

# The syntax-prosody interface in Korean: resolving ambiguity in questions

Stephen Jones

University of Oxford

Proceedings of the Joint 2016 Conference on Head-driven Phrase Structure  
Grammar and Lexical Functional Grammar

Polish Academy of Sciences, Warsaw, Poland

Doug Arnold, Miriam Butt, Berthold Crysmann, Tracy Holloway King, Stefan  
Müller (Editors)

2016

CSLI Publications

pages 318–338

<http://csli-publications.stanford.edu/HeadLex/2016>

Keywords: Korean, prosody, syntax, experimental, questions

Jones, Stephen. 2016. The syntax-prosody interface in Korean: resolving ambiguity in questions. In Arnold, Doug, Butt, Miriam, Crysmann, Berthold, King, Tracy Holloway, & Müller, Stefan (Eds.), *Proceedings of the Joint 2016 Conference on Head-driven Phrase Structure Grammar and Lexical Functional Grammar, Polish Academy of Sciences, Warsaw, Poland*, 318–338. Stanford, CA: CSLI Publications.



## Abstract

The paper<sup>1</sup> considers a phenomenon in Korean where ambiguity in the written language is resolved prosodically. An LFG analysis is provided which extends the proposals of Mycock and Lowe (2013) to Korean, based on experimental evidence on the prosodic expression of focus in Korean which challenges the phrase-boundary based account of Jun and Oh (1996), and suggests that considering expanded pitch range may give a more robust account of focus expression.

## 1 Introduction

This paper aims to give a LFG analysis of the role of prosody in determining the three meanings of the Korean sentence<sup>2</sup> given at (1).

- (1) *acwumeni-ka nwukwu-lul manna-syess-eyo*  
auntie-SBJ someone/who-OBJ met-SH.PST-POL
- 'Auntie met someone.'
  - 'Did auntie meet someone?'
  - 'Who did auntie meet?'

The three meanings result from interactions between three elements of Korean grammar. First, in the polite speech style there is no morphological marking of questions. Instead, mood is specified by a sentence-final tone pattern on the last syllable. Thus the pattern HL (a high tone immediately followed by a low tone) is associated with indicative mood, whereas the pattern LH (a low tone immediately followed by a high tone) is associated with interrogative mood (Jun, 2005). Second, Korean has a set of words that function both as indefinite pronouns and wh-interrogatives, e.g. *edi* 'where/somewhere', *encey* 'when/sometimes', *ettehkey* 'how/somehow', *mwe(s)* 'what/something', *nwukwu* 'who/someone'. Given this dual function, I will refer to them as content pro-forms (CPFs).

Third, Korean allows for scrambling and, as a consequence, does not require a particular position for the content pro-form in open questions (wh-in-situ). These three elements combine to give the possible readings in (1).

The difference between open and polar question readings can be analysed as an alternation in the scope of question focus (Dalrymple, 2001). When the focus includes the predicate together with the CPF, termed *broad focus*, a polar reading is obtained, with the minimal answer 'yes/no' (2), whereas when only the CPF is

<sup>1</sup>I am grateful for support and contributions from Dr. Jieun Kiaer and Dr. Louise Mycock; Korean language advisers Yoolim Kim and Myungsu Kang; the experimental participants; and the anonymous reviewers. I am also grateful for financial support to attend from Kellogg College, Oxford and the International Lexical Functional Grammar Association.

<sup>2</sup>Romanizations of Korean follow the Yale system (Martin, 1992) unless otherwise indicated.

in focus, termed *narrow focus*, an open reading is obtained, with a minimal answer referring to a specific individual (3).

- (2) *acwumeni-ka nwukwu-lul manna-syess-eyo*  
 auntie-SBJ **someone**-OBJ **met**-SH.PST-POL  
 ‘Did auntie meet someone?’
- (3) *acwumeni-ka nwukwu-lul manna-syess-eyo*  
 auntie-SBJ **who**-OBJ met-SH.PST-POL  
 ‘Who did auntie meet?’

Native speakers report no ambiguity when hearing a spoken sentence as each reading is associated with a distinctive prosodic pattern (e.g. Jun and Oh, 1996). However, there is no generally agreed-upon account of acoustic cues by which focus is realised. Some accounts consider the acoustic realisation of narrow focus, rather than comparing narrow and broad focus. These include those of Kim (2000), who describes the focused element as “prominent” and Yun (2012), who concludes that phonological dephrasing after the focused element is more important than the characteristics of the focused element itself.

An alternative account is proposed by Jun and Oh (1996) based on the findings of a perception experiment, who propose that the open and polar readings are distinguished by the placement of phrase boundaries in the whole sentence, rather than the acoustic characteristics of any particular element. Figure 1 is reproduced from their paper and shows the two different readings of the question<sup>3</sup> in (4). In the diagram, for each reading, the x-axis gives the syllables of the question, with each syllable annotated with the symbol  $\sigma$  and, where appropriate, with L or H denoting low or high tone respectively. The y-axis is an unscaled representation of pitch. Phrase boundaries are marked with vertical lines. The boxed sections of each question show the syllables that are in focus.

- (4) atʃuməninin əntʃe                      ətʃiləwəjo  
 madam.TOP sometimes/when dizzy.POL  
 a. “Is madam dizzy at any time?”  
 b. “When is madam dizzy?”

In Jun and Oh’s account, the prosodic pattern seen in (a), where there is a phrase boundary between the CPF and the final verb, is associated with the polar reading, where the CPF and the final verb are both in focus. However, in the open reading (b) when the CPF alone is in focus, there is no phrase boundary between the CPF and the verb.

<sup>3</sup>I have given Jun and Oh’s phonetic rendering of the sentence. The equivalent Yale romanization is *acwumeninun encey ecileweyo*.

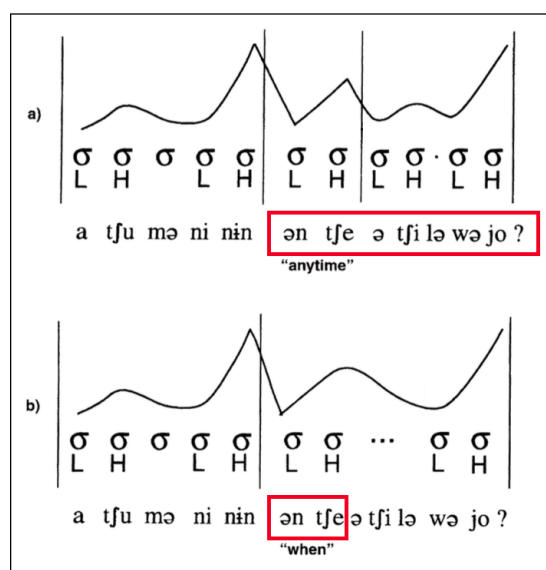


Figure 1: Prosodic disambiguation of focus (from Jun and Oh, 1996, p. 48)

## 2 Korean prosody

I adopt the account of Korean prosody given by Jun (2005). This differs from English prosody in that there is no evidence of nuclear pitch accent, and that phrasal constituents are not syntactically determined (cf. claims for English by e.g. Selkirk, 1984; Nespor and Vogel, 1986; Hayes, 1989). A prosodic hierarchy exists with nested elements in line with the Strict Layer Hypothesis (Selkirk, 1984). Jun identifies the following elements: syllables (Syll), prosodic words (PW), accentual phrases (AccP), and intonational phrases (IntP). Prosodic word boundaries are not marked, and there is no evidence of lexical stress. However, a prosodic word can be identified as the domain of some sandhi phenomena, such as lenis obstruent tensing. Phrasal constituents AccP and IntP are marked prosodically with distinctive tone patterns and phrase-final lengthening. The hierarchy is shown in Figure 2, reproduced from Jun (2005, p. 205).

Each AccP has the minimal structure shown within the double lines in Figure 2. The left edge of an AccP is marked tonally with a pattern described by Jun as *T-H*, where *T* is underlyingly *L*, but can be phonologically conditioned to appear as *H* by an initial tense or aspirated consonant. The right edge of an AccP is marked tonally *L-H*, with lengthening of the final syllable. The boundary pattern *T-H...L-H* is autosegmentally associated (Goldsmith, 1976) with the syllables of the phrase. Accentual phrases can be as short as a single word, and AccPs with a length greater than 7 syllables are seen infrequently. Where a phrase is longer than 4 syllables, the

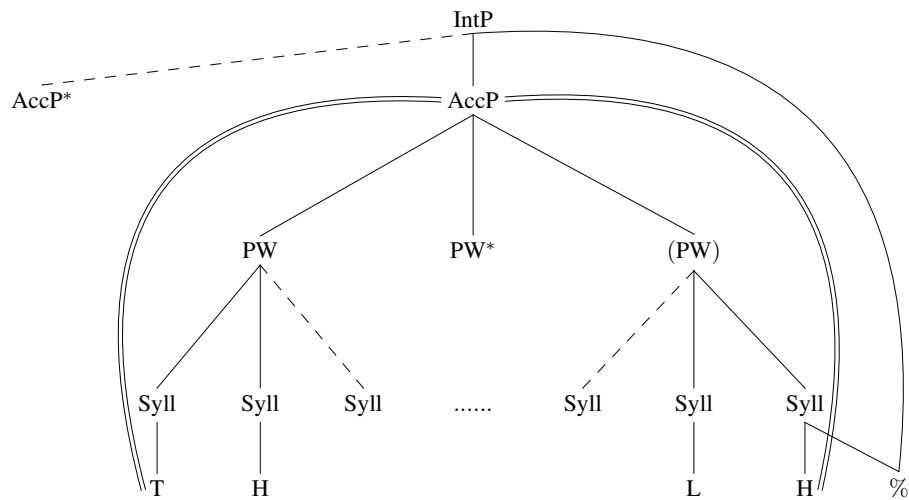


Figure 2: Korean prosodic hierarchy proposed by Jun (2005, p. 205)

left edge H tone may attach to the third rather than the second syllable, and there is a gradual decrease in pitch between the two edge patterns. Where a phrase is shorter than 4 syllables, tone deletion occurs, which results in a variety of possible tone patterns: a full description of this is given in Jun (2005).

Intonational phrases are often a whole sentence or major clause. Their left edge has no particular marking, but the right edge has a boundary tone pattern which replaces the final H tone of the rightmost AccP within the IntP. These boundary tones carry semantic/pragmatic meaning, including the patterns associated with mood mentioned in Section 1: HL ⇒ declarative; LH ⇒ interrogative. In this paper I denote these boundary tones using a variable, %.

Figures 3 and 4 show the respective prosodic patterns for the declarative (a) and interrogative (b) readings respectively of example (5).

- (5) *acwumenika nwunalul mannasyeseyo*  
 auntie.SBJ older.sister.OBJ meet.HON.PST.POL  
 a. “Auntie met older sister.”  
 b. “Did auntie meet older sister?”

In both examples, AccPs can be distinguished for each of the three words, together with the characteristic IntP final tone pattern. Declination of pitch is seen across the IntP. In Figure 4, the pitch range for the IntP-final LH tone pattern is much greater than that for the HL pattern in Figure 3.

One difficulty for Jun and Oh’s account of the prosodic disambiguation is that there is no requirement for the CPF and final verb to be adjacent. Where a con-

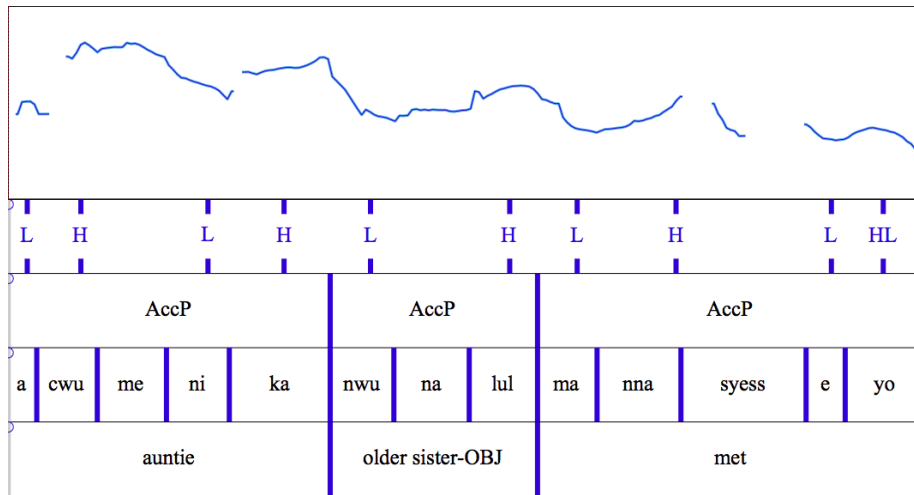


Figure 3: Example prosody for (5a) "Auntie met older sister."

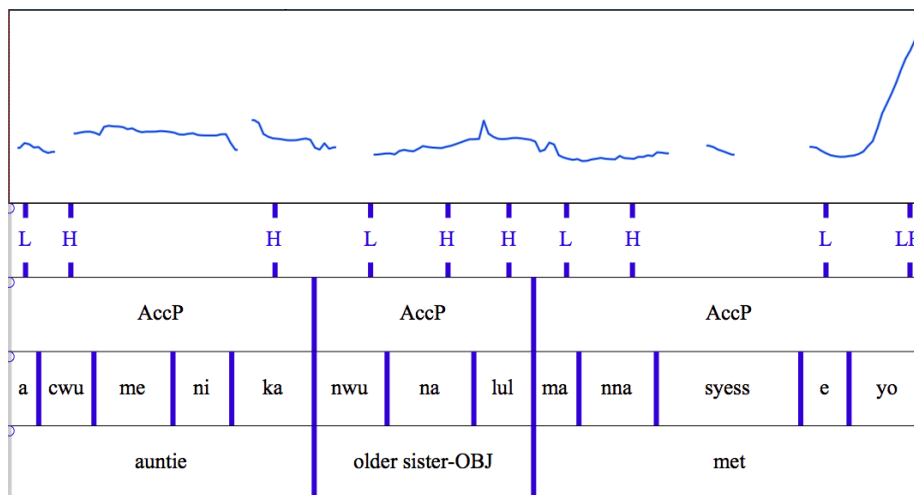


Figure 4: Example prosody for (5b) "Did auntie meet older sister?"

stituent interposes between the CPF and the verb, Jun and Oh's account predicts prosodic patterns that are highly unlikely. Consider example (6).

- (6) *acwumeni-nun encey simhakey swusikantongan ecilewe-syess-eyo*  
 madam-TOP when severely for.several.hours dizzy-HON.PST-POL  
 a. "Was madam sometimes severely dizzy for several hours?"  
 b. "When was madam severely dizzy for several hours?"

Jun and Oh frame their account in terms of the presence or absence of an AccP

boundary between the CPF and the final verb. For the open reading (6b), Jun and Oh’s model predicts the pattern of AccP boundaries shown in Figure 5.

Subject	CPF	Adjunct	Adjunct	Verb
<i>a.cwu.me.ni.nun</i>	<i>en.cey</i>	<i>sim.ha.key</i>	<i>swu.si.kan.to.ngan</i>	<i>e.ci.le.we.syes.se.yo</i>
madam-TOP	when	severely	for.several.hours	dizzy.PST.POL
AccP	AccP			
5 syllables	17 syllables			

Figure 5: Predicted prosody: “When was madam severely dizzy for several hours?”

The requirement for no AccP boundary between the CPF *encey* and the final verb *ecilewesyesseyo* gives an AccP of 17 syllables. This is unlikely given that AccPs generally have a maximum length of around 7 syllables, and very long AccPs (e.g. >10 syllables) are infrequently produced. It is questionable whether Jun and Oh’s model is robust in these circumstances.

However, Jun and Oh’s constraint on AccP boundary placement might also be described as the presence or absence of an AccP boundary either immediately after the CPF, or immediately before the verb, or both. Where the CPF and verb are adjacent, this distinction is moot, but a reframing in terms of the right edge of the CPF and/or the left edge of the verb would avoid the improbably long AccP presented in Figure 5.

### 3 Experiment

An elicitation experiment was carried out to test the hypothesis that Jun and Oh’s account makes the wrong prediction for questions where a constituent intervened between CPF and final verb, in other words, that AccP boundary placement alone would not disambiguate between open and polar readings. The null hypothesis was that Jun and Oh’s model was correct.

**Stimuli** Experimental stimuli were six sets of four context-utterance pairs generated according to the template in Figure 6 with  $2 \times 2$  variation in length of utterance and target reading (open vs. closed). There was an equal number of similarly-constructed fillers.

An example of one context-utterance pair is given below. The context was given for a target open reading (7) or polar reading (8) and this was matched alternately with the short (9) or long (10) version of the question to generate short open (9a), short polar (9b), long open (10a) and long polar (10b) readings respectively.

Background information Target = open: “You know some, but not all, details of an event.”  
 Target = polar: “You don’t know whether an event happened.”

Structure	Introductory constituent	CPF	( intervening constituent )	verb
Variation	$\left\{ \begin{array}{l} \text{open reading} \\ \text{polar reading} \end{array} \right\} \times \left\{ \begin{array}{l} \text{short: } - \text{ intervening constituent} \\ \text{long: } + \text{ intervening constituent} \end{array} \right\}$			

Figure 6: Template used to generate experimental stimuli

- (7) *tangshinun ecey hwanan sarami issessten kesul alko*  
 you.TOP yesterday angered person.SBJ existed thing.OBJ knowing  
*issupnita*  
 exists  
 “You know that someone got angry yesterday.”
- (8) *tangshinun ecey hwanan sarami issessnun ci*  
 you.TOP yesterday angered person.SBJ existed uncertain.thing  
*moruko issupnita*  
 unknowing exists  
 “You don’t know whether anyone got angry yesterday.”
- (9) *ecey nwuka hwanasseyo*  
 yesterday who/someone.SBJ became.angry.POL  
 a. “Who got angry yesterday?”  
 b. “Did someone get angry yesterday?”
- (10) *ecey nwuka orayn.sikan hyepsang tongan*  
 yesterday who/someone.SBJ lengthy negotiations during  
*hwanasseyo*  
 became.angry.POL  
 a. “Who got angry during the lengthy negotiations yesterday?”  
 b. “Did someone get angry during the lengthy negotiations yesterday?”

In order to consider the generality of Jun and Oh’s model, the lengths of utterances varied as shown in Table 1. There was also variation in the CPF used in the utterance: *nwuka* ‘who/someone.SBJ’ (Sets D, H); *nwukwulul* ‘who/someone.OBJ’ (Set B); *nwukwuhako kathi* ‘with whom/with someone’ (Set L); *mwelul* ‘what/something.OBJ’ (Sets F, J).



Table 1: Variation in length of experimental utterances

Stimulus Set	Constituent length				Total length	
	Intro	CPF	(Intervening)	Verb	Short	Long
B	5	3	9	5	13	22
D	7	2	7	4	13	20
F	4	2	6	4	10	16
H	2	2	8	4	8	16
J	5	2	8	3	10	18
L	4	6	6	6	16	22

**Participants** Participants were 9 native speakers of Seoul Korean (7 female, 2 male) aged between 18 and 35, studying at Oxford University, recruited following approval by the university’s Research Ethics Committee.



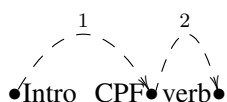
**Procedure** Context-utterance pairs and fillers were presented visually to participants in a random order: participants first saw a blank slide, then pressed a button to reveal the context. After reading the context, they then pressed the button to reveal the target question, which was shown underneath the context. After uttering the target question, they pressed the button again to clear the screen in preparation for to the next pair. Utterances were recorded digitally and manually analysed into syllables using Praat (Boersma and Weenink, 2016). Each participant produced all of the utterances.

For one participant a technical error resulted in only two of the six utterance sets being recorded completely. The other four incomplete sets from this participant were excluded from the data, giving a total of 200 utterances. Pitch maxima and minima for each syllable were obtained using a Praat script modified from a script published by Mietta Lennes<sup>4</sup>. Following this, Accentual Phrases boundaries were determined by the author in line with Jun (2005) and correspondences between AccP boundaries and the edges of constituents were identified.

**Results: Phrase boundary placement in short utterances** For the short utterances, three patterns of AccP boundary placement were observed, shown in Table 2. In pattern (i) the CPF and the verb were together in a single AccP, which following Jun and Oh (1996) was predicted to be associated with an open question reading. In patterns (ii) and (iii), the CPF and the final verb were separated by an AccP boundary. Following Jun and Oh, this was predicted to be associated with a polar question reading.

<sup>4</sup>[http://www.helsinki.fi/~lennes/praat-scripts/public/collect\\_pitch\\_data\\_from\\_files.praat](http://www.helsinki.fi/~lennes/praat-scripts/public/collect_pitch_data_from_files.praat), accessed 3 January 2015.

Table 2: Short utterances: Phrase boundary patterns and overall frequency

	AccP pattern	CPF + verb	Prediction (Jun and Oh)	Frequency $n = 100$
(i)		together	open	50
(ii)		separate	polar	48
(iii)		separate	polar	2

As seen in Table 3, there was no categorical association between the prosodic patterns and open or closed readings. Overall, 66/100 utterances were according to the prediction. However, there was variation between the different question sets, from 15/18 (83%) utterances following prediction for set H to 9/16 (56%) following prediction for sets B and D.

Table 3: Short utterances: Variation in pattern frequency between stimulus sets

Stimulus Set	Open		Polar		In line with prediction	Contra prediction
	CPF+verb together	CPF/verb separate	CPF+verb together	CPF/verb separate		
B	3	5	2	6	9	7
D	5	3	4	4	9	7
F	5	3	2	6	11	5
H	9	0	3	6	15	3
J	8	0	4	4	12	4
L	3	6	2	7	10	8
Totals	33	17	17	33	66	34

**Results: Phrase boundary placement in long utterances** The AccP boundary patterns seen for long utterances are given in Table 4. None of the 100 utterances had the CPF and verb in the same AccP. This suggests that Jun and Oh's account as originally framed does have the problem illustrated in Figure 5 in Section 2. Additionally, all of the long utterances had an AccP boundary at the right edge of the CPF. Accordingly, I reframed the account in terms of the absence or presence of an AccP boundary at the left edge of the verb, with the prediction that this would be associated with an open or polar reading respectively.

Table 4: Long utterances: Phrase boundary patterns and overall frequency

	AccP pattern	Vb = AccP	Prediction	Freq. <i>n</i> = 100
(i)		yes	polar	48
(ii)		yes	polar	35
(iii)		no	open	15
(iv)		no	open	1
(v)		yes	polar	1

Overall 84/100 utterances had an AccP boundary at the left edge of the verb, and 16/100 had no AccP boundary at the left edge of the verb. As with the short utterances, there was no categorical distinction between open and polar readings, and considerable variation between the stimulus sets, shown in Table 5. Frequencies are too small for full statistical analysis, but note that for stimulus sets B and L, every utterance for both open and polar readings was produced with an AccP boundary at the left edge of the verb. Set J, which showed the greatest distinction between open and polar utterances, had 75% of utterances in line with the prediction.

Table 5: Long utterances: Variations in pattern frequency between stimulus sets

Stimulus Set	Open		Polar		In line with prediction	Contra prediction
	Verb <b>not</b> start AccP	Verb starts AccP	Verb <b>not</b> start AccP	Verb starts AccP		
B	0	8	0	8	8	8
D	3	5	1	7	10	6
F	1	7	0	8	9	7
H	0	9	1	8	8	10
J	7	1	3	5	12	4
L	0	9	0	9	9	9
Totals	11	39	5	45	56	44

**Results: Pitch variance** The utterances were also analysed to identify if there were any differences in pitch that might contribute to the differentiation between the two readings (cf. Kim, 2000; Yun, 2012). These results must be treated with caution as the aim of the experiment was to explore a range of conditions (e.g. constituent length) and so there was considerable variation between stimulus sets and between speakers.

Figure 7 shows the maximum pitch data, averaged across all participants, for the short utterance pair from stimulus set B, where no constituent intervenes between CPF and verb. For the open reading, only the CPF is in focus, whereas for the polar reading, the CPF and the verb are in focus. The mean pitch levels show that there is pitch movement against declination at the rightmost AccP of the site of focus. For the open reading, this is seen in the third syllable *lul*, for the polar reading this is seen at the antepenultimate syllable *syess*. The pitch range of the utterance-final LH tone is also greater for the polar reading, where the verb is in focus, than the open reading, where it is not.

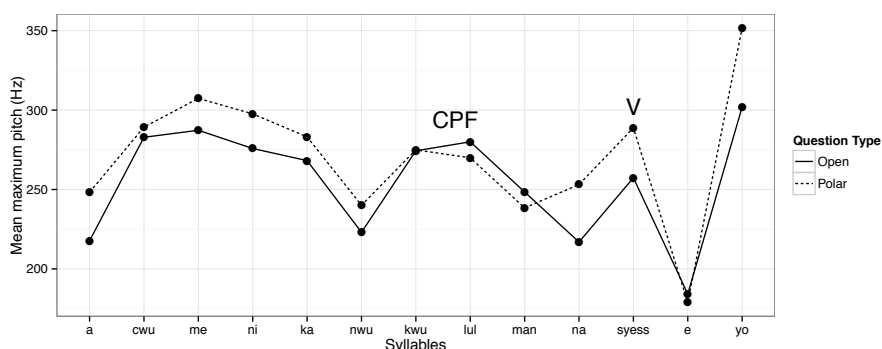


Figure 7: Mean maximum syllable pitch, all participants, set B short utterances

Figure 8 shows the corresponding average maximum pitch data for the longer pair from stimulus set B, where a constituent intervened between CPF and verb. Again, there is an overall pattern of declination through the utterance until the final LH tone. In the open reading, where only the CPF is in focus, there is movement against declination at the CPF. For the polar reading, this is not the case, but the mean pitch levels at syllables *na.syess* in the final verb are higher than in the open reading, and the pitch range of the final LH tone is also greater.

For both readings, there is a further pitch elevation within the constituent that intervenes between the CPF and verb. Discussions with native-speaker language informants suggest that the weight of the intervening constituent might make its position between the object and the verb marked, a phenomenon comparable to heavy-NP shift, but this requires more investigation.

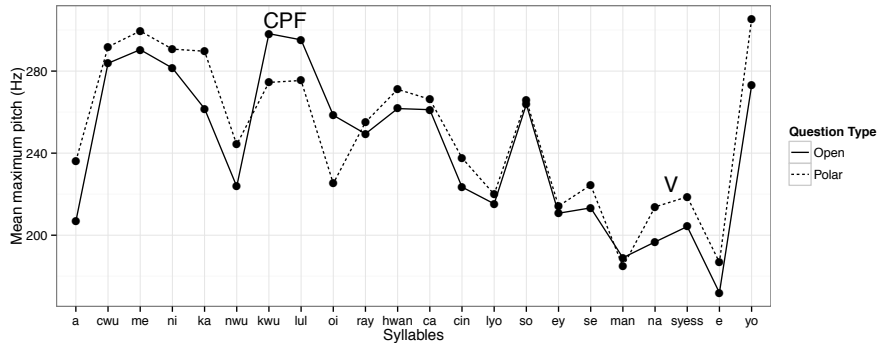


Figure 8: Mean maximum syllable pitch, all participants, set B long utterances

**Discussion** In summary, the experimental results do not support the categorical account proposed by Jun and Oh (1996), even when reframed to take account of intervening constituents. Without a constituent between CPF and verb, 66/100 utterances followed the prediction. Where a constituent intervened, 56/100 utterances followed the prediction. Instead, the results indicate that this is a gradient phenomenon. The differences between question sets suggest that AccP boundary placement in questions with CPFs is determined by factors other than the open/polar reading, which might include the length of preceding constituents or AccPs, and variation between individual speakers.

Based on this initial exploration, I have drawn the following tentative conclusions about the prosodic disambiguation of open and polar readings of questions with content pro-forms in Korean. First, the account of disambiguation provided by Jun and Oh (1996) is not sufficient to explain the observed data. Second, there appears to be a link between the rightmost AccP in the focused constituent and pitch peaks that move against declination. This may be similar to the expanded pitch range for focus described by Peng et al. (2005) for Mandarin. Finally, although I did not see evidence of post-focal dephrasing, it may be that some degree of pitch compression following a focused constituent may affect the placement of subsequent AccP boundaries. This could explain the AccP boundary patterns reported by Jun and Oh (1996), but also the gradient nature of the phenomenon seen in this experiment.

#### 4 An LFG analysis of the phenomenon

This section provides an LFG analysis of the phenomenon in (1) by formally defining the relationship between prosodic expression of focus and the differing information structures of the open and polar readings. The analysis follows the frame-

work used by Mycock and Lowe (2013) to describe prosodic expression of focus in English. A brief summary of the model is given here: for a more thorough discussion please refer to the original paper.

The analysis assumes the structural elements given in Table 6. It also assumes that there are semantic features of focus and question semantics, which each have c-structure and p-structure reflexes. The syntactic scope of focus is denoted by the feature **DF\_Focus**, and question semantics within the c-structure by the feature **Sem\_QSem**. The counterparts for prosodic exponence of these features are *DF\_Focus* and *Sem\_QSem* respectively. Language-specific cascade rules govern the presence of these features in the edge sets of s- and p-string items.

Table 6: Structural elements of the analysis

Element	Derivation
constituent structure (c-structure)	Language-specific phrase structure rules.
prosodic structure (p-structure)	Language-specific prosodic phrase structure rules.
syntactic string (s-string)	Lexical entries.
phonological string (p-string)	Lexical entries, language-specific phonological rules.
edge sets	These are a property of each s- and p-string item. They contain information about the left and right edges of c-structure and p-structure constituents respectively, together with semantic features derived from cascade rules.

The principle of interface harmony (Dalrymple and Mycock, 2011) determines grammaticality and is tested as follows. First, corresponding s-string and p-string units are identified. These are generated from lexical entries, with the p-string subject to language specific phonological processes that may include resyllabification, stress assignment, tone alignment etc. As a result, there may not be a 1-1 correspondence between s-string and p-string units<sup>5</sup>, but the lines of correspondence between the s-string and p-string units should not cross. The edge sets of the corresponding s-string and p-string units are then compared, L with L and R with R. Interface harmony holds if the semantic features are coherent, i.e. if **DF\_Focus** appears in an s-string unit's R edge set and *DF\_Focus* in the R edge set of the corresponding p-string unit.

<sup>5</sup>For example, a prosodic unit may relate to more than one syntactic constituent, such as the syllable [hi:z] in the sentence *He's coming tomorrow*.

## 4.1 Structural rules for Korean

The following structural elements are used for the analysis. The c-structure rules in (11) are a subset of those proposed by Sohn (1999).

- (11) a.  $S \rightarrow \left( \begin{array}{c} \text{NP} \\ \uparrow=\downarrow \end{array} \right) \text{VP}$   
            $\uparrow=\downarrow$
- b.  $\text{NP} \rightarrow \text{N}'$   
            $\uparrow=\downarrow$
- c.  $\text{N}' \rightarrow \begin{array}{cc} \text{N}^* & \text{N} \\ \uparrow=\downarrow & \uparrow=\downarrow \end{array}$
- d.  $\text{VP} \rightarrow \begin{array}{cc} \text{NP}^* & \text{V}' \\ \uparrow=\downarrow & \uparrow=\downarrow \end{array}$
- e.  $\text{V}' \rightarrow \left( \begin{array}{c} \text{NP} \\ \uparrow=\downarrow \end{array} \right) \text{V}$   
            $\uparrow=\downarrow$

The p-structure rules governing the prosodic hierarchy (12) and phonological processes (13)-(15) are derived from Jun (2005). Prosodic words are not included as they play no role in marking phrase boundaries.

- (12) Timing tier: p-structure  
       a.  $\text{IntP} \rightarrow \text{AccP}^+$   
       b.  $\text{AccP} \rightarrow \text{Syll}^+$
- (13) Timing tier: final syllable lengthening  
        $\text{Syll} \rightarrow \text{Syll} / \_ \_ \_ \#$
- (14) Intonation tier: edge tones  
       a.  $\text{IntP} \rightarrow \_ \_ \_ \% \# \#$   
       b.  $\text{AccP} \rightarrow \# \text{TH} \_ \_ \_ \_ \text{LH} \#$
- (15) Intonation tier: assimilation of IntP final tones  
        $\text{H} \rightarrow \emptyset / \_ \_ \_ \% \# \#$

Cascade rules<sup>6</sup> for question semantics (following Dalrymple and Mycock, 2011) are shown below for syntactic scope (16) and prosodic exponence (17). They are based on the link made by Jun (2005) to the semantic and pragmatic function of IntP-final tones, of which question semantics is taken to be an instance.

<sup>6</sup>Operators  $\searrow_R$  and  $\swarrow_R$  denote the right edge set of the rightmost terminal node within the constituent within c- and p-structures respectively (Mycock and Lowe, 2013).

$$(16) \quad S \rightarrow NP \quad VP \\ \left( \mathbf{Sem\_Qsem} \in (\mathbb{N}R) \right)$$

$$(17) \quad \text{IntP} \rightarrow \text{AccP}^* \quad \text{AccP} \\ (\% = \text{TONE LH}) \Rightarrow \\ \text{Sem\_QSem} \in (\mathbb{N}R)$$

Cascade rules for focus (following Mycock and Lowe, 2013) are shown below, again for syntactic scope (18) and prosodic exponents (19). The prosodic exponent rules are derived from the experimental evidence assuming that expanded pitch range is marked by the phonological feature *PITCH = EXP*. A new operator  $\mathbb{N}R$  is proposed for Korean, which shows the correspondence between expanded pitch range and the presence of *DF\_Focus* in the p-string R edge set. This was not used in Mycock and Lowe’s account of English, where nuclear pitch accent plays a role in exponents of focus.

$$(18) \quad \Sigma \rightarrow \Sigma^* \quad \Sigma^* \quad \Sigma \quad \Sigma^* \\ (\uparrow_{\sigma} \text{DF}) = \text{FOCUS} \quad \mathbf{DF\_Focus} \in (\mathbb{N}R) \\ (\downarrow_{\sigma} \text{DF}) = \text{FOCUS} \quad (\uparrow_{\sigma} \text{DF}) = \text{FOCUS} \\ (\downarrow_{\sigma} \text{DF}) = \text{FOCUS}$$

$$(19) \quad \text{AccP} \rightarrow \text{Syll}^* \quad \text{Syll}^+ \quad \text{Syll} \\ (\text{PITCH} = \text{EXP}) \Rightarrow \\ \text{DF\_Focus} \in (\mathbb{N}R)$$

## 5 Analyses of sentences

Analyses using the framework in Section 4.1 are given for example (20), the shorter utterances of experimental stimulus set B. Mean pitch data for these utterances was given in Figure 7.

$$(20) \quad \text{acwumeni-ka nwukwu-lul} \quad \text{manna-syess-eyo} \\ \text{auntie-SBJ} \quad \text{who/someone-OBJ} \quad \text{meet-PST-POL} \\ \text{‘Who did auntie meet? / Did auntie meet someone?’}$$

The full analysis of the open reading ‘Who did auntie meet?’ is given at the end of the paper in Figure 11. A larger-scale extract from this analysis, showing the right-hand edge of the focused constituent *nwukwu-lul* ‘who-OBJ’ is given in Figure 9.

In the c-structure, the feature **DF\_Focus** cascades according to rule (18) to the R edge set of the s-string unit ‘nwukwul’. Expanded pitch range is seen in the



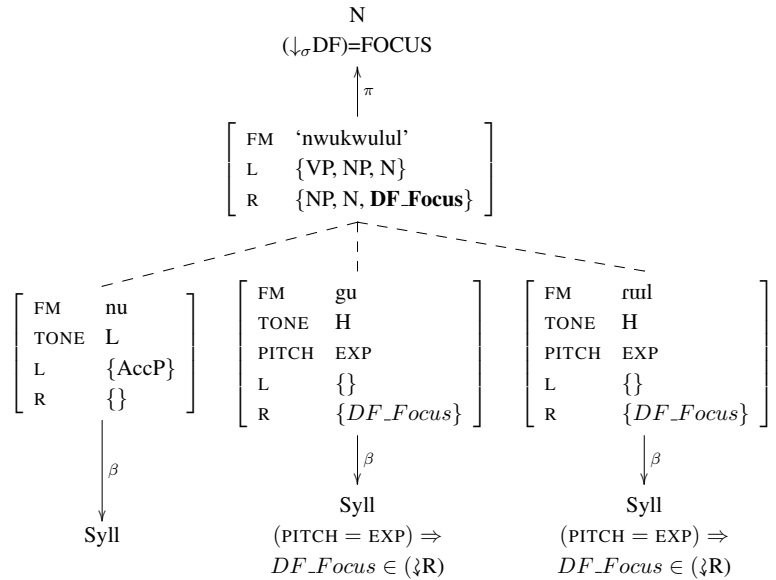


Figure 9: Focused constituent in the open reading (Extract from Figure 11)

syllables [gu] and [ruul] and, following cascade rule (19), the feature *DF.Focus* appears in the R edge sets of these syllables.

Question semantic features are shown in shown in Figure 11. The question semantics s-structure feature **Sem.Qsem** cascades according to rule (16) to the R edge set of the rightmost s-structure element in the utterance, ‘mannasyeseyo’. In the p-structure, prosodic expression of question semantics is given by the LH tone on the final syllable of the final AccP. Following rule (17), this places feature *Sem.Qsem* into the R edge set of its rightmost syllable, [jo:].

Interface harmony is tested by comparing the L and R edge sets of corresponding s- and p-string units. As there is a 1:3 relationship between the s-string ‘nwukwulul’ and its syllables [nu.gu.ruul], comparison is made between the L and R edge sets of ‘nwukwulul’ and the unions of the three syllables’ L and R edge sets. The feature **DF.Focus** is found in the s-string R edge set, and its counterpart *DF.Focus* in the p-string union R edge set. A similar process is followed for ‘mannasyeseyo’ and its syllables [man.na.ʃas.sa.jo:], where features **Sem.Qsem** and *Sem.Qsem* are found in the R edge sets of ‘mannasyeseyo’ and the union of its syllables respectively. Accordingly, the principle of interface harmony is upheld and the utterance is grammatical.

A similar process is followed for the analysis of the polar reading, ‘Did auntie meet someone?’ The full analysis is given at the end of the paper in Figure 12 and a larger-scale extract of the final constituent at Figure 10. As was the case for

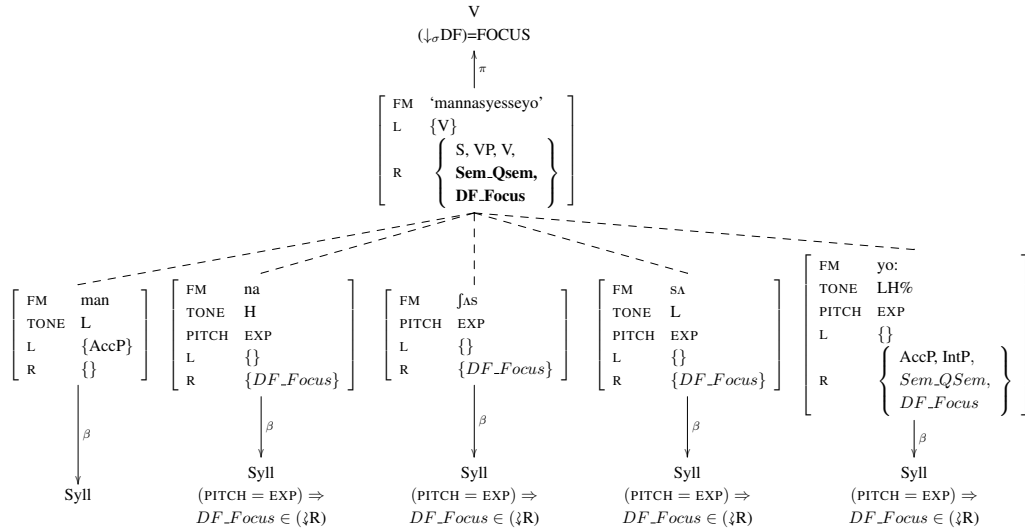


Figure 10: Focused constituent in the polar reading (Extract from Figure 12)

the open reading, rules (16) and (17) place features **Sem\_QSem** and *Sem\_QSem* into the R edge sets of ‘mannasyesseyo’ and [jo:] respectively. From rule (18), the R edge set of ‘mannasyesseyo’ also contains feature **DF\_Focus**. Prosodically, expanded pitch range is seen on syllables [na.ʃas.se.jo:] and following rule (19), this places feature *DF\_Focus* in their R edge sets. Comparing the corresponding edge sets as for the open reading, the principle of interface harmony is again seen to apply.

## 6 Conclusions

The analysis gives an account of the prosodic contribution to semantics by analysing the syntax-prosody interface. The method used does not assume that syntax determines prosody, but rather that the two are mutually constraining. It offers a way to unify the various accounts of the phenomenon in Korean and shows that the model of the syntax-prosody interface proposed for English by Mycock and Lowe (2013) can be adapted for Korean, including the introduction of a new operator to describe particular features of focus expression.

The experimental data from which the LFG analysis is derived led to tentative conclusions. Further experiments, designed specifically to gather pitch information, are necessary to explore the exact nature of EXPANDED PITCH RANGE, and the possible presence and nature of post-focal pitch compression. Other areas for exploration include multiple wh-questions, and other Korean prosodic phenomena.

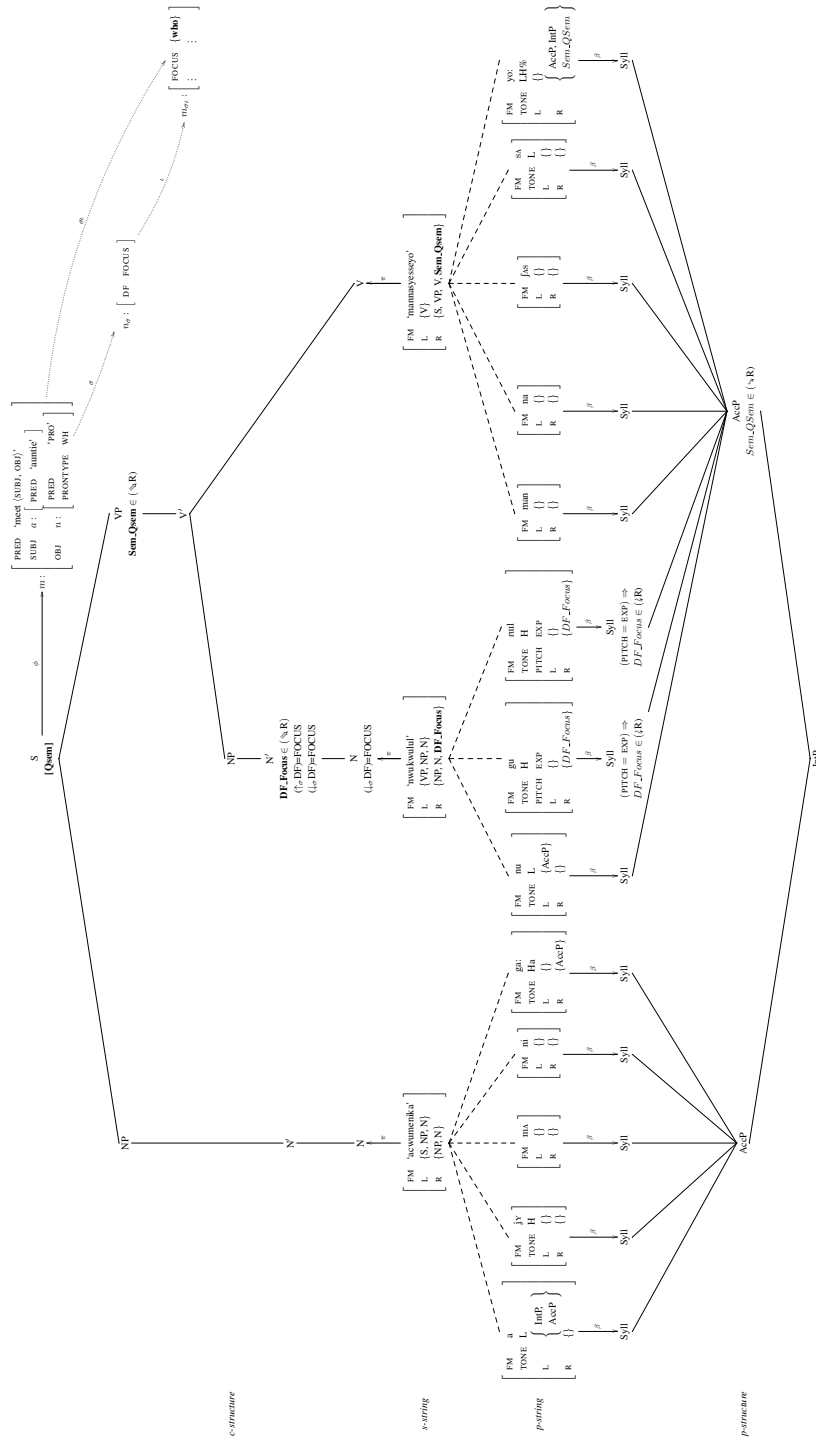


Figure 11: Short open question: 'Who did auntie meet?'



## References

- Boersma, P. and Weenink, D. (2016). Praat: doing phonetics by computer [computer program]. version 6.0.21. <http://www.praat.org>, retrieved 2016/12/03.
- Dalrymple, M. (2001). *Lexical Functional Grammar*. Academic Press, San Diego.
- Dalrymple, M. and Mycock, L. (2011). The prosody-semantics interface. In Butt, M. and King, T. H., editors, *Proceedings of LFG11*, Stanford, CA. CSLI Publications.
- Goldsmith, J. A. (1976). *Autosegmental phonology*. PhD thesis, Massachusetts Institute of Technology, Cambridge, MA.
- Hayes, B. (1989). The prosodic hierarchy in meter. In Kiparsky, P. and Youmans, G., editors, *Perspectives on Meter*, pages 203–260. Academic Press, New York.
- Jun, S.-A. (2005). Korean intonational phonology and prosodic transcription. In *Prosodic typology: the phonology of intonation and phrasing*, chapter 8, pages 202–228. Oxford, UK: Oxford University Press.
- Jun, S.-A. and Oh, M. (1996). A prosodic analysis of three types of wh-phrases in Korean. *Language and Speech*, 39(1):37–61.
- Kim, A.-R. (2000). *A derivational quantification of “wh-phrases”*. PhD thesis, Indiana University.
- Martin, S. E. (1992). *A reference grammar of Korean: a complete guide to the grammar and history of the Korean language*. Tuttle, Rutland, VT.
- Mycock, L. and Lowe, J. (2013). The prosodic marking of discourse functions. In Butt, M. and King, T. H., editors, *Proceedings of LFG13*, Stanford, CA. CSLI Publications.
- Nespor, M. and Vogel, I. (1986). *Prosodic phonology*. Foris.
- Peng, S.-h., Chan, M. K. M., Tseng, C.-y., Huang, T., Lee, O. J., and Beckman, M. E. (2005). Towards a Pan-Mandarin system for prosodic transcription. In Jun, S.-A., editor, *Prosodic typology: the phonology of intonation and phrasing*, chapter 9, pages 230–270. Oxford University Press.
- Selkirk, E. O. (1984). *Phonology and syntax: the relation between sound and structure*. MIT Press.
- Sohn, H.-M. (1999). *The Korean language*. Cambridge University Press, Cambridge, UK.
- Yun, J. (2012). The deterministic prosody of indeterminates. In Choi, J., editor, *Proceedings of the 29th West Coast Conference on Formal Linguistics*, pages 285–293, Somerville, MA. Cascadilla Proceedings Project.