇n	toŋsæŋekepotani̇n(1)	toŋsæŋeke & potani̇n(5)
pumonim-ekepotani̇n	pumonimekepotani̇n(1)	pumonimeke & potani̇n(5)
halapənim-ekepotani̇n	halapənimekepotani̇n(0)	halapənim & ekepotani̇n(2)
		halapənimeke & potani̇n(4)

The symbol & indicates and AP boundary and the number shown in the parenthesis represents the number of tokens spoken with that number of AP's.

3.3 Discussion

Based on the results, the observation we made in Experiment 1 was confirmed: As the target material gets longer, it tends to split into two AP's. That is, when the target material was 5 syllables or less, all the tokens were produced as one AP whereas when the target material was 6 syllables, six tokens out of twelve were produced as 2 AP's, and when it was 7, nine tokens out of twelve were produced as 2 AP's, etc.

The results also show that the second AP in the target material could consist of suffixes only as *-ekenɨn* in *apənim & ekenɨn* and *-ekepota* in *halapənim & ekepota* show (cf. Figure 5 and 6). Unlike *-mank^{h}ɨm* and *-pota* in Type A and B material, *-eke* is not a morpheme that belongs to a lexical category either historically or currently. Therefore, the only reason for the AP boundary to occur after *halapənim* in *halapənim & ekepota* is due to the number of syllables in the target material and the speech rate. See Conclusion how to assign PWD boundaries for this segmental string.

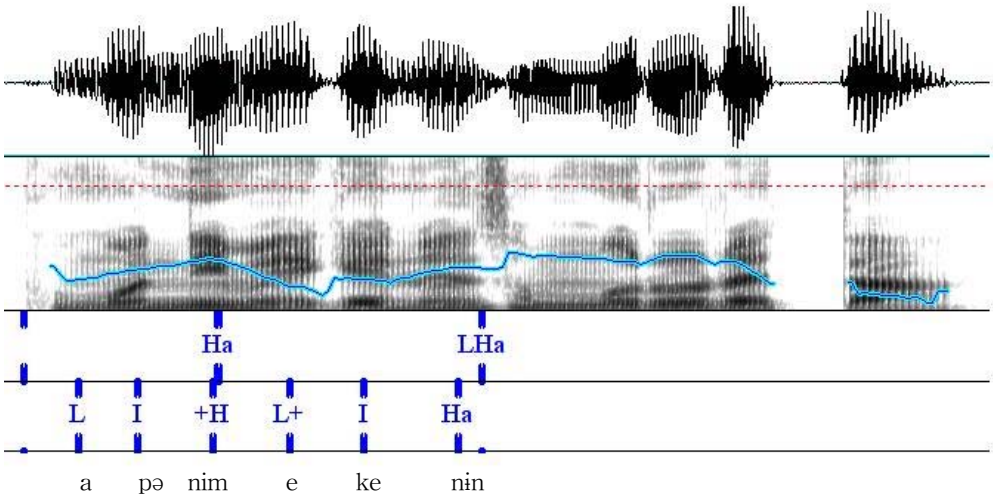


Figure 5. The tonal pattern of the sentence /apənimekenɨn sənmulɨl hætTa/.

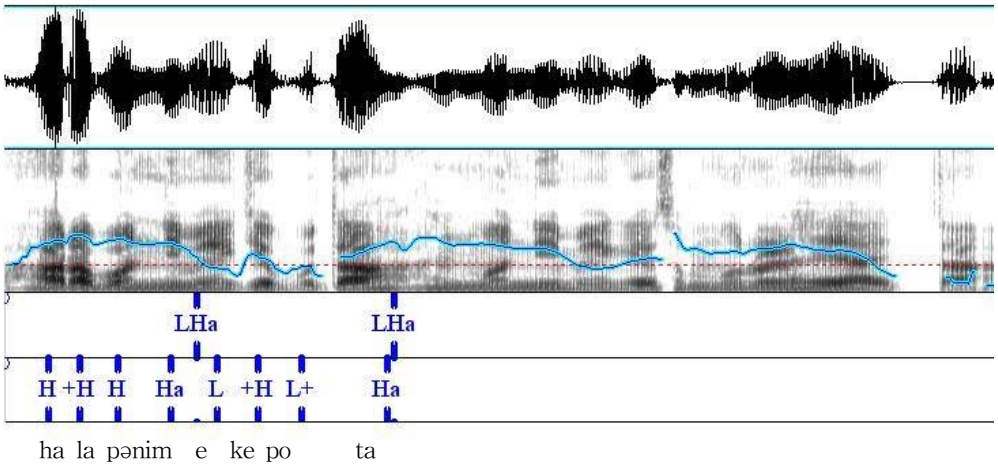


Figure 6. The tonal pattern of the sentence /halapənimekepota halmənimeke sənmulɨl hæyahætTa/.

Furthermore, the results seem to show that the AP respects the morphological integrity of morphemes: for instance, when the content word was 3-syllable long *pumonim* and the suffix was 5 syllable long -*eke*-*pota*-*nin*, four tokens out of six were produced as 2 AP's and the right edge of an AP occurred after the 3-syllable long content word *pumonim*- and before the suffixes -*eke*-*pota*-*nin*, or after *pumonim*-*eke* and before the suffixes -*pota*-*nin*: the AP boundary respects the morphological edge of a morpheme, regardless of whether it is a lexical one or not.

In addition, the results show that a PWD in an AP is not specified with any specific tonal pattern. For example, *halapənim* consists of a prefix with a following stem (and a suffix -*nim*): The first syllable *hal*- historically comes from *han*- 'big' and it should build its own PWD according to Kang (1992). This syllable, however, is realized as a single H tone as is expected for the first syllable in an AP. The following PWD begins with the second tone of the tone sequence of an AP, H_2 in $[T_1H_2..L_{n-1}H_n]$. The tones of syllables in a PWD is therefore determined by their positions within an AP and thus, we can conclude that the constituent PWD is not defined with tones unlike an AP structure that dominates it.

4. Conclusion

This paper investigated tonal patterns and morphological/syntactic structure of the prosodic constituents such as an AP and a PWD in Intonational Phonology. It showed that 1) a PWD in an AP is not specified with any specific tonal pattern. However, it is shown that there are some tendencies in the association of tones with morphemes in an AP. For example, for a content word of 2-syllable long and 3 syllable long suffixes, AP-internal H tone is associated on the second syllable for all the tokens in this experiment, but for a content word of 3-syllable long and 2 syllable long suffixes, AP-internal H tone may be associated either on the second syllable or on the third syllable. This may have something to do with the function of H tones in an AP: whether it is an AP-internal H tone or an AP-final H tone, it shows the position of prominence in perception and thus may indicate the morpheme boundary or the end of the prosodic constituent.

2) The results in this experiment also showed that the definition of the PWD in Prosodic Phonology needs to be modified in Intonational Phonology. Specifically, Experiment 2 showed that suffixes that are not even historically derived from lexical categories may also constitute its own PWD. That is, what determines the number of AP's for the target material is the number of syllables and the speech rate (cf. Kim, 2004), not how many content words there are in the target material.

Let us recapitulate the difference of a PWD in Prosodic Phonology and in Intonational Phonology and consider how to resolve this difference. All PWD's in Prosodic Phonology are matched with a syntactic structure that contains a morpheme of the lexical category according to rules in (3), and phonological phrases are the next higher prosodic structure that were

motivated by other phonological rules. In Intonational Phonology, we have shown that not all PWD's could be matched with syntactic structures as predicted by rules in (3): there is a need to define a certain segmental string as a PWD since it is produced with a sequence of tones of an AP, $[T_1H_2..L_{n-1}H_n]$, which dominates only PWD's.

Thus, instead of abandoning the definition of a PWD in Prosodic Phonology, which seems to be well motivated by concrete phonological rules, we suggest to supplement it with constraints in (5) which match certain AP's with PWD's. These constraints are, in fact, should be assumed by any theory that respects prosodic domination in Selkirk (1995).

(5) a. Align (Left, AP; Left, PWD):
Align the left edge of an AP with the left edge of a PWD.
b. Align (Right, AP; Right, PWD):
Align the right edge of an AP with the right edge of a PWD.

Constraints in (5) will align the edges of an AP with the edges of a PWD, if no PWD edges are assigned with rules in (3), which are restated as constraints in (6).

(6) a. Align (Left, PWD; Left, Lex^0):
Align the left edge of an AP with the left edge of a PWD.
b. Align (Right, PWD; Left, PWD):
Align the right edge of an AP with the right edge of a PWD.
Where Lex^0 stands for word belonging to the lexical categories, N, V, A, Adv.

If the modifications suggested in (5) are accepted, another observation we made in this paper, namely that the final tone of an AP, H, never breaks the morpheme boundary might be taken care of with constraints in (7), which align the edges of a PWD with edges of morphemes by constraints in (7).

(7) Align (Left, PWD; Left, a morpheme)
Align (Right, PWD; Right, a morpheme)

With constraints (7), we can mediate the relationship of morphemes with the tones of an AP with the edges of PWD.

This paper attempted to show then that H-tones of an AP, an AP-internal and an AP-final H tone, indicates some kind of boundary, either a morpheme or a prosodic domain. However, it should be also noted that this is the preliminary research working on the limited data. For the future research, we need to test more materials such as the ones given in Experiment 2 and see whether the suggestions we made in this paper are tenable.

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▲ Hyunsook Kang
Division of English Language and Culture
Hanyang University
Sa-1 dong, Sangnok-gu, Ansansi, Kyunggi-do, Korea, 426-791
Tel: +82-31-400-5348
E-mail: hskang79@gmail.com

Appendix

Experiment 1 Material

Type A

1. nanɨn kɨailɨl atɨlmank^{h}ɨm joahæ.
   나는 그아이를 아들만큼 좋아해.
2. nanɨn kɨpunɨl apəʤimank^{h}ɨm joahæ.
   나는 그분을 아버지만큼 좋아해.
3. nanɨn mikukɨl tæhanminkukmank^{h}ɨm joahæ.
   나는 미국을 대한민국만큼 좋아해.
4. nanɨn epəlentɨlɨl minsokmaɨlmank^{h}ɨm joahæ.
   나는 에버랜드를 민속마을만큼 좋아해.
5. nanɨn kɨailɨl atɨlmank^{h}ɨmina joahæ.
   나는 그아이를 아들만큼이나 좋아해.
6. nanɨn kɨpunɨl apəʤimank^{h}ɨmina joahæ.
   나는 그분을 아버지만큼이나 좋아해.
7. nanɨn mikukɨl tæhanminkukmank^{h}ɨmina joahæ.
   나는 미국을 대한민국만큼이나 좋아해.
8. nanɨn epəlentɨlɨl minsokmaɨlmank^{h}ɨmina joahæ.
   나는 에버랜드를 민속마을만큼이나 좋아해.

Type B

1. napota toŋsæŋɨl tə coahanta.
   나보다 동생을 더 좋아한다.
2. əmmapota aPalɨl tə coahanta.
   엄마보다 아빠를 더 좋아한다.
3. apəʤipota əmmalɨl tə coahanta.
   아버지보다 엄마를 더 좋아한다.
4. minsokmaɨlpota epəlentɨlɨl tə coahanta.
   민속마을보다 에버랜드를 더 좋아한다.
5. tæhanminkukpota tokilɨl tə coahanta.
   대한민국보다 독일을 더 좋아한다.
6. napotanɨn toŋsæŋɨl tə coahanta.
   나보다는 동생을 더 좋아한다.
7. əmmapotanɨn aPalɨl tə coahanta.
   엄마보다는 아빠를 더 좋아한다.
8. apəʤipotanɨn əmmalɨl tə coahanta.
   아버지보다는 엄마를 더 좋아한다.
9. minsokmaɨlpotanɨn epəlentɨlɨl tə coahanta.
   민속마을보다는 에버랜드를 더 좋아한다.
10. tæhanminkukpotanɨn tokilɨl tə coahanta.
    대한민국보다는 독일을 더 좋아한다.

Experiment 2 Material

1. toŋsæŋeke sənmuli̱l hætTa.
   동생에게 선물을 했다.
2. pumonimeke sənmuli̱l hætTa.
   부모님에게 선물을 했다.
3. halapənimeke sənmuli̱l hætTa.
   할아버님에게 선물을 했다.
4. toŋsæŋekeni̱n sənmuli̱l hætTa.
   동생에게는 선물을 했다.
5. pumonimekeni̱n sənmuli̱l hætTa.
   부모님에게는 선물을 했다.
6. halapənimekeni̱n sənmuli̱l hætTa.
   할아버님에게는 선물을 했다.
7. toŋsæŋekepota hyəŋeke sənmuli̱l hæyahætTa.
   동생에게보다 형님에게 선물을 해야했다.
8. pumonimekepota sənsæŋnimeke sənmuli̱l hæyahætTa.
   부모님에게보다 할머님에게 선물을 해야했다.
9. halapənimekepota halmənimeke sənmuli̱l hæyahætTa.
   할아버님에게보다 할머님에게 선물을 해야했다.
10. toŋsæŋekepotani̱n hyəŋnimeke sənmuli̱l hæyahætTa.
    동생에게보다는 형님에게 선물을 해야했다.
11. pumonimekepotani̱n sənsæŋnimeke sənmuli̱l hæyahætTa.
    부모님에게보다는 할머님에게 선물을 해야했다.
12. halapənimekepotani̱n halmənimeke sənmuli̱l hæyahætTa.
    할아버님에게보다는 할머님에게 선물을 해야했다.