Title: Structural, social, and cognitive factors driving adjective order in Korean: a multi-factorial corpus analysis.

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Abstract: Multi-factorial statistical analysis of language corpora is an invaluable tool for revealing the structural, socio-pragmatic, and cognitive factors interacting to drive linguistic form. This paper reports the results of a multi-factorial corpus analysis of the relative order of Korean attributive adjectives in adjective-adjective-noun sequences. Korean attributive adjective sequences can be produced in one of two structures: a coordinated construction or a non-coordinated construction. Seven adjective properties adapted from Wulff's (2003) study of English adjective order were included in a logistic regression model along with construction type. Six of the seven properties investigated were found to have significant interactions with construction type, and for five of those six the direction of the effect is actually reversed. The results are explained with reference to the interaction of linguistic structure with universal motivators of form such as iconicity and ease of processing.

1. Introduction

The study of language structure has seen many important advances in recent years, as corpus linguistic techniques allow researchers to answer questions that were not possible to assess with limited data and manual analysis. Corpus studies have revealed that the traditional view of language structure as a collection of rules is an abstraction over a set of interweaving patterns with varying degrees of rigidity. Corpus techniques have been particularly important for deciphering patterns that are not well-explained by traditional rule-based analysis, such as the choice between ostensibly synonymous syntactic structures (Gries & Stefanowitsch 2004). The relative ordering of words from the same class, such as in multi-adjective attributive sequences, represents one such type of pattern that illustrates the necessity and effectiveness of usage-based approaches to language structure. The existence of attributive adjective ordering preferences has been well-documented for English (Vendler 1968, Martin 1969, Biber et al. 1999, Wulff 2003). Dispreferred adjective order sequences in English are judged less grammatical than preferred sequences (Danks & Glucksberg 1971), and cause the N400 EEG spike normally associated with semantic incongruity (Huang & Federmeier 2012). In a multi-factorial corpus study, Wulff (2003) identified various factors correlating with adjective order preferences in English. However, adjective ordering preferences have not been well described for other languages, so the cross-linguistic validity of these factors is not known.

In addition, the syntactic alternation between coordinated and non-coordinated adjective sequences, (e.g. English *small and pretty flower* vs. *small pretty flower*), and the effect of this alternation on ordering preferences, have not been investigated for any language using corpus linguistic methodology. Some authors (Vendler 1968, Hetzron 1978) have claimed that ordering preferences are weaker or non-existant for coordinated sequences, due to the 'breaking' of the sequence by the conjunction. Vendler (1968) states that the only principle governing adjective order in coordinated sequences is that phonologically shorter adjectives precede longer ones. However, he does not support this claim with corpus or experimental evidence. Other authors (Richards 1977, Wulff 2003), have restricted their analysis of adjective order to non-coordinated sequences, on the assumption that the coordinated structure will behave differently, but do not directly evaluate the validity of Vendler's claim. Hetzron (1978) found that for his sample of more than fifteen languages, languages with obligatory conjunctions and other similar obligatory morphology such as definite articles had no adjective order preferences. However, his data sample was very limited, seeming to consist of one or two sequences per language, with preferred order provided by a native speaker consultant.

The current study on Korean adjective order will address both of these gaps in the literature, by being the first multi-factorial study of adjective order preferences in a non-Indo-European language, and the first corpus analysis of the effect of syntactic structure on adjective order preferences in any language. Korean is a particularly interesting language to pursue this analysis, because there is evidence that the 'break' between Korean coordinated adjectives is relatively weak compared to other languages with the same structural alternation (see Section 5.8 for further discussion). Thus, if a significant effect of construction type is found, that would be a more powerful argument for an effect of syntactic structure on adjective order.

2. Previous research on adjective order

Many different factors governing adjective order have been proposed in previous literature, from purely syntactic (Annear 1964), to purely semantic (Hetzron 1978). The set of factors claimed to be responsible for adjective order can be broadly divided into three groups: degree of association of adjectives with the noun, processing speed, and social-pragmatic factors.

Many authors have made the claim that adjectives which are more 'inherent', 'essential', or 'intrinsic' to the noun tend to appear closer to the noun (e.g. Sweet 1898, Vendler 1968, Danks & Glucksberg 1971, Biber et al. 1999). There is no agreed-upon definition for intrinsicness of a quality, but some properties of adjectives that have been linked or equated with intrinsicness to a noun are: having a more objective meaning (Quirk et al. 1985) or more context-independent meaning (Martin 1969), and being more selective, i.e. combining with a smaller number of noun types than expected based on frequency (Wulff 2003). Other adjective properties cited as leading to closer positioning to the noun include being more noun-like in terms of form and/or syntactic behavior (Posner 1986, Biber et al. 1999), and having higher collocational frequency with the noun (Wulff 2003). All of these factors can be grouped together under the broad category of the degree of association of the adjective to the noun.

The two main factors in the literature relating purely to processing speed are length and frequency. Shorter and more frequent words have been shown to be processed more quickly and accurately than longer, less frequent words in various psycholinguistic tasks, such as induced tip of the tongue states (Brown & McNeill 1966), immediate serial recall (Baddeley et al. 1975), and picture-naming (Jeschniak & Levelt 1994). These effects have been found even when colinearity of word length and frequency is factored out (Bock 1982). Bock (1982) points out that all else being equal, if two words are being produced in sequence, the one which is faster to process should be produced first. This prediction has been supported by studies of English adjective order; shorter and more frequent adjectives have been shown to be preferred in first position in a two-adjective sequence (Martin 1969, Wulff 2003).

The third category of ordering factors, which I am terming 'socio-pragmatic', is based on the factor of affective load, i.e. whether the adjective conveys positive, neutral, or negative affective meaning. For example, in English, an adjective like *beautiful* has positive affective load, *terrible* has negative affective load, and *green* has neutral affective load. The prediction of some previous authors is that positive information will be conveyed before negative information (Boucher and Osgood 1969, Richards 1977). However, processing facilitation effects for positive information may be confounded by other effects such as frequency (c.f. Bock 1982), and have not been found in all studies (Klugman 1956).

Wulff (2003) developed corpus linguistic operationalizations for eight of these proposed adjective ordering principles, and conducted the first multi-factorial corpus analysis for English, using the spoken portion of the British National Corpus (BNC). Overall, her results supported previous claims about adjective order preferences, with six of the eight variables found to have significant effects in the predicted direction. Seven of the eight variables in her study were included in the current study. The factor which was excluded related to the use of English adjectives as zero-derived nouns, which is not possible for Korean adjectives.

Korean and English both have pre-nominal attributive order and the ability to stack multiple attributive adjectives. Both languages therefore have an adjective-adjective-noun construction, facilitating cross-linguistic comparison, but they are structurally distinct in many other ways. Korean is genetically unrelated to English, and the adjective word classes in the two languages have significant differences. If their behavior is similar, it would show that the ordering factors in question can apply across typologically diverse languages, and thus represent a cross-linguistic pattern that may prove to be a common tendency across languages.

3. Korean adjectives

Korean adjectives share most of their grammatical behavior with verbs, and so can be considered a subclass of verbs (Sohn 1994, Kim 2002, Kim-Renaud 2009). Korean adjectives are inflected for tense, aspect and mood in both attributive and predicative position, and do not take the copula 이다 *ita*[1] in predicative position. Korean verbs and adjectives both require a special modifier suffix when directly preceding the noun they modify. The only structural property distinguishing Korean adjectives from Korean verbs is a slight difference in form in that suffix. Where verbs would have the non-past modifier suffix 는 *–nun,* adjectives in the same tense have a similar form without the initial consonant, 은 *–un*.

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[1] The Yale romanization system is used for transliterations in this paper.

3.1. Coordinated vs. Non-coordinated construction

When multiple attributive adjectives combine in Korean, the additional adjectives can be inflected either with the modifier suffix or a connective suffix such as the conjunctive suffix -고 –*ko* 'and' or -거나 –*kena* 'or'. The structure with only modifier suffixes will be referred to here as the non-coordinated construction, and the sequence with the conjunctive suffix as the coordinated construction.

Some examples of Korean adjective sequences with their morphological glosses are provided in (1) below. Examples (1a-c) show the coordinated construction, and (1d-e) show the non-coordinated construction.

(1)[2]

a.

길고	굵은	부리
*kil-**ko***	*kwulk-un*	*pwuli*
long-**and**	thick-MOD	beak

'long and thick beak'

b.

붉고	노란	잎
*pwulk-**ko***	*nola-n*	*iph*
red-**and**	yellow-MOD	leaf

'red and yellow leaf'

c.

아름답거나	추한	것
*alumtap-**kena***	*chwu-ha-n*	*kes*
beautiful-**or**	ugly-do-MOD	thing

'beautiful or ugly thing'

d.

둥근	작은	섬처럼
*twungku-**n***	*cak-un*	*semchelem*
round-**MOD**	small-MOD	island

'round and small island'

e.

아픈	빈	자리
*aphu-**n***	*bi-n*	*cali*
hurt-**MOD**	empty-MOD	space

'painful and empty space'

The structural contrast between Korean coordinated and non-coordinated adjective sequences appears to be analogous to the English coordinated and non-coordinated constructions (illustrated in the corresponding free translations in (1) above). Just as in English, the adjectives in the Korean non-coordinated construction can be considered to be in parataxis, since the suffix used in the non-coordinated construction simply indicates that the adjective is being used attributively, and is the same for all adjectives in the sequence.

[2] All examples are taken from the KAIST corpus.

4. Data

4.1. Corpus

The corpus used to investigate Korean adjective order is the Korea Advanced Institute of Science & Technology (KAIST) corpus (Chae & Choi 2000), which contains approximately 30 million tokens in 11,622 texts representing various written genres such as novels, plays, newspapers, and academic articles, as well as some transcribed news broadcasts. An effort was made to keep the data filtering and analysis as similar to Wulff (2003) as possible to facilitate cross-linguistic comparison. The major difference between the data in the two studies is that limited accessibility of Korean spoken corpora resulted in use of a corpus that is mainly in the written modality, whereas Wulff (2003) used spoken data only. Thus, generalizations to the spoken modality based on the current results must be made with caution.

4.2. Data Sample

The HanNanum morphological analyzer, developed using a hand-tagged subset of the KAIST corpus, was used to automatically tag the full KAIST corpus. No published information on the tagger's accuracy is available, but high accuracy is expected for adjectives in attributive position because Korean has consistent morphological cues for that construction. Adjective-adjective-noun sequences were identified using a script written in R, manually reviewed by a Korean native speaker research assistant, and filtered for inappropriately matched sequences, such as mistagged items, or cases where the first adjective was the final item in a multi-word phrase. The final filtered data sample contains 1810 adjective-adjective-noun sequences.

Due to time constraints, the current study focuses mainly on Korean non-compound adjectives, i.e. adjectives that were tagged by the HanNanum tagger as a directly inflected adjective root. Some examples of adjectives with directly inflected roots are given in (2).

(2)

a.
좋다
coh-ta
good-DC
'be good'

b.
희다
huy-ta
white-DC
'be white'

Korean also has compound adjectives, which are words consisting of a noun, adjective, or adverb roots that combine with a small set of adjectives like 있다 *issta* 'to exist' or 하다 *hata* 'to do, to be in the state of' to form an adjective, as in the examples in (3).[3]

(3)

a.

미련하다
milyen-ha-ta
stupidity-do-DC
N-ADJ-DC
'to be stupid, foolish'

b.

딱딱하다
ttakttak-ha-ta
hard-do-DC
ADV-ADJ-DC
'to be hard, stiff, firm'

c.

재미있다
caymi-iss-ta
interest-exist-DC
N-ADJ-DC
'to be interesting'

Some compound adjectives, such as 약하다 *yakhata* 'to be weak', were tagged in the same way as the non-compound adjectives, as a single adjective root + modifier/conjunctive suffix. The reason for the distinction made by the tagger is not entirely clear. These adjetives were included in the current study, as there was no reason other than time constraints to exclude compound adjectives.

5. Modifier Order Variables

5.1. Root Length

It is predicted, based on studies of English frozen conjoined expressions (Cooper & Ross 1975) and English and French nonsense word ordering (Pinker & Birdsong 1979), that longer adjectives will appear closer to the noun. Bock (1982) proposes that this may be due to faster processing times for short lexical items, which will make them available for production before longer items. Bock (1982) and McDonald, Bock, & Kelly (1993) point out that the cited studies do not clearly disentangle the effects of word frequency from word length, however Wulff (2003) found that when English adjective frequency and adjective length were included in a multi-factorial model, they both contributed significant effects on ordering in the predicted direction, where both the more frequent and shorter words came first. Length in Wulff (2003) was operationalized as the number of orthographic characters in the adjective token.

3

Length in the current study was operationalized as the number of orthographic syllables in the adjective root. In Korean orthography, alphabetic symbols are organized into syllables, so this count represents the number of syllables in each adjective root. Root length was used rather than full adjective length because of length differences resulting from the suffixes accompanying first and second position adjectives. In second position, adjectives must take the modifier suffix -은 *–un*. For roots ending in a vowel, the modifier suffix is reduced to a coda nasal, and thus does not add a syllable to the count. In first position, the most common suffix is the conjunctive suffix -고 *-ko* 'and', which necessarily adds another syllable. Therefore, the length of the full adjective form will be consistently longer overall for adjectives in first position.

Although first adjectives tend to be longer overall, it was assumed that the length-based processing facilitation effect would apply during lexical access, and therefore length of the adjective root would be the significant predictor rather than length of the inflected form.

Some examples from the current dataset exhibiting predicted and non-predicted orders based on RTLENGTH are provided in Table 1.

TABLE 1 HERE

5.2. Semantic Openness

The quality of semantic openness, as operationalized in Wulff (2003), was intended to approximate how intrinsic an adjective is to a noun by measuring its selectivity, i.e. how many different noun types it combined with compared to its overall frequency. The reasoning was that the adjectives which combined with fewer noun types were more likely to represent a quality specific to that noun, and that such a quality would be likely to be highly intrinsic to that noun. Wulff (2003) did not find a significant effect of semantic openness on English adjective order, but she acknowledges that her corpus linguistic operationalization may not have properly captured the notion of intrinsicness to the noun. As mentioned in Section 1 above, there is no general agreement on what measurements would accurately capture the intrinsicness of a quality. Semantic openness seems a particularly problematic measure for intrinsicness, in fact, since it does not include any direct information about the relationship of the adjective to the specific noun type in the sequence. Rather, it is a measure of the overall selectivity of the adjective. However, overall selectivity can be used as in indirect measure of the association of an adjective to the noun it modifies. If adjectives collocate with a proportionally smaller number of noun types, their token frequency will be spread out over fewer noun types than adjectives with a higher proportional number of noun type collocations. Assuming that the distribution of an adjective across head noun types is fairly even, the more selective adjective will have a higher statistical association strength with each of its collocating noun types than adjectives which combine with a large set of noun types. This type of cue-outcome contingency has been shown to correlate with human learning of associations (Shanks 1995).

Therefore, in the current analysis, semantic openness was not assumed to be a measure of the intrinsicness of the quality to the noun, but was included as a measure of adjective selectivity, and thus of association to the noun. As with other noun association measures, it is predicted that adjectives which are more closely associated with the noun will appear closer to the noun. As discussed above, adjectives which are more selective should be more likely to appear closer to the noun, i.e. to appear as the second adjective in the pair.

The formula representing the semantic openness is shown in (4). The formula measures the total number of noun types modified by an adjective in attributive position, divided by the total frequency of the adjective. The formula is the same as in Wulff (2003), but the name of the variable was changed from SEMCLOSE to SEMOPEN to make the direction of the correlation more intuitive, i.e. higher values indicate a more open (less selective) adjective.

(4) SEMOPEN = $$\frac{f_{\text{adj-noun types}}}{f_{\text{adjective}}}$$

First position adjectives therefore are predicted to have a significantly higher semantic openness value than second position adjectives. In the current study, the adjective token frequency was calculated as the frequency of the adjective stem in both predicative and attributive constructions. Some examples of various adjectives and the components of their SEMOPEN values are given in Table 2 below.

TABLE 2 HERE

Some examples from the current dataset exhibiting predicted and non-predicted orders based on SEMOPEN are provided in Table 3.

TABLE 3 HERE

The data in Tables 2 and 3 illustrate an issue with this variable as a measure of adjective selectivity. It seems suspicious that adjectives like 좋다 *cohta* 'good' or 크다 *khuta* 'big' would have such low SEMOPEN values (0.089 and 0.093, respectively), lower than 붉다 *pwulkta* 'crimson' (0.258) or 까다롭다 *kkatalopta* 'picky' (0.316). It is likely that for highly frequent adjectives like 크다 *khuta* 'big', their SEMOPEN value is lowered due to their participation in some very frequent repeated adjective-noun combinations, which would increase overall frequency without increasing the number of noun types, and thus lower their SEMOPEN value. In fact, overall adjective frequency has a medium-strength negative Pearson product-moment correlation with semantic openness ($r = -0.403$). However, because the relationship between the two variables is not perfectly linear, presumably SEMOPEN values can distinguish adjective selectivity between adjectives at a similar frequency level. In keeping with this assumption, performance was worse for both a version of the regression model without SEMOPEN, and a version with an unrelativized noun type frequency count instead of SEMOPEN. Therefore the SEMOPEN variable was kept in the model discussed in Section 6.

5.3. Independence from Comparison

Martin (1969) argues that adjectives with highly consistent meanings across contexts encode more intrinsic qualities of the noun they modify than adjectives whose meanings vary depending on context. He identifies two aspects of this type of context-independence: the amount of polysemy an adjective has, and whether the adjective is independent from comparison. It is this second aspect that will be considered in the current study. Independence from comparison is the degree to which attributing a quality to an item requires comparison with other items of that type. For example, to label a table as 'red' or 'square' does not require any reference to other tables, but labeling a table as 'big' requires some knowledge of the normal size of tables, since the absolute size of objects labeled 'big' is not consistent across object types. A 'big' table could be bigger than a 'big' pencil, and smaller than a 'big' building, for instance.

It is predicted, based on the English results and previous literature (Martin 1969, Posner 1986, Wulff 2003), that modifiers which are less dependent on comparison will appear closer to the noun. Independence from comparison (INDCOMP) was operationalized as in Wulff (2003), as the likelihood for an adjective to be expressed in a comparative or superlative construction, relative to its overall corpus frequency, represented in the formula in (5).

(5) $$\text{INDCOMP} = \frac{f_{\text{adj in comparative}} + f_{\text{adj in superlative}}}{f_{\text{adj}}}$$

A lower value for INDCOMP means that an adjective was used less often in the comparative and superlative constructions, and therefore is more independent from comparison. Adjectives with lower values are predicted to appear closer to the noun, i.e., as the second adjective in the pair.

Some examples of various adjectives and the components of their INDCOMP values are given in Table 4 below.

TABLE 4 HERE

Some examples from the current dataset exhibiting predicted and non-predicted orders based on INDCOMP are provided in Table 5.

TABLE 5 HERE

5.4. Subjectivity-objectivity

Previous authors (Hetzron 1978, Quirk et al. 1985) have claimed that subjectivity of a quality affects adjective placement; specifically, adjectives denoting subjective assessments appear farther from the noun than those denoting more objective qualities. More subjective qualities are those which are more likely to be disputed between different observers, and which have little or no direct assessability through reference to an externally measurable quality. For example, two observers may disagree on whether they find a particular piece of furniture to be beautiful or ugly, and there is no objective way to determine which one of them is correct without simply referencing other subjective opinions, such as by taking a poll. However, one would expect two observers to be less likely to disagree on an object's color or shape, and determing those properties involves reference to an objectively measurable property of the object, such as the wavelength of light it reflects. Presumably, qualities that are more inherent or intrinsic would be less disputable and more easily verifiable, and thus objectivity can be associated with intrinsicness of a quality.

Hetzron (1978) outlines thirteen categories that are ordered based on subjectivity, and found to apply to English and Hungarian. The source of the judgments for English and Hungarian is unspecified, so it is presumed to be based on the intuitions of the author. Subjectivity-objectivity (SUBJOBJ) was coded by classifying each modifier into these thirteen semantic categories. The thirteen categories and English examples for each are listed in Table 6 below.

TABLE 6 HERE

The categories are ordered from 1 (most objective) to 13 (most subjective). Hetzron (1978) provides arguments for each delineation, based on such factors as how easily observable a quality is, to what degree the personal experience of the observer is involved, and how falsifiable the quality is. As is often the case when assessing subtle semantic differences based on intuition, the conceptual distinctions here are difficult to pin down reliably. It seems to be the case that his ordering is primarily based on the acceptable order of the various categories in English, with reasoning developed post-hoc. However, the order in general seems to be intuitively sensible as a cline of subjectivity. For example, it is intuitive to consider color and shape as more objective qualities than taste, for example, and all of the static permanent properties as more objective than evaluative qualities such as ‘beautiful’. Therefore, though the exact degree of correspondence with a cline of subjectivity is debatable, this variable is included as an approximation of such a cline, and to allow comparison with English ordering. The adjectives with lower values of SUBJOBJ are predicted to appear closer to the noun, i.e., as the second adjective in the pair.

The Korean adjective-adjective-noun sequences in the current dataset were coded for this variable by a Korean native speaker research assistant, with spot-checking by the author. As in Wulff (2003), qualities that did not fit in any of the categories were excluded from analysis. For example, 같다 *kathta* ‘same’ and 다르다 *taluta* ‘different’ were excluded because they could be expected to vary greatly in their objectivity in different contexts, depending on whether they are being used to encode objective equivalence in identity, e.g. ‘same brand/model’, or being used in a more evaluative sense, e.g. ‘Since that incident he is not the same person’, or ‘I’ve been in the same situation’.

No examples of Category 4 occurred in the dataset analyzed in the current study. Category 4, ‘Physical Defect’, including words such as ‘blind’ or ‘deaf’, are presumably low frequency concepts. In addition, the concepts ‘blind’ and ‘deaf’ are commonly expressed using the phrase 눈이/귀가 먼 *nwun-i/kwi-ka men,* an idiomatic expression with the nouns meaning ‘eyes’ or ‘ears’ marked for nominative case and the attributive form of the adjective 멀다 *mel-ta* meaning ‘be far’. Since this is a multi-word expression, these modifiers are excluded from the dataset.

Concepts belonging to Categories 1-3 are almost always expressed either as noun-noun sequences (e.g. 6a below) or as single-word compound nouns (e.g. 6b below), and thus were excluded.

(6)

a. 나무 상자
namwu sangca
wood box
'wooden box'

b. 다리미판
talimi-phan
iron-board
'ironing board'

It should be noted that the fact that categories 1-3 are disproportionately represented as compound nouns constitutes support for the predicted effect of SUBJOBJ, since by definition they will appear closer to the noun than any other modifier.

The frequency distribution of the nine remaining semantic classes (Hetzron's 9-13 from Table 6) in the current dataset is shown in Table 7 below. Non-predicted orderings are shaded.

TABLE 7 HERE

Some examples from the current dataset exhibiting predicted and non-predicted orders based on SUBJOBJ are provided in Table 8.

TABLE 8 HERE

The intuitive sense of subjectivity seems to be related to independence from comparison. Qualities that could be a matter of opinion seem likely to also be gradable qualities, since opinions would be more likely to differ when it is possible for the referent fit a quality to varying degrees. This connection is made explicitly by researchers in sentiment analysis, who have found some experimental evidence that gradability correlates with judgments of human subjectivity (Hatzivassiloglou & Wiebe 2000). With this in mind, a Pearson product-moment correlation was computed for SUBJOBJ and INDCOMP. The result was a correlation of 0.302, showing a medium-strength tendency for more subjective qualities to be less independent from comparison. However, as discussed in Section 6 below, collinearity measures for all variables were at an acceptable level, so both variables were included in the model.

5.5. *Affective Load*

Affective load (AFFLOAD) indicates the polarity of a given quality, e.g., *terrible* would have a negative polarity, *gorgeous* a positive polarity, and *round* a neutral polarity. It is predicted that adjectives denoting positive affect will precede adjectives denoting negative affect, following the "first the good news, then the bad news" principle found for English adjectives (Richards 1977, Wulff 2003). Modifiers were coded for a three-way polarity distinction: -1 (negative), 0 (neutral), or 1 (positive). As with SUBJOBJ, coding was done by a Korean native speaker research assistant, with spot-checking by the author. Following Wulff (2003), qualities with no affective load outside of a specific context, such as color and temperature, were coded as neutral, even in contexts where they may have some positive or negative connotations (e.g., 'hot room', 'hot coffee').

The prediction based on previous literature is that positive adjectives precede negative adjectives. A further prediction was made, namely, that neutral adjectives would also be more likely to precede negative adjectives, since the neutral adjective could provide a similar mitigating effect by delaying the presentation of the negative quality. Therefore, affective load was treated as a numeric variable, and the first adjective in a pair is expected to have a higher AFFLOAD value than the second adjective. This is in contrast with Wulff (2003), who recoded this variable as a binary distinction between positive and non-positive adjectives.

The frequency distribution by adjective position of AFFLOAD values in the current dataset is provided in Table 9 below. Non-predicted values are shaded.

TABLE 9 HERE

Some examples from the current dataset exhibiting predicted and non-predicted orders based on AFFLOAD are provided in Table 10.

TABLE 10 HERE

Affective load is another quality that has been linked to subjectivity by researchers in sentiment analysis (Hill 2012). Adjectives which have a non-neutral affective load have been shown to correlate to some extent with human judgments of higher subjectivity (Hatzivassiloglou & Wiebe 2000). In support of their findings, a Chi-square test performed on the current dataset shows that there was a significant skewing in the number of neutral vs. non-neutral adjectives based on SUBJOBJ category. As would be expected, the Social Property and Evaluative categories had the most significant skewing towards non-neutral adjectives. The rest of the SUBJOBJ categories had the expected or higher than expected amount of neutral adjectives.

5.6. Noun-Specific Frequency

Co-occurence frequency has been shown experimentally to correspond with behavioral measures of strength of association between items, for adjective-noun pairs (albeit indirectly) by Lockhart & Martin (1969), and linguistic and non-linguistic stimuli in general (Shanks 1995). Thus, it is predicted that adjectives which frequently collocate with a particular noun will appear closer to the noun in multi-adjective sequences than adjectives occurring in fewer collocations with that noun.

This factor was operationalized, as in Wulff (2003), as the conditional probability, for each adjective, of predicting that adjective given knowledge of the noun in the triple. This calculation is represented in the formula in (7).

(7) $$\text{NSPECFREQ} = p_{(adj|n)} = \frac{p_{(adj + n)}}{p_{(n)}} = \frac{f_{(adj + n)}}{f_{(n)}}$$

In other words, this is the number of times the adjective has appeared in attributive position modifying the noun, divided by the corpus frequency of the noun. Only tokens of the adjective that directly precede the noun (i.e. with no intervening adjective) are included in the count. A high value of NSPECFREQ corresponds to a high proportion of collocations with the specific noun in question, and thus a higher predictability of that adjective given use of that noun. The adjective with a higher value for NSPECFREQ is predicted to appear closer to the noun in adjective-adjective sequences. Accordingly, adjectives in first position are expected to have a lower NSPECFREQ value than adjectives in second position.

Some examples of various adjective-noun combinations and the components of their NSPECFREQ values are given in Table 11 below.

TABLE 11 HERE

Some examples from the current dataset exhibiting predicted and non-predicted orders based on NSPECFREQ are provided in Table 12.

TABLE 12 HERE

5.7. General Frequency

Overall frequency of a lexical item has been shown in many studies to correspond with faster recognition and retrieval (Bock 1982). Bock (1982) points out that, all other factors being equal, faster processing for an item should result in it being produced first. Therefore, more frequent adjectives are predicted to precede less frequent adjectives in a pair. This prediction was upheld by Martin (1969) and Wulff (2003) for English adjective sequences.

General frequency (GENFREQ) was measured in the current study as the logged token frequency of the adjective in the KAIST corpus. It is not specified in Wulff (2003) whether predicative uses of adjectives are included in her token counts, but it is assumed that they are, as there is no formal difference in English between predicative and attributive forms of adjectives. In Korean, however, there are morphological differences between the two forms, e.g., in predicative position a sentence-ending suffix may be added. Therefore, GENFREQ was calculated using the adjective stem frequency rather than the full adjective form. The log of the raw frequency was used to help reveal variation that would otherwise be obscured due to the Zipfian distribution of word frequencies. This is a deviation from Wulff (2003), where the raw frequency was used.

Again, the prediction for adjective order based on frequency is that more frequent adjectives will precede less frequent adjectives. Therefore, adjectives in first position are expected to have a higher GENFREQ value than adjectives in second position.

Some examples from the current dataset exhibiting predicted and non-predicted orders based on GENFREQ are provided in Table 13.

5.8. Construction Type

As discussed in Section 1, Korean has two possible structures for an adjective-adjective sequence, differentiated by which of two suffix types is attached to the first adjective. In the coordinated construction, in which the first adjective is inflected with a coordinating conjunctive suffix (-고 –*ko* ‘and’, or -어나 *-ena* ‘or’). In the non-coordinated construction, both adjectives in the sequence are inflected with the modifier suffix -은 –*un*. A variable for construction type, CON, was used in the current analysis to examine variation in ordering behavior based on sequence structure.

As described in Section 1, previous authors have claimed that coordinated adjectives will have weaker ordering preferences than non-coordinated adjectives (Vendler 1968, Hetzron 1978). It is thus predicted that all other variables investigated will have a significant interaction with construction type, whereby coordinated adjective sequences exhibit a significantly weaker effect in the same direction as non-coordinated adjective sequences.

However, there are two major arguments for the relative weakness of the 'break' in Korean coordinated adjective sequences compared to languages like English. First, unlike English speakers (Biber 1999), Korean speakers seem to prefer the coordinated over the non-coordinated construction. In the dataset used in the current study, the coordinated construction accounted for over 80% of multi-adjective sequences. Its higher frequency could make it easier to process than the non-coordinated construction, in line with well-known facilitory effects of frequency on processing (Bock 1982, Bybee 2010). In addition, frequent usage of a linguistic construction is predicted to lead to processes such as chunking and analogy (Bybee 2010), which could result in a larger number of coordinated expressions with strong ordering preferences.

Second, the Korean coordinating element is a suffix, not a separate word, and the non-coordinated construction also requires a suffix. Thus the contrast between the two constructions, at least in one particular sense of linguistic distance (Haiman 1983), is smaller for Korean than for languages where conjunctions are separate words.

Therefore, if construction type does have a significant effect on Korean adjective order, it would be a particularly strong argument for the role of structure in ordering preference, since the 'break' in coordinated sequences is perhaps weaker than in other languages.

6. Data Analysis

Operationalizing adjective position in a multi-factorial model is complex, since information about both modifiers must be taken into account for both the independent variables and the dependent variable. Conceptually, the model should provide a prediction for the position of each adjective in a pair (first vs. second), based on their values for root length (RTLENGTH), adjective selectivity (SEMOPEN), independence from comparison (INDCOMP), subjectivity (SUBJOBJ), affective load (AFFLOAD), noun collocation strength (NSPECFREQ), general frequency (GENFREQ), and connecting suffix type (CON). However, if POSITION were made a dependent variable with two levels, 'first' and 'second', the set of independent variables would need to include all factors except for CON twice, to include the values for both adjectives in each pair. Such a large number of independent variables would make the model weak and unstable without very large amounts of data. Another possibility is to have the dependent variable represent the order of the pair of adjectives as a single value, rather than represent the position for each adjective in the pair separately. The independent variables can then be represented once, as the difference between the two adjective values in each pair. The problem then becomes defining the dependent variable. Two categories in the dependent variable are necessary, otherwise there is no variation for the model to predict. If the actual order is one level of the dependent variable, there is nothing that can serve as the contrasting level.

The solution to this problem, following Wulff and Gries (to appear), was to codify adjective order as a binary dependent variable, ORDER, with two levels, 'predict' and 'non-predict'. The 'predict' level serves to represent the attested order of adjectives, and the 'nonpredict' level represents the unattested order. The eight independent variables were each doubled in length, creating an artificially doubled dataset. To create the attested and unattested independent variable values, each of the seven numeric measures for each adjective pair was subtracted from the other measure, once in each direction: once subtracting the adjective_1 values from the adjective_2 values, and once subtracting adjective_2 from adjective_1. The attested and unattested orders could have been represented with either subtraction direction, but to aid in interpretation, the direction chosen for the attested order was the one resulting in a positive correlation if the prediction was true (hence the label 'predict'). In other words, the subtraction direction that was predicted based on previous literature to have a positive value was mapped to the 'predict' level, and the one that was predicted to have a negative value was mapped to the 'non-predict' level. For example, since RTLENGTH is predicted to be smaller for the first adjective in a pair, $\text{RTLENGTH}_{adj2} - \text{RTLENGTH}_{adj1}$ is predicted to be a positive value. Thus, $\text{RTLENGTH}_{adj2} - \text{RTLENGTH}_{adj1}$ was mapped to 'predict', and $\text{RTLENGTH}_{adj1} - \text{RTLENGTH}_{adj2}$ was mapped to 'non-predict'.

If there is no effect of RTLENGTH on adjective order, then there should be no correlation between RTLENGTH difference (RLdiff) and the dependent variable ORDER. A positive correlation would indicate that there is a tendency for the RLdiff values to be higher for 'predict' and lower for 'non-predict', meaning that RTLENGTH_{adj1} values tend to be smaller than RTLENGTH_{adj2} values. Thus, a positive correlation with 'predict' is mapped to the correlation direction predicted in Section 3. Table 14 provides corpus examples with three RLdiff 'predict' datapoints and their corresponding 'nonpredict' datapoints.

TABLE 14 HERE

This process was repeated for all seven numeric measures, meaning that any positive correlations indicate that the values were in the predicted direction. CON was kept the same for both 'predict' and 'non-predict' levels of the dependent variable, as its effect can only be understood in terms of its interactions with the other seven independent variables. The names of the other variables were changed to reflect the fact that they represent the difference between two values, by appending "diff". Table 15 provides a summary of the predicted effects of these variables.

TABLE 15 HERE

A binomial logistic regression was run using adjective order (ORDER) as the dependent variable, and the difference between adjective 1 and 2 values for all seven numeric factors, along with CON, as independent variables. Due to the low number of datapoints contributed per text (92% of texts contributed between 1 and 5 datapoints), a random effect for text was not included. The variance inflation factors of the maximal main effects model were tested and all variables were at an acceptable level (<2.5).

The model was initially run with all two-way interactions between all variables. All interactions that did not involve CON returned a p-value of 1.000, but did not lower the

Akaike Information Criterion (AIC) value. Since there was no clear deciding factor for which interaction to remove, interactions were built up from the maximal set of main effects, using the add1 function in R, rather than beginning with the maximally inclusive model. The results of the final model selection process are discussed in Section 7 below.

7. Results

All variables were found to be significant as main effects ($p<.05$), except for independence from comparison (ICdiff) and construction type (CON). CON could not be significant as a main effect since its values were identical for 'predict' and 'non-predict' datapoints. Six out of seven tested interactions with CON are significant, and five of the six are highly significant ($p<.001$). The six significant interactions are the interactions of CON with the difference in root length (RLdiff), independence from comparison (ICdiff), collocation strength with the noun (NSpFdiff), semantic openness (SemOpdiff), subjectivity (SubObjdiff), and logged general frequncy (GFdiff). Affective load (ALdiff) is the only variable which does not have a significant interaction with suffix type. The classification accuracy of the model is good (C=0.796), and its correlational strength is intermediate (Nagelkerke's R^2=0.363). The model is summarized in Table 16 below, and plotted in Figure 1.

TABLE 16 HERE

FIGURE 1 HERE

The level for ORDER shown on the y-axis here is the alphabetically second one, 'predict'. As explained in Section 6, the input to the model has been designed such that a positive slope for 'predict' indicates that the correlation is in the predicted direction. Of the significant main effects, root length (RLdiff), affective load (ALdiff), noun-specific frequency (NSpFdiff), and general frequency (GFdiff) are in the predicted direction, and subjectivity (SubObjdiff) and selectivity (SemOpdiff) are in the 'not predicted' direction. Interaction with construction type (CON) changes the direction of the effect for all variables except NSpFdiff.

Affective load (ALdiff) has a positive correlation with 'predict' and does not have a significant interaction with CON, meaning that for both constructions, more positive adjectives tend to precede less positive adjectives. Root length (RLdiff) has a positive correlation with 'predict' for coordinated sequences, and a negative coorelation for non-coordinated sequences. This means that shorter adjectives tend to precede longer adjectives in coordinated sequences, but longer adjectives tend to precede shorter ones in non-coordinated sequences. Subjectivity (SubObjdiff) has a positive correlation with 'predict' for non-coordinated sequences, and a negative correlation for coordinated sequences. This means that more subjective adjectives tend to precede more objective adjectives in non-coordinated sequences, but more objective adjectives tend to precede more subjective ones in coordinated sequences.

Noun-specific frequency (NSpFdiff) has a positive correlation with 'predict' for both construction types, but there is a weaker effect for coordinated sequences compared to non-coordinated sequences.[4] This means that adjectives which are more probable given the noun are more likely to occur closer to the noun for both sequence types, but the effect is stronger for non-coordinated sequences. Independence from comparison (ICdiff) has a positive correlation with 'predict' for non-coordinated sequences, and a negative correlation for coordinated sequences. This means that in non-coordinated sequences, adjectives used more often in the comparative and superlative tend to precede adjectives used less often in the comparative and superlative, with the opposite pattern holding for coordinated sequences.

Semantic openness (SemOpdiff) has a positive correlation with 'predict' for non-coordinated sequences, and a negative correlation for coordinated sequences. This means that less selective adjectives tend to precede more selective adjectives in non-coordinated sequences, but more selective adjectives tend to precede less selective ones in coordinated sequences.

General frequency (GFdiff) has a positive correlation with 'predict' for coordinated sequences, and a negative coorelation for non-coordinated sequences. This means that more frequent adjectives tend to precede less frequent adjectives in coordinated sequences, but less frequent adjectives tend to precede more frequent ones in non-coordinated sequences.

8. Discussion

All of the variables found by Wulff (2003) to affect English adjective order were also found to have significant effects on Korean adjective order, providing evidence for the cross-linguistic importance of these factors. As predicted, use of the coordinated vs. non-coordinated adjective constructions significantly affected adjective order preferences. However, coordination did not simply weaken the ordering preferences of non-coordinated sequences, as predicted by previous authors (Vendler 1968, Hetzron 1978). Rather, non-coordinated and coordinated sequences exhibited two different sets of ordering preferences, with five of seven potential interactions with construction type returning a positive correlation with predicted order for one construction, and a negative correlation for the other.

The differences in adjective ordering preferences between the two constructions can be explained with reference to their structure. Non-coordinated sequences can be analyzed as a sequence of modifiers that build on each other hierarchically, just as for English adjective sequences with no intervening grammar. This structure is motivated by iconicity between linguistic form and meaning, as discussed for paratactic constructions in Haiman (1983). Since there is no distinction in form between the two adjectives, iconicity plays a strong role, causing the second adjective, which directly precedes the noun, to form a conceptual sub-unit with the noun. Use of a coordinating suffix, on the other hand, links the adjectives together as a single conjoined modifier. Thus, in coordinated sequences, the two adjectives are treated as a sub-unit that modifies the noun.

[4] The effect of CON on NSpFdiff is not visible in the plot in Figure 2 because the allEffects function used to generate this plot in R fits the y-axis to a 0-1 scale (for easy comparison between effects), but for NSpFdiff, the actual predicted values fall within a fairly small range.

Independent evidence for the difference between these structures can be seen in their behavior with respect to antonymic adjectives. Non-coordinated sequences would be expected to disallow or strongly disprefer antonymic adjective pairs, because if an antonym were to modify the restrictive set denoted by the second adjective-noun unit, the result would be contradictory. This is the case for the equivalent English constructions, as evaluated by the native speaker intuition of the author for the examples in (8).

(8)

a. ?It's a good bad thing
b. It's a good and bad thing
c. ?All the big small pieces
d. All the big and small pieces

(8a) seems semantically odd, but possible if it is intended to mean something like 'the best of all the bad things', or 'a bad thing that is somehow good as well.' The same is true for (8c), which can only mean something like 'the biggest of the small pieces'. Clearly, there is an intuitive sense that the second adjective and noun in non-coordinated sequences form a referential sub-unit, which is further restricted by the first adjective.

Just as for English non-coordinated sequences, Korean non-coordinated sequences convey an intuitive sense to native speakers that the second adjective and noun form a sub-unit modified by the first adjective. The Korean coordinated equivalents of (8b) and (8d) sound natural, but native speaker consultants report that the non-coordinated equivalents of (8a) and (8c) sound highly unnatural and may be considered ungrammatical. In support of these intuitions, a preliminary corpus analysis of Korean adjectives with opposite affective polarity values (i.e. a positive adjective paired with a negative adjective) suggests that antonyms are strongly dispreferred or disallowed in non-coordinated sequences: of 76 positive-negative adjective pairs in the dataset used in the current study, all 76 are in coordinated sequences.

In keeping with the iconically motivated treatment of the second adjective and noun as a sub-unit, it would be expected that in Korean non-coordinated sequences, the adjective more strongly associated with the noun will tend to appear in second position, closest to the noun. In contrast, in coordinated sequences, the two adjectives are treated as a sub-unit, creating conceptual distance between the second adjective and noun. Therefore, processing speed, rather than iconic distance from the noun, could be the main determinant of adjective order in coordinated sequences. The factors related purely to processing speed, length and frequency, would then be expected to be significant in the predicted direction for coordinated sequences, but not necessarily for non-coordinated sequences. The primacy of processing speed as a motivation also leads to a prediction for noun association effects in coordinated sequences. If an adjective is more highly associated to a noun, assuming the noun has been planned at the time the adjectives are produced, that adjective will likely be faster to process as it is more strongly primed by the noun. Such facilitation of processing for strongly associated words has been shown in various psycholinguistic studies, e.g. lexical decision on noun-noun pairs (Meyer & Schavneveldt 1971). Therefore, if processing speed is the most important factor for coordinated sequences, noun association factors would be expected to have the opposite of the predicted effect for coordinated sequences, i.e. the more closely associated adjective to the noun will tend to appear first, farther from the noun.

This is indeed what was found for Korean adjective sequences in the current dataset. All factors related to noun association strength revealed a tendency for the more closely associated adjective to appear in second position in non-coordinated sequences. Both factors relating purely to processing speed, length and frequency, were significant in the predicted direction for coordinated sequences but had the opposite effect in non-coordinated sequences. In addition, three of the four noun association factors exhibited a reversal of the predicted effect for coordinated sequences, indicating a tendency for the more closely associated adjective to appear first. In line with this explanation, the socio-pragmatic factor of affective load, which is the only factor not related to either processing speed or noun association, is also the only effect that did not vary significantly between the two construction types.

It should be noted that though the above argument does not in itself explain why there appears to be a reversed effect, rather than a null effect, of the pure processing speed factors (length and frequency) for non-coordinated sequences. This may be explained in part due to collinearity between some of the factors. Though the variance inflation factors of the variables were all below 2.5, there may still be some collinearity affecting the results. For example, general frequency has a medium-strength negative correlation with semantic openness (Pearson product-moment correlation coeffecient = -0.403), and since less open adjectives tended to appear in second position, this may explain in part why more frequent adjectives tended to appear in second position in non-coordinated sequences. In addition to collinearity effects, general frequency and root length have fairly large variation in their effect on order for non-coordinated sequences, as seen from the area of grey shading around the fitted regression line of the GFdiff and RLdiff plots in Figure 1. This indicates that the effect of these variables is not as strong for non-coordinated sequences as it is for coordinated sequences, where the effect is in the predicted direction. In contrast to this result, in Wulff (2003) shorter and more frequent words were found to appear first in English non-coordinated adjective sequences, however the length and frequency effects were weaker than most of the other variables in her study, and it is possible that they could be comparatively stronger for coordinated sequences in English, providing evidence for similar effects of sequence structure on ordering preferences in English.

A fruitful direction for future work would be to repeat the corpus analysis in Wulff (2003) with the addition of coordinated sequences and a variable for construction type to allow analysis of potential interactions with the other ordering factors. This result could then be compared with the construction type effects found for Korean in the current study.

9. Conclusion

This study is the first to use multi-factorial statistical modeling to examine adjective order preferences on Korean, and is the first corpus-based study of the effect of the coordinated vs. non-coordinated structural alternation on adjective order preferences. It constitutes an important follow-up and expansion of Wulff (2003)'s findings for English, by allowing comparison between adjective order preferences in two unrelated languages. The results show that despite their typological differences, English and Korean adjectives are both affected by all seven factors which were tested in both studies. The direction of the effect, however, is not always the same for both languages.

Adjective sequence structure was found to strongly affect adjective order preferences in Korean. Contrary to claims from previous literature, coordinated adjective sequences did not simply exhibit weakened versions of the same effects as non-coordinated adjectives. For five out of six significant interactions with construction type, coordinated adjective sequences exhibited the opposite preference from non-coordinated sequences. The iconic relationship between linguistic and conceptual distance to the noun (Haiman 1983) seems to be driving ordering preferences for non-coordinated constructions in Korean. In coordinated constructions, it is processing speed that is the driving factor, resulting in more accessible adjectives appearing first. The only factor not related to either of these motivations, affective load, was the only factor which did not significantly differ based on construction type. Construction type effects in other languages have yet to be examined from a corpus-based perspective, but there is some suggestive evidence based on the relative strength of the factors found by Wulff (2003), that a similar pattern may apply in English. The effect of adjective sequence structure in Korean was only apparent when multi-factorial analysis is applied to corpora of language in use, illustrating how usage-driven data analysis with multi-factorial methods is crucial to observe the intertwining effects of grammatical structure, semantics, pragmatics, and 'pure' cognitive processing on linguistic form.

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Tables and Figures

Table 1. Predicted and non-predicted adjective order based on RTLENGTH

Predicted ordering				
adj1	RTLENGTH 1	adj2	RTLENGTH 2	noun root
밉고 *mip-ko* hateful-and 'hateful and'	1	귀찮은 *kwichanh-un* annoying-MOD 'annoying'	2	존재일 *concayil* existence 'existence'
가늘고 *kanul-ko* thin-and 'thin and'	2	뾰족한 *ppyocok-ha-n* pointy-do-MOD 'pointy'	3	송곳 *songkos* awl 'awl'
길고 *kil-go* long-and 'long and'	1	구불구불한 *kwupwulkwupwul-ha-n* curly-do-MOD 'curly'	5	머리카락 *melikhalak* hair 'hair'
Non-predicted ordering				
어둡고 *etwup-ko* dark-and 'dark and'	2	긴 *ki-n* long-MOD 'long'	1	과거 *kwake* past 'past'
아름다운 *alumtawu-n* beautiful-MOD 'beautiful'	4	작은 *cak-un* small-MOD 'small'	1	숲 *swuph* forest 'forest'
까다롭고 *kkatalop-ko* picky-and 'picky and'	3	어려운 *elyewu-n* difficult-MOD 'difficult'	2	관객 *kwankaek* audience 'audience'

Table 2. SEMOPEN examples

adj root	adj frequency	unique noun collocates	SEMOPEN value
좋 *coh-* 'good'	30141	2691	0.089
높 *noph-* 'high, tall, noble'	15020	2344	0.156
새롭 *saylop-* 'new'	13604	3833	0.282
가볍 *kapyep-* 'light, frivolous'	2542	464	0.183
빨갛 *ppalkah-* 'red'	950	312	0.328
철없 *cheleps-* 'immature'	79	47	0.595

Table 3. Predicted and non-predicted adjective order based on SEMOPEN

adj1	SEMOPEN1	adj2	SEMOPEN2	noun root
Predicted ordering				
컴컴한 *khemkhem-ha-n* dark-do-MOD ‘dark’	0.547	큰 *khu-n* big-MOD ‘big’	0.093	도시 *tosi* city ‘city’
까다롭고 *kkatalop-ko* picky-and ‘picky and’	0.316	어려운 *elyewu-n* difficult-MOD ‘difficult’	0.107	관객 *kwankayk* audience ‘audience’
Non-predicted ordering				
아름다운 *alumtawu-n* beautiful-MOD ‘beautiful’	0.222	작은 *cak-un* small-MOD ‘small’	0.278	숲 *swuph* forest ‘forest’
검고 *kem-ko* black-and ‘black and’	0.105	붉은 *pwulk-un* crimson-do-MOD ‘crimson’	0.258	법복 *peppok* uniform ‘uniform’

Table 4. INDCOMP examples

adj	adj frequency	comparative and superlative frequency	INDCOMP value
넓 *nelp-* 'large, wide'	3415	212	0.062
낮 *nac-* 'low, flat'	4353	144	0.033
예쁘 *yeyppu-* 'pretty'	1221	34	0.028
놀랍 *nollap-* 'surprising'	1754	25	0.014
눈부시 *nwunpwusi-* 'dazzling, glaring, blinding'	569	4	0.007
붉 *pwulk-* 'crimson, ruddy'	2400	5	0.002

Table 5. Predicted and non-predicted adjective order based on INDCOMP

Predicted ordering				
adj1	INDCOMP 1	adj2	INDCOMP 2	noun root
질기고 *cilki-ko* tough-and 'tough and'	0.034	매운 *maewu-n* spicy-MOD 'spicy'	0.003	냉면 *nayngmyen* cold.noodles 'cold noodles'
악명높고 *akmyengnoph-ko* notorious-and 'notorious and'	0.111	지겨운 *cikyewu-n* boring-MOD 'boring'	0.009	신문들 *sinmun-tul* newspaper-PL 'newspapers'
Non-predicted ordering				
가볍고 *kapyep-ko* light-and 'light and'	0.007	작은 *cak-un* small-MOD 'small'	0.017	수연화노리개 *swuyenhwanolikay* accessory 'accessory'
하얀 *haya-n* white-MOD 'white'	0.002	넓은 *nelp-un* wide-MOD 'wide'	0.062	이마 *ima* forehead 'forehead'

Table 6. SUBJOBJ semantic classes

Class Number	Class Name	English Examples
1	Purpose/Destination	*legal*, *ironing* as in *ironing board*
2	Composition	*wooden*, *iron*
3	Origin	*Asian*, *Japanese*
4	Physical Defect[5]	*blind*, *deaf*
5	Color	*red*, *clear* as in *crystal clear*
6	Shape	*round*, *square*, *curly*
7	Age	*young*, *ancient*, *new*
8	Social Property	*jealous*, *happy*, *sick*, *rich*, *cheap*, *comfortable*
9	Speed	*fast*, *sluggish*
10	Sensory contact property	*sweet*, *rough*, *stiff*, *hot*, *smelly*
11	Static permanent property	*wide*, *long*, *fat*, *small*, *heavy*, *bright* as in *bright light*
12	Evaluation	*good*, *beautiful*, *horrible*, *dangerous*, *difficult*
13	Epistemic qualifier	*unfamiliar*, *famous*

[5] The order given in Wulff (2003) for Physical Defect and Color is used here, however Hetzron (1978) actually argued for Color to precede Physical Defect, writing: 'While colour is immediately observable, Physical Defect shows through deficient use or non-use of the expected physical equipment of living beings.'

Table 7. Distribution of adjective1 and adjective2 with respect to SUBJOBJ

	adj2								
adj1	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
5	51	4	0	0	0	16	61	14	0
6	6	2	0	0	0	1	24	3	0
7	1	0	2	6	1	0	10	40	23
8	1	0	13	72	0	3	20	38	0
9	0	0	1	1	3	1	5	4	0
10	13	1	1	5	0	50	33	6	1
11	94	40	37	17	3	41	424	115	3
12	21	2	32	24	1	5	48	359	0
13	0	0	2	0	0	0	2	3	0

Table 8. Predicted and non-predicted adjective order based on SUBJOBJ

adj1	SBOBJ1	adj2	SBOBJ 2	noun root
Predicted ordering				
맑고 *malk-ko* clear-and 'clear/good and'	11	더운 *tewu-n* hot-MOD 'hot'	10	날 *nal* day 'day'
커다랗고 *khetalah-ko* huge-and 'big and'	11	새까만 *saekkama-n* jet.black-MOD 'jet black'	5	동네곰 *tongney-kom* town-bear 'town bear'
빠른 *ppalu-n* fast-MOD 'fast'	9	새로운 *saelowu-n* new-MOD 'new'	7	뱃길 *paes-kil* boat-road 'boat road'
Non-predicted ordering				
작고 *cak-ko* small-and 'small and'	11	예쁜 *yeypp-un* pretty-MOD 'pretty'	12	꽃 *kkoch* flower 'flower'
젊고 *celm-ko* young-and 'young and'	7	아름다운 *alumtawu-n* beautiful-MOD 'beautiful'	12	여자 *yeca* woman 'woman'
불그스름한 *pwulkusulum-ha-n* reddish-do-MOD 'reddish'	5	긴 *ki-n* long-MOD 'long'	11	수염 *swuyem* mustache 'mustache'

Table 9. Distribution of AFFLOAD with respect to adjective position

	adj2		
adj1	-1	0	1
-1	110	59	9
0	70	1091	137
1	67	92	175

Table 10. Predicted and non-predicted adjective order based on AFFLOAD

Predicted ordering				
adj1	AFFLOAD 1	adj2	AFFLOAD 2	noun root
좋고 *coh-ko* nice-and 'nice and'	1	부드러운 *pwutulewu-n* soft-MOD 'soft'	0	헝겊이나 *hengkephina* fabric 'fabric'
기쁘거나 *kippu-kena* happy-or 'happy'	1	슬플 *sulph-ul-Ø*[6] sad-PROSP-MOD 'sad'	-1	때 *ttay* moment 'moment'
Non-predicted ordering				
붉고 *pwulk-ko* crimson-and 'crimson and'	0	아름다운 *alumtawu-n* beautiful-MOD 'beautiful'	1	꽃 *kkoch* flower 'flower'
무섭고 *mwusep-ko* scary-and 'scary'	-1	강한 *kang-ha-n* strong-do-MOD 'strong'	1	이빨 *ippal* teeth 'teeth'

[6] Alternatively, −을 *-ul* could be analyzed as PROSP.MOD, but here MOD is given a zero morpheme gloss following Sohn (1994)

Table 11. NSPECFREQ examples

adj + n	frequency of adj+n	frequency of n	NSPECFREQ value
굵은 것 *kwulk-un kes* thick-MOD thing 'thick thing'	26	359688	0.000
매끄러운 섬섬옥수 *maykkulewu-n semsemokswu* smooth-MOD dainty.hands 'smooth dainty hands'	2	23	0.087
긴 외침 *ki-n oychim* 'long-MOD shout'	3	13	0.231
긴 나뭇 *ki-n namwus* 'long-MOD tree branch'	3	7	0.429

Table 12. Predicted and non-predicted adjective order based on NSPECFREQ

Predicted ordering				
adj1	NSPECFREQ 1	adj2	NSPECFREQ 2	noun root
아름다운 *alumtawu-n* beautiful-MOD ‘beautiful’	0	흰 *huy-n* white-MOD ‘white’	0.032	모래 *molay* sand ‘sand’
어여쁜 *eyeppu-n* pretty-MOD ‘pretty and’	0.003	젊은 *celm-un* young-MOD ‘young’	0.215	여인들 *yein-tul* lady-PL ‘ladies’
Non-predicted ordering				
많은 *manh-un* many-MOD ‘many’[7]	0.004	성스러운 *sengsulewu-n* holy-MOD ‘holy’	0.001	언어들 *ene-tul* language-PL ‘languages’
낯설고 *nachsel-ko* strange-and ‘strange and’	0.097	머나먼 *mename-n* far.away- MOD ‘far away’	0.016	이방 *ibang* alien.country ‘alien country’

[7] In Korean, words denoting quantities such as 많다 *manhta* ‘many’ and 적다 *cekta* ‘few’ are adjectives, rather than a separate quantifier word class as in English.

Table 13. Predicted and non-predicted adjective order based on GENFREQ

Predicted ordering				
adj1	GENFREQ 1	adj2	GENFREQ 2	noun root
넓고 *neph-ko* spacious-and 'spacious and'	8.14	푸른 *phwulu-n* blue-MOD 'blue'	7.35	정원 *cengwen* garden 'garden'
크고 *khu-ko* big-and 'big and'	10.71	상스러운 *sangsulewu-n* rough-MOD 'rough'	3.53	손 *son* hand 'hand'
Non-predicted ordering				
으스스한 *ususu-ha-n* creepy-do-MOD 'creepy and'	3.58	큰 *khu-n* big-MOD 'big'	10.71	집 *cip* house 'house'
얕고 *yath-ko* shallow-and 'shallow and'	5.59	작은 *cak-un* small-MOD 'small'	9.06	장방형 *cangpanghyeng* rectangle 'rectangle'

Table 14. RLdiff 'predict' and 'nonpredict' examples

attested order	RL_{adj1}	RL_{adj2}	RLdiff (RL_{adj2}-RL_{adj1})	ORDER value
당차고 똑똑한 김동희 *tangcha-ko ttokttokha-n kim tonghuy* 'practical and smart Kim Dong-hee'	2	3	1	predict
희고 붉은 연꽃 *huy-ko pwulk-un yenkkoch* 'white and red lotus'	1	1	0	predict
서투르고 수줍은 것 *sethwulu-ko swucwup-un kes* 'clumsy and shy thing'	3	2	-1	predict
unattested order	RL_{adj2}	RL_{adj1}	RLdiff (RL_{adj1}-RL_{adj2})	
똑똑하고 당찬 김동희씨 *ttokttok-ko tangchahan kimtonghuyssi* 'smart and practical Kim Dong-hee'	3	2	-1	nonpredict
붉고 흰 연꽃 *pwulk-ko huy-n yenkkoch* 'red and white lotus'	1	1	0	nonpredict
수줍고 서투른 것 *swucwup-ko sethwulu-n kes* 'shy and clumsy thing'	2	3	-1	nonpredict

Table 15. Predictions for adjective order variables

variable name	calculated from	predicted difference	predicted order (ADJ1, ADJ2)	possible values	actual values
RLdiff	RTLENGTH	ADJ1 < ADJ2	short adjective, long adjective	1+	1-5
SemOpdiff	SEMOPEN	ADJ1 > ADJ2	more open/less selective, less open/more selective	0-1	0.01-1
ICdiff	INDCOMP	ADJ1 > ADJ2	more dependent on comparison, more independent from comparison	0-1	0-0.11
SubObjdiff	SUBJOBJ	ADJ1 > ADJ2	subjective, objective	1-13	5-13
ALdiff	AFFLOAD	ADJ1 > ADJ2	positive, neutral neutral, negative positive, negative	-1, 0, 1	-1, 0, 1
NSpFdiff	NSPECFREQ	ADJ1 < ADJ2	low noun collocation strength, high noun collocation strength	0-1	0-1
GFdiff	GENFREQ	ADJ1 > ADJ2	high freq, low freq	0+	0-10.8
CON	n/a	n/a	n/a	coord, non-cord	coord, non-coord

Table 16. Summary of binomial logistic regression model predicting ORDER

	Estimate	Standard Error	z-value	p-value	sign. level
Intercept	-2.513e-15	4.104e-02	0.000	1	
NSpFdiff	1.993e+01	1.896e+00	10.510	< 2e-16	***
RLdiff	5.211e-01	5.251e-02	9.923	< 2e-16	***
SubObjdiff	-1.011e-01	1.664e-02	-6.079	1.21e-09	***
SemOpdiff	-1.821e+00	3.620e-01	-5.030	4.91e-07	***
GFdiff	1.102e-01	2.709e-02	4.068	4.75e-05	**
ALdiff	2.708e-01	6.797e-02	3.984	6.78e-05	***
ICdiff	-1.998e+00	2.400e+00	-0.833	0.4050	ns
CON	1.467e-16	1.278e-01	0.000	1.00000	ns
ICdiff:CON	6.229e+01	8.042e+00	7.746	9.49e-15	***
RLdiff:CON	9.49e-15	1.535e-01	-7.717	1.19e-14	***
NSpFdiff:CON	7.134e+01	1.257e+01	5.674	1.40e-08	***
SemOpdiff:CON	4.371e+00	9.672e-01	4.519	6.21e-06	***
SubObjdiff:CON	1.803e-01	4.181e-02	4.313	1.61e-05	***
GFdiff:CON	-1.766e-01	8.452e-02	-2.089	0.0367	*

Figure 1. Plot of significant effects on ORDER