Using a Meta-Grammar for LTAG Korean Grammar

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Abstract

Generating elementary trees for wide-coverage Lexicalized Tree Adjoining Grammars (LTAG) is one of the great concerns in the TAG project. We know that the Korean LTAG developed in (Han C.-H. et al., 2000) was not sufficient to handle various syntactic structures. Therefore, a Korean Meta-Grammar (KMG) is proposed to generate and maintain a large number of elementary tree schemata. Describing Korean MG with more precise tree families and with class encoding Korean syntactic properties leads to a larger coverage capacity for Korean LTAG.

1 Motivations for this work

The first development of LTAG Korean Grammar (KTAG) was proposed in (Han C.-H. et al., 2000). Few grammars for Korean exist, the one for TAG is quite small with limited coverage. Our goal is to generate a wider-coverage KTAG, using a now well-established grammar development technique. We propose using the Meta-Grammar for KTAG :

a) The MG was successfully used to generate wide-coverage grammars for French and medium size TAG for Italian (Candito 1996; Candito 1999), within the FTAG project at the Univ. of Paris 7 (Abeillé, 2002). So the use of the MG to generate real-size grammars has already been established [1] .

b) In addition, the MG was also used to generate wide-coverage grammars for frameworks like LFG (Clement and Kinyon, 2003). This stronly suggests that the MG is more portable to non-TAG frameworks, unlike other approaches such as Metarules

c) The MG was also used to generate test-suite sentences for German (Kinyon and Rambow, 2003), as well as a medium-size grammar for German (Gerdes, 2002). This specific use of the MG for text-generation shows over-generation is not a real issue. i.e., not more than for any standard grammar development technique[2]. Moreover, the MG is particularly appropriate to handle relatively "free-word order" languages such as Korean and German, because of underspecification. This mechanism is used for handling phenomena such as scrambling.

2 What is a Meta Grammar

The notion of Meta Grammar (MG) was originally presented to automatically generate wide-coverage TAGs for French and Italian, using a hierarchical-level and compact layer of linguistic description which imposes a general organization for the syntactic information, shared by the different elementary tree families, in a three dimensional inheritance network. The elementary structures of a MG are the classes organized in the Inheritance Graph. The classes in a graph order from more general classes to more specific classes, e.g., the class TRANSITIVE-VERB inherits information from one general class VERB. The three dimensional hierarchies in a MG represent the following information (Candito, 1999):

- In Dimension 1, each terminal class encodes an initial sub-categorization, i.e., a list of arguments associated with a given head with an initial syntactic function for each, e.g., a subject and an object for a transitive verbal anchor.
- In Dimension 2, each terminal class encodes a list of final function, i.e., a possible change in the initial grammatical function from dimension 1, including the possibility to increase or decrease the number of syntactic functions to be realized, e.g., adding an

[1] For French, the MG is also used for the syntax of nouns and adjectives (see (Barrier and Barrier, 2003);(Barrier and Barrier, 2004))

[2] Even the 5000 tree FTAG was successfully used in the G-TAG text generation project

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argument for the causative, and erasing an argument for passive with no agent.

- In Dimension 3, each terminal class encodes the surface realization of a final syntactic function. The category and the word order are selected.

Each class in the hierarchy is associated with a partial description of a tree. These partial descriptions of trees, called *quasi-trees*, encode *father, dominance, equality* and *precedence* relations between tree nodes. A well-formed tree is generated by inheriting information from exactly one terminal class from dimension 1, one terminal class from dimension 2, and *n* terminal classes from dimension 3. For instance, in order to generate the elementary tree for *By whom will Mary be accompanied ?*, a MG compiler creates one crossing class which is inherited from a *strict-transitive* class in dimension 1, from a *personal-full-passive* class in dimension 2, and from a *Wh-questioned-By-complement* class in dimension 3.

3 Hierarchical Descriptions in Korean Meta-Grammar (KMG) for LTAG

The Korean LTAG (Han C.-H. et al., 2000) consists of 15 tree families (see Fig.(1)). The 289 elementary trees

	Tree Families
8 for Verbs	Tnx0V, Tnx0nx1V, Tnx0nxp1V, Tnx0nxp1nx2V Tnx0s1V, Tnx0nxp1s2V, Tnx0nxNOM1V, Tnx0nx1CO
3 for Adjectives	Tnx0A, Tnx0nxp1A, Tnx0nxNOM1A
4 for Structures	Declarative and Relative Constructions, Gerund and Adverbial Clauses

Figure 1: Tree Families in (Han C.-H. et al., 2000)

have been created. Han C.-H. et al, 2000 said that it was expected to increase the number of elementary trees in order to handle more syntactic phenomena : passive, causative, resultative, light verb construction, coordination construction, and scrambling. In particular, the most important concern about the coverage capacity for a Korean grammar is the ability to handle the scrambling phenomenon. Because free-word order probably leads to an enormous expansion in the number of elementary trees due to permutations of arguments.

3.1 Initial Syntactic Functions in KMG

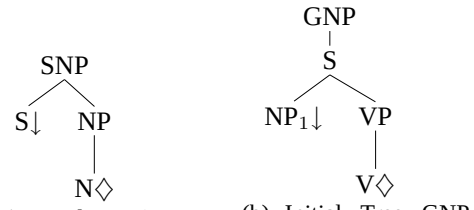
Lexicalized TAG elementary trees represent extended projections of lexical items and encapsulate all syntactic arguments of a lexical anchor. We describe the initial subcategorization frames for Korean verbs, which will be encoded in each elementary tree. Tree families proposed here cover those of (Han C.-H. et al., 2000).

Before representing initial subcategorization frames, we explain the linguistic choice for KMG : As defective verbs, auxiliary verbs, causative and/or passive auxiliary verbs, raising verbs are not represented by sentential structures, i.e., they have a reduced projection to VP and not to S. We use the syntactic category SNP (sentential noun phrase) for the complex noun phrase, and the syntactic category GNP (gerund noun phrase) for the gerund construction. When sentential clauses appear in an argument position, they become either like complex noun phrases as in (1), or like gerund noun phrases as in (2). Head items in SNP and GNP take a case marker such as a lexical head noun in NP[3]. SNP and GNP behave as nouns as a whole. But in contrast to NP nodes, modifiers for nouns can not adjoin at a SNP (complex NP) or a GNP (gerund NP) node. We have specified SNP↓ and GNP↓ nodes in tree families of predicates for which subcategorize.

Complex NPs are represented by an initial tree, whose root node is SNP. It is anchored by the head dependant noun and it has a substitution node S for the clause that modifies the head noun in Fig. 2(a). Gerund NPs are represented by an initial tree, whose root node is GNP, that is anchored by the head verb that represents appropriate subcategorization frames in Fig. 2(b).

(1) Minho-ga $[_{snp}$ yaksok-e neujossda-n-sasil-eul]
Minho$_{nom}$ appointment$_{pp}$ be.late$_{adn.FACT.acc}$
arassda.
realize
'Minho realizes that he is late for the appointment'

(2) Minho-ga $[_{gnp}$ sakwa-reul meok-gi-reul]
Minho$_{nom}$ apple$_{acc}$ eat$_{nominalizer.acc}$
silheohanda.
dislike
'Minho does not like to eat apples.'



(a) Initial Tree SNP (b) Initial Tree GNP (intransitive)

Figure 2: Trees that anchor complex and gerund NPs

We have defined 26 tree families for verbs (see Tab. (5)), and 9 tree families for the adjectives are defined (see Tab.(5)). We know that, in Korean, the syntactic functions of an argument are assigned by the markers. I.e., an

[3]i.e., a head noun in a complex NP and a head verb in gerund NP inflected with a nominalizer marker (*-gi/-eum*) are inflected with one of the case markers.

argument function will be fixed depending on the marker taken by an argument. For example, in order to realize the bare noun *Minho* as a subject in a sentence, this bare noun 'Minho' is marked with the nominative case *-i/-ga*, e.g., *Minho-ga* as a subject. According to our subcategorization frames, we proposed 10 initial syntactic functions to realize each constituent in its phrase-structure in the surface realization dimension.

1. *nom1* function for the subject argument
2. *nom2* function for the second subject argument in the double nominative construction, which can not be permuted, and for the causee with nominative in the causative
3. *acc1* function for the object argument
4. *acc2* function for the second object argument in the double accusative construction, which can not be permuted and can not be promoted to a subject position in a passive
5. *dat* function for the dative argument
6. *obli1* function for the obligatory argument marked by a postposition
7. *obli2* function for the facultative argument marked by a postposition
8. *adv* function for the adverbial argument
9. *loc* function for the locative argument of movement verbs
10. *noun-scomp* function for the complex noun phrase and for the gerund.

3.2 Redistribution of Functions in KMG

The initial functions for a predicate can be changed by a series of redistribution of functions. The passive and causative constructions determine the redistribution of grammatical functions (Suh J. -S., 1996; Lee S. -O., 1999).

Passive : Korean has two passive types. -i) A predicate is inflected with one of passive morphemes *i, hi, ri, gi*. This is the morphological passive as in (3). -ii) A predicate is realized with a passive auxiliary verb *-eo jida, -ge doeta* as in (4). This is the analytical passive.

(3) a. saengjwi-ga goyangi-reul mureossda.
mouse$_{nom}$ cat$_{acc}$ bit
'A mouse bit a cat.'

b. goyangi-ga saengjwi-ege mur*i*eossda.
cat$_{nom}$ mouse$_{pp}$ be.bitten
'A cat was bitten by a mouse.'

(4) a. saramdeul-i geu norae-reul pureunda.
people$_{nom}$ that song$_{acc}$ sing
'The people sing this song.'

b. geu norae-ga saramdeul-e uihae bur-*yeo jinda*.
that sing$_{nom}$ people$_{pp}$ is.sung
'This song is sung by the people.'

Two tree schemata are proposed for the Korean passive construction in Fig.(3). The tree schema (Fig.3(a)) represents the structure for the morphological passive. This elementary tree is anchored by a morphological passive verb. The tree schema (Fig.3(b)) represents the structure for the syntactical passive which contains two verbal anchor nodes : the one is for a main verb, and the other is for a passive auxiliary verb. The subject in the active becomes the agent marked with a postposition in the passive. An additional `agent` function is used for agent. The initial `nom1` function for subject changes into an additional `agent` function. Concerning the subject in the passive, in Korean, not only the accusative argument, but the argument marked with an other postposition can be promoted to a subject position, e.g., the *Minho-egeseo*, the NP marked by a postposition is promoted to the subject position in the passive (5b). So an additional `patient` function waits for `acc1` or `obli` functions, whose arguments take the PATIENT feature in the thematique relation with respect to its predicate.

(5) a. keu namja-ga Minho-egeseo jigab-eul
that man$_{nom}$ Minho$_{pp}$ purse$_{acc}$
ppaesassada.
stole
'That man stole a purse from Minho.'

b. Minho-ga keu namja-hante jigab-eul
Miho$_{nom}$ that man$_{pp}$ purse$_{acc}$
ppaesass*gi*eossda.
be.stolen
'Minho had his purse stolen by that man'

In KMG, in order to represent the morphological passive sentence as in (5b), in redistribution dimension, the *Morph.nom1-agent-patient-nom1* terminal class is used. This class inherits information from the `nom1` → `agent` class for the demotion of the subject, from the `patient` → `nom1` class for the promotion to subject, and from the *Morph.* class for morphological passive type. In the surface realization dimension, the sentence (5b) is generated with the tree schema (Fig. 3(a)).

Causative: Likewise in the passive construction, Korean has two different causative forms[4]. -i) One is a morphological causative: a predicate is inflected by one of morphemes *i, hi, ri, gi, u, gu, chu* as in (7), -ii) The other type is a syntactical causative: the main verb is followed by a causative auxiliary verb *-ge(-dorok) hada*,

[4]Examples ((7) and (8)) are causative sentences of (6).

(a) Morphological Passive (b) Analytical Passive

Figure 3: Tree Schemata for Passive

manteulda, sikida as in (8). In causative construction, the causer is a new argument. The `nom1` function is assigned to this new argument for the subject realization in causatives. Concerning the causee, it can be marked by various markers, e.g., causees with dative in (7(a) and 8(a)), the causee with nominative in (8b). There are constraints for causee realizations in Korean. For example, the nominative causee never appears in the morphological causative such as in (7b), while it can be accepted in the syntactical causative such as in (8b). Because the analytic causative construction contains two verbs (the matrix verb and the auxiliary verb), except for the subject of the causative auxiliary verb, we can also expect that another subject in the sentence will appear in addition to the matrix verb. That is why the nominative marker can be accepted.

(6) Sumi-ga yak-eul meokneunda.
Sumi$_{nom}$ medicine$_{acc}$ takes
'Sumi takes medicine.'

(7) a. Minho-ga Sumi-ege yak-eul mog*i*nda.
Minho$_{nom}$ Sumi$_{dat}$ medicine$_{acc}$ take$_{Mcau}$
'Minho makes Sumi take medicine.'

*b. Minho-ga Sumi-ga(Sumi$_{nom}$) yak-eul mog*i*nda.

(8) a. Minho-ga Sumi-ege yak-eul mok-ge handa.
Minho$_{nom}$ Sumi$_{dat}$ medicine$_{acc}$ take$_{Aux.cau}$

b. Minho-ga Sumi-ga(Sumi$_{nom}$) yak-eul mok-ge handa.

In causatives, the sentence meaning is changed according to causee markers[5] We can consider that the function for causee depends on the transitivity of the embedded verb, and on the causative form. We propose the following constraints for the causee :

	Intransitivity	**Transitivity**
Suffix	Acc1	Acc1, Dat [animate]
Aux	Nom1, Acc1, Dat [animate]	Nom1, Acc1, Dat [animate],Obli

Table 1: Functions of causee in Korean Causative

According to the redistribution of the initial subject function (`nom1`), we have various terminal classes for the causative. Tree schemata are proposed for the Korean causative construction in Fig.(4) : The monoclausal structure is recommended for morphological causatives, in which the nominative causee is not accepted, and in which the rest except the causer forms one constituent. Bi-clausal structures are recommended for complex causatives, in which the causee can be represented with the nominative or with other markers, and in which the sentence meaning is changed according to the markers of the causee.

3.3 Surface Realization in KMG

For syntactic realizations, three general classes are used : `non-realization` is used for empty constituents, and the `pre-verbal` is used for canonical position realizations. It can also cover the questioned element realization because Korean does not have a *wh-* movement, and the `post-verbal` is used for constituents of cleft, relative construction and extraposition.

`non-realization`: Korean freely allows empty arguments as in (10). In order to represent empty arguments, elementary trees whose argument NPs are associated with ϵ are used.

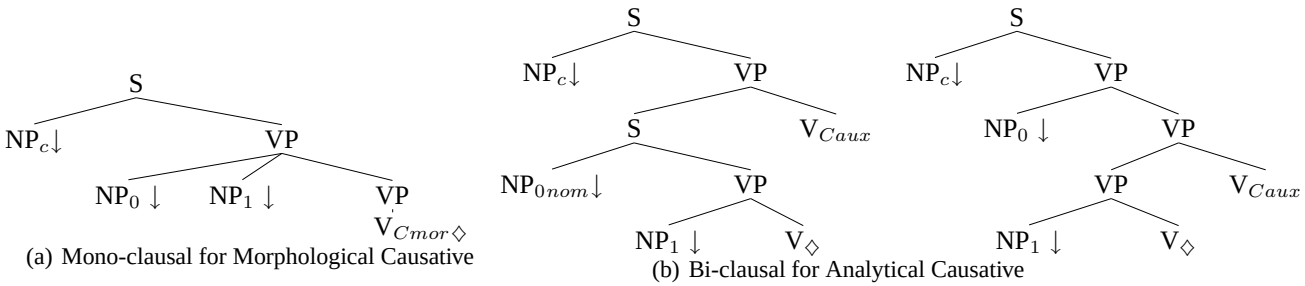
(10) ϵ ϵ ilkeossda.
ϵ ϵ read
'(I/you/he/we/they) read (it/them)

`pre-verbal` : This class is used for argument appearances before their predicates that have a syntactical dependance in a clause. For example, when a normal subject argument is realized, a nominal argument appears in

[5]For a more detailed explanation about the relationship between the sentence meaning and causee markers, see (Yoon S.-W., 2003). For instance, the causation with the nominative causee such as (9a) is permissive, whereas the causation with the accusative causee such as (9b) is coercive.

(9) a. Minho-ga Sumi-ga ga-dorok haessda.
Minho$_{nom}$ Sumi$_{nom}$ go$_{Aux.cau}$
Minho made Sumi go

b. Minho-ga Sumi-reul(Sumi$_{acc}$) ga-dorok haessda.



(a) Mono-clausal for Morphological Causative

(b) Bi-clausal for Analytical Causative

Figure 4: Tree Schemata for Causative

front of the verb with a nominative marker *-ga/ -i* as in (11a), and it permutes with other constituents in a clause, i.e., local scrambling as in (11b). By under-specifying realization positions with `pre-verbal`, elementary trees for permutations of arguments before a predicate are automatically generated. The local scrambling can be handled with the KMG.

(11) a. *Minho-ga* chaek-reul ilkeossda.
Minho$_{nom}$ chaek$_{acc}$ read
'Minho read a book.'

b. chaek-reul *Minho-ga* ilkeossda.

It will be the same for pronoun subjects*na (I), neo (you), geunyeo (she), geu (he), uri (we), neohui (you)*, and the interrogative pronouns subjects *(nu(gu): who, mueos: what)*. Therefore, we use the same tree schemata for a verb with a simple subject, for a verb with an interrogative subject, and for a verb with a pronominal subject.

Concerning a direct object realization and other oblique object realizations, whether they are nominal, pronoun, interrogative pronoun or sentential, they are identical to the realization of the subject.

`post-verbal`: This class is used for argument appearances after their predicates that have a syntactical dependance in a clause, i.e., *Extraposition* or *Korean inversion*. Not only nominal elements as in (12a), but sentential elements can also be extraposed as in (12b). Likewise for local scrambling, by under-specifying realization positions with the `post-verbal` class, we obtain elementary trees for extraposed elements - even elementary trees for the permutation among extraposed elements.

(12) a. Minho-ga *t* johahanda, [Sumi-reul]$_t$
Minho$_{nom}$ likes Sumi$_{acc}$
'Minho likes Sumi.'

b. John-i *t* malhaessda,
John$_{nom}$ *t* said
Minho-ga Sumi-reul johahan-dago.
[Minho$_{nom}$ Sumi$_{acc}$ like$_{comp}$]$_t$
'John said that Minho liked Sumi.'

We also use this `post-verbal` class for realizations of relative constructions. Relative clauses are NP modifiers in which an argument position is empty. For instance, a subject argument position is empty in the relative clause of (14). We can consider that there is an empty element after the main verb, which corresponds to this empty-subject argument, and which is syntactically related to the relative clause, e.g., *saram(person)* in (14). We call this a relativized-subject. By adjoining an auxiliary tree representing the relativized-subject to a NP, the NP is modified by a relative with an empty-subject[6]. In KMG, the relative modification comes about through the `post-verbal` class.

(14) [$_s$ Sumi-hanteseo satang-eul eot-eun] (saram)
Sumi$_{pp}$ candy$_{acc}$ get$_{rel}$ (person)
'(person) [who gets a candy from Sumi.]'

In the same way, the `post-verbal` class is used for clefted-arguments in cleft sentence. In order to represent the relativized-subject in (14), and the clefted-subject in (15), tree schemata are proposed in Fig.(5). The tree family for the relativized-subject is represented is by the auxiliary tree with the foot node NP. The tree family for the clefted-subject is selected by the copular *i* as the main verb and a sentential noun phrase (SNP) as the subject.

(15) [$_s$ satang-eul meok-eun] saram-eun (saram) ida.
candy$_{acc}$ eat$_{adn}$ person$_{top}$ (person) be
'It is (person) who ate the candy.'

we can see in (Yoon S.-W., 2003) more detailed explanations about linguistic organizations and about the relationship among the classes in KMG.

[6]The modified NP is now semantically associated with the empty-subject in the relative. The same NP can be modified by an auxiliary tree representing a relativized-object :

(13) [$_s$ Sumi-ga johaha-neun] (saram)
Sumi$_{nom}$ like$_{rel}$ (person)
'(person) [whom Sumi likes]'

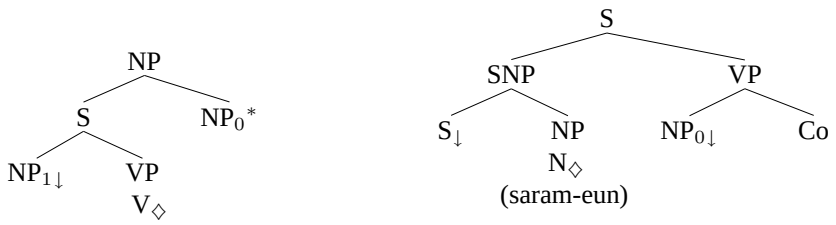


Figure 5: Tree Schemata for relativized and clefted-subject

4 Implementations

The implementation for Korean Meta Grammar is working with the Meta Grammar compiler maintained by B. Gaiffe (Gaiffe et al., 2002). A more specific status will be reported. Korean is a language with a very productive morphological system. In order to handle the morphology with a Korean Meta-Grammar, a MG generates tree templates, the morphology is encoded in the form of a dictionary of inflected terms like the French Meta-Grammar (Abeillé and Candito, 2000). The handling for unbounded dependency phenomena,e.g., non-local scrambling, is one of non-resolved problems with a MG compiler. We propose to use a compiler adapted by the new TAG variant, Tree-local MC TAG with shared nodes(RSN MC TAG), that is used to handle the unbounded dependency phenomena in free-word order variation (see (Kallmeyer and Yoon, 2004)).

5 Conclusion

We offer to develop and implement a wide-coverage LTAG Korean Grammar using a meta-grammar. The 26 tree families for verbs and 9 tree families for adjectives are proposed for Korean LTAG. With the hierarchical grammar, various syntactic phenomena can be covered in a Korean MG. For example, the auxiliary verb constructions, the nominal and/or sentential complements, the raising verb and/or the control verb constructions, the passive and/or causative constructions, and the relative and/or cleft constructions are handled. Furthermore, by suggesting *pre-verbal* and *post-verbal* classes in the syntactic realization dimension, we can also deal with the Korean local scrambling and the (simple) extraposition. The first evaluation for KMG is promising, but more has to improve the lexical coverage by increasing the lexical database, and the grammar coverage by refining the constraints on agrammatical syntactic constructions.

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References

Abeillé, A. 2002. *Une Grammaire électronique du FRANCAIS.* CNRS (eds).

Abeillé, A., and Candito, M. -H. 2000. FTAG : A Lexicalized Tree Adjoining Grammar for French. In *Tree Adjoining Grammars.* CSLI (eds).

Aravind. K. Joshi. 1985. Tree Adjoining Grammars : How much context Sensitivity is required to provide a reasonable struictural description. In D. Dowty, I Karttumen, and A. Zwicky, eds., *Natural Language Parsing*, Cambridge University Press, Cambridge, U.K., 206-250J.

Aravind. K. Joshi. 1987. An Introduction to Tree Adjoining Grammars. In A. Manaster-Ramer, editor, *Mathematics of Languages*, John Benjamins, Amsterdam.

Barrier, S. and Barrier, N. 2003. Une métagrammaire pour les noms prédicatifs du FRANCAIS. In *Proceedings of TALN 03'*.

Barrier, S. and Barrier, N. 2004. Metagrammars: a new implementation for FTAG. In *Proceedings of TAG+7*, Vancouver.

Candito, M. -H. 1996. A Principle-based hierarchical representation of LTAGs. In *Proceedings of COLING 96'*, Copenhagen.

Candito, M. -H. 1999. *Organisation Modulaire et paramétrable de grammaire électroniques lexicalisées*. Ph.D. thesis, University of Paris 7.

Clement L. and Kinyon A. 2003. Generating parallel multilingual LFG-TAG grammars using a MetaGrammar. In *Proceedings of ACL'03.*, Sapporo.

Gaiffe, B. Crabbé, B. Roussanaly, A. 2002. A New Metagrammar Compiler. In *Proceedings of TAG+6* , Venice.

Gerdes, K. 2002. *Topologie et grammaires formelles de l'allemand* Ph.D. thesis, University of Paris 7.

Han C.-H, Yoon J. -T, Kim N. -R, and Palmer Martha. 2000. *A Feature-Based Lexicalized Tree Adjoining Grammar for Korean*. Technical Report IRCS 00-04, University of Pennsylvania.

Tree Families for adjectives	Examples
n0A	haneul-i pureuda. The sky is blue
n0dat1A	Minho-ga modeun saramdeul-ege chinjeolhada. Minho is attentitive to everyone.
n0pn1A	A seon-i B seon-kwa pyeonghaenghada. Line A is paralell to line B.
n0pn1pn2A	Minho-neun Sumi-wa seongkyeok-eseo dareuda. Minho's character is different from Sumi's.
n0nNOM1A	Minho-ga deum-i pilyohada. Minho needs help.
sn0A	Minho-ga onil sukje-reul cechulha-ki-ka eolyeopda. It will be hard for Minho to hand in his homework today.
sn0pn1A	jeongchi anjeong-eul doechassneun-geos-i gyeongjebaljeon-e iopda. It is profitable in the economic development to restore the political stability .
sn0dat1A	Sumi-ga neul honja issda-neun-sasil-i Minho-ege buranseureowossda. It is anxious to Minho that Sumi is always alone.
n0s1A	Minho-ga Sumi-reul manna-go sipeohanda. Minho hopes to see Sumi.

Table 2: Tree Families for adjectival anchors in KMG

Suh J.-S. 1996. *Korean Grammar*. HanYang (eds)., Seoul.

Kallmeyer, L., and Yoon, S.-W. 2004. Tree-local MCTAG with shared Nodes : Word Order variation in German and Korean. In *Proceedings of TAG+7* , Vancouver.

Kinyon A. 2003. *MetaGrammars for efficient development, extraction and generation of parallel grammars*. Ph.D. thesis proposal, University of Pennsylvania.

Kinyon A. and Prolo C. 2002. A classification of Grammar Development Strategies. In *Proceedings of COLING-GEE 02*, Carroll, Oostdijk, Sutcliffe (eds)., Taipei.

Kinyon A. and Rambow O. 2003. The MetaGrammar: across-framework and cross-language test-suite generation tool. In *LINC-EACL-2003*, Budapest.

Nam J.-S. 1994. *Classification Syntaxique des Constructions Adjectivales en Coreen*. Ph.D. thesis, University of Paris 7.

Prolo, C. 2002. Generating the Xtag english grammar using metarules. In *Proceedings of COLING 02'*, Taipei.

Rogers, J. and Vijay-Shanker, K. 1994. Obtaining trees from their description : an application to TAGs. *Computational Intelligence 10:4*.

Lee S.-O. 1999. *A Study of Causative and Passive Constructions in Korean*. JipMunDang (eds). Seoul.

Lee Y. -S. 1993. *Scrambling as Case-driven Obligatory Movement*. Technical Report IRCS 01-03, University of Pennsylvania.

XTAG Research Group. 2001. *A Lexicalized Tree Adjoining Grammar*. Technical Report IRCS 01-03, University of Pennsylvania.

Yoon J.-T., Han C.-H., Kim N.-R. 2000. Customizing the XTAG system for efficient grammar development for Korean. In *Proceedings of TAG+5*, Paris.

Yoon S. -W. 2003. *Une Meta-Grammaire pour Le Coreen.* Manuscrit

Tree Families for verbs	Examples
n0V	Minho-ga janda. Minho is sleeping.
n0ad1V	Sonyo-ga yeppeuge saengkyeossda. The girl looks beautiful.
n0pn1ad2V	Minho-ga Sumi-hante mulyehage kunda. Minho is being rude to Sumi.
n0acc1V	Minho-ga sakwa-reul meokneunda. Minho is eating an apple.
n0acc1adv2V	Minho-neun geu gangaji-reul josimseuleopge darueossda. Minho is stroking his puppy.
n0acc1ACC2V	Minho-ga Sumi-reul pal-eul japassda. Minho is taking Sumi by the arm.
n0dat1V	Minho-ga Sumi-ege malhanda. Minho is speaking to Sumi
n0acc1dat2V	Minho-ga sakwa-reul Sumi-ege jueossda. Minho gave an apple to Sumi.
n0pn1V	ceongbo-ga yeoreo chwulcheo-robuteo giinhada. The information originates from various sources.
n0acc1pn2V	Minho-neun Sumi-reul geunyeo innaesim-edaehae chinchanhassda. Minho admired Sumi for her patience.
n0dat1pn2V	Minho-neun Sumi-ege jigeum sanghwang-edaehae seolmyeonghassda. Minho explained this situation to Sumi.
n0n1CO	Minho-ga uisa ida. Minho is a doctor.
n0NOM1V	Minho-ga kyosu-ga doeossda. Minho became a professor.
sn0V	mulgeon-e haja-ga issda-neun sasil-i deureonassda. A default revealed itself in the product.
sn0acc1V	Sumi-ga tteonassda-n geos-i Minho-reul goerophinda. The fact that Sumi went out upsets Minho.
sn0acc1adv2V	gangaji-ga jugossda-n sasil-i Minho-reul seulpeuge mandeunda. The fact that the puppy died makes Minho sad.
sn0pn1V	Minho-ga eolida-neun-geos-i baesimwon pankyeo-e yeongyangjueossda. The fact that Minho was young influenced on the jury's decision.
n0sacc1V	Minho-neun Sumi-ga jigap-eul humchi-n sasil-eul arassda. Minho noticed that Sumi had stolen his wallet.
n0s1V	Minho-neun chakhage cheosinhaess-dago saenggakhanda. Minho thinks that he behaved very wisely.
n0dat1s2V	Minho-ga Sumi-ege yeonghwakwan-e gasseoss-dago malhaessda. Minho told to Sumi to go to the movies.
n0pn1s2V	Minho-neun sijang-euro saengseon-eul sa-ro hyanghassda. Minho moved to buy fish to the market.
n0acc1s2pn3V	Minho-ga Sumi-reul saengseon-eul sa-ro sijang-euro ponaessda. Minho sent Sumi to buy fish (at the market)
n0acc1s2V	Minho-neun i nonjeungdeul-eul deol seoldeukjeoi-rago saenggakhanda. Minho doen't find these arguments very convincing.
n0s1Vc	Minho-neun honja jip-e namgess-dago gyeolsimhaessda. Minhonom decides to leave alone at home.
n0dat1s2Vc	Minho-ga Sumi-ege Inho-wa tteona-rago kangyohaessda. Minho forced Sumi to leave with Inho.
n0pn1s2Vc	Minho-ga Sumi-wa jadongcha-reul guipha-gilo hapuipoassda. Minho confers with Sumi to buy a car.

Table 3: Tree Families for verbal anchors in KMG