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An HPSG based OT Syntax: English Interrogative Constructions[1]

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Choi, Incheol. 2006. An HPSG based OT Syntax: English Interrogative Constructions. *Linguistic Research* 23.2, 103-126. The aim of this article is to examine whether the basic idea and constraints of HPSG framework can coalesce with OT syntax to get over some theoretical and empirical problems that may be confronted by the monotonic constraint based HPSG. Here, I show that the HPSG based OT syntax, as an alternative to the default inheritance system in current HPSG research, well explains inversion, *do*-support and *wh*-fronting exhibited by interrogative constructions. In the proposal, those phenomena are explained by the ranked, violable constraints together with HPSG attribute and value system. By doing this, we can obtain the generalization that accounts for the typological characteristics of the language and the explanatory tool that explicitly shows how each universal constraint interacts. **(Kyungpook National University)**

Keywords optimality theory, HPSG, feature structure, interrogative constructions, violable constraints, ranking

1. Introduction

The purpose of this paper is to examine whether the basic idea and constraints of HPSG framework can coalesce with OT syntax to get over some theoretical and empirical problems that may be confronted by the monotonic constraint based HPSG. The monotonicity used to be considered a tenet of HPSG framework since it was widely accepted that the internal structure of language should be transparent in the external structure of language. However, recently such a tenet has been loosened. The change was triggered by the idea that natural languages exhibit a great many regularities of that have exception (Sag and Wasow 1999). This change also reflects the common wisdom that 'rules are made to be broken.' Such a concern led the scholars working on HPSG framework to the adoption of the ideas in Construction Grammar. That is, the constraints of a supertype construction can be overridden by the

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more specific constraints of the subtypes. Although such an adaptation opened various possibilities that otherwise may not be allowed, I believe there has also been some concern about the excessive unmotivated constructions that could be resorted to by HPSG grammarians.

This paper shows that the basic ideas of OT can be an alternative to the default inheritance mechanism, while providing a convincing explanation for inversion, *wh*-construction, and *do*-support in English. Within OT framework, such phenomena are widely discussed by Grimshaw (1997), where the output consists of representations derived by transformational derivation in Gen. A corresponding effort is shown in Bresnan (1997), in which she tries to attribute the effect of the movement in Gen to the imperfect correspondences between different dimension of linguistic substances such as roles, functions and categories. Both Grimshaw and Bresnan treat inversion, *wh*-construction, and *do*-support as a byproduct of the syntacticized operator or discourse function (DF), depending on the positions of the operator or DF on the syntactic trees that conform to X' or extended X' structure. Here I will suggest that inversion and *do*-support in English question sentences are the result of the interaction between these specific construction types and word orders that are determined by the type declaration in Gen and the language specific ranking of the universal constraints.

2. Input and Candidate Set

Bresnan (1997) defines Input as an abstract characterization of lexical elements and sentential constituents. Thus, the Input represents morphosyntactic contents in a universal, language independent form. The abstract feature structure in Input is recoverable from the overt perceptible forms of expression. In her Optimal Syntax, the candidate set is subject to the extended X' theory of LFG and related universal constraints such as the Head Principle and Co-Head Principle. Analogously, I will investigate how construction types and their feature declarations in HPSG, in addition to universal principles, come together in optimality theory and how they combine with the ranked universal constraints to draw the optimal candidates.

The abstract forms in Input are passed to Gen, in which all candidates are generated with construction types that are shown in (1).

(1) Type Declarations for Phrase Structures (Construction Type)

Head Phrase : [$_{HD}$, phrase [HEAD Y] [$_{HD}$, HEAD Y]]

Head-Specifier Phrase: [$_{SPR}$ [1]] [$_{HD}$, phrase VAL[SPR<[1]>]]

Head-Comp Phrase: [$_{HD}$ word, VAL[COMPS< X_1, .. Xn>, (Y)]]

[$_{COMP}$ X_1]....[$_{COMP}$ Xn]

Head-Subject-Complement Phrase:

[$_{HD}$ word, VAL[COMPS <X1.. Xn>, SUB<X$_1$..Xn>]]

[$_{SUB}$X1]… [$_{SUB}$ Xn] [$_{COMP}$ X1]….[$_{COMP}$ Xn]

Head-Filler Phrase : [$_{HD}$ GAP Y, COMP sat'd] [$_{FILLER}$ X]

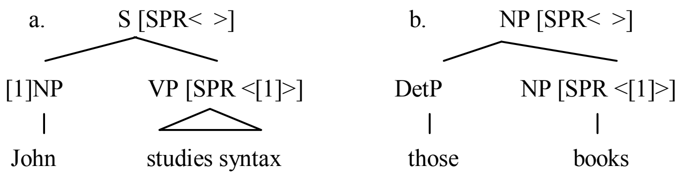
The formulas in (1) specifie possible phrasal structures and their type declarations based on HPSG. These construction types are universal, in that all candidates are categorized within these universal types, and the candidates that belong to a particular construction type obey the type declarations. Also every candidate conforms to the universal principles in HPSG such as Head Principle, Valence Principle, Filler Principle, GAP principle, Raising Principle and so on. All of the candidates are created with totally well typed, sort resolved universal feature structures. When a candidate observes the declarations of its construction types and the universal principles, it is a well-formed candidate. Thus, when input is passed to Gen, Gen creates only the well-formed candidates, and the well-formed candidates with each possible construction type compete with each other to be the optimal candidate.

3. Optimal Syntax

3.1 Phrase Type and Word Order

There is person and number agreement between subject and head verb in English. Such agreement phenomena can be observed between determiner and head noun. Introducing both subject and determiner to the feature SPECIFER (SPR) can capture such correspondent properties.

(2) head-specifier phrase

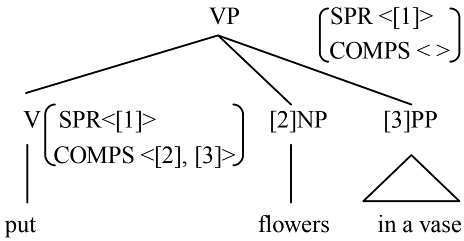


(2) a and b illustrate the head-specifier phrases. According to the type declarations in (1), the head-specifier phrase consists of a head-daughter and a specifier-daughter, and the valence list of the head-daughter must have the value that is token identical to the synsem value of the specifier-daughter. Then, the Valence Principle of HPSG will

ensure a saturated valence list to the phrase.[2] (2)a and b conform to the type declaration of the head-specifier phrase. Thus they are well-formed candidates.

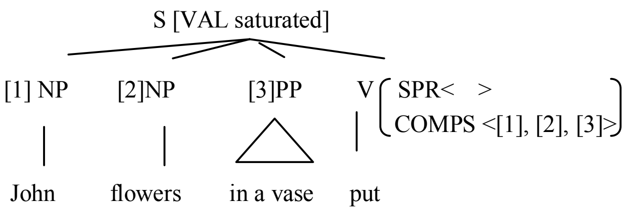
Like specifiers, complements are elements that characteristically cooccur with a lexical head. However, contrary to a head-specifier phrase, a head complement phrase doesn't have to have a fully saturated valence list, but does require a fully saturated COMPS list. This property of the valence feature is illustrated in (3).

(3)



The English sentence "John puts flowers in a vase" consists of a head specifier phase for the S node and a head-complement phrase for the VP node. (3) illustrates the VP node that is a head-complement phrase. However, construction types are not fixed cross linguistically. Therefore, the same sentence in Korean may have different construction types. For instance, the subject in Korean is classified as a complement rather than a specifier (see Chung, 1996). This typological difference between English and Korean results in a different configurational structure.

(4)



(4) shows the construction type of the Korean declarative sentence. Contrary to English, this construction type consists of only one phrase type. Such typological difference is mainly due to the syntactic property of the subject. Thus, I will assume that the specifier and the complement compete for subject.

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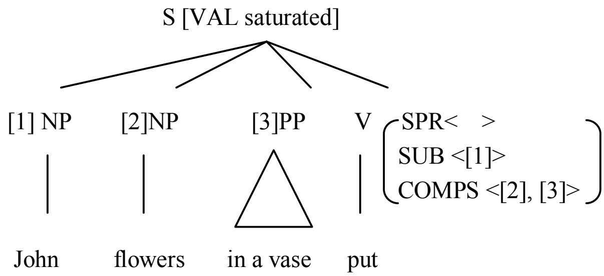
[2] In Pollard and Sag (1994), for each valence feature F, the F value of the head daughter is defined as the concatenation of the phrase's F value with the list of synsem values of the F-DTRs value.

Borsley (1987) suggests that subject should be distinguished from other complements. Although subject in (4) is realized as a sister of a head, its agreement, semantic role and case show that the subject is different from other complements. Thus, I suggest that the subject in the sister position of the lexical head must be specified in the SUB list of the valence feature. As described in the construction types in (1), subject-daughter appears only in the head-subject-complement phrase. Thus, the Korean declarative sentences have structures like (5) rather than (4).

(5)



One remarkable fact is that SPR and SUB has a complementary distribution with respect to sentential subject. For instance, if a subject is listed in SPR feature as shown in (2), then the SUB list will be empty, or when subject is listed in SUB list like Korean example in (5), the SPR list will always be empty.[3]

In OT theory, (2) and (5) are generated from the same input. Thus, this typological difference is the result of the competition between SUB and SPR list for hosting subject. Such competitions can be captured in the constraints below.

(6) Subject constraints
  A: subject is specified in SPR list of verb. (SC)
  B: subject is specified in SUB list of verb.[4]

The two constraints in (6) cannot be satisfied together because they show mutual contradiction. The constraint A and B are ranked and such a ranking explains the typological difference. For example, English and Korean show the typological difference with respect to the sentential structures of the declarative sentences as illustrated in (6)a and (5). The constraint rankings in (7) explain the variance.

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[3] The valence feature in (5) is the same as the feature type in Pollard & Sag (1994). Contrary to my idea, Pollard & Sag treat SUB as a unique list for all subjects. Thus, SPR lists specify specifiers but not subjects.

[4] Because input is an abstract structure that doesn't specify any grammatical relation, we need also some matching condition between input information and grammatical relations such as subject and object. In this paper, I will skip over the matter for focusing on the issue in question.

(7) English: Subject Constraint A (SC) >> Subject Constraint B
Korean: Subject Constraint B >> Subject Constraint A

In English, when subject occurs in the subject-daughter, it incurs the violation of the SC. As shown in the ranking in (7), the violation of SC is more critical than the violation of subject constraint B. Thus, in English, (2)a is more optimal than (5), contrary to Korean.

So far, I have discussed phase types. However, phrase types cannot explain word order phenomena. For example, head-daughter in English always precedes complement-daughter, but follow specifier-daughter, as shown in (8).

(8) (a) [$_{SPR}$ John] [$_{HD}$ [$_{HD}$ likes] [$_{COMPS}$ syntax]]
(b) * [$_{HD}$ [$_{HD}$ likes] [$_{COMPS}$ syntax]] [$_{SPR}$ John]
(c) [$_{HD}$ in] [$_{COMP}$ a vase]
(d) * [$_{COMP}$ a vase] [$_{HD}$ in]

In contrast with English, head-daughters in Korean appear in phrase final position.

(9) (a) [$_{SUBJ}$ John] [$_{COMP}$ syntax] [$_{HD}$ likes]
(b) * [$_{COMP}$ syntax] [$_{HD}$ likes] [$_{SUBJ}$ John]
(c) [$_{COMP}$ a vase] [$_{HD}$ in]
(d) * [$_{HD}$ in] [$_{COMP}$ a vase]

The construction type that I have discussed cannot capture the word order phenomena in (8) and (9). Thus, we need word order constraints like those in (10) that interact with construction types.

(10) Word Order Constraints
ALIGN-L(Hd): align head-dtr with the left edge of phrase.
ALIGN-R(Hd): align head-dtr with right edge of phrase
ALIGN-L (Spr): align Spr-dtr with the left edge of phrase.
ALIGN-L(Sub): align subject-dtr with left edge of phrase.
ALIGN-L (filler): align filler-dtr with left edge of phrase
ALIGN-R (Com): align complement with right edge of phrase.

Each word order constraint in (10) defines how a daughter should be arranged in a phrase. Thus, the word orders of sentences are determined by the interaction between word order constraints and phrase structure configuration. For instance SC, which determines the construction type for an Input, dominates these word order constraints in English. In addition, the word order constraints are ranked among each other. In English ALIGN-L(Spr) is higher ranked than ALIGN-L(Hd), and ALIGN-L(HD) is higher ranked than ALIGN-R(Com). Contrary to English, ALIGN-L(filler) dominates ALIGN-R(Hd) and ALIGN-L(Sub) in Korean.

Now, I can suggest below a tableau that explains English declarative sentences.

(11) Tableau for English declarative:

study(John, syntax)	SC	ALIGN-L(Spr)	ALIGN-L(Hd)	ALIGN-R(Com)
[$_{spr}$John] [$_{hd}$[$_{hd}$ study] [$_{com}$ syntax]] =>			*	
[$_{hd}$ [$_{hd}$ study] [$_{com}$ syntax]][$_{spr}$John]		*!		
[[$_{sub}$John] [$_{hd}$ study] [$_{com}$ syntax]]	*!		*	

Every subject-daughter incurs the violation of SC. Because SC is top ranked in (11), the third candidate is ruled out. With respect to word order constraints, ALIGN-L(Spr) is the highest ranked. Thus, rightward specifier like the second candidate incurs the violation of ALIGN-Left-Specifier. The first candidate then becomes the optimal candidate.

3.2 Inversion and yes/no Questions

In English declarative sentences, the optimal candidates have top S nodes that consist of specifier-daughter and head-daughter. In the previous section, the optimal candidate for English declarative has shown a hierarchical structure, which is drawn by the ranking of the constraints such as SC and word order constraints. In contrast with declarative sentences, question sentences are formed with flat structures, i.e. head-subject-complement construction.

In Sag & Wasow 1997, the information of clause types such as declaratives and questions is carried by the semantic MODE values. Thus, in their approach, the inversion lexical rule is triggered by the MODE value "question" as shown in (12).

(12) Inversion Lexical rule:

$$< [4], \begin{pmatrix} \text{verb-lxm} \\ \text{SYN} \begin{pmatrix} \text{HEAD [AUX +]} \\ \text{VAL [SPR<NP>]} \end{pmatrix} \\ \text{SEM [MODE prop]} \end{pmatrix} > \Rightarrow <[4], \begin{pmatrix} \text{SYN} \begin{pmatrix} \text{HEAD[FORM fin]} \\ \text{VAL [SPR < >]} \end{pmatrix} \\ \text{SEM [MODE ques]} \end{pmatrix} >$$

This lexical rule defines that auxiliary verb in the proposition sentence specifies its subject in the SPR list, whereas finite auxiliary in the question must not specifies its subject in the SPR list.

According to Bresnan (1998), in OT the lexicon is not the source but the result of syntactic variation, via the reranking of violable universal constraints. Thus, the ranking of the violable universal constraints must draw the result of the inversion lexical rule in (12). One of the properties of the lexical rule in (12) is that question sentences consist of a head-subject-complement phrase because subject is not appeared as a specifier-daughter but as a subject-daughter. However, as long as SC blocks the occurrence of the head-subject-complement phrase, we cannot get flat structures for question sentences. Thus, I suggest below the Question Constraint (QC), which makes SC powerless in question sentences.

(13) Question Constraint (QC)
The phrase whose head-daughter specifies V[MODE question] is fully saturated.

The occurrence of the specifier-daughter in a question sentence incurs the violation of QC in (13) since the VP node combining specifier is not fully saturated according to the construction type in (1). Then, the candidates that observe QC should have a head-subject-complement phrase or fully saturated VP.[5] Another result of QC is that observing this constraint incurs the violation of SC that I have defined in the previous section. However, QC does not have to dominate SC. Suppose that QC ties SC in the ranking. Because all candidates that satisfy SC incur the violation of QC in question clause, SC becomes powerless. That is, all question candidates in English violate either QC or SC. Therefore, the duty for selecting the optimal candidate is turned over to word order constraints.

Another fact shown in (12) is that the input of the lexical rule specifies [+AUX] as its head feature. This means that only the auxiliary undergoes inversion. The sentence that undergoes inversion becomes the projection of the auxiliary. This can be captured by making the head-subject-complement phrase have [+AUX] as its head feature. This can be drawn below by the constraint in (14).

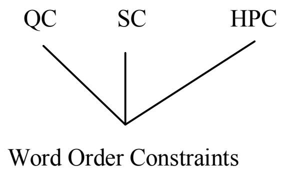
(14) Head-Subject-Complement Phrase Constraint(HPC)
The HEAD feature of the hd-subj-comp phrase specifies [+AUX].

[5] In HPSG, VP means unsaturated phrase. However, the syntactic operation such as the emergence of the GAP feature that encodes missing subject makes the VP fully saturated. This will be explained in 3.3.

HPC explains the fact that only auxiliary verbs undergo inversion. This also explains why *do*-insertion must occur in the inversion construction. For instance, if information in Input specifies "question", the output optimal candidate sentence will have a head-subject-complement phrase because of QC. Also, HPC forces the candidate to be the projection of auxiliary because question sentences consist of head-subject-complement phrases. When Input of a question sentence does not have any information about auxiliary, HPC will cause *do*-insertion in the sentence.

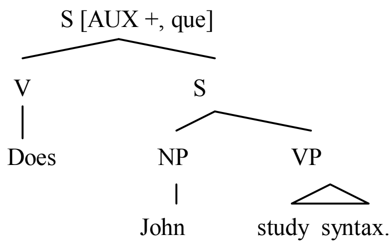
So far, I have suggested 5 violable universal constraints to explain English declarative and question sentences. The rules are ranked as in (15):

(15)



Now, let's check to see if (20) can be a possible candidate.

(16)



In OT syntax based on HPSG, (16) cannot be a possible candidate, because it doesn't conform to Raising Principle. In HPSG every auxiliary verb belongs to raising verb that must observe the Raising Principle. Below explains the raising principle for auxiliary (Sag & Wasow, 1997):

(17)

aux-verb
ARG-S < X , [SYN HEAD [PRED +]] VAL[X] ; SEM [INDEX [2]]]
SEM [MODE proposition ∨ question … ; INDEX [2] ; RESTR < >]

As shown in the lexical sign for auxiliary verb, the auxiliary takes one unsaturated argument in its ARG-S and the elements in the unsaturated ARG-S should also appear in the ARG-S of the auxiliary. However, the auxiliary verb in (16) cannot have such a lexical property, because it combines with a fully saturated phrase. Thus, (16) is not well typed candidate. Therefore, it should be excluded from our candidate list.[6]

Now we can explain the inversion construction of the question sentence as illustrated in (18).

(18) a, INPUT: question, study (x,y) GFx: John, GFy: syntax

b, Candidates:

1. [$_{SPR}$ John] [$_{HD}$ [$_{HD}$ studies] [$_{COM}$ syntax]]
2. [$_{SPR}$ John] [$_{HD}$ [$_{HD}$ does] [$_{COM}$ [$_{HD}$ study] [$_{COM}$ syntax]]]
3. [$_{SUB}$ John] [$_{HD}$ studies] [$_{COM}$ syntax]]
4. [$_{HD}$ studies] [$_{SUB}$ John][$_{COM}$ syntax]]
5. [$_{SUB}$ John] [$_{HD}$ does] [$_{COM}$ [$_{HD}$ study] [$_{COM}$ syntax]]
6. [$_{HD}$ does] [$_{SUB}$ John] [$_{COM}$ [$_{HD}$ study] [$_{COM}$ syntax]]
7. [$_{HD}$ does] [$_{COM}$ [$_{HD}$ study] [$_{COM}$ syntax]] [$_{SUB}$ John]

c, Tableau

Can	HPC	QC	SC	ALI-L-SPR	ALI-L-HD	ALI-R-COM
1		*			*!	
2		*			*!	
3	*!		*		*	
4	*!		*			
5			*		*!	
6 ➔			*			
7			*			*!

As shown in tableau c in (18), all candidates violate either QC or SC. Thus, word order constraints take over the duty for selecting the optimal candidate. The candidates that can satisfy ALIGN-Left-Head are 1, 4, and 6. However candidate 1 has the head-specifier construction that violates the higher constraint ALIGN-Left-Specifier. Thus the candidates that satisfy both ALIGN-Left-Specifier and ALIGN-

[6] However, every surface expression that a speaker can produce must be a possible candidate in OT syntax regardless the grammaticality of the candidate. Thus, although the structure in (20) is not possible candidate, the same surface expression must be a possible candidate. Of course, the candidate will observe the Raising Principle contrary to the candidate in (16).That is shown in 6th candidate in (18).

Left-Head should have the head-subject-complement construction type with inversion word order. Candidate 4 and 6 satisfy the properties, but 4 violates one additional constraint, HPC. Thus, the optimal candidate is 6.

In this approach for English question sentence, inversion was caused by the construction type. That is, contrary to declarative, question consists of a head-subject-complement phrase. QC forces this construction type. Then, HPC and word order constraints make the auxiliary verb occur before subject.

3.3 Wh-Construction

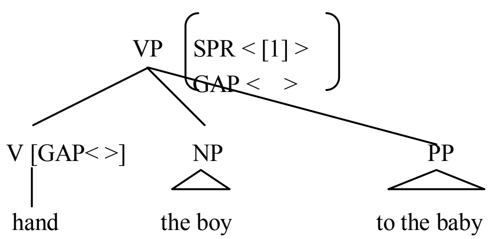
In long distance dependencies, the locality of coocurence restriction is violated. In these cases, two elements (say a NP and a verb) may appear arbitrarily far from one another in a sentence, despite the fact that there is a syntactic dependency such as case marking and agreement between them (Sag & Wasow, 1997). In this section, I will focus on the *wh*-question as an instance of long distance dependency phenomena.

To encode the missing elements in long distance dependency constructions, Sag and Wasow (1997) uses a particular feature: GAP. In their approach, when all arguments are realized in the VALENCE list, GAP feature specifies null list as shown in (19)

(19) a.

word
SYN [VAL [SPR < [1] > ; COMPS < [2] NP[acc], [3] PP>] ; GAP < >]
ARG-ST <[1], [2], [3]>

b.

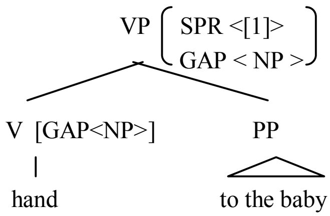


However, when any arguments are missing in a VALENCE list of lexical head, GAP feature encodes the missing elements.

(20) a.

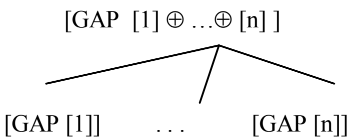
word
SYN [VAL [SPR < [1] >, COMPS < [3] PP>], GAP < [2] NP[acc] >]
ARG-ST <[1], [2], [3]>

b.



As shown in (20)b, once the GAP feature occurs with non-null value, the GAP feature is passed into the mother node. The GAP principle explains the inheritance of the GAP feature.

(21) GAP Principle (Sag & Wasow, 1997)



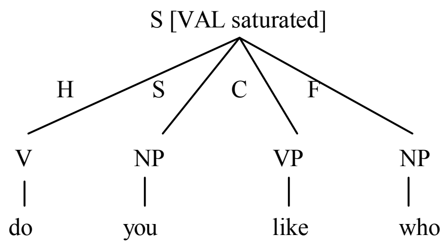
As illustrated in the GAP principle, the GAP values of all the daughters must add up to be the GAP value of the mother. The GAP value identifies the missing elements. Then, the GAP values disappear when they confront the missing elements in a sister. Such missing elements can appear in filler-daughter, but not in specifier-daughter and subject-daughter. Let’s call the specifier, subject and complement-daughters “valency-daughters”. In HPSG, filler-daughter is defined as containing some dependents of the lexical head that are not realized as valency-daughters, that is missing elements. Thus, filler-daughter comes to be located on the outside of the valency-daughters. As explained in the type declaration in section 2, filler-daughter combines with the head-daughter that has a saturated COMPS list. This means that the head-daughter combining with filler-daughter should be S or VP. However, this type declaration cannot guarantee that filler appears outside of specifier-daughter.

Thus, we need the Filler Principle.[7] This Filler Principle is stated in (22) below.

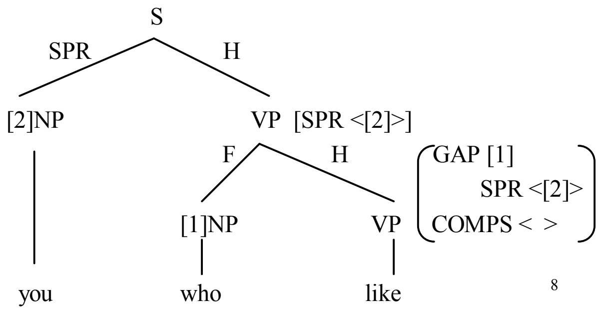
(22) Filler Principle
Filler is located outside of the valency-daughters.

Now, the Filler Principle explains, together with the declaration of head-filler type, what can be a well-formed candidate for *wh*-constructions. For instance, (23) will never be generated by Gen.

(23) a.



b.



[8]

(23) a is not a well-formed candidate because the phrase combining with filler does not have a saturated COMPS list. That is, (23) a does not conform to the type declaration for head-filler construction. (23)b is not a well-formed candidate either because it violates the Filler Principle.

Although Gen can restrict the possible structures for candidates, its role is very restricted in that Gen generates all possible surface expressions as candidates. For instance, Gap Principle and Filler Principle restrict the structures of the possible

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[7] Whether a daughter is Filler or not is determined by theory internal apparatus. Thus, any daughter that appears midst valency daughters will not be defined as Filler daughter. In other words, Gen will never create any candidate that has a Filler daughter midst valency daughters. Thus, Filler Principle should be a role of Gen.

[8] (25) a and (b) are not generated in Gen. However, the candidates that has the same word order and surface form are possible as shown in candidate 5 and 6 in (29).

candidates. However, they cannot determine if a candidate should have filler or not. filler-daughter can occur in *wh*-construction, when the *wh*-fronting takes place. According to Bresnan (1997), the fronting of *wh*-element is caused by the alignment of the discourse function DF.

(24) a. What will they read?
b. They will read what?

Bresnan argues that a difference in Input content underlies the grammaticality of both *in situ* (24)b and fronted (24)a *wh*-questions. The evidence of the difference can be shown in (25), where a class of intensifiers is possible only with a fronted *wh*-element.

(25) a. Who the hell/ on earth/ in the world / in God's name is he talking about?
b. He is talking about who (*the hell / *on earth / *in the world / *in God's name)?
(Bresnan, 1997)

Thus, Bresnan concludes that some attribute of the clause is associated with fronted *wh*-questions, but not with the *in situ* type. The attribute is assumed to be syntacticized discourse function DF. Likewise, I will assume that the Input of (24)a is different from the Input of (24)b. I will call the fronted *wh*-element "prominent *wh*-element". However, instead of stipulating any syntacticized function, a constraint that constrains VALENCE feature explains the *wh*-fronting in OT syntax based on HPSG. (26) states the relevant constraint.

(26) WH Constraint (WH)
Prominent *wh*-elements are not listed in VALENCE feature.[9]

WH in (26) forces an optimal candidate not to specify any prominent *wh*-element in the head's VALENCE list. That means the missing elements are encoded in the GAP feature.

According to the GAP Principle, the GAP feature is inherited to the mother node until it is bound off. The GAP feature can be bound off when it meets the filler in a sister position. Thus, we need a constraint that blocks the occurrence of the unbounded GAP feature.

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[9] Instead of (26), we can suggest more general rule containing other long distance dependencies such as topicalization. For example, we can propose that prominent elements (TOP, wh, ..) should not be listed in VALENCE feature.

(27) Filler Constraint (FC) [10]
Every GAP feature should be bound off.

In English WH and FC dominate QC and SC in that WH and FC will never be violated in an optimal candidate.

To see how our OT syntax works for *wh*-question, let's check English *wh*-question "who do you like?" (28) explains the process.

(28) a. INUT: question, like (x,y) GFx: 2[nd] person sing, GFy: Y (who)
b. Candidates:
1. [$_{\text{FILLER}}$ [1]who] [$_{\text{HD}}$ GAP <[1]> [$_{\text{SPR}}$ you] [$_{\text{HD}}$ like]]
2. [$_{\text{FILLER}}$ [1]who] [$_{\text{HD}}$ GAP <[1]> [$_{\text{HD}}$ do] [$_{\text{SUB}}$ you] [$_{\text{COMPS}}$ like]]
3. [$_{\text{FILLER}}$ [1]who] [$_{\text{HD}}$ GAP <[1]> [$_{\text{SUB}}$ you] [$_{\text{HD}}$ do] [$_{\text{COMPS}}$ like]]
4. [$_{\text{FILLER}}$ [1]who] [$_{\text{HD}}$ GAP <[1]> [$_{\text{HD}}$ like] [$_{\text{SPR}}$ you]]
5. [$_{\text{HD}}$ GAP <[1]> [$_{\text{HD}}$ do] [$_{\text{SUB}}$ you] [$_{\text{COMP}}$ like]] [$_{\text{FILLER}}$ [1] who]
6. [$_{\text{SPR}}$ you] [$_{\text{HD}}$ [$_{\text{COMPS}}$ who] [$_{\text{HD}}$ like]]
7. [$_{\text{FILLER}}$ [2]who] [$_{\text{HD}}$ GAP<[1]> [$_{\text{HD}}$ do] [$_{\text{SUB}}$ you] [$_{\text{COMPS}}$ like]]

c. Tableau

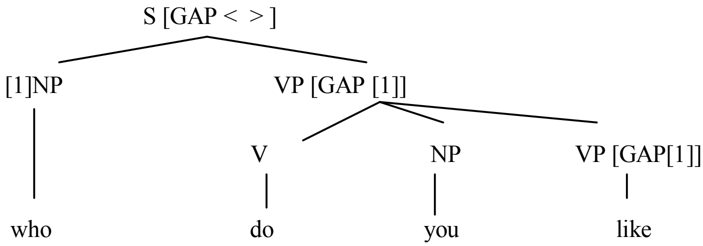
Can	FC	WH	HPC	QC	SC	ALI-L-SPR (filler)	ALI-L-HD	ALI-R-COM
1				*			**!	
2 →					*		*	
3					*		**!	
4				*		*!	*	
5					*	*!		
6		*!		*			**	*
7	*!				*		*	

(28)a approximately shows the Input of the *wh*-question. With respect to the Input, Gen generates various candidates as shown in (28)b. Among the candidates, 6 and 7 will not be the optimal one because they violate the top ranked constraints: FC and WH. Candidate 5 cannot be the optimal one either because filler is located in the sentence final position. To rule out the sentence final filler, we need additional word

[10] Although the name of FC hints that Filler daughter bound off the GAP feature, it is not necessary, because GAP feature can also be in a different way, e.g., tough-construction (Pollard & Sag, 1994).

order constraint: ALIGN-L-filler. We can obtain the aim by locating the ALIGN-L-filler on the same rank as ALI-S-SPR. Among the other candidates, only 2 shows inversion construction. Thus, 2 becomes the optimal candidate. The candidate 2 can be illustrated as tree structure below in (29)

(29)

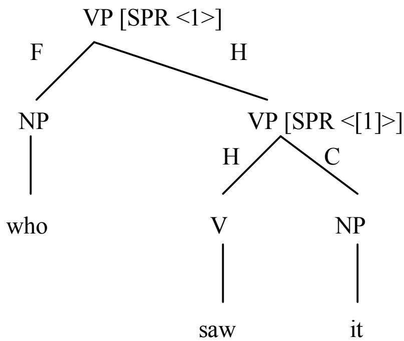


In contrast with the wh-construction in (29), wh-subject constructions such as (30) do not require do-insertion or inversion.

(30) a. who saw it?
b. *Who did see it?

To see why wh-subject construction do not need any inversion process, let's see the possible candidate (31).

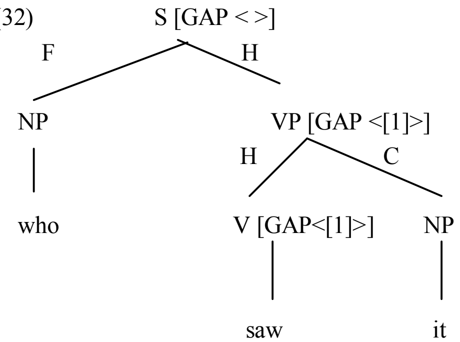
(31)



In (31) VP combing with filler is not saturated. In our OT theory, such a structure as (31) is a possible candidate to draw (30)a because the construction type in (1) declares that the head-daughter in head-filler phrase has a saturated COMP list, but not a saturated VALENCE list.[11]

Now look at (32), which competes with (31) to be an optimal candidate.

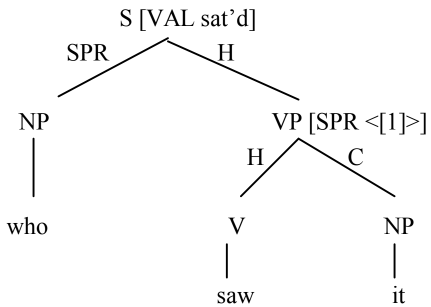
(32)



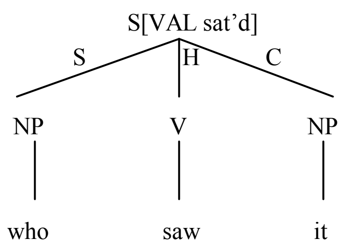
In (32), subject is missed in the valence feature. Therefore, GAP feature encodes the missing subject and the head verb inherits the GAP feature to its mother VP.

Other possible candidates would be (33) and (34).

(33)



(34)



[11] To block (35), we may need one additional constraint to prohibit a main sentence from being an unsaturated VP, although here I will not discuss that.

Now we can draw the resulting tableau for this wh-subject question by using the OT syntax based on HPSG.

(35) Tableau: *Wh*-Subject Question

Can	FC	WH	HPC	QC	SC	ALI-L-SPR (filler)	ALI-L-HD	ALI-R-COM
(31)		*		*			*	
(32) ➔							*	
(33)		*		*			*	
(34)		*	*		*		*	

The candidate (32) violate only ALIGN-Left-Head. Although (32) doesn't specify its subject in the SPR list, no subject appears in the VALENCE feature; (32) vacuously satisfies SC. Also, (32) does not violate HPC because it is not a head-subject-complement phrase. Thus, (32) becomes the optimal candidate as we expected.

Although I have explained the so-called wh-subject construction without any additional constraint, so far it was not explained why (30) b is bad. According to Grimshaw (1997) and Bresnan (1998), Input does not contribute any semantic information to the appearance of auxiliary *do*. In our grammar, there should be a faithfulness constraint that ensures the parsing of the auxiliaries to output candidate. I will call the constraint Parse-Aux.

(36) Parse-Aux.
Parse modality, voice, aspect to auxiliary verb.[12]

The faithfulness constraint Parse-Aux dominates the HPC. Also this constraints dominates a new constraint that blocks the appearance of the auxiliary verb.

(37) * AUX: no auxiliary
Now we can explain why (30) b is bad as shown by the tableau in (38).

[12] Which elements can be realized as auxiliaries will differ in each language. Also, this issue will require more complex sets of conditions. Here, I will just assume that there is a faithfulness constraint such as Parse-Aux.

(38) Tableau

	Parse-Aux	*AUX
[[$_{\text{FILLER}}$ who] [$_{\text{HD}}$ [$_{\text{HD}}$ saw] [$_{\text{COMP}}$ it]]] ➔		
[[$_{\text{FILLER}}$ who] [$_{\text{HD}}$ [$_{\text{HD}}$ did] [$_{\text{COMP}}$ [$_{\text{HD}}$ see] [$_{\text{COMP}}$ it]]]		*

This constraint ranking also explains how our OT syntax blocks the ungrammatical sentences in (39).

(39) a. Who will you like?
b. * Who you like?
c. * who will you will like?

(40) Tableau

Candidates	Parse aux	*AUX
who will you like? ➔		*
who you like?	*	
who will you will like?		**

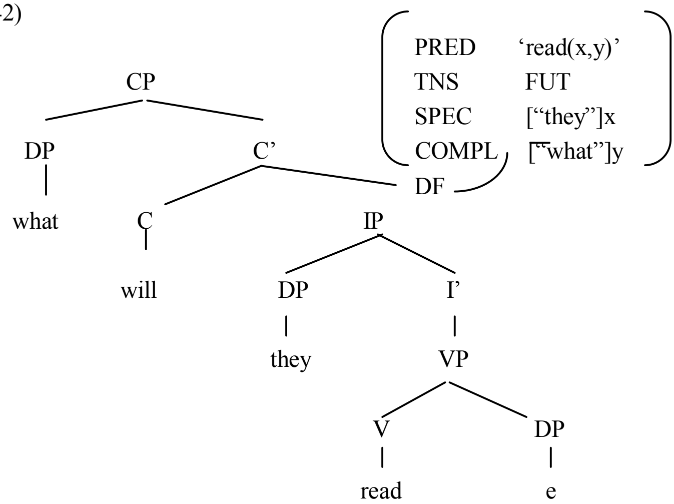
As shown in the Tableau, each occurrence of the auxiliary verb incurs the violation of *AUX. However, because Parse-Aux dominates *AUX, the auxiliary such as *can, will, have, be* and so on should occur in the optimal output candidate. In contrast with other auxiliaries, *do* is not affected by Prase-Aux because its information is not specified in Input. Every occurrence of *do* incurs the violation of *AUX. However, HPC requires that *do*-insertion is obligatory in some question sentences as shown in (18) and (29). This problem will be resolved by a ranking where HPC dominates *AUX. Now, the ranking that is consistent with all of these dominance relations can be shown in (41).

(41) FC, WH, Parse-Aux >> HPC, SC, QC >> ALI-L-SPR, ALI-L-Filler
>> ALI-L-HD >> ALI-R-COM >> * AUX

3.4 Bresnan (1997) and Subordinate Wh-Construction

Bresnan treats inversion as a byproduct of the *wh*-constituent fronting or DF alignment through her OB-HD constraint as illustrated in (42).

(42)



(Bresnan (1997))

The functional structure in (42) is the Input information. As shown in the Input information, the syntacticized discourse function DF is associated with the *wh*-constituent. Because DF is aligned with the specifier of FP such as CP or IP, *wh*-constituents appear in CP Spec. Then, the empty heads of the FP's should be filled by some functional category such as auxiliaries to avoid violating OB-HD.[13]

However, this account is not likely to explain the subordinate *wh*-construction.

(43) I don't know what you mean?

As shown in the subordinate clause in (43), subordinate *wh*-constructions do not undergo inversion. In Bresnan's approach, fronted *wh*-elements mean that DF's are associated with the *wh*-elements. Because the *wh*-elements appear in CP Specs, the heads of CP's become empty. In her approach, OB-HD will cause inversion even in subordinate clause. Thus, she might need an additional apparatus to block such problems.

She will also confront the same problem for the topicalization construction.

(44) Syntax, I like.

(44) is a topicalized construction. In the same way as the *wh*-fronting,

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[13] The OB-HD that Bresnan suggests is based on her definition about extended head. See Bresnan (1997).

topicalization is an instance of long distance dependency. Then, she may have to explain topicalization in the same manner as *wh*-fronting. That is, DF will be aligned with topic and be placed in the Spec of FP. Thus, in her approach, topic construction should also undergo inversion.

This problem occurs because Bresnan considers the inversion to be triggered by the tree structure. That is, inversion occurs to occupy the empty lexical head position. However, in our OT syntax based on HPSG, inversions are triggered by the interactions of clause types and word order constraints. For determining the construction type, semantic information such as question and declaration play a role. Thus, we can explain why no inversion occurs in the subordinate *wh*-construction and topicalization without any additional constraints or stipulations.

One important fact about the subordinate *wh*-construction is that the head of the clause is not classified as a question clause. This means that QC does not influence the subordinate clauses. Thus, if a candidate for the subordinate clause has the head-subject-complement phrase type, the candidate will always incur the violation of SC. However, if the candidate has the head-specifier phrase type, the candidate will violate neither QC nor SC. This is why (45) a is good whereas (45) b is bad.

(45) a. I don't know what you mean.
b. * I don't know what do you mean.

In (45)a semantic MODE value of the matrix sentence will be declarative and the MODE value of the subordinate clause will be proposition. However, even if the matrix sentence is question, the MODE value of the subordinate clause will still be proposition. This means that question cannot be the MODE value for subordinate clauses. Now (46) shows how the optimal candidate such as (45) a can be drawn.

(46) *wh* fronting in subordinate clause
a, Candidates
1) [$_{\text{FILLER}}$ what] [$_{\text{HD}}$ [$_{\text{HD}}$ do] [$_{\text{SUB}}$ you] [$_{\text{COM}}$ mean]
2) [$_{\text{SPR}}$ You] [$_{\text{HD}}$ [$_{\text{HD}}$ mean] [$_{\text{COM}}$ what]
3) [$_{\text{SUB}}$ You] [$_{\text{HD}}$ mean] [$_{\text{COM}}$ what]
4) [$_{\text{HD}}$ Do] [$_{\text{SUB}}$ you] [$_{\text{COMP}}$ [$_{\text{HD}}$ mean] [$_{\text{COM}}$ what]]
5) [$_{\text{FILLER}}$ What] [$_{\text{HD}}$ [$_{\text{SPR}}$ you] [$_{\text{HD}}$ mean]]

b. Tableau

Can	Filler	WH	HPC	QC	SC	ALI-L-SPR (filler)	ALI-L-HD	ALI-R-COM
1					*		*	
2		*						
3		*						
4		*						
5=>							*	

To explain why inversion does not occur in the subordinate *wh*-construction, five candidates are assumed in (46)a. Because WH works regardless of the MODE value of the clause, candidate 2, 3 and 4 will be ruled out. Candidate 1 violates SC because subject is not realized as a specifier-daughter. Candidate 5 violates neither QC nor SC. Because subordinate clause cannot have question as its MODE value, 5 satisfies QC vacuously. Therefore, the optimal candidate is 5.

To sum up, Bresnan's account does not explain why subordinate clauses do not undergo inversion. She will need additional constraints to block the inversion in subordinate clause. However, in my approach, without additional constraints, non-inversion of subordinate clauses can be explained. This is possible because inversion does not depend on the position of syntactic tree for the syntacticized discourse function or operator. In this feature structure based OT syntax, the constraints of feature structure and the competition of values for feature structure explain the optimal candidates. Thus inversion is explained by the interaction of construction type and word order constraints.

4. Conclusion

In the proposed OT syntax, we have seen that a wide range of data can be explained by ranked universal, violable constraints. Contrary to the Grimshaw's (1997) constraints, the OT syntax based on HPSG does not appeal to any theory internal mechanism of movement. The Gen in my approach does not provide any language specific syntactic processes. The Gen should generate all possible candidates. For instance, Gen should generate every possible word order regarding Input. However, the Gen in my approach generates the candidates with strong restrictions. The construction type is one of the restrictions. There are a limited number of construction types in our syntax. When Gen generates candidates, the Gen provides the candidates only with the possible construction types. If a candidate belongs to a construction type, then the candidate obeys the declaration for the construction type. When Gen generates these candidates with various construction types, word orders, and so on, our universal and violable constraints evaluate the candidates. HPSG consists of attribute and value system with respect to various linguistic categories. In the OT syntax, each constraint restricts the attribute and value system. For instance, QC and SC restrict the VALENCE feature. Through applying this OT framework to HPSG syntax, we can obtain the generalization that accounts for the language types and the explanatory tool that explicitly shows how each constraint interacts.

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