

# Some Notes on the Syntax and Semantics of Functional *Wh*-Constituents

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## 1. Introduction

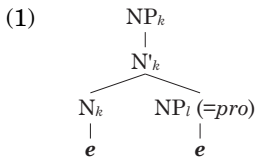
Chierchia (1993) has made a pivotal work on the syntacto-semantic analysis of the scopal interpretation of a *wh*-interrogative sentence with a quantifier, and the basics of his approach have now been widely accepted in the literature. As has been pointed out by not a few researchers, however, several theoretical and empirical problems are alleged to remain in Chierchia's (1993) theorization/explanation. In this paper, we will aim at solving major technical/empirical problems inherent in it through establishing a more stable theory for the syntax of functional *wh*-phrases and the semantics of their LF interpretation.

Indeed, Chierchia's (1993) theory of functional *wh*-interrogatives has succeeded in solving core problems immanent in the mystery concerning the *wh*/quantifier interaction: it enables us to predict the existence/absence of the functional interpretation of a *wh*-constituent in a given sentence. Owing to the space limitation, however, we will omit introducing Chierchia's (1993) theory, referring the reader to Ura (2013) and references cited therein for an in-depth review of Chierchia (1993) and discussion on its pros and cons.

## 2. Problems in Chierchia (1993)

### 2.1. Theoretical Problems

Chierchia (1993) has proposed that the trace left by the movement of a functional *wh*-constituent has the structure depicted as in (1) below:



(Chierchia 1993: 197)

In this structure remains a syntactically serious problem, however: it is not at all clear what is the thematic/selectional relation between the head  $N_k$  and the empty category  $NP_i (=pro)$ , which is assumed under Chierchia's (1993) theory to be bound/controlled by the c-commanding nominal phrase to be related with the  $NP_k$  by a Skolem function, which describes a relation from individuals to individuals. In order to admit (1) as the syntactically proper structure of a functional *wh*-trace, we have to assume that a nominal head ( $=N_k$  in (1)) can (optionally) select an (empty) argument ( $=NP_i$  in (1)) that has a functional relation with that head (a Skolem function). But it seems highly implausible that there is a thematic/selectional relation between  $N_k$  and  $NP_i$  in (1). Notice that it is a common stipulation in syntax that there should always be a thematic/selectional relation between a lexical head and the NP that is selected and base-generated within the projection of that head. Syntactically, this is the biggest problem of Chierchia's (1993) theory.

Moreover, it is quite unclear in the structure of (1) where the functional interpretation between  $N_k$  and  $NP_i$  comes from. Since noun phrases do not always denote Skolem functions, there must be something responsible for their interpretation when they denote a Skolem function. This is Chierchia's (1993) biggest problem in the semantic facet.

In addition to the abovementioned problems, all of which are technical/theoretical ones, we will overview the empirical problems of Chierchia's (1993) theory in the next subsection.

## 2.2. Empirical Problems

As pointed out in Sloan (1990) and Aoun and Li (1993) among others, *wh*-phrases do not always interact with quantified NPs in giving rise to pair-list readings. When *wh*-phrases undergo long-distant movement, they interact with quantified NPs in the same clause but not with those in a higher clause.

- (2) Which book<sub>*k*</sub> do you say [everyone should read *t<sub>k</sub>* for Chomsky's class]? (<sup>OK</sup>functional; <sup>OK</sup>pair-list)
- (3) a. Which book<sub>*k*</sub> does everyone say [*t<sub>k</sub>* should be read for Chomsky's class]? (<sup>OK</sup>functional; \*pair-list)
- b. Which book<sub>*k*</sub> does everyone say [you should read *t<sub>k</sub>* for Chomsky's class]? (<sup>OK</sup>functional; \*pair-list)

Chierchia (1993) discusses examples like (2) and argues that *Absorption* takes place at LF between the embedded quantified subject and the intermediate trace of the *wh*-phrase, and that the entire phrase moves to the Spec of the matrix CP. Under Chierchia's (1993) theory of *wh*/quantifier-interaction, *Absorption* is prerequisite to the pair-list reading. Now, given the availability of the pair-list reading in (2), it is not at all clear why *Absorption* cannot take place between (a trace of) the moved *wh*-phrase and the quantified NP in (3a, b).

The same disparagement at Chierchia's (1993) analysis of the lack of the pair-list reading also applies to the following examples, in which a weak island is involved.

- (4) Negative islands (Schein 1993: 361):
  - a. [Which friends of yours]<sub>*k*</sub> do you think [everyone invited *t<sub>k</sub>*]? (<sup>OK</sup>functional; <sup>OK</sup>pair-list)
  - b. [Which friends of yours]<sub>*k*</sub> does no one think [everyone invited *t<sub>k</sub>*]? (<sup>OK</sup>functional; \*pair-list)
- (5) *Wh*-islands (Lasnik & Saito 1992; Frampton 1999):

- a. Which book<sub>*t*</sub> do you say that everyone read *t<sub>t</sub>*?  
(<sup>OK</sup>functional; <sup>OK</sup>pair-list)
  - b. Which book<sub>*t*</sub> do you wonder whether everyone read *t<sub>t</sub>*?  
(<sup>OK</sup>functional; \*pair-list)
- (6) Factive-islands (Ura 2003):
- a. Which book<sub>*t*</sub> do you believe that everyone read *t<sub>t</sub>*?  
(<sup>OK</sup>functional; <sup>OK</sup>pair-list)
  - b. Which book<sub>*t*</sub> do you regret that everyone read *t<sub>t</sub>*?  
(<sup>OK</sup>functional; \*pair-list)

In these examples, we find the systematic lack of the pair-list reading in the environments involving a weak island where the functional reading<sup>1</sup> is indeed obtained (see Yoshida 1993 for much discussion on this point).

Because Chierchia's (1993) theory has no device to explain why a weak island blocks *Absorption*, these examples, too, pose another empirical problem to Chierchia (1993).

### 2.3. Summary

To sum up this section, we argued that Chierchia's (1993) theory of the *wh*/quantifier interaction has some theoretically technical problems and fails to capture some empirical facts concerning the existence/absence of the pair-list reading in some *wh*-interrogative sentences with quantifiers. In the next section, we will therefore propose a new theory of *wh*-interrogatives with quantifiers on both syntactic and semantic grounds,

## 3. New Proposals

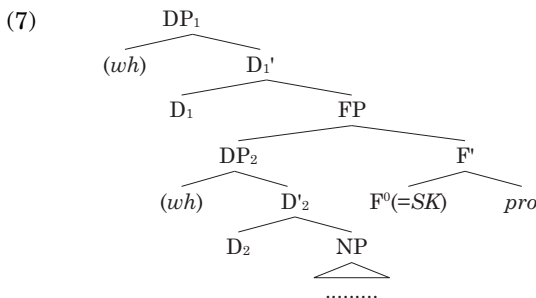
### 3.1. Syntactic Bases

Now, following the basic idea of Ura (2013), we hypothesize that there

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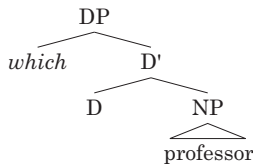
<sup>1</sup> Cresti (1995), incidentally, reports that there are some people who are apt not to accept the functional reading within a weak-island context. We will leave it to future research to explore this dialectal variation.

exists a (functional) category within a functional *wh*-constituent when the whole DP as a *wh*-phrase denotes a (Skolem) function, as illustrated in (7):

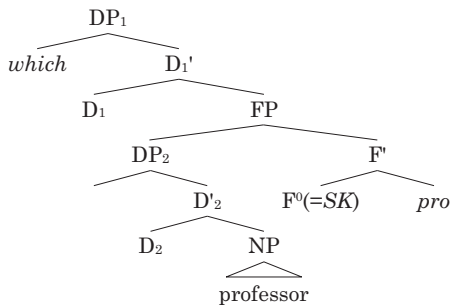
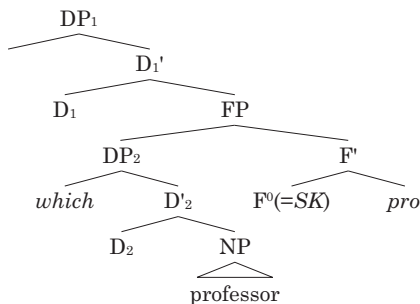


Here, we propose to hypothesize that the whole phrase of a functional *wh*-constituent ( $DP_1$  in (7)) is headed by a determiner, which selects, as its complement, a functional phrase (FP) whose head is responsible for the interpretation of a Skolem function ( $F^0 = SK$ ), and FP selects *pro* in its complement and another DP ( $DP_2$ ) in its specifier. As will be clarified later in this section, a head responsible for the Skolem function (i.e., *SK* in (7)) acts interpretationally as a functor mapping from individuals to individuals; accordingly, it is natural on syntactic grounds that it has a selectional relation with *pro* and  $DP_2$ , which are functionally related with each other by *SK*. Furthermore, following Chomsky (1986) and Abney (1987), we assume that a *wh*-operator appears at the specifier of a determiner phrase. Therefore, it is possible to posit two positions for a *wh*-operator within a functional *wh*-constituent: as illustrated in (7) above; namely, a *wh*-operator may appear either at the Spec of  $DP_1$  or at the Spec of  $DP_2$ .

As a concrete example, let us observe the structure of the phrase *which professor* under our hypothesis. When it is construed as having no functional interpretation, its structure is straightforwardly illustrated as in (8) below:

(8) **non-functional structure for *which professor***

When *which professor* is construed as having a functional interpretation, its structure is illustrated as in (9) below:

(9) **functional structure for *which professor*****TYPE I****TYPE II**

The structurally sole difference between TYPE I and TYPE II in (9) lies in the base-position of the *wh*-operator. This structural difference between TYPE I and TYPE II yields a large difference in syntactic derivation, however: In TYPE I, a *wh*-operator, quantifying over Skolem functions, is generated at the Spec of DP<sub>1</sub> (= the whole *wh*-constituent);

consequently, when *wh*-movement is evoked,  $DP_1$  is to move by way of pied-piping owing to the *wh*-operator at its Spec. In TYPE II, a *wh*-operator, quantifying over individuals, is generated at the Spec of  $DP_2$ ; consequently, when *wh*-movement is evoked,  $DP_2$  is to move by way of pied-piping owing to the *wh*-operator at its Spec. Let us assume that the whole  $DP_1$  undergoes *wh*-movement when TYPE I is involved (i.e., when functions are interrogated) and  $DP_2$  undergoes *wh*-movement when TYPE II is involved (i.e., when individuals are interrogated). Then, it comes as no surprise to find some syntactically different behaviors between TYPE I and TYPE II, because the entity that moves differs in each case. More specifically, it is predicted, given Rizzi's (1990) and Cinque's (1990) locality theory of syntactic movement, that TYPE I can move across weak islands but TYPE II cannot. This is because the *wh*-constituent that actually moves in TYPE I corresponds to  $DP_1$ , which can be assigned a referential index in the sense of Rizzi (1990, 1991) if the predicate that selects it is appropriate for assigning a referential index, whereas the *wh*-constituent that actually moves in TYPE II corresponds to  $DP_2$ , which can never be assigned a referential index owing to the semantic nature of the selecting head (i.e., *SK*); for, the head *SK* never participates interpretationally in any event activity, which is assumed, under Rizzi's (1991) hypothesis, to be responsible for assigning a referential index.

Under our theory of functional *wh*-constituents proposed herein, the individual reading for a *wh*-constituent emerges only when the *wh*-constituent has no *SK*; that is, it corresponds to (8) above, and the functional reading for a *wh*-constituent emerges only when the *wh*-constituent has *SK* within it; that is, it corresponds to (9) above. Now let us follow Chierchia (1993) as to the following assumptions: (I) the pair-list reading of questions with quantifiers emerges only when the *wh*-traces involved are interpreted as a function; and (II) the pair-list reading is available only when the *wh*-constituent undergoes *Absorption* (in the sense of Higginbotham & May 1981) with another quantifier.

Under our theory of functional *wh*-constituents, the assumption (I) leads us to the conclusion that the pair-list reading emerges only when the *wh*-constituent includes *SK* within it; that is, it corresponds either to TYPE I or to TYPE II in (9) above. Given the semantic restriction of *Absorption* (May 1989 and Barss 2000), which requires that two operators to which *Absorption* applies must be of the same semantic type, the TYPE I *wh*-constituent cannot undergo *Absorption* with quantifiers like *every* or *some*, because the former quantifies over functions but the latter quantifies over individuals. It is important to note that the TYPE II *wh*-constituent can undergo *Absorption* with the latter type of quantifiers because it also quantifies over individuals. Thus, it follows from (II) that the pair-list reading of questions with quantifiers is available only when the TYPE II *wh*-constituent in (9) is involved.

### 3.2. Semantic Bases

Before presenting our proposal on the interpretation of functional *wh*-constituents, let us give some preliminary assumptions regarding the syntax and semantics of questions. We assume that question sentences denote sets of propositions (Hamblin 1973, Karttunen 1977) and that question denotations are introduced by the covert *Q* morpheme located in *C* (Karttunen 1977). We follow Heim (2012) and assume that a covert propositional argument for *Q* is represented in the syntax and abstracted over at a higher point. When a *wh*-question is interpreted non-functionally (that is, the *wh*-constituent concerned has no *SK* within it), its LF is analyzed as follows:

(10) a. Which student does John admire?

b.  $\lambda p. [\text{CF which student}_{@} 1 [\text{C } Q(p) \lambda w [\text{VP John admire}_w t_1]]]$

World arguments are represented in the syntax as a bound variable or an indexical *@* referring to the actual world. The followings are



semantic denotations of the relevant parts in the LF above.

- (11) a.  $Q_{\dot{z}} = \lambda p \in D_{st}. \lambda q \in D_{st}. p = q$   
 b.  $which_{\dot{z}} = \lambda P \in D_{et}. \lambda Q \in D_{et}. \exists x \in D_e. [P(x) \ \& \ Q(x)]$   
 c.  $student_{@z} = \lambda x \in D_e. student_{@}(x)$

The LF above yields the characteristic function of the set of propositions below:

- (12)  $\{p: \exists x [student_{@}(x) \ \& \ p = \lambda w. admire_w(x)(john)]\}$

In the above LF representation in (10b), the restrictor of *which* is pied-piped and sits at the Spec of the matrix CP, and this LF directly feeds the semantic interpretation. There are, however, a number of examples showing that restrictor NPs are ‘reconstructed’ at LF into their base positions (see Chomsky 1995 for more discussion).

- (13) a. Which picture of himself<sub>i</sub> does John<sub>i</sub> like?  
 b.\*Which picture of John<sub>i</sub> does he<sub>i</sub> like?

Assuming that the Binding Conditions apply at LF, the (un)grammaticality of the above examples are explained under a reconstruction view of pied-piped NPs.

Under Chomsky’s (1995) copy theory of movement, such ‘reconstruction’ phenomena are reduced to the following operations of movement.

- (14) a. John does admire which student (Base)  
 b. Which student does John admire which student (Copy)  
 c. Which ~~student~~ does John admire ~~which~~ student (Delete)

The ‘LF’ in (14c) is not interpretable, as it does not contain any operator

-variable chain necessary for question interpretations. Fox (1999, 2000) proposes Trace Conversion rule to make such LFs interpretable. After the operation, (14c) is converted into the following LF:

- (15) Which  $x$  does John admire the boy  $x$

The interpretation obtained by this LF is roughly the following: Which is the  $x$ , such that John invited the boy  $x$ ? Heim (2012) goes on further to arguing that the following LF is what we need to yield this interpretation. The type-shifters **THE** and **IDENT** are inserted, whose semantics are given below:

- (16)  $\lambda p. [_{CP} \text{which } 1 [_{C'} Q(p) \lambda w [_{VP} \text{John admire}_w [\text{THE} [\text{student}_@ [\text{IDENT } x_1]]]]]$
- (17) a.  $\text{THE}_{\dot{y}} = \lambda P \in D_{et} : \exists ! x \in D_e. [P(x)]. \text{ } 1x[P(x)]$   
 b.  $\text{IDENT}_{\dot{y}} = \lambda x \in D_e. \lambda y \in D_e. x = y$

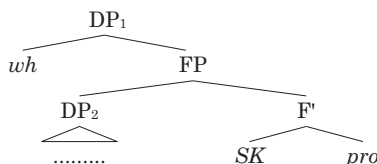
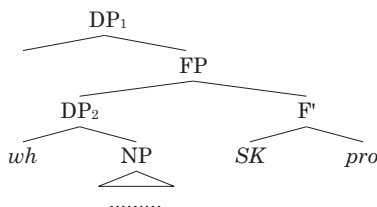
The restrictor NP *student@* and *[IDENT  $x_1$ ]* are combined via Predicate Modification, and the object NP denotes the following partial function:

- (18)  $[\text{THE} [\text{student}_@ [\text{IDENT } x_1]]]_{\dot{y}} = g(1)$  if  $g(1)$  is a student in the actual world; otherwise, undefined.

The entire LF yields the following denotation, which is equivalent to (12).

- (19)  $\{p : \exists x. p = \text{student}_@(x) \ \& \ \lambda w. \text{admire}_w(x)(\text{john})\}$

Now let us return to our new proposal for the syntactic structure for a functional *wh*-constituent, as introduced in the previous subsection:<sup>2</sup>

(20) a. **TYPE I**b. **TYPE II**

Both types of functional *wh*-constituents contain a functional projection FP which is headed by *SK* (for a Skolem function) and *SK* takes a null pronoun (= *pro*) in its complement and the restrictor ( $DP_2$ ) in its specifier. The only difference between the two is the placement of *wh*-quantifier, which is located in the Spec of the higher  $DP_1$  in Type I and in the Spec of the lower  $DP_2$  in Type II. This difference results in the difference in their surface structure after *wh*-movement takes place. In the case of Type I, the entire  $DP_1$  moves, which contains FP. In the case of Type II, on the other hand, only the lower  $DP_2$  moves, leaving FP in its base position.

We assume that functional *wh*-phrases behave similarly in terms of Copy and Delete in that they leave a copy when they move and the restrictor in the higher copy and the operator in the lower copy is deleted.

## (21) a. Which professor does every student admire?

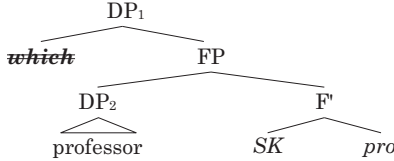
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<sup>2</sup> In (20), we omit irrelevant heads and intermediate projections if they make no semantic contributions.

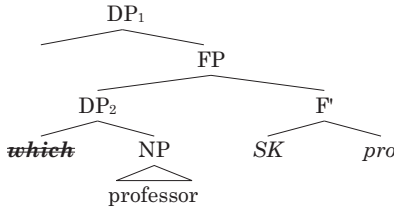
- b. Which ~~professor~~ does every student admire ~~which~~ professor

This means that both types of functional *wh*-constituents have the ‘same’ structure after ‘reconstruction’ at LF:

- (22) a. **TYPE I**



- b. **TYPE II**



After the insertion of the type-shifters, the entire LF looks like the following:

- (23)  $\lambda p. [_{CP} \text{which } 1 [_{C'} Q(p) \lambda w [_{VP} t_2 \text{admire}_w \text{admire}$   
 $[_{DP} \text{THE } [_{FP} [_{DP} \text{professor}_@ \text{IDENT } [_{F'} SK_1 \text{pro}_2]]]]]]]$

*SK* is bound by the abstractor created by *wh*-movement and *pro* is bound by the subject of the sentence.

We follow Heim (2012) in that *which* is an unrestricted existential quantifier over Skolem functions.

- (24)  $\text{which}_? = \lambda P \in D_{\langle ee, t \rangle}. \exists f \in D_{\langle e, e \rangle} [P(f)]$

Now we have all the semantic ingredients to compute the denotation of (22). The object denotes the following partial function and after computing presupposition triggered by the universally quantified subject, we get the set of propositions in (26)

$$(25) \text{ } [_{DP} \text{ THE } [_{FP} [_{DP} \text{ professor}_{@} \text{ IDENT } [_F \text{ SK}_1 \text{ pro}_2]]]] \dot{=}^{\neq} = g(1)(g(2)) \text{ if } g(2) \in \text{dom}(g(1)) \text{ and } g(1)(g(2)) \text{ is a professor in the actual world.}$$

Otherwise undefined.

$$(26) \text{ (21)} \dot{=} = \{p: \exists f [\forall x [\text{student}_{@}(x) \rightarrow x \in \text{dom}(f) \ \& \ \text{professor}_{@}(f(x))] \ \& \ p = \lambda w. \forall y [\text{student}_{@}(y) \rightarrow \text{admire}_w(f(y))(y)]]\}$$

The question in (21a) interpreted as in (26) asks for a particular Skolem function from students to professors such that all students invited the professor which the function maps him/her to. Both Type I and Type II *wh*-phrases yield the same interpretation, namely the one that admits answers like ‘his/her thesis supervisor’, when no other syntactic operation applies.

We argue, following Chierchia (1993), that when Type II *wh*-phrase is involved, it may undergo *Absorption* with the subject DP.<sup>3</sup>

$$(27) \lambda p. [_{CP} [[\text{which}][\text{every student}_{@}]] \text{ } 1 \text{ } [_C \text{ Q}(p) \lambda w \text{ } 2 \text{ } [_{VP} \text{ t}_2 \text{ admire}_w \text{ } [_{DP} \text{ THE } [_{FP} [_{DP} \text{ professor}_{@} \text{ IDENT } [_F \text{ SK}_1 \text{ pro}_2]]]]]]]$$

This yields the following set of propositions:

$$(28) \{p: \exists f [\text{dom}(f) = \{x: \text{student}_{@}(x)\} \ \& \ \text{professor}_{@}(f(x))] \ \& \ \exists x. \text{student}_{@}(x) \ \& \ p = \lambda w. \text{admire}_w(f(x))(x)\}$$

The question in (21a) interpreted as in (28) asks for a function *f* from

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<sup>3</sup> In the next section, we will observe the syntactic mechanism of *Absorption*.

students to professors and a student  $x$  such that  $x$  admires  $f(x)$ . Assuming that it is known that John and Bill are the relevant students, the question may be answered by giving a pair-list such as John invited Prof. Smith and Bill invited Prof. Johnson.

To sum up, we thus far successfully demonstrated that our theory of functional *wh*-constituents makes a correct prediction about the fact that (21a) is interpreted as (26) (i.e., functional reading) when *Absorption* does not take place, and (21a) is interpreted as (28) (i.e., pair-list reading) when the TYPE II functional *wh*-constituent is involved and it undergoes *Absorption*. Notice, here, that (21a) allows another reading; namely, individual reading (Sloan 1991 and Chierchia 1993). Under our theory, it is totally possible that the *wh*-constituent in (21a) (i.e., the whole DP, *which professor*) does not involve any functional head *SK* within it, as illustrated in (8) above. In this case, the non-functional *wh*-constituent in (21a) yields the individual reading, just in the same way as in (10) above.

## 4. Explanations

### 4.1. Technical Problems Resolved

It is noteworthy, here, that our newly proposed theory of functional *wh*-constituents is free from the technical/theoretical problems immanent in Chierchia's (1993) theory: each head/phrase within the structures of a functional *wh*-constituent (as illustrated in (9) above) is properly connected to the other by a selectional/thematic relation:  $D_1$  selects the maximal projection of the head for a Skolem function (i.e., *SK*), and a *wh*-operator is filled with the Spec of  $D$  (the Spec of  $D_1$  in TYPE I and the Spec of  $D_2$  in TYPE II); *SK* selects *pro* in its complement and  $DP_2$  in its specifier, both of which are interpretationally related with each other by *SK* as its domain and range. Therefore, the structurally strange assumptions abound in Chierchia's (1993) theory for a functional *wh*-constituent (as illustrated in (1)) have disappeared in our theory.

Moreover, as argued in the previous section, there exists a head responsible for the interpretation of functional *wh*-constituent (namely, *SK*) under our theory for the interpretation of functional *wh*-constituents. Thus, the compositionally unclear point found in Chierchia's (1993) theory of the interpretation for a functional *wh*-constituent can straightforwardly be resolved under our theory.

Now that we have demonstrated that our new theory is free from the major technical/theoretical problems of Chierchia (1993), let us go on to the issue as to how to solve Chierchia's (1993) empirical problems.

## 4.2. Empirical Data

To make our story concrete, let us consider how our hypothesis proposed above explains the classic case of the subject/object asymmetry concerning the *wh*/quantifier interaction, and then let us see how our theory can solve the empirical problems immanent in Chierchia's (1993) theory.

#### 4.2.1. Subject/Object Asymmetry

First of all, let us see how our proposals work in analyzing the issue about the subject/object asymmetry found in a *wh*-interrogative clause with a quantifier like *every*.

- (29) a.  $[_{CP} \text{ Which professor } t_k \text{ does } [_{IP} \text{ every student admire } t_{k,l}]]?$   
(<sup>OK</sup>functional; <sup>OK</sup>pair-list)  
 b.  $[_{CP} \text{ Which professor } t_k \text{ C}^0 [_{IP} t_k \text{ criticizes every student}]]?$   
(\*functional; \*pair-list)

In the previous subsection, we have indeed sketched out the semantic derivation of such an example as in (29a), but let us, here, observe its syntactic derivation in a careful way.

Now suppose that a functional *wh*-constituent is involved in (29a).<sup>4</sup>

<sup>4</sup> It is possible, of course, that the *wh*-constituent in (29a) has no functional projection FP within it: in such a case, the *wh*-operator simply

Then, the  $vP$ -level stage in the derivation for (29a) can be delineated either as in (30) (in the case where the  $wh$ -constituent corresponds to TYPE I in (9) above) or as in (31) (in the case where the  $wh$ -constituent is of TYPE II in (9)).

$$(30) \quad [{}_{vP} \text{ every student } v \quad [{}_{VP} V \quad [{}_{DP1} \text{ which } [{}_{FP} SK \quad [{}_{DP2} \text{ pro } [{}_{NP} \text{ professor}]]]]]] \quad \hookrightarrow \text{TYPE I}$$

$$(31) \quad [{}_{vP} \text{ every student } v \quad [{}_{VP} V \quad [{}_{DP1} [{}_{FP} [{}_{DP2} \text{ which } [{}_{NP} \text{ professor}]] SK \text{ pro}]]]] \quad \hookrightarrow \text{TYPE II}$$

Note that  $DP_1$ ,  $DP_2$ , and  $vP$  in (30) and (31) are strong phases in the sense of Chomsky (2001). In (30), the TYPE I  $wh$ -constituent (i.e.,  $DP_1$ ) has a motivation to move up to an edge of  $v$  owing to the edge<sub>5</sub>-feature of  $v$ , and this movement does not violate the PIC nor the DIC. Then, (32) is derived legitimately from (30).

$$(32) \quad [{}_{vP} \text{ which professor}_k \quad [{}_{vP} \text{ every student } v \quad [{}_{VP} V \text{ t}_k]]]$$

Notice that both the  $wh$ -constituent and the quantified NP (QNP), being located at the edge of the phase  $vP$ , are visible to syntactic operations to be executed at the next phase-level (i.e., CP).

The structure shown in (29a) is derived appropriately from (32) through moving the QNP to the Spec of IP due to the EPP of Infl and moving the  $wh$ -constituent to the Spec of CP due to the  $[+wh]$ -feature of C. Notice that both movements observe the PIC and the DIC. Since

interrogates the set of the individuals denoted by its complement NP, resulting in the simple individual reading of (29a).

<sup>5</sup> DIC (Defective Intervention Condition) prohibits a probe  $A$  from agreeing with  $C$  where there is a matching goal  $B$  intervening structurally between  $A$  and  $C$  and  $B$  is inactive due to a prior Agree with some other probe. PIC (Phase Impenetrability Condition) prohibits any syntactic movement of  $A$  out of a syntactic phase unless  $A$  is at the edge of a phase. See Chomsky (2001) for more discussion.



we follow Chierchia (1993) in assuming the nonexistence of QR at LF, the structure shown in (33) below corresponds to the LF representation of (29a).

- (33)  $[_{CP} [_{DP1} \text{which} [_{FP} SK [_{DP2} \text{pro}_j [_{NP} \text{professor}]]]]]_k \text{ does } [_{IP} \text{every student}_j [_{VP} \text{admire } t_k]]]$

As the final step, (33) is mapped, according to our semantic theory for *wh*-constituents introduced in the above subsection, to the logical representation shown in (34) below through the standard assumptions for LF interpretation:

- (34)  $\{p: \exists f [\forall x[\text{student}_e(x) \rightarrow x \in \text{dom}(f) \ \& \ \text{professor}_e(f(x))] \ \& \ p = \lambda w. \forall y[\text{student}_e(y) \rightarrow \text{admire}_e(f(y))(y)]]\}$

This denotes the set of propositions according to which there is a Skolem function *f* from students to professors such that for every *x*, if *x* is a student, *x* admires *f*(*x*).

- (35) Which Skolem function *f* mapping from students to professors is such that every student admires what *f* maps him/her to?

As expected, (35) corresponds exactly to the functional reading of (29a).

Now, suppose that the TYPE II functional *wh*-interpretation is involved in (29a). Then, the base structure for (29a) starts with (31), which is repeated as (36) below:

- (36)  $[_{VP} \text{every student } v [_{VP} \underline{V [_{DP1} [_{FP} [_{DP2} \text{which} [_{NP} \text{professor}]]] SK \text{pro}}]]]]]$   
 $\hookrightarrow \text{TYPE II}$

In (36), the phrase that is about to undergo *wh*-movement corresponds to  $DP_2$  and it starts at the Spec of FP; consequently, it has to move to

the Spec of  $DP_1$  before it moves out of  $DP_1$  to the Spec of the matrix CP. Because it is commonly assumed that the Spec of D can afford to accommodate a *wh*-movement (Chomsky 1986),  $DP_2$  can safely land at the Spec of  $DP_1$ , deriving (37) from (36):

- (37) [<sub>VP</sub> every student *v* [<sub>VP</sub> V [<sub>DP1</sub> [<sub>DP2</sub> which [<sub>NP</sub> professor]]]<sub>k</sub> [<sub>FP</sub> *t<sub>k</sub>* SK *pro*]]]]

Now that  $DP_2$  *which professor* in (37) is at the edge of  $DP_1$ , it is entitled to be moved out of  $DP_1$  upon the condition that such a movement must be invoked somehow to save the derivation from crash (i.e., Last Resort Condition), or it contributes to an interpretational difference (i.e., Interpretation-sensitive Economy à la Fox 2000). It should be noted that the edge-feature of *v* cannot motivate the movement of  $DP_2$  in the TYPE II functional *wh*-constituent out of  $DP_1$ , because the  $DP_1$ , being the object of the clause, would fail to have its Case evaluated by *v* if the edge-feature of *v* was checked by  $DP_2$  in the TYPE II functional *wh*-constituent. Unless  $DP_2$  in the TYPE II functional *wh*-constituent moves to the edge of *v*P, it cannot move to the Spec of the matrix CP, where it is to be interpreted properly as a *wh*-phrase.

Indeed, there is a way to give a legitimate motivation to the movement of  $DP_2$  in the TYPE II functional *wh*-constituent from the edge of  $DP_1$  to the edge of *v*P in (37). Fox (2000) persuasively argues, with ample empirical data, that the Economy Condition is fulfilled when an application of an operation results in an interpretation which is truth conditionally different from the interpretation without that application of the operation. Returning to the structure in (37), let us suppose that  $DP_2$  of the TYPE II functional *wh*-constituent moves to the edge of *v*P, resulting in the structure illustrated in (38).

- (38) [<sub>VP</sub> [<sub>DP2</sub> which [<sub>NP</sub> professor]]]<sub>k</sub> [<sub>VP</sub> every student<sub>j</sub> *v* [<sub>VP</sub> V [<sub>DP1</sub> *t<sub>k</sub>* [<sub>FP</sub> *t<sub>k</sub>* SK *pro<sub>j</sub>*]]]]]]

Then, what will happen in (38) afterwards? Notice that *Absorption* can be applicable, at no cost, to any two quantified phrases if they mutually m-command each other (see Higginbotham & May 1981). In (38),  $DP_2$  of the TYPE II functional *wh*-constituent, which is a *wh*-phrase, and the QNP mutually m-command each other. It is noteworthy that  $DP_2$  of the TYPE II functional *wh*-constituent is an interrogative quantifier over individuals, so that the application of *Absorption* to  $DP_2$  in the TYPE II functional *wh*-constituent and the QNP *every student* in (38), both of which denote individuals, fulfills May's (1989) S-Invariance Condition, which imposes upon an application of *Absorption* type parallelism between the two input operators and the output operator. Naturally, *Absorption* changes truth-conditional interpretation; accordingly,  $DP_2$  of the TYPE II functional *wh*-constituent is able to move to the edge of  $\nu P$ , thanks to Fox's (2000) Interpretation-sensitive Economy, upon the condition that it undergoes *Absorption* after its movement. Now the conclusion is that  $DP_2$  of the TYPE II functional *wh*-constituent in (37) can move to the edge of  $\nu P$ , deriving (38), if *Absorption* applies to it and the QNP.

In (38),  $DP_2$  as a *wh*-phrase is at the edge of  $\nu P$ , so that it can move to the Spec of CP without violating the PIC, deriving (39) from (38).<sup>6</sup>

$$(39) \quad [_{CP} [_{DP_2} \text{which } [_{NP} \text{professor}]]_k C^0 [_{IP} \text{every student}_{t_j} [_{\nu P} t''_k [_{\nu P} t_j \nu [_{VP} V [_{DP_1} t'_k [_{FP} t_k SK \text{pro}_j]]]]]]]$$

This represents the final LF representation for the case where the TYPE II functional *wh*-constituent is involved in (29a). From (39), the logical representation shown in (40) below can be derived.

$$(40) \quad \{p: \exists f [\text{dom}(f) = \{x: \text{student}_{\otimes}(x)\} \ \& \ \text{professor}_{\otimes}(f(x))]\ \& \ \exists x. \text{student}(x) \ \& \ p = \lambda w. \text{invite}_w(f(x))(x)\}$$

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<sup>6</sup> Here we assume that *Absorption* applies derivationally (Watanabe 2000).

To (40), *Absorption* is semantically applied as in the way explicated in (27) above, from which (41) below results, which represents a natural language translation of (40).

- (41) Which Skolem function  $f$  mapping from students to professors and which student  $x$  are such that  $x$  admires what  $f$  maps  $x$  to?

As expected, (41) corresponds exactly to the pair-list interpretation of (29a).

To recapitulate, we can correctly show, under our theory of functional *wh*-constituents, that (29a) has both the functional reading and the pair-list one.

Next, let us consider, under our theory of functional *wh*-constituents, why neither the functional reading nor the pair-list one is available in (29b), which is repeated here as (42):

- (42) [<sub>CP</sub> Which professor<sub>*k*</sub> C<sup>0</sup> [<sub>IP</sub> t<sub>*k*</sub> criticizes every student]]?  
 (\*functional; \*pair-list)

Suppose that a functional *wh*-constituent is involved in (42). Then, the *vP*-level stage of the derivation for (42) can be delineated either as in (43) (in the case where the *wh*-constituent corresponds to TYPE I) or as in (44) (in the case where the *wh*-constituent corresponds to TYPE II).

- (43) [<sub>vP</sub> [<sub>DP1</sub> which D<sup>0</sup> [<sub>FP</sub> SK [<sub>DP2</sub> pro [<sub>NP</sub> professor]]]] v [<sub>VP</sub> V every student]]  
 $\hookrightarrow$ TYPE I

- (44) [<sub>vP</sub> [<sub>DP1</sub> [<sub>FP</sub> [<sub>DP2</sub> which [<sub>NP</sub> professor]] SK pro]] v [<sub>VP</sub> V every student]]  
 $\hookrightarrow$ TYPE II

Because we assume, following Chierchia (1993), the nonexistence of QR at LF, the QNP *every student* at the object position never undergoes any

A-bar movement. Its  $\phi$ -features (including Case value) can be checked/evaluated in situ by *v* through *Agree*. Thus, the QNP *every student* cannot be located, in any stage throughout the derivation, at a position where it can c-command the Spec of *v*P, where the whole *wh*-constituent (i.e., DP<sub>i</sub>) is base-generated in (43) and (44). Now, recall that, under our theory of functional *wh*-constituents, *pro* is contained within the structure of a functional *wh*-constituent, regardless of whether the functional *wh*-constituent is of TYPE I or TYPE II, and it must receive an index from a c-commanding argument at some stage in the course of the derivation. Now that there is no stage where the QNP can c-command *pro* in (43) and (44), the functional *wh*-constituents in (43) and (44) cannot be construed properly, resulting in the lack of the functional/pair-list readings in (42) (= (29b)).

To sum up, we have illustrated, in this subsection, how our theory works in analyzing the classical subject/object asymmetry concerning the *wh*/quantifier interaction. In the subsection that follows it will be demonstrated how the empirical problems with Chierchia's (1993) theory can be explained with our theory.

#### 4.2.2. Blocking Effects by Weak Islands on Pair-list Reading

Now let us reconsider the abovementioned examples in (4), which Schein (1993) presents as a serious problem with Chierchia's (1993) theory of functional *wh*-interrogatives. According to Schein (1993: 361), functional answers are possible both in (4a) and in (4b), while the pair-list reading is possible only in (4a).

First, let us observe the syntactic behavior of weak islands. It is obvious from the ill-formedness of (45) below that *no one* induces a weak island.

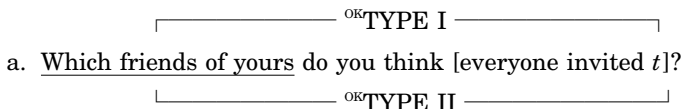
(45)\* How<sub>k</sub> does *no one* think [everyone fixed a car *t<sub>k</sub>*]?

(cf. <sup>OK</sup>How<sub>k</sub> do you think [everyone fixed a car *t<sub>k</sub>*]?)

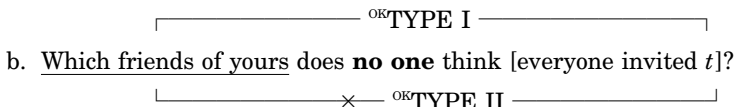
Recall that the element that undergoes *wh*-movement when the TYPE

II functional *wh*-constituent is involved (namely,  $DP_2$  in TYPE II of (9) above) has no referential index in the sense of Rizzi (1990, 1991), so that a weak island blocks the *wh*-movement of the *wh*-phrase for the TYPE II functional *wh*-constituent. Consequently, the interpretation that is produced when the TYPE II functional *wh*-constituent is involved (namely, the pair-list reading) is blocked by a weak island; whence, the lack of the pair-list reading of (4b) follows directly and correctly, because the weak island in (4b) blocks the movement of  $DP_2$  in the TYPE II *wh*-constituent (as illustrated in (47) below).

(46) (= (4a))



(47) (= (4b))



In contrast, the element that undergoes *wh*-movement when the TYPE I functional *wh*-constituent is involved (namely,  $DP_1$  in TYPE I of (9) above) has a referential index if it is in the object position of an eventive predicate (Rizzi 1991); accordingly, the *wh*-phrase in the TYPE I functional *wh*-constituent can move over weak islands (as illustrated in (47) above). Thus, the functional reading is available in (4b) despite the fact that the pair-list reading is not in (4b).

In §2.2. above, we also observed that other types of weak island block the pair-list reading of a *wh*-interrogative with quantifiers. The same reasoning as in the above enables us to make a correct prediction concerning the lack of the pair-list reading in the (b)-examples in (5) and (6), where the movement of  $DP_2$  in the TYPE II *wh*-constituent is

blocked, just in the same manner as in (4b) above.

#### 4.2.3. Matrix/Embedded Asymmetry

As pointed out also in §2.2., whereas the functional and the pair-list readings can be both available if the base-generated position of the functional *wh*-constituent and the QNP are within the same clause, the pair-list reading, but not the functional one, is blocked if the QNP is in a clause different from the clause containing the base-position of the functional *wh*-constituent. The contrast between (48) and (49) illustrates this fact.

- (48) Which book<sub>*t*</sub> do you say [everyone should read *t*<sub>*k*</sub> for Chomsky's class]?  
 (°<sup>OK</sup>functional; °<sup>OK</sup>pair-list)
- (49) a. Which book<sub>*t*</sub> does everyone say [*t*<sub>*k*</sub> should be read for Chomsky's class]?  
 (°<sup>OK</sup>functional; \*pair-list)
- b. Which book<sub>*t*</sub> does everyone say [you should read *t*<sub>*k*</sub> for Chomsky's class]?  
 (°<sup>OK</sup>functional; \*pair-list)

The problem with Chierchia's (1993) theory is that the nonexistence of the pair-list reading in (49a, b) is hard to explain with it (see Ura 2013 for extensive discussion).

First, let us consider (48). Our explanation of the availability of both the functional and the pair-list readings in (48) is easily inferred from the aforementioned explanation given to the availability of the two readings in (29a).

In order to explain the unavailability of the pair-list reading in (49 a, b), let us recall our discussion on the derivation from (36) to (41), where we considered the availability of the pair-list reading in (29a). The crucial step in the derivation is the one from (37) to (38). The movement of DP<sub>2</sub> in the TYPE II functional *wh*-constituent from the edge of DP<sub>1</sub> to the edge of *v*P derives (38) from (37). As was emphasized therein, this movement is permitted as a last resort operation by the

interpretation-sensitive economy of Fox (2000) only when *Absorption* applies to the moved  $DP_2$  of the TYPE II functional *wh*-constituent and the QNP in (38); for, the application of *Absorption*, contributing an interpretational effect, motivates the movement of  $DP_2$  in the TYPE II functional *wh*-constituent. To conclude, in order for  $DP_2$  in the TYPE II functional *wh*-constituent to move out of the whole  $DP_1$ , there must be a QNP at the edge of the next phase.

Returning to (49a, b), we can delineate (50a) for the embedded CP-level stage in the derivation of (49a) and (50b) for the embedded *v*P-level stage in the derivation of (49b).

- (50) a.  $[_{CP} \text{ that } [_{IP} [_{DP_1} [_{DP_2} \text{ which } [_{NP} \text{ professor}]]_k [_{FP} t_k \text{ SK pro}]] \text{ Infl VP}]]$   
 b.  $\dots [_{vP} \text{ you } v [_{VP} V [_{DP_1} [_{DP_2} \text{ which } [_{NP} \text{ professor}]]_k [_{FP} t_k \text{ SK pro}]]]]]$

In (50a, b), there is no way to motivate the movement of  $DP_2$  in the TYPE II functional *wh*-constituent to the edge of CP/*v*P, because there is no quantifier with the ability of *Absorption* there. Consequently, *Absorption* cannot be applicable even if  $DP_2$  in the TYPE II functional *wh*-constituent moves to the edge of CP/*v*P. Thus,  $DP_2$  in the TYPE II functional *wh*-constituent has no motivation for its movement to the edge of CP/*v*P; as a result, it cannot undergo *wh*-movement out of the whole  $DP_1$  in (50a, b) nor it cannot move to its final destination (i.e., the Spec of the matrix CP). Therefore, the derivation leads to crash if the TYPE II functional *wh*-constituent is involved in (49a, b); resulting in the lack of the pair-list reading in (49a, b) under our theory of functional *wh*-constituents.

As for the availability of the functional reading in (49a, b), it is also readily accounted for: In the case of the TYPE I functional *wh*-constituent, which leads to the functional reading, unless there exists an intervening strong island, it can undergo cyclic movement through each edge of the intermediate phases to its final destination, upon the condition that it is assigned a referential index at its base-position,



without violating the PIC or the Last Resort Condition/Economy Condition under Chomsky's (2001) theory of movement. Thus, the TYPE I functional *wh*-constituent as a whole can undergo *wh*-movement legitimately to the Spec of the matrix CP in (49a, b), deriving the well-formed LF representations for the interpretation of the functional reading.

## 5. Conclusion

In this paper we demonstrated that the elucidation of both the syntactically appropriate structure of a functional *wh*-constituents and its semantically proper treatment at LF can give a highly consistent solution to the theoretical/empirical defects of Chierchia's (1993) theory of *wh*/quantifier-interactions.

More specifically, we first pointed out some theoretical/empirical problems with Chierchia's (1993) analysis of *wh*/QNP interactions. Then, we proposed to hypothesize that "functional" and "pair-list" questions differ from each other in their syntactic structure of the relevant DP. Under our hypothesis, the *wh*-quantified DP in the functional reading syntactically and semantically behaves differently from the one in the pair-list reading: The latter, which always lacks a referential index, is sensitive to any island, while the former, if provided with a referential index, can escape from an island. We illustrated that these syntactic and semantic differences between the two readings afford a definitive clue to Chierchia's (1993) empirical shortcomings.

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