The Superiority Violation for Multiple Wh-Interrogatives in the Optimality Theory Framework on the Synthetic Constraints

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Hwang, Yoonah. 2007. The Superiority Violation for Multiple Wh-Interrogatives in the Optimality Theory Framework on the Synthetic Constraints. *SNU Working Papers in English Linguistics and Language 6*, 122-140. In English multiple wh-interrogatives are particularly blocked as they violates the superiority condition (e.g., *What has seen who?) and remain an active issue of debate. There have been various analysis on the superiority violation (hereafter, SUV). For instance, Kuno and Robinson (1972) initially identified multiple wh-interrogatives. They used the syntactic approach on analysing SUV of wh-interrogatives. The higher wh- should c-command the lower wh-. (e.g., *What will who buy?) Next, the triple wh-, which first appeared on Chomsky (1973), results a problem according to the syntactic approach (e.g., John wonders what who say when.). Additionally, Pesetsky (1984) develops the D(discourse)-linking and the non-D-linking as the semantic approach to illustrate triple wh-interrogatives (e.g., What did which woman buy?). Futhermore, Dayal (2005) studied multiple wh-interrogatives as the phonological approach (e.g., Has who seem what?). Despite a lot of discussion have been done, previous papers are not sufficient for describing SUV. The upshot of this study is to investigate how well multiple wh-interrogatives as one of syntactic phenomenon can be controlled by an integrative alternative, the synthetic approach which utilize syntactic (e.g., Q-free, *Q-cross), semantic (e.g, *New), and phonological constraints (e.g., Rhythm) in OT framework and to refer rhythm patterns.

Keywords: superiority, wh-interrogatives, syntatic, semantic, phonological, optimality

1. Linguistic approaches

1.1 The syntactic approach

1.1.1 The definition of superiority violation (SUV) and syntactic analysis of Kuno and Robinson (1972) and Chomsky (1976)

Kuno and Robinson (1972) defined the SUV as that it is more ungrammatical that only the lower wh-element moves than that the higher wh-element does. (e.g., *What will who buy?) Yet, some triple wh-elements are acceptable though they violate the Superiority Condition. (e.g., What did who buy where?) In addition, Chomsky (1976) referred the Superiority Condition as that the S-structure trace of the phrase in COMP must c-command the S-structure position of the WH-in-situ if a WH phrase is in COMP and another is in situ in the multiple wh-interrogative. Moreover, relating to the multiple wh-interrogative, Chomsky illustrated the Nested Dependency Condition as the wh-trace must include the other wh- when two wh-trace dependencies overlap.

However, the problem is that the syntactic theory cannot explain the acceptability of the SUV which is violating what-who sequence. Thus, we will have a necessity to give the comprehensive description for the exceptional English SUV.

1.2 The phonological approaches

1.2.1 The syntactic constraints in OT of Dayal, V. (2005)

Dayal (2005) described the SUV in the syntactic aspect in the optimal theory (Hereafter, OT). In German, the SUV is not similar to that of English. In some sentences, the who-what sequence is grammatical. In other sentences, the who-what sequence is ungrammatical. The first instance is (1).

Dayal (2005) described the SUV in German.

(1) a. Who has seen what?
    b. *What has seen who?
    c. *Who what has seen?
    d. *Has who seen what?

	Q-Marking	STAY	Q-Scope
☞¹)a.[Who$_i$ [t$_i$ has seen what]]?		******²)	*
b.[What$_i$ [t$_i$ has seen who]]?		*******|³)	*
c.[Who$_j$ what$_i$ [t$_i$ has seen t$_j$]]?		********|****	
d. [Has who$_i$ [t$_i$ seen what]]?	*!	***	**

(2) a. Q-Marking: requiring a wh in Spec CP
    b. STAY   : prohibition against movement
    c. Q-Scope : requiring all wh expressions to front
                        (Ackema and Neeleman 1998, Dayal 2005)

He used three constraints; Q-Marking, STAY, and Q-Scope. The meaning of the constraint is defined above. He put Q-Marking in the highest hierarchy, STAY in the second, and Q-Scope in the last respectively. In (1), the candidate d violates the most crucial Q-Marking. All candidates do not follow STAY despite the violation of candidate c is fatal. Both a and b candidate violate both STAY and Q-Scope. The mere difference between the former a and the latter b is that the candidate a has one more asterisk (*).

Here, we explain the problem of Dayal's theory. The one more asterisk could not be the crucial thing. The small difference could not say that the candidate b is not grammatical. Specifically, he did not suggest the essential solution for English SUV. Thus, in this paper, we will describe the exceptional English SUV instances.

1.3 The semantic approaches

1.3.1 The semantic analysis of Pesetskey (1984)

Pesetsky (1982) introduced the semantic D(iscorse)-linking and non-D-linking conception to us. He mentioned "Which-phrases are discourse-linked, while who or what are non-D-linking. In a single which-question such as 'which book did you read', the bound of answers is in 'a set of books'. In a multiple which-question like which man read which book, both speaker and hearer know a set of men and a set of books, and that the D-linked man-book pairs in a answer will be drawn from the sets in the discourse. Wh-phrases like who, what, or how many books are non-D-linked. In how many angels fit on the head of a pin,

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1) "☞" describes the optimal candidate.

2) One "*" means that the candidate does not follow one constraint. The more "*" refers that the candidate is more unacceptable.

3) "!" refers the fatal violation on the constraint.

neither speakers nor hearers have a particular set of angels in mind.

Non-D-linked wh-phrases are quantifiers and are adjoined to S'. D-linked wh-phrases are not quantifiers. D-linked wh-phrases escape the Nested Dependency Condition and fail to exhibit Superiority effects.

All the wh-phrases have the extremely heavy stress. Wh must be moved at the lexical form if it is non-D-linked. D-linked wh need not to be moved.

We suggest that the Pesetsky's semantic analysis cannot illustrate why 'the Which-NP Which-NP sequence' is grammatical though that has SUV. We still need more exact analysis for the SUV.

2. Our SUV analysis for multiple wh- interrogatives in OT framework using the synthetic constraints; the syntactic, the phonological, the semantic, and the processing constraints

The superiority violation is quite tough to be explained only by the syntactic account. Additionally, there exist the gradable acceptabilities in the SUV. Thus, to grip with this gradable acceptability of the exceptional SUV, We will analyze all superiority-violating multiple wh-questions in the OT framework.

According to the Dayal's analysis, we start to study the SUV for the multiple wh- interrogatives again. We will use some constraints. Also, we will show some hierarchy of the constraints that deal English superiority-violating multiple wh-questions like Q-Marking>>*New, Rhythm, *Q-Cross>> STAY>> Q-Scope. Especially, we will analyze the problematic sentence according to others. The tableau of OT analysis will show the reason of the superiority acceptability and grammaticality differences.

The advantages of the synthetic constraints, that are applied to the optimality analysis, are that we could describe, not only the general superiority violation, but also the exceptional superiority violation generally. Any linguistic phenomena cannot be illustrated just by the single syntactic or just by the one semantic reason. Moreover, the ultimate goals of the language use are for the effectiveness, that is resulted by the easiness of pronunciation, the fastness of understanding, and the most acceptable form to speakers and listeners.

The previous study said that the choice of which wh-expression is fronted in a multiple wh-question is sensitive to the status of the argument. A subject is chosen over the object for the fronting. An adjunct is preferred over the object. This is the 'Superiority'.

However, this is always applied well, specifically in complex wh-questions as more than three wh-questions or as wh-NP questions. Thus, we need to find some other reasons to explain the SUV, especially the exceptions of the SUV.

2.1 Two Wh-interrogatives

We start the synthetic analysis or the SUV in the simplest form among multiple wh-interrogatives.

The below (3) is about the order of who and what. (3a) has who and what in the original places. The wh-s is not moved. Who precedes what. Who c-commands what and it follow the SUV. Thus, (3a) is acceptable although it could be less acceptable the one wh- interrogative. In (3b), the direct object what precedes the subject who. In the second sentence, who cannot c-command what. Thus, (3b) violates the SUV and it is ungrammatical. These sentences are often addressed as the representative ones which are related to the SUV. In the next tableau, these three constraints are used.

(3) a. Who saw what?
    b. ?*What did who see? (Kuno and Robinson 1972)
    (Q-Marking >> STAY >> Q-Scope)

	Q-Marking	STAY	Q-Scope
☞a. [Who$_i$ [t$_i$ saw what]]?		*	*
b. [What$_i$ did who$_j$ [t$_j$ see t$_i$]]?		*|*****	*

Here, Dayal's analysis can comprehensively explain this English grammaticality of SUV. Chomsky can also give us a description to this. Thus, in this instance, we cannot judge whether the phonological approach is better than the syntactic approach or not. The candidate

a is optimal because the candidate b has a fatal violation in STAY. Therefore, a is more acceptable than b. The hierarchy of these three constraints is Q-Marking, STAY, and Q-Scope in order. Dayal's analysis that is applied to German gives us the general explanations for English multiple wh- interrogatives for the exceptional SUV.

Next is the SUV where How and What coexist. In (4a), the adverbial how precedes the direct object what that is grammatical. In (4b), the direct object what precedes the adverb how that is unacceptable. We will consider this in the OT framework here. Their analysis is affected by Q-Marking, STAY, and Q-Scope.

(4) a. How did Bill read what?
    b. *What did Bill read how? (Veneota 2005)
    (Q-Marking >>STAY >>Q-Scope)

	Q-Marking	Q-Free	STAY	Q-Scope
☞a. [How$_i$ did [Bill read what t$_i$]]?	.		****!*	*
b. [What$_i$ did [Bill read t$_i$ how]]?		*!	****	*

(5) Q-Free: The adverbial wh- is freer to move from the original position than the argument wh- as the SUBJ or the OBJ. The movement of the adverbial wh- cannot affect the c-command phenomena while the movement of the argument can hinder that the higher one cannot c-command the lower one.

(4a) is the optimal candidate because (4b) is excluded by the fatal violation of the Q-Free constraint that is higher than the STAY constraint which is violated by the (4a). Thus, we can choose the (4a) is more acceptable than (4b) because the violation of the higher constraint is worse than that of the lower constraint.

There are also the superiority violation in What and Where combination. In (6), we can apply another syntactic constraint plus the Dayal's three syntactic constraints. In next instances, in the spec position, if the only one what exists and the other wh- 'where' is in the original position, it is grammatical. However, in a spec place, 'the direct object what-auxiliary will-locative adverb where sequence' can not be acceptable.

(6) a. What will they put where?
    b. *What will where they put? (Grimshaw 1997)
    (Q-Marking >> *Q-Cross>>STAY >> Q-Scope)

	Q-Marking	*Q-Cross	STAY	Q-Scope
☞a. [What₁ t₁ will [they put where]]?			*	*
b. [What₁ will where₁ [they put t₁ t₁]]?		*!	●|●●●●●●●●●●	

(7) *Q-Cross: Nested Dependency Condition (NDC) - If two Wh-trace dependencies overlap, one must contain the other. The two wh-traces for the movement must not be crossed each other in the multiple wh- interrogatives.

The (6a) is selected as the optimal one because (6b) do not follow *Q-Cross and STAY. Also, in English interrogatives, if the first spec position is occupied, we disfavor another wh-movement to spec position. It blocks the processing. *Q-Cross is one of the syntactic constraints. The trace of wh- should not be crossed to be a grammatical sentence.

Below (8) is about the order of 'How and Where' and that of 'Who and where'. In (8a), how is moved to the spec while where is not moved in the original position. In (8b), the locative adverb where is moved to the front yet how is not moved from the original place. In (8c), the subject who and the adverb where are not moved. In multiple wh-questions, English dislikes the wh-movement, especially the distant movement, because of the processing difficulty.

(8) a. *How did John go where?
    b. *Where did John go how?
    c. Who went where? (Dayal 2005)
    (Q-Marking >> STAY >> Q-Scope)

	Q-Marking	STAY	Q-Scope
a. [How₁ did [John go where t₁]]?		●●●●!	●
b. [Where₁ did [John go t₁ how]]?		●●●●!	●
☞c. [Who₁ [t₁ went where]]?		*	*

In (8), the candidate a and b violate the second ranked STAY constraint.

Thus, the candidate c is optimal. There is no difference between the movement of the locative wh- where and the movement of the manner adverb wh- how. Further, the movement of subject who is better than the movement of adverb wh-. Dayal's analysis is so wonderful to cover to the English multiple wh- interrogatives that violate the SUV.

Next (9) is the position of Who and What in embedded sentences. The candidate c is firstly excluded because it violate *Q-Cross constraint. Next, (9a) and (9c) are not the optimal one because they violate STAY and *Q-Cross respectively. That the wh-word stays in the original position makes the processing time shorter. Thus, (9b) is optimal for the processing.

(9) a. ?What do you wonder who bought?
    b. You wonder who bought what.
    c. *Who do you wonder what bought.
    (Q-Marking >> *Q-Cross >> STAY >> Q-Scope)

	Q-Marking	*Q-Cross	STAY	Q-Scope
a. [What$_j$ do you wonder who$_i$ [t$_i$ bought t$_j$]]			••••••••!	•
☞b. You wonder [who$_i$ [t$_i$ bought what]]			•	•
c. [Who$_i$ do you wonder [what$_j$ [t$_i$ bought t$_j$]]]		*!	••••••••	

Moreover, we can also notice why '*[How$_j$ did [they ask you [who$_i$ [t$_i$ behaved t$_j$]]]]?' is ungrammatical. This sentence is ungrammatical because 'the adjunct how' precedes subject who. According to the syntactic constraint, it violates the superiority condition. Also, it is bad that how and who moves from their original position. Especially, this instance seriously violates the STAY constraint by getting nine asterisks (*).

2.2 Three Wh-interrogatives

Now we will study three wh-interrogatives which are more complicated than two wh-interrogatives. (10) is the position of Who, What, and Whom. Here '*Adjunct Island' is firstly used. The candidates (10a) and (10b) are optimal ones. Again, Dayal's analysis can be applied to three

wh- interrogatives.

(10) a. Who gave what to whom?
    b. What did who give to whom?
    c. ?Who did who give what to? (Pesetsky 2000)
(Q-Marking >>STAY >> Q-Scope)

	Q-Marking	STAY	Q-Scope
☞ a. [Who$_i$ [t$_i$ gave what to whom]]?		*	**
☞ b. [What$_j$ did who$_i$ [t$_i$ give t$_j$ to whom]]?		******	**
c. [Who$_j$ did who$_i$ [t$_i$ give what to t$_j$]]?		********!	**

This is the adequate order of Who, What and Where in embedded sentences. (10c) violates STAY. Thus, (10a) and (10b) are grammatical while (10c) is not acceptable. We have no question about the grammaticality of (10a) because it has no movement of wh- and the higher who c-commands what and whom. The interesting thing is that (11b) is acceptable but (10c) is sometimes acceptable or sometimes unacceptable. In both (10b) and (10c), the lower argument what and whom precede the higher who respectively. In (10b), what is the direct object. In (10c), whom is the prepositional object. In other words, what is the object of the verb 'give'. Whom is the NP that is the object of the preposition 'to'. Whom in (10c) is one more lower than the what in (10b). Thus, in (10c), the subject who can not c-command whom. In (10b), the subject who can c-command what. In (10c), because the far lower element whom is fronted before the higher who, we can not accept (10c) all the time.

Next, we will study the place of who, what, and wherein an embedded indirect interrogative. (11a) have who and what in the subject and the direct object place that is acceptable. In (11b), the direct object what is fronted to the spec of the embedded clause that is ungrammatical. In (11c), there is replaced by where, unlikely with (11b) that can be accepted or cannot be accepted.

(11) a. I'd like to know who hid what there.
    b. *I'd like to know what who hid there.
    c. ?I'd like to know what who hid where. (Clifton 2006)

(Q-Marking >> Rhythm>>STAY >> Q-Scope)

	Q-Marking	Rhythm	STAY	Q-Scope
☞a. I'd like to know [who₁ [t₁ hid what there]].			*	*
b. I'd like to know [whatⱼ who₁ [t₁ hid tⱼ there].		*!	*****	
c. I'd like to know [whatⱼ who₁ [t₁ hid tⱼ where]].			*|****	

(12) Rhythm: Preference for the common English rhythm rule; the
alternation of Strong and Weak after the stress clash is transferred
rightward. That is, the prohibition for the falling intonation or
the rising intonation for the easiness of pronunciation in English.

This is the position of Who, Where and What in embedded sentences.
Syntactically (11b) and (11c) violate the superiority condition because
they have what-who sequence, while (11a) does not. In (11b-c), both
what and who are moved form the original position. Also, (11b-c) have
two wh- in one spec position that can result the phonological difficulty
and the longer answering time as the processing problem. Besides, we
can check the optimality of (11a) because of the respective Rhythm and
STAY violations of (11b) and (11c) in the above (11) tableau.

In the next section, we will study for the bare wh- as who and wh-NP
as which people. There are some interesting differences in the same
syntactic structure.

In comma- wh sequences, despite the triple-wh form was less preferred
to the two wh-form. The triple form with a comma improves the
acceptability of SUV more than no-comma forms. (e.g., What can who
do about it, when?)

Adding a separate question (", and") does improve their acceptability.
Here again, comma (,) can make the SUV far more acceptable. (e.g., I'd
like to know where who hid it, and when.)

Additionally, there are two SUVs which are violating examples.
However, (13b) is grammatical while (13a) is not. Their difference is that
there are only two wh- in (13a) and there are three wh- in (13b).

(13)   a. *John wonders what who say then.
        b. John wonders what who say when.

We can use this to show the rhythm pattern much clearly. We suppose that wh-words have the strong stress and the other words have the weak stress here. That is, the interrogative what, who, and when has strong stress (hereafter, S) while the verb say and the adverb then except the interrogative is weak stress (hereafter, W). After the stress is transferred rightward, there are some changes of rhythms. In a, SSWW is changed to SMMW that has the falling intonation. In b, SSWS is replaced to SMMS that has the falling initial and rising final intonation.

(14)   a. what who say then
        S S W W   →   S M M W
        * *   *
        * *   * * *
        * * * *   * * * *
        (stress clash)   (falling)

      b. what who say when
        S S W S   →   S M M S
        * *   *   *   *
        * *   *   * * * *
        * * * *   * * * *
        (stress clash)   (falling and rising)

In (14), (14a) and (14b) violate the SUV according to the syntactic theory. Thus, we syntactically can not judge which one is better. However, in the phonological aspect, we can show that (14b) is more acceptable than (14a). Roca and Johnson (1999) defined that "the rhythm rule is that the favorite rhythm of English involves an alternation between stressed and unstressed syllables." According to them, the stress clash is described as that "there are adjacent stressed elements. To maintain rhythm, we should prevent the stress clash. English strongly resist the stress clash."

Even though both (14a) and (14b) have the stress clash of what-who sequence at first, later the stress is moved to the right. Thus, the stress clash is disappeared and the rhythm is changed differently as falling in 3a and the combined falling and rising in (14b). The falling intonation from S to W is worse for the easiness for pronunciation and English Rhythm Rule than falling and rising intonation from S - Middle stress

(hereafter, M) – W in (14b).

The rhythm rule, that SMMW that has the falling intonations worse than SMMS that has the rhythmical alternation of the falling and rising intonation, cannot illustrate that 'Which-NP Which-NP sequence' is more acceptable than 'What-Who-When sequence.' We will refer why these phenomenon happen. This approach is attractive but we need to study specifically for English SUV exceptions.

2.3 Bare *Wh-* and *Wh-*NP

This time, in (15), we will compare the usages of the bare wh- and wh-NP. This is What, Who and Which-NP related to SUV. In these examples, we firstly use the *New constraint. All of the above candidates violate the superiority condition. However, (15c) is better than (15a) and (15b) because (15c) has old information which makes the answering and reading time for the multiple wh-interrogatives shorter.

(15)   a. *What did who buy?
       b. *What did which woman buy?
       c. Which type of book does which type of man buy?
          (Comorovski 1996)
       (Q-Marking >>*New>>STAY >> Q-Scope)

	Q-Marking	*New	STAY	Q-Scope
a. [What$_j$ did who$_i$ [t$_i$ buy t$_j$]?		**!	******	
b. [What$_j$ did [which woman]$_i$ [t$_i$ buy t$_j$]?		*!	******	
☞c. [[Which type of book]$_j$ does [which type of man]$_i$ [t$_i$ buy t$_j$]]?			******	

(16) *New: prohibition for the new information which has the specificity. What is the New Information while Which-NP is not the New Information.

This is the Which-NP, What-NP, How many-NP in situ. (15c) is more acceptable when it is compared to (15a-b) that fatally violate the higher ranked *New, though (15a-c) all violate STAY. Here, the semantic

constraint, *New, is used to analyze (15). In the fronted object position, which type of book is more grammatical than what because what has the new meaning. The brand new meaning hinders the natural interaction. In the subject position, which type of man is better than which woman that is more acceptable who. The bare wh-, Who, has the new meaning more than wh-NP, which woman and which type of man. Therefore, (15c) is selected to the optimal candidate.

In (17a), how-NP and whom are not moved and that sentence is grammatical. In (17b), the argument whom precedes how-NP that is ungrammatical. We will show this in the OT framework.

(17)   a. I need to know how many peoplei ti voted for whom.
　　　b. *I need to know who(m)j how many people voted for tj.
　　　(Pesetsky 1987)
　　　(Q-Marking>> Rhythm>>STAY>> Q-Scope)

	Q-Marking	Rhythm	STAY	Q-Scope
☞a. [I need to know [[how many people]ᵢ [tᵢ voted for whom]]].			*	
b. [I need to know [who(m)ⱼ [how many people]ᵢ [tᵢ voted for tⱼ]]].		*!		

The stress marking of (17) is like below. Strong has three asterisks (*), Middle has two asterisks, and Weak has one asterisk for the convenience.

(18) a. [how many] [people] [voted for] whom
　　　　　S　　　　W　　　W　　　　S
　　　　　*　　　　　　　　　　　　　*
　　　　　*　　　　　　　　　　　　　*
　　　　　*　　　　*　　　　*　　　　*

　　　(Rhythmical, phonologically good)
　　　(falling and rising intonation)

　　b. who(m) [how many people] [voted for]
　　　　　S　　　　S　　　W　　　M　　　　S M M M
　　　　　*　　　　*　　　　　　　　　　　　　　　*
　　　　　*　　　　*　　　　　　　*　　→　*　*　*　*
　　　　　*　　　　*　　　　*　　　*　　　*　*　*　*

(stress clash)	(stress transferred)
(phonologically bad)	(falling intonation)
	(phonologically still bad)

Syntactically, the second candidate b is also bad according to the SUV. In addition, phonologically, the candidate a is optimal because the rhythm of (17a) is more natural than that of (17b). In (17a), there is not the stress clash while, in (17b), there is surely the stress clash between who(m) and how. The two strongly stressed wh- are adjoined in (17b). That is not good for the Rhythm. After the stress is transferred to the right, the rhythm is just falling from strong to middle stress. The rhythm is unnatural and still bad. Thus, (17b) is not optimal candidate.

The below is another example. In (19a), which-NP is moved across two CPs while, in (19b), which-NP is moved across three CPs. However, only (19a) is unacceptable.

(19) a. *Which book does John know where Mary bought t?
    b. Which book is such that John knows where Mary bought it?
       (Levin and Hukari 2006)
    (Q-Marking>>*Q-Cross>>STAY>> Q-Scope)

	Q-Marking	*Q-Cross	STAY	Q-Scope
a. [[Which book], does [cpJohn know [where, [cpMary bought t, t,]]]]?		•	••••••|•••••••	
☞ b. [[Which book]; [cp t, is such [cpthat [John knows [where; [cpMary bought it t,]]]]?		•	•••••	

This is 'Which-NP and Which of NP' and 'Where and Who' in embedded sentence. In (19b), which-NP is leftward moved to eight positions while, in (19b), where is done to eleven positions. Thus, (19a) can be excluded from the optimal candidate due to the fatal violation for STAY.

In (20), the direct object precedes the subject in the embedded sentence. That is the SUV because the higher subject cannot c-command the lower object. Here, Rhythm and *New constraint have the same level in the whole constraint hierarchy. Thus, we mark that as the dotted line between Rhythm and *New.

(20)   a. You need to work out which hotels which of our clients

we're going to assign.
b. *You need to work out where who to assign to.
(Levin and Hukari 2006)
(Q-Marking>>*New, Rhythm>>STAY>> Q-Scope)

	Q-Marking	*New	Rhythm	STAY	Q-Scope
☞a. [You need to work out [[which hotels]ⱼ [which of our clients]ᵢ [we're going to assign tᵢ tⱼ]]].				•••••••••••|••••	
b. [You need to work out [whereⱼ whoᵢ [to assign to tᵢ tⱼ]]]		**!	•|	••••••••••	

(21) a. which hotel   which [of our clients]
```
     S    W    S        W
     *         *
     *         *
     *    *    *        *
```

(the alternation of falling and rising)
(the natural intonation)

b. where who [to assign to]
```
     S    S      W              S  M  M
     *    *                      *
     *    *                →     *  *  *
     *    *      *                *  *  *
```
(Stress clash)   (stress transfer)
(difficult pronunciation)   (falling intonation,
                                   rhythmically bad)

This is the comparative of 'What, Who' and 'Which-NP, Which of NP' in embedded sentences. (20a) is optimal because it violates the lower ranked syntactic constraint STAY while (20b) does the higher ranked phonological Rhythm and the semantic *New at the same time. The higher ranked phonological and semantic constraints can refer that the syntactic approach is the more comprehensive one to show the SUV. Moreover, in the phonological analysis, Which-NP and Which-NP is better than What-Who. In What-Who sequence, there is a stress clash while, in Which-NP and Which-NP, there is not the stress clash. After incurring the stress transfer, the intonation of Which-NP and Which-NP is better than What-Who sequence. Which-NP and Which-NP sequence

has the rhythmical alternation of falling and rising. This is good for English rhythm. Yet, the What-Who sequence has the falling intonation that is not good in English rhythm.

Next (22) is similar to the example (20). (22a) and (22b) have the same structure that violates the SUV. However, only (22a) is ungrammatical.

(22)   a. *I wonder what who read over the summer.
        b. I wonder which books which of our students read over.
        (Chomsky 1973)
        (Q-Marking>>*New, Rhythm>> STAY>> Q-Scope)

	Q-Marking	*New	Rhythm	STAY	Q-Scope
a. [I wonder [what; who; [t; read over t; the summer]]].		**!	*!	******	
☞b. [I wonder [[which books]j [which of our students]i [t; read over t;]]].				*******!	

This is Which-NP as Verbal accusatives, How vs Which-NP in Prepositional Objects vs Which-NP in that-clause, How. (22b) is optimal because (22a) is bad in three ways as the semantic *New, the phonological Rhythm, and the syntactic STAY.

Last, (23) is included of three sentences. (23a-c) has the same syntactic structure except the structure of to-infinitive. (23a) has a single verb after to. (23b) has verb and prepositional phrase after to. (23c) has the verb and the antecedent that are modified by that-clause. Among (23a-c), only (23c) is unacceptable. Here again, Dayal's analysis gives us a good solution to describe these complicated instances.

(23)   a. Which problems did you wonder how to solve?
        b. Which problems did you wonder how to go about solving?
        c. ??Which problems did you wonder how to persuade Robin
           that she could solve? (Levin and Hukari 2006)
        (Q-Marking>>STAY>> Q-Scope)

	Q-Marking	STAY	Q-Scope
☞a. [[Which problems]j did [cp you wonder [how [vp to solve t;]]]]?		*******	
☞b. [[Which problems]j did [cp you wonder [how [vp to go about [solving t;]]]]]?		*********	
c. ??[[Which problems]jdid [cp you wonder [how [vp to persuade Robin [cp that [she could solve t;]]]]]?		************!	

In (23), we can notice that the SUV is not only the pure syntactic phenomena but also the synthetic phenomena that are mingled with the pronunciation, the meaning, the grammar, and the reaction of the reader and the hearer.

From now on, we study the OT analysis for multiple wh-interrogatives. We used the new constraints as *New, *Q-Cross, and Rhythm. *New is for the semantic approach. *Q-Cross is for the syntactic approach. Rhythm is for the phonological approach. The SUV cannot be solved only by the syntactic approach. Thus, we need the other approaches but the syntactic approach to describe the SUV more exactly.

Dayal's three constraints are surely helpful to illustrate the untypical SUV instances. His main three constraints are Q-Marking, STAY, and Q-Scope. Those constraints can show us many SUV phenomena. Still, there remain some problems which can be solved by our new constraints. Their whole hierarchy is Q-Marking>>*New, *Q-Cross, Rhythm >> STAY >> Q-Scope. Our new constraints are posited between Q-Marking and STAY. Among our new constraints, there is not any hierarchy, that is, they are in the same level. Besides, the SUV can be shown clearly in the OT framework. In sum, the SUV should be explained by the syntactic approach which is mingled by the syntactic, the semantic, and the phonological analysis.

3. Conclusion

We do not deny the previous studies. Rather, we accept the advantages as well as the disadvantages. Also, we apply some semantic and phonological constraints between Q-Scope and STAY in the OT frame work. This can be one example of the syntactic approach to solve the complicated linguistic problems.

The triple wh-interrogatives that violate the superiority constraint were the problem in the syntactic approach. The multiple which-NP interrogatives that violate the superiority constraint were not fully described in the phonological, the semantic, and the processing approach respectively. Therefore, these complicated SUV for multiple wh-construction should be shown in the elastic approach. we strongly suggest that the synthetic approach would illustrate the whole picture of the SUV.

The constraint ranking on the SUV is like this: (Q-Marking>>*New, Rhythm, Q-Free, *Q-Cross>> STAY>> Q-Scope). This ranking tells us that some syntactic rules like Q-Marking is more crucial than not only the semantic (e.g., *New) but also the phonological (e.g., Rhythm). Other syntactic rules like Q-Free or *Q-Cross have similar to the nonsyntactic aspects. Other syntactic rules as STAY or Q-Scope are lower than the nonsyntactic aspects. Depending solely on the syntactic explanation, we cannot illustrate the SUV. Thus, we propose the syntactic approach to reveal the SUV.

In the current paper, there are still other unsolved problems especially in bare-NP and wh-NP. In the future, we will research the SUV on the syntactic, the phonological, the semantic, the pragmatic and the processing approach at the same time to describe bare-NP and wh-NP as well as other SUVs much more clearly.

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