



## Effects of Parts of Speech on Implicit Prosodic Prominence by Native English Speakers and Korean Learners of English

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### ABSTRACT

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It has been proposed that content words are more likely to be prosodically prominent than function words. Such a binary distinction in word classes (content words versus function words) has been considered insufficient to predict the occurrence of prosodic prominence in more recent research. This study investigates the effects of (1) word classes and (2) parts of speech on prosodic prominence by native English speakers and Korean learners of English in silent reading of public speech. Results showed that Korean learners of English were more likely than native English speakers to assign prosodic prominence on content words as well as function words. The difference was greatest for verb for content words and determiner for function words. Also, Korean learners of English tended to show coarser mapping between prosodic prominence and parts of speech than native English speakers. In particular, native English speakers favored pronoun, among function words, which may convey co-referential information in discourse context, but this part of speech was treated equally with other function words by Korean learners of English. Based on the results, we propose a hierarchy of (sentence-level) stressability. These results are not identical to those from the previous studies on perception of prosodic prominence, suggesting a weak perception-production link of prosodic prominence. Overall, the present study expands our understanding of (a) the relationship between prosodic prominence and word classes/parts of speech and (b) the perception-production link of the suprasegmental feature in L2.

### KEYWORDS

implicit prosody, prosodic prominence, word class, part of speech, stressability, Korean learners of English, perception-production link

## 1. Introduction

Prosodic prominence highlights words relative to other neighboring words in an utterance. If a word is prominent, it is likely to be produced with enhanced acoustic cues (e.g., higher pitch, longer duration, or greater intensity), compared with other surrounding words (Beckman 1986, Breen et al. 2010, Cole et al. 2010, Kochanski et al. 2005, Ladd 2008, Pierrehumbert 1980, Sluijter and van Heuven 1996, Turk and White 1999, among many others). In English, prosodic prominence is anchored at the stressed syllable of a word (Bolinger 1958, Liberman 1975, Pierrehumbert 1980). It usually lands on the rightmost content word in an utterance. More than one word can be optionally prominent (Shattuck-Hufnagel 1995, Shattuck-Hufnagel et al. 1994). The function word tends to be cliticized to the adjacent content word in an utterance, but it can be prosodically prominent under focus. Prosodic prominence conveys the information status of a word (Pierrehumbert and Hirschberg 1990) and can be subject to other linguistic or paralinguistic factors, such as rhythm, speech style, speech mode, and so on (Calhoun 2010, Chodroff and Cole 2018, Hirschberg 1993, Im et al. 2018, Pierrehumbert and Hirschberg 1990, Vogel et al. 1995, among many others). Hirschberg (1993) examined prosodic prominence in speech corpora of American English, including a read speech corpus and two news speech corpora. The occurrence of prosodic prominence appeared to be most predicted by parts of speech, followed by information status in the corpora. Content words (adjective, adverb, noun, and verb) seemed to be the most predictable locations of prosodic prominence, although not every content word was found to be accented by the speakers in the corpora. This was explained by the author that prosodic prominence on all the content words would sound unnatural in English.

More recent studies argue that prosodic prominence cannot be fully addressed by the dichotomous distinction in word classes (content words versus function words). They propose that each part of speech may have an inherently different strength of prosodic prominence. Anttila (2015) examined the relationship between prosodic prominence and parts of speech in a conversational speech from the Buckeye corpus. The author argued that words would vary with a strength for attracting sentence-level stress. Content words are more stressable than function words. Some function words are more stressable than other function words. The author categorized parts of speech into four classes, depending on stressability, and proposed a hierarchy of stressability, as shown in Table 1. In Table 1, stressability increases from Class 1 (least stressable) to Class 4 (most stressable). Content words consist of Class 4. Function words involve a wider range of classes, Classes 1-3. Similarly, Shih (2018) proposed four clusters of parts of speech in relation to prosodic prominence (i.e., a duration measure) based on the clustering analysis of monosyllabic words in the Buckeye corpus, as shown in Table 1. Compared with Anttila (2015), only adjective and noun belong to Class 4. Verb and adverb involve more than one class, Classes 2-4. Function words are spread over all four classes. Taken together, these studies suggest that prosodic prominence has a gradient and probabilistic relationship with parts of speech.

**Table 1. Parts of Speech Presented along the (Sentence-level) Stressability in English  
(Adopted from Anttila 2015 and Shih 2018)**

Class	Anttila (2015)	Shih (2018)
1	weak pronoun	conjunction, determiner, preposition <i>to</i>
2	strong pronoun, finite auxiliaries	preposition, pronoun, <i>wh</i> -adverb, <i>wh</i> -determiner
3	modal, <i>wh</i> -words	particle, modal auxiliary, some adverbs, past tense verb, present tense verb, <i>wh</i> -pronoun, existential <i>there</i>
4	adjective, adverb, noun, verb	cardinal number, possessive, <i>wh</i> -pronoun, adjective, noun, proper noun, predeterminer, present tense verb, some adverbs

Korean is an edge-prominence language (Jun 2005). Korean differs from English in that it does not have a word-level stress (cf. Lee 1997). Prosodic prominence is anchored at the edge of a prosodic boundary, which may consist of content words or function words. If the final syllable is an affix, which is often the case in Korean, it may become acoustically enhanced. This clearly differs from function words in English, which tend to be non-prominent and acoustically reduced.

The differences in prosodic system between English and Korean may raise difficulties in learning English prosody for Korean learners of English. Previous studies show some differences between native English speakers and Korean learners of English in perception or production of prosodic prominence in relation to parts of speech (Im 2019, Oh 2013, Um et al. 2001, Yoo 2014, among many others). Im (2019) investigated perception of prosodic prominence by native English speakers and Korean learners of English in a corpus of public speech. There was a group difference in the content words but not in the function words. Korean learners of English were more likely to perceive content words as prominent than were native English speakers. Both groups of speakers did not significantly differ in perceived prominence on function words. From a post-hoc analysis, certain parts of speech (noun and verb for content words and conjunction for function words) showed higher likelihoods of perceived prominence by Korean learners of English than other parts of speech, although such parts of speech were not acoustically more salient than others in the stimulus speech. In other words, perceived prominence by Korean learners of English seemed to be influenced by non-signal driven factors, for instance, prior linguistic experience or knowledge. These results indicate that (1) the main difference in the perception of prosodic prominence between native English speakers and Korean learners of English lies on content words; (2) the relationship between perceived prominence and parts of speech is gradient and probabilistic for Korean learners of English, in alignment with native English speakers in Anttila (2015) and Shih (2018); and (3) prominence perception is driven by not only signal-based factors (e.g., F0), but also expectation-based factors (e.g., prior linguistic experience or knowledge). Yoo (2014) examined the production of prosodic prominence (F0, duration, intensity) by native English speakers and Korean learners of English using monosyllabic words in read sentences. For all the groups, (a) word classes showed systematic differences in duration but not in F0 and intensity; (b) duration was longer for content words than function words; and (c) duration was shortest for modal, which could be regarded as the least stressable word, disconfirming the hierarchy of stressability in Anttila (2015) and Shih (2018). In particular, for Korean learners of English, duration was particularly longer for possessive and conjunction than other parts of speech for function words. This clearly differed from the native English speakers in that their duration was shortest for possessive and conjunction, along with modal, which were regarded as the least stressable words. The proposed hierarchy of stressability for function words was as follows: modal, indefinite article, definite article, preposition, finite auxiliary, pronoun, relative pronoun, possessive, conjunction < demonstrative, *wh*-words < predeterminer for the (female) native English speakers, and modal, indefinite article, definite article, preposition, finite auxiliary, pronoun, relative pronoun < possessive, conjunction < demonstrative, *wh*-words < predeterminer for the (female) Korean learners of English.

The previous studies mentioned above do not show unanimous results on the relationship between prosodic prominence and parts of speech. First, the hierarchy of stressability varies with the production studies. One such case is content words. All the parts of speech for content words show identical stressability in Anttila (2015) and Yoo (2014), while they have different stressability in Shih (2018). Another case is modal for function words. Whereas modal is substantially stressable (Class 3) in Anttila (2015) and Shih (2018), it is considered the least stressable in Yoo (2014). Second, the main difference between native English speakers and Korean learners of English varies with the perception and production studies. In Im (2019), Korean learners of English differed from native English speakers in content words but not in function words in perception of prosodic prominence. This

was opposite in Yoo (2014). Native English speakers and Korean learners of English showed similar patterns of prosodic prominence on content words but not on function words in actual production. Also, Korean learners of English favored noun and verb to a greater extent than adjective and adverb as the landing location of prosodic prominence in perception (Im 2019), but such a difference in parts of speech for content words was not observed in production (Yoo 2014).

The present study investigates how native English speakers and Korean learners of English assign prosodic prominence in relation to parts of speech while reading a complete public speech in English. More specifically, we address the following research questions:

RQ1: How do native English speakers assign prosodic prominence in relation to (a) word classes and (b) parts of speech? What is their hierarchy of stressability?

RQ2: How do Korean learners of English assign prosodic prominence as a function of (a) word classes and (b) parts of speech? What is the difference in the hierarchy of stressability between native English speakers and Korean learners of English, if any?

Whereas some prior studies (Shih 2018, Yoo 2014) analyzed monosyllabic words only, the present study attempts to yield more comprehensive and generalizable implications by analyzing all the (monosyllabic or polysyllabic) words in a complete public speech. Moreover, the present study attempts to yield an implication for the link between perception and production by comparing the production results obtained from the present study with the perception results from the previous studies (e.g., Im 2019). Overall, the present study will inform us more about (a) the relationship between prosodic prominence and word classes/parts of speech and (b) the link between perception and production of the suprasegmental feature in L2.

## 2. Method

### 2.1 Participants and Task

Ratings of prosodic prominence were obtained from two groups of speakers. The first group consisted of thirty-five native English speakers (NES, 12 males and 23 females, mean age 24.3), who were undergraduate or graduate students in a midwestern university in the United States. The second group was composed of thirty Korean learners of English (KLE, 4 males and 26 females, mean age 20.6), who were undergraduate students majoring in English language education at a university in Seoul in the Republic of Korea. These participants were considered advanced learners of English based on their scores on the Test of English Proficiency (TEPS). The average TEPS score of the participants was 820 out of 990 (820/990), which would correspond to 464-465/600 in New TEPS, 965/990 in TOEIC, or 114-115/120 in TOEFL iBT (<https://www.teps.or.kr/InfoBoard/ConversionTable>). Advanced learners of English were recruited because they were expected to have few difficulties understanding the semantic or pragmatic meaning of a word, which may influence judgment of prosodic prominence.

In the experiments, participants were asked to imagine that they would deliver a speech to an audience in public and select words that they would highlight for listeners on a transcript of a speech. The method was adopted from Rapid Prosody Transcription (Cole and Shattuck-Hufnagel 2016). We assumed that the speaker's default prosodic pattern would be projected onto the stimulus sentences in silent reading (Implicit Prosody Hypothesis; Fodor 1998). There is empirical evidence of a strong link between implicit (silent or imagined) production and actual production

(Abramson 2007, Bishop 2021, Jun 2003), although a few studies show discrepancy between implicit prosody and explicit prosody (e.g., Jun 2010). By examining implicit prosodic prominence, we attempted to circumvent the potential issues of (a) incomplete phonetic implementation of intended forms by speakers, especially by language learners, and (b) inconsistent results across phonetic cues from actual production, as observed in Yoo (2014).

The transcript of a speech (361 words) was downloaded from TED Talks ([https://www.ted.com/talks/matt\\_cutts\\_try\\_something\\_new\\_for\\_30\\_days](https://www.ted.com/talks/matt_cutts_try_something_new_for_30_days)). It covered a non-technical topic and contained a plain vocabulary, as shown in (1):

- (1) A few years ago, I felt like I was stuck in a rut, so I decided to follow in the footsteps of the great American philosopher, Morgan Spurlock, and try something new for 30 days. The idea is actually pretty simple. Think about something you've always wanted to add to your life and try it for the next 30 days. (...)

## 2.2 Annotation

Parts of speech were labelled for each word in the entire speech following the Penn Treebank P.O.S. Tags (Taylor et al. 2003). The Penn Treebank P.O.S. Tags are used for the Buckeye corpus, which was examined in Anttila (2015) and Shih (2018). In the present study, eleven parts of speech were obtained: adjective, adverb, conjunction, determiner, interjection, modal, noun, number, preposition, pronoun, and verb. Note that interjection has not been examined in Anttila (2015), Shih (2018), and Yoo (2014), but it is included in the present study.

## 2.3 Analyses

The rating of prosodic prominence was converted into binary mode, 0 for the words judged as non-prominent and 1 for the words rated as prominent. Prominence (p-) scores were calculated for each word in the entire speech by dividing the sum of a word's prominence rating by the number of participants in each group (Cole et al. 2010). The p-scores, ranging from 0 to 1, represent how many participants rate a word as prominent. For instance, 0 means that none of the participants have judged a word as prominent, while 1 means that all the participants have rated a word as prominent.

We are interested in the effects of (1) word classes (content words versus function words) and also, (2) parts of speech on judgment of prosodic prominence. These two factors were submitted as fixed factors to two generalized linear mixed-effects models, one factor for a model, in consideration of the nested relationship between the word classes and the parts of speech. For the first model, prominence rating (0 for non-prominent words, 1 for prominent words) was modeled in relation to L1 group (native English speakers, Korean learners of English), word class (content words, function words), and interaction between L1 group and word class. For the second model, prominence rating (0 for non-prominent words, 1 for prominent words) was estimated as a function of L1 group (native English speakers, Korean learners of English), part of speech (adjectives, adverbs, conjunctions, determiners, interjections, modals, nouns, prepositions, pronouns, verbs), and interaction between L1 group and part of speech. For the part of speech, modal was set as the reference level. This was because modal was found to be the least stressable part of speech in Yoo (2014) for both native English speakers and Korean learners of English. Therefore, modal was considered an ideal reference level for comparison with other parts of speech. The two generalized linear mixed-effects models were run using *lme4* (Bates et al. 2015) and *lsmeans* (Lenth 2016) in *R* (R Core Team 2019).

## 2.4 Predictions

In the present study, we address two research questions: (1) how native English speakers assign prosodic prominence in relation to (a) word classes and (b) parts of speech; and (2) how Korean learners of English differ from native English speakers in assigning prosodic prominence as a function of (a) word classes as well as (b) parts of speech. More specifically, we formulate predictions (P1-P5) based on the previous studies mentioned above (Im 2019, Shih 2018, Yoo 2014). P1-P3 inform us about the first research question. P4-P5 address the second research question.

- P1: Content words would show higher probability of prosodic prominence than function words.
- P2: Among content words, noun and adjective would show higher probability of prosodic prominence than adjective and adverb.
- P3: Among function words, modal would show the lowest stressability. Stressability would increase in the following order: modal, determiner, preposition, pronoun, conjunction for native English speakers.
- P4: Korean learners of English would be more likely than native English speakers to associate prosodic prominence with content words. Among content words, noun and verb would be associated with higher probability of prosodic prominence than adverb and adjective.
- P5: Korean learners of English would be more likely than native English speakers to associate prosodic prominence with function words. Stressability would increase in the following order: modal, determiner, preposition, pronoun < conjunction for Korean learners of English.

## 3. Results

We first made a casual observation of the overall patterns of prosodic prominence rated by native English speakers and Korean learners of English. Figure 1 shows the prominence scores (y-axis) obtained from native English speakers (solid line) and Korean learners of English (dotted line) for one of the stimulus sentences, *so I decided to follow in the footsteps of the great American philosopher, Morgan Spurlock, and try something new for thirty days* (x-axis). We observe that the prominence scores of some words are higher for Korean learners of English than for native English speakers. Such words are mostly content words (e.g., *decided, follow, footsteps*). For instance, 66% of Korean learners of English judged the verb *decided* as prominent, while only 13% of native English speakers did so. We also find that most function words (e.g., *I, to, the*), except *so*, show similar prominence scores between native English speakers and Korean learners of English. For example, the pronoun *I* was rated as prominent by 3% of Korean learners of English and 5% of native English speakers, respectively. However, for the conjunction *so*, the two L1 groups differ in that Korean learners of English show higher prominence scores than native English speakers. Twenty-one percent of Korean learners of English judged the word *so* as prominent, while only 3% of native English speakers did so.

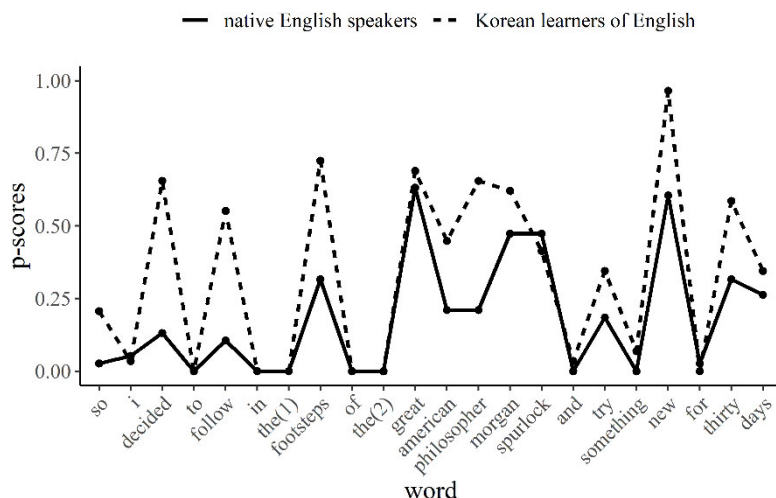


Figure 1. Prominence (p-) Scores for One of the Stimulus Sentences

We move on to the results obtained from the two generalized linear mixed-effect models. Table 2 shows the results from the first model on the predicted prominence rating in relation to L1 group (native English speakers, Korean learners of English), word class (content words, function words), and interaction between L1 group and word class. All these factors are significant, indicating the factors would yield significant effects on the occurrence of prosodic prominence. First, there is a main effect of the two L1 groups. In other words, Korean learners of English differ from native English speakers in rating prosodic prominence. Second, we observe the main effect of word class, suggesting that content words have different effects from function words on the occurrence of prosodic prominence. Third, we find a significant interaction between L1 group and word class. This indicates that the two L1 groups differ in rating the prosodic prominence of a word, depending on the class of the word. We will visualize the results from the first model (Table 2) and discuss more about them below.

Table 2. Effects on Predicted Prominence Rating of L1 Group, Word Class and Interaction between L1 Group and Word Class

Variable	est.	SE	z	p-value
(intercept)	-2.51	0.08	-30.52	< 0.001
KLE	0.23	0.07	3.35	< 0.001
content word	1.48	0.06	25.13	< 0.001
KLE: content word	0.59	0.08	7.38	< 0.001

Table 3 shows the results from the second model on the estimated prominence rating as a function of L1 group (native English speakers, Korean learners of English), part of speech (adjectives, adverbs, conjunctions, determiners, interjections, modals, nouns, prepositions, pronouns, and verbs), and interaction between L1 group and part of speech. Most, but not all, factors are significant. First, there is no main effect of the L1 group. Korean learners of English do not significantly differ from native English speakers in judging prosodic prominence if parts of speech are considered in the second model. This differs from the results from the first model: Korean learners of English significantly differ from native English speakers in rating prosodic prominence when word classes are included in the first model. These (seemingly contradictory) results can be interpreted as showing that the difference between the two L1 groups is more apparent if fewer levels/factors are included in the model. In other

words, the difference between the two L1 groups in the assignment of prosodic prominence looks greater if the model includes the binary distinction in word classes, rather than more distinction in parts of speech. Second, we observe main effects for most, but not all, parts of speech. Whereas most function words do not look significant, most content words appear to be significant. Conjunction, determiner, preposition, and pronoun do not significantly differ from modal (set as the reference level in the second model) in the occurrence of prosodic prominence, indicating that these parts of speech can be categorized in the same class as the modal. Interjection, number, adjective, adverb, noun, and verb significantly differ from modal, suggesting that these parts of speech belong to a class different from modal. Third, we find a significant interaction between L1 group and parts of speech. This suggests that the two L1 groups differ in judging the prosodic prominence of a word, depending on the part of speech of the word. We will visualize the results from the second model (Table 3) and discuss more about them below.

**Table 3. Effects on Predicted Prominence Rating of L1 Group, Part of Speech and Interaction between L1 Group and Part of Speech**

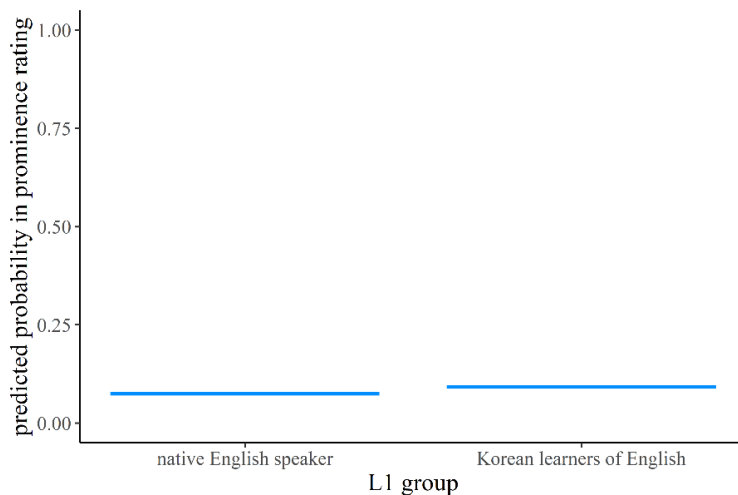
Variable	est.	SE	z	p-value
(intercept)	-3.12	0.21	-14.87	< 0.001
KLE	-0.46	0.32	-1.44	0.15
conjunction	0.11	0.27	0.41	0.68
determiner	-0.23	0.24	-0.94	0.35
interjection	3.73	0.30	12.50	< 0.001
number	2.78	0.23	12.33	< 0.001
preposition	-0.34	0.25	-1.34	0.18
pronoun	0.42	0.23	1.85	0.06
adjective	2.62	0.21	12.19	< 0.001
adverb	2.14	0.21	10.10	< 0.001
noun	2.16	0.20	10.58	< 0.001
verb	1.66	0.21	7.98	< 0.001
KLE: conjunction	1.22	0.39	3.11	< 0.01
KLE: determiner	1.13	0.36	3.12	< 0.01
KLE: interjection	-0.29	0.44	-0.64	0.52
KLE: number	0.63	0.35	1.79	0.07
KLE: preposition	0.11	0.40	0.28	0.78
KLE: pronoun	0.94	0.35	2.71	< 0.01
KLE: adjective	1.33	0.34	3.93	< 0.001
KLE: adverb	1.01	0.33	3.05	< 0.01
KLE: noun	1.20	0.32	3.71	< 0.001
KLE: verb	1.57	0.33	4.80	< 0.001

The results from the first model and the second model are visualized in Figures 2, 3, and 5 and in Figures 4 and 6, respectively. For Figures 2-6, we will discuss the effects of each factor (on the x-axis) on predicted probability in prominence rating (on the y-axis). The predicted probability in prominence rating was transformed from the log odds using *visreg* (Breheny and Burchett 2017). Similar to the p-scores, the predicted probability in prominence rating ranges between 0 and 1. 0 would indicate that none of the participants are predicted to judge a word as prominent, while 1 means that all the participants are estimated to rate a word as prominent.

Figures 2-4 show the main effects of fixed factors. Figure 2 illustrates the effects of the L1 groups (x-axis) on predicted probability in prominence ratings (y-axis). The estimates are significantly higher for Korean learners of English than native English speakers, although this is not clearly shown in Figure 2. This indicates that Korean

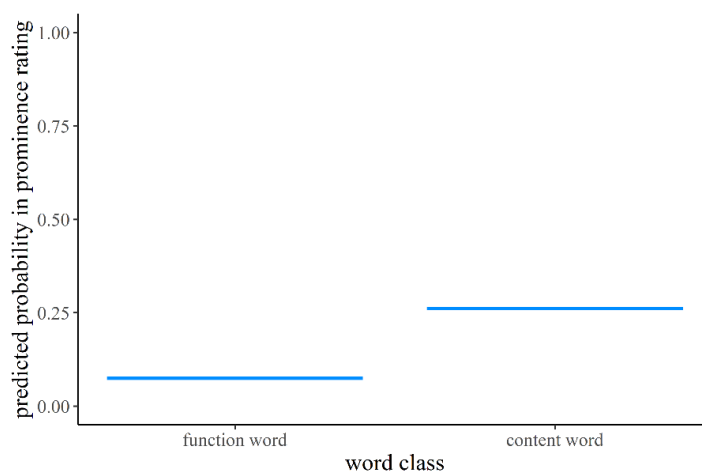


learners of English are more likely to rate (any) words as prominent than are native English speakers.



**Figure 2. Effects of L1 Group on Predicted Probability in Prominence Rating**

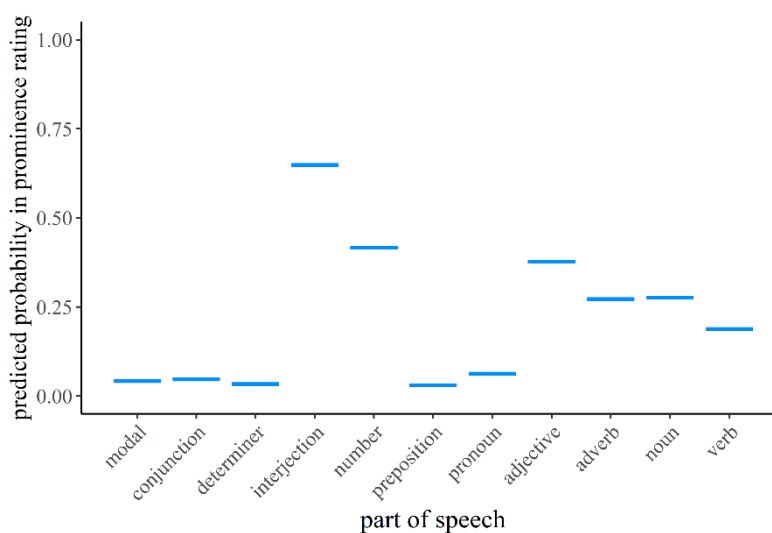
Figure 3 displays the effects of word classes (x-axis) on predicted probability in prominence ratings (y-axis). The estimates are significantly higher for content words than function words, confirming that content words are more likely to be judged as prominent than are function words.



**Figure 3. Effects of Word Class on Predicted Probability in Prominence Rating**

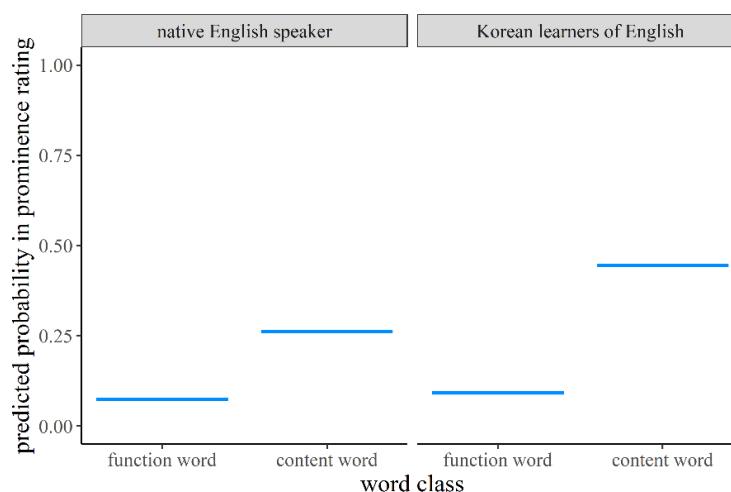
Figure 4 shows the effects of parts of speech (x-axis) on predicted probability in prominence ratings (y-axis). Recall that modal was set as the reference level in the second model. First, preposition, determiner, conjunction, and pronoun did not significantly differ from modal (the reference level). Among these, the estimate was lowest for preposition. Second, other parts of speech—interjection, number, adjective, adverb, noun, and verb—significantly differed from modal (the reference level). Among these, a couple of parts of speech (interjection and number) tended to show higher estimates than content words, except adjective. A post-hoc pairwise comparison showed that the estimates were higher for interjection, number, and adjective than adverb and noun, which were

followed by verb ( $\beta = 0.49$ ,  $z = 2.84$ , *n.s.* for interjection-number;  $\beta = -0.18$ ,  $z = -1.88$ , *n.s.* for number-adjective;  $\beta = 0.63$ ,  $z = 8.09$ ,  $p < 0.001$  for adjective-adverb;  $\beta = -0.11$ ,  $z = -1.81$ , *n.s.* for adverb-noun;  $\beta = 0.31$ ,  $z = 5.74$ ,  $p < 0.001$  for noun-verb). In sum, the effects of parts of speech on predicted probability in prominence ratings increased in the following order: preposition, determiner, modal, conjunction, pronoun < verb < adverb, noun < adjective, number, interjection.



**Figure 4. Effects of Part of Speech on Predicted Probability in Prominence Rating**

Figures 5-6 display the effects of interaction between the fixed factors. Figure 5 illustrates the effects of word classes (x-axis) on predicted probability in prominence ratings (y-axis) in relation to native English speakers (left panel) and Korean learners of English (right panel). A post-hoc pairwise comparison revealed that the L1 groups differed in predicted prominence ratings on content words ( $\beta = -0.82$ ,  $z = -18.83$ ,  $p < 0.001$ ) as well as function words ( $\beta = -0.23$ ,  $z = -3.35$ ,  $p < 0.01$ ). For content words, Korean learners of English showed higher estimates than native English speakers. Also, for function words, Korean learners of English had slightly higher estimates than native English speakers, although this is not clearly shown in Figure 5. The difference in the estimates between the two L1 groups turned out to be greater for content words than function words.



**Figure 5. Effects of Word Class on Predicted Probability in Prominence Rating by L1 Group**

Figure 6 shows the effects of parts of speech (x-axis) on predicted probability in prominence ratings (y-axis) in relation to native English speakers (left panel) and Korean learners of English (right panel). We will discuss each L1 group and compare the two L1 groups based on the results from a post-hoc pairwise comparison. First, for native English speakers, the estimate was lowest for preposition, followed by determiner, which, in turn, had a lower estimate than modal. Despite this, the estimates did not significantly differ for modal, conjunction, determiner, and preposition ( $\beta = -0.11, z = -0.41, n.s.$  for modal-conjunction;  $\beta = 0.34, z = 1.44, n.s.$  for conjunction-determiner;  $\beta = 0.11, z = 0.52, n.s.$  for determiner-preposition). Pronoun showed a significantly higher estimate than preposition ( $\beta = -0.76, z = -3.96, p < 0.05$ ). Also, the estimates gradually increased for the parts of speech for content words: verb < adverb, noun < adjective ( $\beta = 0.48, z = 4.26, p < 0.01$  for adjective-adverb;  $\beta = -0.02, z = -0.21, n.s.$  for adverb-noun;  $\beta = 0.50, z = 6.06, p < 0.001$  for noun-verb). The estimate was highest for interjection, followed by number ( $\beta = 0.95, z = 3.83, p < 0.05$  for interjection-number). In sum, for native English speakers, the effects of parts of speech on predicted probability in prominence rating increased in the following order: preposition, determiner, modal, conjunction < pronoun < verb < adverb, noun < adjective, number < interjection.

Next, for Korean learners of English, the estimate was lowest for preposition, followed by modal, which had a lower estimate than determiner. There were some significant differences in the parts of speech for function words. Conjunction, determiner, and pronoun showed significantly higher estimates than modal and preposition ( $\beta = -1.33, z = -4.71, p < 0.001$  for modal-conjunction;  $\beta = 0.43, z = 2.45, n.s.$  for conjunction-determiner;  $\beta = 1.13, z = 5.28, p < 0.001$  for determiner-preposition;  $\beta = -1.59, z = -7.66, p < 0.001$  for preposition-pronoun). There were no significant differences in the estimates of the parts of speech for content words, except adjective ( $\beta = -0.20, z = -2.43, n.s.$  for adverb-noun;  $\beta = 0.12, z = 1.76, n.s.$  for noun-verb). The estimate was highest for adjective, followed by interjection, number, adverb, noun, and verb ( $\beta = -0.53, z = -3.85, p < 0.05$  for number-adjective;  $\beta = 0.79, z = 7.22, p < 0.001$  for adjective-adverb). To sum up, for Korean learners of English, the effects of parts of speech on estimated probability in prominence rating increased as follows: preposition < modal, determiner, conjunction, pronoun < adverb, verb, noun, number, interjection < adjective.

Lastly, the difference between the two L1 groups lies in all the parts of speech for content words and few parts of speech for function words. Such parts of speech are determiner, adjective, adverb, noun, and verb. For these parts of speech, Korean learners of English showed significantly higher estimates than native English speakers ( $\beta = -0.68, z = -3.78, p < 0.05$  for NES determiner-KLE determiner;  $\beta = -0.87, z = -7.35, p < 0.001$  for NES adjective-

KLE adjective;  $\beta = -0.56$ ,  $z = -5.42$ ,  $p < 0.001$  for NES adverb-KLE adverb;  $\beta = -0.74$ ,  $z = -11.01$ ,  $p < 0.001$  for NES noun-KLE noun;  $\beta = -1.11$ ,  $z = -13.20$ ,  $p < 0.001$  for NES verb-KLE verb). The estimates of the five parts of speech increased in the following order: adverb < determiner < noun < adjective < verb. This can be interpreted as the order of increase in the difference between the two L1 groups. In other words, there is a relatively small difference between the two L1 groups for adverb and determiner. The difference is substantial for noun and adjective. The L1 groups show the greatest difference in judging prosodic prominence on verb.

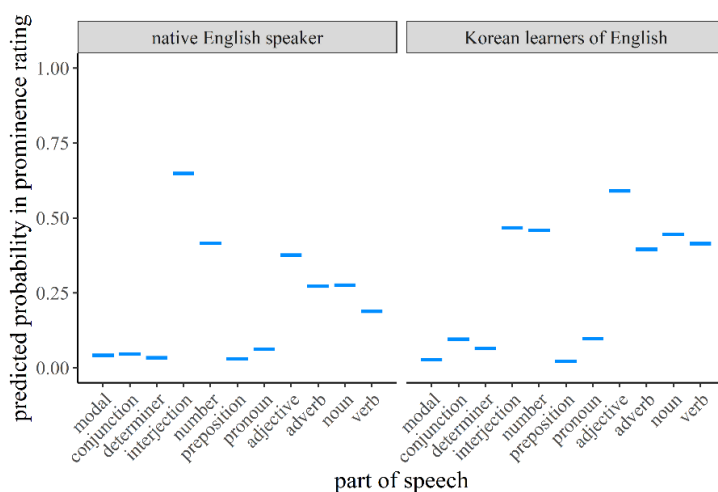


Figure 6. Effects of Part of Speech on Predicted Probability in Prominence Rating by L1 Group

#### 4. Discussion

The present study explored how implicit prosodic prominence is associated with (a) word classes and (b) parts of speech by native English speakers and Korean learners of English using a complete public speech. In this public speech, prosodic prominence is broadly mapped with the binary distinction of word classes (content words versus function words). We found supporting evidence for higher probability of prosodic prominence with content words than function words. Both native English speakers and Korean learners of English were more likely to assign prosodic prominence to content words than function words. There was a difference between the two L1 groups. Korean learners of English were more likely than native English speakers to assign prosodic prominence to content words, as well as function words. This tendency was greater for content words than function words. Our post-hoc analysis further revealed that native English speakers and Korean learners of English differed in five parts of speech, among all. These five parts of speech involved one part of speech for function words (determiner) and four parts of speech for content words (adjective, adverb, noun, and verb). The difference between the two L1 groups increased in the following order: adverb < determiner < noun < adjective < verb. For these parts of speech, Korean learners of English showed higher likelihood of prosodic prominence than native English speakers. These results indicate (1) Korean learners of English differ from native English speakers in that they have a higher likelihood of rating prosodic prominence, and (2) Korean learners of English overweigh content words, especially verb, in the assignment of prosodic prominence compared with native English speakers. Note that verb is the least stressable content word for native English speakers in the present study. The overproduction of prosodic prominence, as well as the overweight of content words by Korean learners of English, might not be felicitous in production of prosodic

prominence in English and must be improved through the medium of language instruction.

Also, prosodic prominence is probabilistically mapped with the parts of speech within the identical word classes. For native English speakers, the parts of speech for content words were categorized into three subgroups. The probability of prosodic prominence was higher for adjective than noun and adverb, which in turn showed higher likelihood than verb. The parts of speech for function words were categorized into two groups. The likelihood of prosodic prominence was higher for pronoun than preposition, determiner, modal, and conjunction. It was lowest for preposition, not for modal, in the present study, disconfirming Yoo (2014). The likelihood of prosodic prominence was highest for interjection among all the parts of speech, followed by number. The hierarchy of stressability obtained from this public speech is shown in Table 4. Compared with the previous studies (Anttila 2015, Shih 2018), the present study proposes six classes in English. First, Classes 1-2 consist of function words. The pronoun is distinct from other parts of speech for function words and is more stressable than others. Second, Classes 3-5 are composed of content words. Among the parts of speech for content words, verb is the least likely to be associated with prosodic prominence, while adjective is the most likely to be mapped with prosodic prominence. Noun and adverb are somewhat between verb and adjective. Note that number is as stressable as adjective. Third, Class 6 consists of interjection. The interjection has not been explored in the previous studies (e.g., Anttila 2015, Shih 2018, Yoo 2014), but it turned out to be the most stressable part of speech in the present study. Overall, these results can be taken as evidence of the gradual and probabilistic relationship between prosodic prominence and parts of speech. This relationship is not only observed with the parts of speech for function words, but also with the parts of speech for content words, in alignment with Shih (2018).

**Table 4. Parts of Speech Presented along the (Sentence-level) Stressability Obtained from Native English Speakers in the Present Study**

Class	Part of speech
1	preposition, determiner, modal, conjunction
2	pronoun
3	verb
4	adverb, noun
5	adjective, number
6	interjection

For Korean learners of English, there was also higher probability of prosodic prominence for content words than function words, confirming Im (2019) and Yoo (2014). The likelihood of prosodic prominence also varied with the parts of speech within each word class. The hierarchy of stressability for Korean learners of English is summarized in Table 5. First, the parts of speech for function words are categorized into two classes, Classes 1-2. The likelihood of prosodic prominence is lower for preposition (Class 1) than modal, determiner, conjunction, and pronoun (Class 2). Second, the parts of speech for content words are categorized into two classes, Classes 3-4. The probability of prosodic prominence is higher for adjective (Class 4) than adverb, noun, and verb (Class 3).

**Table 5. Parts of Speech Presented along the (Sentence-level) Stressability Obtained from Korean Learners of English in the Present Study**

Class	Part of speech
1	preposition
2	modal, determiner, conjunction, pronoun
3	adverb, verb, noun, number, interjection
4	adjective

There are some similarities and differences between native English speakers (Table 4) and Korean learners of English (Table 5). First, both groups of speakers show gradual and probabilistic relationships between prosodic prominence and parts of speech. The parts of speech for function words are located at the lower end of the stressability hierarchy, while those for content words are on the higher end of the hierarchy. This suggests that native English speakers as well as Korean learners of English respect the binary distinction in word classes (content words versus function words), and within each word class, they make further distinctions in parts of speech in production of prosodic prominence. The overall similarity of stressability hierarchy between the two L1 groups indicates that the assignment of prosodic prominence is systematic, not random, across the parts of speech. However, native English speakers and Korean learners of English differ in that the number of classes is greater for native English speakers than Korean learners of English. In other words, native English speakers show a more gradient relationship between prosodic prominence and parts of speech than Korean learners of English. The occurrence of prosodic prominence is influenced by not only parts of speech, but also other factors, including rhythm, speech style, and speech mode (Calhoun 2010, Chodroff and Cole 2018, Hirschberg 1993, Im et al. 2018, Pierrehumbert and Hirschberg 1990, Vogel et al. 1995, among many others). All these potential factors can be reflected in the judgment of prosodic prominence by native English speakers, while they might not be fully taken into account by Korean learners of English. This may explain more varied versus simplified distinctions in parts of speech between native English speakers and Korean learners of English. Second, native English speakers and Korean learners of English show similar, but not identical, hierarchies of stressability for function words. For both groups of speakers, stressability increases as follows: preposition < determiner < conjunction < pronoun. One of the differences between the two groups is pronoun. Native English speakers seem to consider all the parts of speech for function words similarly, except that they are more likely to assign prosodic prominence to pronoun. The higher probability of prosodic prominence on pronoun is also observed in other studies (Sitayev 2000, Yoo 2014). The pronoun belongs to a function word (e.g., *I, you, this*), but it conveys the co-referential information of a word. In this regard, the pronoun, compared with other parts of speech for function words, plays an important role in delivering the information status of a word. This seems to be reflected in the hierarchy of stressability by native English speakers. Native English speakers tend to mark pronoun with prosodic prominence to a greater extent than other parts of speech for function words. Korean learners of English, however, seem to treat pronoun similarly with other parts of speech for function words. This indirectly suggests that Korean learners of English are less likely to consider additional pragmatic information that pronoun may convey (i.e., co-referentiality) than native English speakers in production of prosodic prominence. Third, the two groups of speakers show similar hierarchies of stressability for content words. Stressability increases in the following order: verb < noun < adjective. Both native English speakers and Korean learners of English consider adjective the most stressable part of speech for content words. However, there is a difference between the two groups. The highest-ranked part of speech among all is adjective for Korean learners of English and interjection for native English speakers. The favoring of interjection by native English speakers reminds us of Pike's (1945) formulation that one of the most important goals in speech communication is to convey one's attitude (for instance, interjection in the present study), rather than to deliver one's (lexical) meaning. Such a tendency is less likely to be observed with Korean learners of English.

The present study does not propose a strong and direct perception-production link of prosodic prominence for Korean learners of English. The implicit production of prosodic prominence in the present study does not seem identical with the perception of prosodic prominence in Im (2019) or with the actual production of prosodic prominence in Yoo (2014). To recall, in perception (Im 2019), Korean learners of English showed greater likelihood of perceived prominence on content words only. Among the content words, Korean learners of English

avored noun and verb more than adjective and adverb. In actual production (Yoo 2014), Korean learners of English differed from native English speakers in function words. Among the function words, Korean learners of English preferred conjunction and possessive to other parts of speech as the landing location of prosodic prominence. Modal was the least favored part of speech. This is not exactly what we found in the implicit production, which may reflect speakers' planned prosodic pattern in the cognitive representation. In the present study, Korean learners of English showed higher probability of prosodic prominence for content words and function words than native English speakers. Among content words, adjective and noun were the most favored parts of speech for prosodic prominence. The difference between the two L1 groups was greatest for verb. Among function words, preposition was the least favored part of speech for prosodic prominence. Whereas native English speakers favored pronoun as the landing location of prosodic prominence, Korean learners of English did not do so. The mismatch of the pattern across the studies directs us to consider a weak association between perception and production of the suprasegmental feature in L2, in alignment with that of the segmental feature in Levy and Law (2000).

Previous research (e.g., Yoo 2014) has proposed that Korean learners of English differ from native English speakers in phonetic realization of function words. In other words, Korean learners of English fail to produce a reduced form of function words in English. The present study, however, reveals that Korean learners of English already differ from native English speakers at the speech planning level (i.e., implicit production) in that they plan to (over)produce prosodic prominence on function words. As a result, they seem to fail to produce a reduced form of function words (e.g., Yoo 2014). We believe that the difference between the two groups of L1 speakers is concerned not only with the level of speech production, but also the level of speech planning (i.e., the level of implicit production). This is presumably because Korean learners of English might not be fully aware that function words are an infelicitous location for prosodic prominence. We also believe that the difference between the two L1 groups is relevant to the speech planning and production levels but not the speech perception level. We have seen that Korean learners of English do not differ from native English speakers on function words in perception, as in Im (2019). These results indicate that Korean learners of English do not perceive function words as prominent, but they plan to produce prosodic prominence on function words. Overall, these results can be considered clear evidence of the mismatch of the perception-production link.

Previous instruction guidelines of English rhythm (Kim 2000, Yoon 1999, among many others) have introduced mapping between prosodic prominence and word classes. Content words are the location of prosodic prominence, while function words are not. This can be misunderstood as all or nothing by Korean learners of English, that is, all content words are equally stressable, and function words are equally non-stressable. Indeed, the present study observed that Korean learners of English tended to overproduce prosodic prominence on all the content words, as discussed above. Also, among function words, pronoun was equally treated with other parts of speech by Korean learners of English, although it was considered more stressable than others by native English speakers. We believe that the instruction of simple mapping between prosodic prominence and word classes is important and efficient for Korean learners of English. In addition to this, we propose that the gradual and probabilistic relationship between prosodic prominence and parts of speech (i.e., hierarchy of stressability) needs to be supplemented in the instruction of English rhythm.

## 5. Conclusion

The present study has investigated the implicit prosodic prominence in relation to word classes/parts of speech

by native English speakers and Korean learners of English in a corpus of public speech. Results are summarized as follows: (1) Prosodic prominence is broadly mapped with the binary distinction of word classes. Higher probability of prosodic prominence is observed with content words than function words for both native English speakers and Korean learners of English. The two groups of speakers differ in that Korean learners of English are more likely than native English speakers to produce prosodic prominence on (content and function) words, especially verb. (2) Prosodic prominence is gradually and probabilistically associated with parts of speech. Hierarchies of stressability have been proposed for both native English speakers and Korean learners of English in the present study. The hierarchy for Korean learners of English shows coarser mapping between prosodic prominence and parts of speech than that for native English speakers. (3) There seems to be a weak perception-production link for prosodic prominence in second language acquisition. The production of prosodic prominence in the present study is not identical with the perception of prosodic prominence in the previous research. Overall, the present study extends our knowledge of (a) the relationship between prosodic prominence and word classes/parts of speech and (b) the perception-production link of the suprasegmental feature in L2.

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Examples in: English

Applicable Languages: English

Applicable Level: Tertiary