

## **A match-theoretic approach to Korean intonational phonology**

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### **1 Introduction**

The distinction between the intermediate phrase (ip, or major phrase) and the accentual phrase (AP, or minor phrase) has been suggested in literature to account for prosody of certain languages including Korean (Yim 2004; Jun 2005a). However, having this distinction in some languages but not in others runs counter to cross-linguistic prosody research. The addition of language-specific prosodic categories such as ip was based on a hypothesis that prosodic categories are strictly layered and thus do not occur recursively. However, a number of more recent studies on a direct syntax-prosody mapping (Match Theory; Selkirk 2011) have claimed that prosody does allow recursive occurrence of categories in order to preserve recursive heads or phrases in syntax (Elfner 2012, 2015; Elordieta 2015; Ito & Mester 2010, 2013; Ladd 1986; Myrberg 2013). Once recursion of prosodic categories is allowed, the motivation for adding ip to the prosodic hierarchy needs to be reconsidered (cf. Ito & Mester 2010). Adopting this theoretical framework, this paper reconsiders the prosodic domains of ip and AP in Korean and suggests a way to unify them through a constraint-based approach to syntax-prosody interface.

### **2 Intermediate Phrase in Korean Prosodic Hierarchy**

In the literature, Korean was analyzed to have a prosodic hierarchy with three hierarchically ordered prosodic categories as illustrated in (1) (Jun 2005b).

- (1) Intonation Phrase (IP)  
    Accentual Phrase (AP)  
    Phonological Word (w)

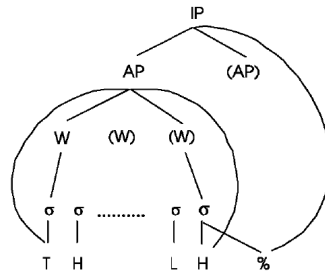
The lowest category, Phonological Word, usually contains one lexical item. It has no tonal specification but serves as the domain of phonetic strengthening and weakening. Accentual Phrase (AP) contains one or more Phonological Words, and each AP is associated with a tonal pattern of LHLH or HHLH. Its final H tone is an AP boundary tone, which is always realized on the final syllable of the AP. The topmost category is Intonation Phrase (IP), which usually consists of a clause or a sentence. The right edge of IP is marked by a boundary tone (e.g., L, H, LH, HL), which overrides an AP boundary tone, and the lengthening of the final syllable.

As most previous studies in intonational phonology did, this Korean prosodic hierarchy is grounded upon Strict Layer Hypothesis (Selkirk 1984; Nespor &

Vogel 1986), which assumes a universal hierarchy of prosodic categories above foot as follows.

- (2) Intonation Phrase (IP;  $\iota$ )
  - Phonological Phrase (PhP;  $\varphi$ ) or Accentual Phrase (AP)
  - Prosodic Word (Wd;  $\omega$ )
  - Foot (Ft)
  - Syllable (Syl)

As shown by its name, this theory holds that each category in this prosodic hierarchy is *strictly layered*. That is, a prosodic category must immediately and exhaustively dominate at least one prosodic category of one level below itself. In the Korean prosodic hierarchy in Figure 1, for example, an IP must immediately dominate at least one AP, which in turn has to dominate at least one phonological word.



**Figure 1:** Strictly layered prosodic categories in Korean (Jun 2005b)  
(T can be either H or L.)

As a consequence of the strictly-layering property of categories, no prosodic category can occur recursively (i.e., a prosodic category  $\alpha$  cannot dominate another  $\alpha$ ), and no level in the hierarchy can be skipped (i.e., a prosodic category  $\alpha$  of level  $n$  cannot immediately dominate a prosodic category of level  $n-2$ ). However, in some languages including Korean, certain prosodic phenomena have been argued to be unaccountable by these strictly layered categories. These observations have led to the addition of a language-specific prosodic category in the prosodic structure of each language. In the following two subsections, I will go over two motivations for the addition of *intermediate phrase (ip)* in the Korean prosodic hierarchy.

## 2.1 Pitch reset in complex DPs

(3) below illustrates a complex DP, consisting of a relative clause followed by two noun phrases. Below are three different intonations that this phrase can be produced with.

- (3) [pyengwen-ey ipwenha-n]<sub>CP</sub> [tonglyo-uy]<sub>NP</sub> [puin-eykey]<sub>NP</sub>  
 (L L Ha) ↓(L L Ha) ↓(L L Ha) ↓(L H L Ha)  
 (L L Ha) ↓(L L HL%) ↑(L L Ha) ↓(L H L Ha)  
 (L L Ha) (L L ↑Ha) (L L Ha) (L H L Ha)  
 hospital-LOC hospitalized-COMP colleague-POSS wife-DAT  
 ‘to (my) colleague’s wife who is hospitalized’

(Jun 2005a)

In (3a), the last syllable of each word is realized with an AP boundary tone, labeled as *Ha*, indicating that each word forms an AP. Also, the sequence of AP tonal patterns undergoes pitch downstep, as indicated by the downward arrows. That is, each of the tones (L, L, and *Ha*) in the first AP have higher pitch than their counterparts in the second AP, which in turn have higher pitch than those in the third AP. In (3b), the final syllable of the second word has an IP boundary tone, labeled as *HL%*. This shows that each of the first two words forms an AP, and the two APs together form an IP, while the last two APs form another IP. Pitch downstep occurs across APs within the same IP, while pitch reset occurs at the IP boundary (the upward arrow). Both (3a) and (3b) can be explained by the three strictly layered prosodic categories and their boundary tones. However, this is not the case in (3c), where the four words form four APs within one IP but the boundary tone of the second AP is higher than that of the first AP (the upward arrow), breaking the chain of pitch downstep, as highlighted in Figure 2 as well. This makes the juncture between the relative clause and the first noun perceptually bigger than normal AP boundaries. Since this is accounted for neither by AP nor IP, an additional prosodic category, *ip*, had to be posited between these two categories as the domain of pitch reset.

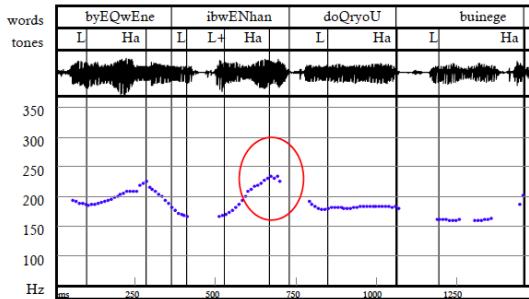


Figure 2: Pitch reset in Complex DP (Jun 2005a)

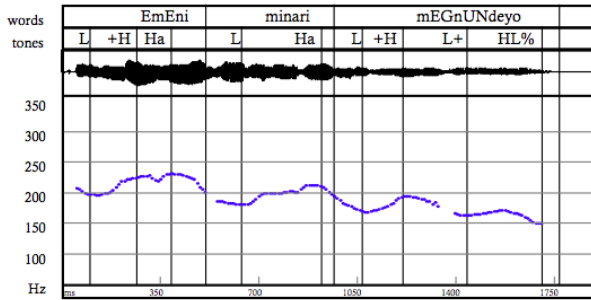
## 2.2 Post-focus dephrasing

Another motivation for adding *ip* to the Korean prosodic hierarchy concerns post-focus dephrasing. The sentence in (4) is a neutral sentence with no narrow focus.

In this sentence, each word forms one AP, and the three APs form one IP together. Again, the pitch contour in Figure 3 shows pitch downstep across the APs.

- (4) [*emeni*]<sub>DP</sub>                      [[*minari*]<sub>DP</sub>                      *mek-nundeyyo*]<sub>VP</sub>  
 (L L Ha)                              ↓(L L Ha)                              ↓(L H L L%)  
 mother                                  parsley                                  eat-ENDING  
 ‘(My) mother eats parsley.’

(Jun 2005a)

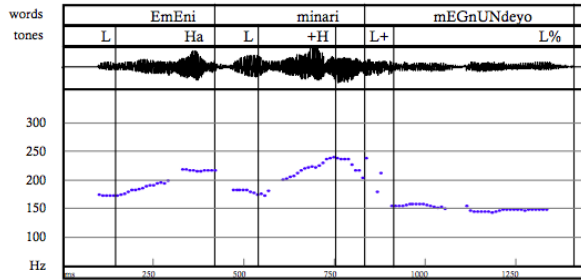


**Figure 3:** Sentence with no narrow focus (Jun 2005a)

The same sentence in (5) has narrow focus on the second word. Unlike in the case of the neutral sentence, there is no AP boundary between the second and third words. As Figure 4 shows, the focused word has an expanded pitch range and the third word lacks an AP tonal pattern. This indicates that the focused element and the post-focus element together form one prosodic domain larger than regular AP. As neither IP nor AP explains this prosodic domain, ip was considered to also serve as the domain of focus.

- (5) [*emeni*]<sub>DP</sub>    [[*minari*]<sub>DP-focused</sub>    *mek-nundeyyo*]<sub>Given</sub>]<sub>VP</sub>  
 (L L Ha)    (L ↑+H                                  L%)  
 mother    parsley                                  eat-ENDING  
 ‘It is parsley that my mother eats.’

(Jun 2005a)



**Figure 4:** Sentence with narrow focus on *minari* ('parsley') (Jun 2005a)

(6) is a revised Korean prosodic hierarchy that includes *ip* as the domain of pitch reset and focus, higher than AP but lower than IP. Despite the revision, this hierarchy is still based on Strict Layer Hypothesis, and therefore no prosodic category can occur recursively.

- (6) Intonation Phrase (IP)
- Intermediate Phrase (*ip*)
- Accental Phrase (AP)
- Phonological Word (*w*)

Although the above empirical observations provide motivations for adding *ip* as a descriptively useful label, whether such an additional category is necessary in the system of intonation phonology is still debatable. If one assumes the Strict Layer Hypothesis, which strictly prohibits recursion of prosodic domains, positing an intermediate domain, *ip*, would be inevitable. However, once recursion of prosodic categories is allowed, the motivation for such addition needs to be reconsidered. In Match Theory, for instance, prosodic categories above foot and syllables are derived from constituents in syntactic structure, and thus recursive syntactic constituency results in recursion in prosody as well (Selkirk 2011; Selkirk & Lee 2015). Indeed, a number of recent studies have shown that a prosodic hierarchy that allows recursive prosodic categories is able to explain and predict intonational patterns in languages (e.g., Elfner 2012, 2015; Elordieta 2015; Ito & Mester 2007, 2010, 2013; Ladd 1986; Myrberg 2013). In the following section, I provide alternative analyses of the Korean data introduced above taking a Match Theoretic approach to syntax-prosody interface, which allows recursion of prosodic domains, and which takes away the need of a language-specific prosodic domain.

### 3 Analysis

Match Theory posits a universal prosodic hierarchy consisting of three prosodic categories as in (7).

- (7) Intonational Phrase ( $\iota$ )  
 Phonological Phrase ( $\varphi$ )  
 Prosodic Word ( $\omega$ )

Constituents in prosodic structure must correspond to constituents in syntactic structure and vice versa, as required by Match constraints. The schemata of Match constraints are given in (8) below, where  $\alpha$  is a variable for syntactic constituents and  $\pi$  is a variable for prosodic constituents.

- (8) Match constraints
- a. Match ( $\alpha, \pi$ ) [ = S-P Match]  
 The left and right edges of a constituent of type  $\alpha$  in the input syntactic representation must correspond to the left and right edges of a constituent of type  $\pi$  in the output phonological representation.
- b. Match ( $\pi, \alpha$ ) [ = P-S Match]  
 The left and right edges of a constituent of type  $\pi$  in the output phonological representation must correspond to the left and right edges of a constituent of type  $\alpha$  in the input syntactic representation.
- (Selkirk 2011)

These Match constraints interact with prosodic markedness constraints based on a language-specific ranking among them. When Match constraints are dominated by higher-ranking prosodic markedness constraints, the faithful mapping between syntactic constituency and prosodic constituency is broken and non-isomorphisms arise. Crucially, the recursion of prosodic categories is allowed in this approach, as formalized as a violable constraint NORECURSION.

- (9) NORECURSION  
 No recursive structures. Assign one violation for each node of category  $\alpha$  immediately dominated by another node of category  $\alpha$ .
- (Ito & Mester 2013)

Another crucial notion in Match theory is the distinction between maximal and minimal prosodic categories. In a prosodic structure with recursive projections of a prosodic category  $\alpha$ , a maximal projection of  $\alpha$  is the topmost projection of  $\alpha$ , and a minimal projection of  $\alpha$  is the lowest projection of  $\alpha$  (Ito & Mester 2007, 2013).

- (10) a. maximal  $\alpha$ :  $\alpha$  not dominated by  $\alpha$   
 b. minimal  $\alpha$ :  $\alpha$  not dominating  $\alpha$

The notion of being maximal or minimal is binary, and thus a prosodic category in a tree can be non-maximal or non-minimal as well, as defined in (11).

- (11) a. non-maximal  $\alpha$  ( $\alpha_{\text{non-max}}$ ):  $\alpha$  dominated by at least one  $\alpha$   
 b. non-minimal  $\alpha$  ( $\alpha_{\text{non-min}}$ ):  $\alpha$  dominating at least one  $\alpha$

This distinction is significant, as prosodic categories have been found to behave differently depending upon their (non-)minimality status. For example, in her study on Connemara Irish, Elfner (2015) showed that every  $\varphi$  has HL accent at the right edge, but only non-minimal  $\varphi$  has LH accent at the left edge. Also, Elordieta (2015) found in Lekeitio Basque that pitch reset applies at the left edge of non-minimal  $\varphi$ , and downstep applies at the left edge of minimal  $\varphi$  not aligned with the left edge of non-minimal  $\varphi$ .

Noting this distinction, I assume in my further analysis that i) in Korean minimal  $\varphi$  is associated with a tonal pattern of LHLH or HHLH, which was called AP tonal pattern in previous studies, and that ii) pitch reset occurs at the left or right edge of non-minimal  $\varphi$  (Baek 2016). Table 1 compares the theoretical framework and terminology for prosodic categories used in literature (Jun 2005) with those of the current paper. The critical issue at our hand is whether the distinction between ip and AP in literature can be replaced by the distinction between minimal and non-minimal  $\varphi$ .<sup>1</sup>

	Jun (2005)	Current analysis
Theoretical Background	Strict Layer Hypothesis (Selkirk 1984)	Match Theory (Selkirk 2011)
Prosodic Categories	Intonation Phrase (IP)	Intonational Phrase (t)
	Intermediate Phrase (ip) (the domain of focus and pitch reset)	<b>Non-minimal Phonological Phrase (<math>\varphi_{\text{non-min}}</math>)</b>
	Accentual Phrase (AP) (tonal pattern of LHLH, HHLH)	<b>Minimal Phonological Phrase (<math>\varphi_{\text{min}}</math>)</b>
	Phonological Word (w)	Prosodic Word ( $\omega$ )

**Table 1:** Korean prosodic hierarchies in two frameworks: Jun (2005) vs. current analysis

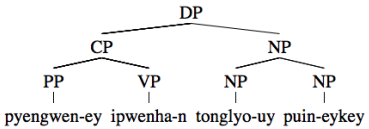
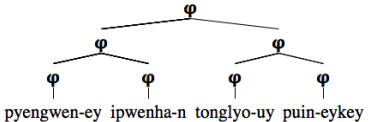
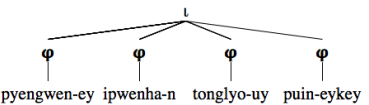
### 3.1 Analysis 1: Pitch reset in complex DPs

This section analyzes pitch reset that occurs in complex DPs by referring to the interaction between Match constraints and prosodic markedness constraints.

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<sup>1</sup> Other comparisons between the two hierarchies (e.g., Phonological Word vs. Prosodic Word) or the recursivity of other prosodic categories in the framework of Match Theory (e.g., (non-)minimal/maximal t or  $\omega$ ) are beyond the scope of this paper, but they must also have great theoretical significance and deserve further research.

Given the input syntactic structure as in (12), the Match constraint  $\text{MATCH}(\text{Phrase}, \varphi)$  requires that each maximal phrase in input must correspond to  $\varphi$  in output.<sup>2</sup> The fully faithful candidate (a) has recursive  $\varphi$ , where the four lowest  $\varphi$  are minimal and the other three  $\varphi$  above are non-minimal.

(12)		MATCH (Phrase, $\varphi$ )	NO RECURSION
a.			*
b.		***!	

The observation that the boundary between the relative clause and the first noun is associated with pitch reset (3c) indicates that there is a left or right edge of  $\varphi_{\text{non-min}}$  occurring at the boundary, just as in candidate (a). Therefore, the faithful candidate (a) with recursive prosodic categories wins over the other candidate (b), which has a ‘flatter’ structure with no recursion. That the prosodic structure that is faithful to syntactic structure is the winner shows that the S-P Match constraint is ranked above NORECURSION in Korean. In other words, Korean tolerates the violation of the restriction on recursive prosodic categories so as to maintain a faithful mapping between syntax and prosody.

(13)  $\text{MATCH}(\text{Phrase}, \varphi) \gg \text{NORECURSION}$

### 3.2 Analysis 2: Post-focus dephrasing

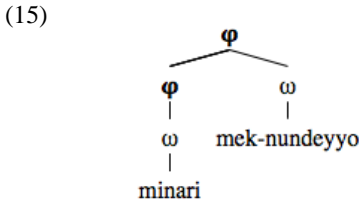
Post-focus dephrasing was another prosodic pattern that was attributed to ip, but it can also be explained by constraint interaction in Match Theory. Unlike in the previous case of pitch reset, we can see a non-isomorphism between syntax and prosody in the neutral sentence (4), repeated in (14) here.

<sup>2</sup> Each minimal  $\varphi$  in Tableau (12) is assumed to contain one  $\omega$ , corresponding to the head of XPs in syntax, although not explicitly shown in the trees.



- (14) [*emeni*]<sub>DP</sub> [[*minari*]<sub>DP</sub> *mek-nunde<sup>yo</sup>*]<sub>VP</sub>  
 (L L Ha) ↓(L L Ha) ↓(L H L L%)  
 mother parsley eat-ENDING  
 ‘(My) mother eats parsley.’

In syntax, the verb *mek-nunde<sup>yo</sup>* does not form a maximal projection itself. If a prosodic structure was to be faithfully mapped to the given syntactic structure, as in (15), it has to have  $\phi$  for the complement DP and prosodic word ( $\omega$ ) for the verb itself, which together forms a non-minimal  $\phi$ .



In prosody, however, the verb is given its own tonal pattern of LHLH, where the final H tone is overridden by the IP boundary tone L%. This indicates that the resulting prosodic structure is divergent from (15), suggesting the presence of a prosodic markedness constraint dominating MATCH( $\phi$ , Phrase). Myrberg (2013) has reported a prosodic restriction on the nodes in a sister relationship (e.g., minimal  $\phi$  and the righthand  $\omega$  in (15)) in Stockholm Swedish. That is, two prosodic nodes that are in a sister relationship must be the same prosodic category, regardless of their status in syntax. Based on her observation, she suggests a prosodic markedness constraint EQUALSISTERS, defined as (16).

- (16) EQUALSISTERS  
 Sister nodes in prosodic structure are instantiations of the same prosodic category.

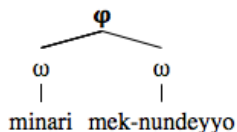
(Myrberg 2013)

That fact that the prosodic structure (15) is disfavored in Korean indicates that this prosodic markedness constraint dominates some match constraints in this language, forcing syntax-prosody non-isomorphisms to surface.

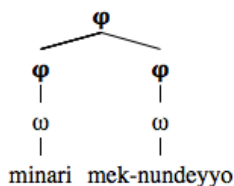
Trees in (17) suggest two alternatives for prosodic structure to modify the sister nodes to avoid violating this constraint. The first alternative (17a) is to remove  $\phi$  from the complement DP to make two  $\omega$  sister nodes. This derivation will violate a S-P Match constraint, since there is a syntactic constituent (DP) that is not faithfully mapped onto a  $\phi$  in syntax. The other alternative (17b) is to add  $\phi$  above the verb to make two  $\phi$  sister nodes. This will violate a P-S Match

constraint, since there is a prosodic constituent ( $\varphi$ ) that does not have a corresponding syntactic phrase.

(17) a. removing  $\varphi$



b. adding  $\varphi$



What surfaces in production is the second alternative (17b), where each minimal  $\varphi$  – both the complement and the verb – is associated with a tonal pattern of LHLH. That is, the violation of a S-P Match constraint is more critical than the violation of a P-S Match constraint, indicating a higher ranking of the former than the latter. Tableau (18) summarizes the interaction among these constraints. The input and output structures in the tableau only show the internal structure of VP.

(18)

$[[\text{minari}]_{\text{DP}} \text{meknundeyyo}]_{\text{VP}}$	EQUAL SISTERS	MATCH (Phrase, $\varphi$ )	MATCH ( $\varphi$ , Phrase)	NO REC.
a. $((\text{minari})_{\varphi} (\text{meknundeyyo})_{\omega})_{\varphi}$	*!			*
b. $((\text{minari})_{\omega} (\text{meknundeyyo})_{\omega})_{\varphi}$		*!		
c. $((\text{minari})_{\varphi} ((\text{meknundeyyo})_{\omega})_{\varphi})_{\varphi}$			*	*

The case of complex DP discussed in the previous section showed that NORECURSION is dominated by Match constraints. In addition, the case of VP without focus discussed here shows that i) a prosodic markedness constraint EQUALSISTERS dominates Match constraints, resulting in non-isomorphisms between syntax and prosody, and that ii) among Match constraints, S-P Match constraints are ranked higher than P-S Match constraints.

(19) EQUALSISTERS  $\gg$  MATCH(Phrase,  $\varphi$ )  $\gg$  MATCH( $\varphi$ , Phrase)  
 $\gg$  NORECURSION

On the other hand, different intonation surfaces when a narrow focus is given to the complement DP, as shown in (5), repeated below in (20). That is, the focused word *minari* does not have a boundary tone at its right edge, and the post-focus word *mek-nundeyyo* does not form a prosodic domain itself lacking a distinct tonal pattern. This indicates that the focused element and the post-focus element together form one prosodic unit. However, since the sentence (20) has the same syntactic constituency as the sentence (14), there must be some high-ranking constraint that prefers another candidate only in (20) but not in (14).

- (20) [*emeni*]<sub>DP</sub> [[*minari*]<sub>DP-focused</sub> *mek-nundeyyo*]<sub>GIVEN</sub>]<sub>VP</sub>  
 (L L Ha) (L ↑+H L%)  
 mother parsley eat-ENDING  
 ‘It is parsley that my mother eats.’

It is not uncommon across languages that when a sentence has new information or narrow focus, other unfocused elements that bear old information are prosodically compressed. Féry and Samek-Lodovici (2006) has formalized this as a constraint DESTRESSGIVEN. This constraint rules out a *Given* element if it is produced with prosodic prominence.

- (21) DESTRESSGIVEN  
 A Given phrase is prosodically nonprominent.  
 (Féry & Samek-Lodovici 2006)

In the prosodic structure (17b) (= candidate (c) in (22) below), the verb *mek-nundeyyo* forms a minimal  $\phi$ , which has a tonal pattern of LHLH. Having its own tonal pattern, makes the element perceptually prominent, forming an independent prosodic unit itself. This structure is thus penalized by the constraint DESTRESSGIVEN. Consequently, the other alternative (17a) (= candidate (b) in (22) below), where the verb does not form a minimal  $\phi$  (and neither does the complement DP, as required by EQUALSISTERS) wins, and the two words together are associated with a LHLH tonal pattern.

(22)

	[[ <i>minari</i> ] <sub>DP-focused</sub> <i>meknundeyyo</i> ] <sub>GIVEN</sub> ] <sub>VP</sub>	DEST. GIVEN	EQUAL SISTERS	MATCH (P, $\phi$ )	MATCH ( $\phi$ ,P)	NO REC.
a.	(( <i>minari</i> ) <sub><math>\omega</math></sub> ) <sub><math>\phi</math></sub> ( <i>meknundeyyo</i> ) <sub><math>\omega</math></sub> ) <sub><math>\phi</math></sub>		*!			*
b.	(( <i>minari</i> ) <sub><math>\omega</math></sub> ) ( <i>meknundeyyo</i> ) <sub><math>\omega</math></sub> ) <sub><math>\phi</math></sub>			*		
c.	(( <i>minari</i> ) <sub><math>\omega</math></sub> ) <sub><math>\phi</math></sub> (( <i>meknundeyyo</i> ) <sub><math>\omega</math></sub> ) <sub><math>\phi</math></sub> ) <sub><math>\phi</math></sub>	*!			*	*

In the winning prosodic structure, another prosodic markedness constraint such as STRESS FOCUS (Selkirk 2011) will require the focused element to be realized with a stronger prominence, thus the expanded pitch range.

Jun (2005a) analyzed post-focus dephrasing as two words – the focused word and the following word – forming two APs, which together form a higher

prosodic domain, *ip*. However, this analysis fails to explain why each of the two APs does not have the tonal pattern of AP (LHLH). The focused word lacks an AP boundary tone, and the post-focus word does not have a distinct tonal pattern, which is unexpected if each of them forms an AP. In the current analysis, on the other hand, the post-focus word is actually dephrased from its expected  $\varphi$  and is subsumed under the same  $\varphi$  as the focused word. According to this analysis, it follows that neither of the words has a separate LHLH tonal pattern, since neither of them forms a minimal  $\varphi$  alone.

#### 4 Summary and conclusion

This paper takes a constraint-based approach to syntax-prosody interface, where Match constraints interact with prosodic markedness constraints. It provides alternative analyses of pitch reset in complex DP and post-focus dephrasing in Korean to confirm that prosodic structure with recursive prosodic constraints and the distinction between minimal and non-minimal prosodic categories can replace the Korean-specific prosodic hierarchy with an intermediate domain, *ip*. The case of complex DP shows that Match constraints dominate a prosodic markedness constraint, NORECURSION, which leads to a faithful mapping between syntax and prosody. In the case of post-focus dephrasing, it was shown that Match constraints are dominated by prosodic markedness constraints such as EQUALSISTERS, resulting in syntax-prosody non-isomorphisms. In addition, the interaction between prosodic markedness constraints – EQUALSISTERS and DESTRESSGIVEN – result in different winning outputs. This approach allows one to analyze Korean with a universal prosodic hierarchy, rather than positing language-specific prosodic domains, while accounting for relevant empirical observations.

I conclude this paper by suggesting future directions to complement this research. First, since the data analyzed in this paper are taken from a previous study, experimental studies involving a larger set of data must follow in order to verify the assumptions and analyses made here. For example, as briefly noted in Jun (2005a) as well, a complex DP such as (3) is syntactically ambiguous, since the relative clause can modify either the first or the second noun phrase. More than one underlying syntactic structures will result in more than one prosodic structures, which can account for its variable intonations given in (3a-c) (Baek 2016). Furthermore, as a consequence of the low ranking of NORECURSION, not only  $\varphi$  but also  $\iota$  and  $\omega$  are given freedom to occur recursively. The recursion of  $\iota$  and  $\omega$  and the distinction between minimal and non-minimal  $\iota$  or  $\omega$  will also contribute to the establishment of a Korean prosodic system that is derived by a universal mechanism of syntax-prosody interface.

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