

Quantification and *wh*-in-situ in Mandarin Chinese: An Introduction*

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1. Introduction

Despite superficially observed distinctions, human languages share many common characteristics in a fundamental way, which is biologically and genetically determined. “Principles and Parameters” is a generative syntactic modal to capture this property of human language. Common characteristics shared by different languages are determined by principles which do not vary from one language to another; however, individual properties observed in a given language are determined by parameters. Thus, it is important to understand in what specific way an individual language is different from the others and this is a scientific way to conduct researches on language typology. This article aims to illustrate such a point with a concrete example based on quantification in formal linguistics. Readers interested in the generative syntax can refer to Haegemann (1994) and Ouhalla (1999) for a complete introduction to the Government and Binding Theory and the modal of Principles and Parameters. In this section, I only give a very brief presentation of the relevant terminology to be used in this article. Table 1 includes basic phrase types that I will use.¹

NP	Noun Phrase	<i>book, table</i>
DP	Determiner Phrase	<i>a book, the book, some book</i>
PP	Prepositional Phrase	<i>on the table</i>
VP	Verb Phrase	<i>John love Mary</i>
TP	Tense Phrase	<i>John loves Mary.</i> (Full declarative sentence)
CP	Complementizer Phrase	<i>(I think) that John loves Mary.</i> (Subordinate clauses) <i>What will John eat?</i> (Root questions)

Table 1

The article is organized as follows: section 2 introduces the quantification theory in formal linguistics; section 3 examines one particular type of quantification: *wh*-quantification in English; sections 4 to 6 present different analyses of *wh*-quantification in Chinese and section 7 concludes the paper.

¹ Note that a full declarative sentence is a projection of Tense, represented by TP. CP can either be a subordinate clause or a root question, as will be detailed in section 3.

2. Quantification in formal linguistics

In a very simplified way, semantics should be mapped onto syntax. Each semantic interpretation corresponds to one and only one syntactic structure; each syntactic structure gives rise to one and only one specific semantic interpretation. Syntax and semantics can be transparent, for instance, (1) is an ordinary declarative sentence and therefore, is a projection of TP. All of the argumental relations can be represented inside a TP. Sentence in (1) can be paraphrased as “there is an individual John and another individual Mary, such that John loves Mary.” *John* and *Mary* are interpreted as arguments of the verb *love*.

(1) [_{TP} John [_{T'} loves Mary]].

However, syntax and semantics are not always transparent; for instance, sentences like (2) are ambiguous between two different readings.

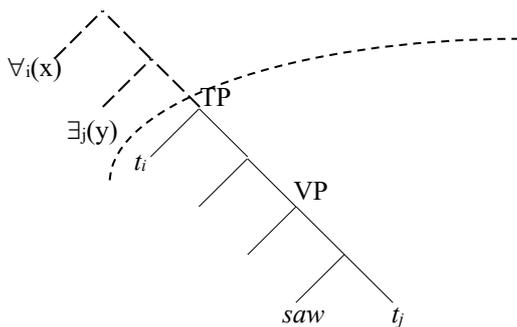
- (2) Everyone saw someone.
a. Each person saw a potentially different person.
b. All of the people saw exactly the same person.

In order to account for such an ambiguity, we need additional knowledge on mathematics and formal logic. In Mathematics, functions such as $f(x) = x^2$, $f(x) = x\%$, $f(x) = x+6$, consist of operators (e.g. the square, percentage and addition) and a variable x . The value of x varies according to the operator that binds it. Sentence in (2) contains two quantified expressions in terms of formal logic: a universally quantified phrase *everyone* (\forall) and an existentially quantified phrase *someone* (\exists). Quantifiers are essentially operators and they cannot be interpreted as arguments inside the TP. (2) does not mean that there are two individuals, such that one is named *everyone* and the other is named *someone*, and that “the individual *everyone*” saw “the individual *someone*”. Instead, *everyone* should be interpreted as ‘for every x , x human’ and *someone* should be interpreted as ‘there is x , x human’. Quantifiers (operators) are not arguments and in formal logic they are always raised to the scope position (i.e. an A'-position), which is the highest position in a sentence, either explicitly at syntax or implicitly at Logical Form (LF) to be interpreted properly.² This movement is also referred to as Quantifier

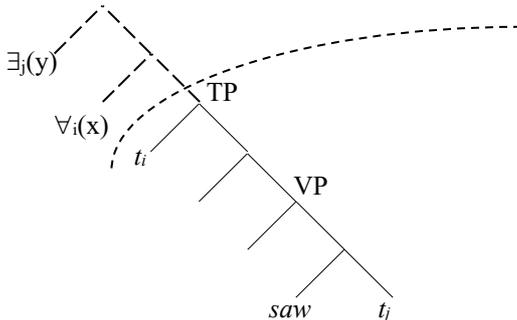
² In the generative grammar, Logical Form (LF) is a level of grammar representing the interpretation of a sentence and it is located between the Surface Structure (S-S) representing syntactic structures and formal semantics. Semantic interpretation should be compositionally represented at LF.

Raising (henceforth QR). The scope of a quantifier consists of all the nodes that this quantifier c-commands at Logical Form.³ Importantly, a raised quantifier binds the trace that it leaves as a variable. In (2), both quantifiers are raised at LF and one can be raised higher than the other, which creates two possible LF representations (cf. 3).

(3) a.



b.



(3') a. LF: Everyone x , someone y , x saw y . ($\forall > \exists$)
 = For every x , x human, there is y , y human, such that x saw y .
 → Everyone saw a different person.

b. LF: Someone y , everyone x , x saw y . ($\exists > \forall$)
 = There is y , y human, for every x , x human, such that x saw y .
 → Everyone saw exactly the same person.

³ In a tree diagram, α and β are two nodes which can be occupied by two constituents. α c-commands β iff the first branching node that dominates α also dominates β and α does not dominate β .

In (3a), after the raising, the universal quantifier \forall is higher than the existential quantifier \exists , and therefore, \forall c-commands \exists . In this situation, \exists is in the scope of \forall and the value of \exists varies according to the variation of the value of \forall . As a result, for each person x , there exists a corresponding person y . The number of people who saw and the number of people who have been seen are equal. However, in (3b), \exists is higher than \forall and therefore \exists c-commands \forall . In this case, the interpretation of \exists does not vary according to the value of \forall . In other words, the existence of the people who have been seen, y , is independent of *everyone*, and this ensures that all of the people x saw exactly the same person y . As a result, only one person y has been seen in this scenario.

Any quantificational structure is tripartite, as illustrated in (4d). In languages like English, a *wh*-phrase moves from its base-position, which its non-interrogative counterpart would occupy, to the sentence initial position. In fact, the nature of *wh*-movement is quantifier raising because a *wh*-phrase in English contains an interrogative operator Q (cf. Tsai's 1994 typological observation in section 5).

- (4) a. *Every boy* likes football. (Universal quantification)
 b. *Some boy* likes football. (Existential quantification)
 c. *Which boy* do you like? (Interrogative quantification)
 (= For which x , x a boy, such that you like x ?)
 d.

	Quantifier	Restriction	Nuclear scope
<i>Every boy</i>	$\forall_{(x)}$	$x \in \{\text{boy}\}$	x likes football
<i>Some/a boy</i>	$\exists_{(x)}$	$x \in \{\text{boy}\}$	x likes football
<i>Which boy</i>	$Q_{(x)}$	$x \in \{\text{boy}\}$	you like x

The only difference between (4a, b) and the case of *wh*-movement in (4c) is that the former raising is realized at LF and the latter at Surface-Structure (S-S) (i.e. at syntax). Movement at the syntactic level is also called overt movement and movement at LF is called covert movement. In the next section, I will concentrate on properties of *wh*-movement.

3. *Wh*-movement

3.1 *Wh*-movement as an operator movement

In English, a question (cf. 5c) is assumed to be transformed from its declarative counterpart (cf. 5a).

- (5) a. John will eat an apple.
 b. John will eat what
 c. What_j will John eat t_j?

In generative syntax, the specifier position of a CP is a non-argument position, noted as A'-position, which is available for raised quantifiers. In English, *wh*-words move from their base-position (i.e. A(argument)-position) to the specifier position of CP in overt syntax (i.e. S-S) to form a *wh*-question, such as in (5c); after the movement of *what*_j, a trace *t*_j, which bears the same index *j* as the moved *wh*-word, is left in the original site.

(5c) [CP What_j [C' [C° will] [TP John eat t_j]]]?

As detailed in the previous section, the nature of *wh*-movement is quantifier raising. In semantics, a moved *wh*-word is treated as an interrogative operator which binds the trace that it left as a variable. The highest scope position (i.e. CP) bears an interrogative force which is realized as a request for an answer from the co-speaker.

3.2 Locality conditions

Wh-movement is not free and must obey locality conditions, such as Subjacency, Empty Category Principle (ECP) and Condition on Extraction Domain (CED). Subjacency requires that *wh*-movement must be realized cyclically: a *wh*-phrase must stop at the specifier of each intermediate CP. In this sense, a *wh*-movement can be very long by leaving intermediate traces, such as *t*_j' and *t*_j'' in (6).

(6) [CP₁ Which book_j did [TP₁ you say [CP₂ t_j'' that [TP₂ John thought [CP₃ t_j' that [TP₃ Mary likes reading t_j]]]]]]]?

Each step (i.e. each subordinate CP) cannot cross two bounding nodes (i.e. NP and TP are bounding nodes in English); in this sense, long distance movement crossing several bounding nodes in a single step is prohibited. Subjacency is a principle and the syntactic categories constructing bounding nodes are parameterized in different languages. It has been observed that certain types of

subordinate clauses, such as indirect questions, relative clauses, complement clauses of noun, sentential subject, coordinated clauses and adjunct clauses, block *wh*-movement and these clauses are metaphorically called islands (Ross 1967). Extraction of a *wh*-word out of these islands violates Subjacency condition and results in ungrammatical sentences. Here are some examples,

- (7) a. *Wh*-island
 * [CP₁ Who_j do [TP₁ you think [CP₂ *why* [C' C [TP₂ John met t_j]]]]]]?
- b. Complex-NP: relative clause
 * [CP₁ Who_j do [TP₁ you like [NP the books [CP₂ t_j' [C' that [TP₂ t_j wrote]]]]]]]?
- c. Complex-NP: complement clause of noun
 * [CP₁ Who_j did [TP₁ you hear [NP the rumor [CP₂ t_j' [C' that [TP₂ Mary scolded t_j yesterday]]]]]]]?
- d. Adjunct clause
 * [CP₁ Which book_k do [TP₁ you want to go to Japan [CP₂ because [C' C [TP₂ you read t_j]]]]]]]?
- e. Sentential subject
 (i) [NP [CP That [TP John beat Tom]]] pleased us.
 (ii) * [CP₁ Who_j did [TP₁ [NP [CP₂ t_j' [C' that [TP₂ John beat t_j]]]]] pleased us]]]?

In the above sentences, some steps of *wh*-movement crosses more than one bounding node, and therefore, Subjacency is violated.

An argument-adjunct asymmetry has also been observed in *wh*-movement: extraction of a *wh*-object (cf. 8a) is always better than that of a *wh*-subject (cf. 8b) or that of a *wh*-adjunct (cf. 8c).

- (8) a. Which book_k do [TP₁ you think [CP that [TP₂ John will read t_j]]]]?
 b. * Who_j do [TP₁ you think [CP that [TP₂ t_j will read this book]]]]]?
 c. * How_j do [TP₁ you think [CP that [TP₂ John will go to Paris t_j]]]]?

The principle that describes such an asymmetry is called Empty Category Principle (ECP), as illustrated in (9).

(9) Empty Category Principle (ECP)

A *wh*-trace must be properly governed. α properly governs β iff α theta governs β or α antecedent governs β .

(i) α theta governs β iff α assigns β a theta role.

(ii) α antecedent governs β iff α and β share the same index.

(iii) Relativized minimality must be obeyed.

Theta government is also called lexical government and it only applies to the case of *wh*-objects. A *wh*-object is always lexically governed by the verb (located at V) which assigns such an object a theta role, such as theme or patient. However, *wh*-subject is governed by T rather than by V; *wh*-adjunct cannot be theta-marked by V. Therefore, both *wh*-subject and *wh*-adjunct must be properly governed by their antecedents in a very local fashion (i.e. in each intermediate CP). In (8b, c), the intermediate C head has already been occupied by the complementizer *that* which blocks the antecedent government between *who/how* and their traces. The complementizer *that* bears its own index, say *k*, and as a head, it transmits its index *k* to the entire CP_k ; in this case, even if a *wh*-subject or a *wh*-adjunct can move to the specifier of the CP_k hosting *that*, the relevant *wh*-word cannot transfer its index to CP_k . As a result, *that* is considered as an intervener and it blocks the government between the antecedent *wh*-word and its trace.

Huang (1982) captures another asymmetry between two types of islands: strong islands and weak islands. The extraction of *wh*-object out of a strong island, such as relatives (cf. 10c), sentential subjects (cf. 10d) or adjunct clauses (cf. 10e), is worse than the extraction of *wh*-object out of a weak island, such as *wh*-islands (cf. 10a) or complement clauses of noun (cf. 10b).

(10) a. *Wh*-island

? Which book_i did John ask [why_j Mary read t_i with pleasure t_j]?

b. Complex-NP : complement clause of noun

? Which book_i did Paul hear the rumor [that his brother will offer him t_i]?

c. Complex-NP: relatives

* Which book_i does John know the girl [to whom_j Paul will give t_i t_j]?

d. Sentential subject

* Which book_i [that Paul finished reading t_i] will make his mother happy?

e. Adjunct clause

* Which book_i will Paul go to Paris [because he finished reading t_i]?

Such an asymmetry is described as a Condition on Extraction Domain (CED).

(11) Condition on Extraction Domain (CED)

A phrase XP may be extracted out of a domain YP only if YP is properly governed.

Accordingly, weak islands constitute properly governed domains and strong islands do not.

The following table gives an overview of the three locality conditions. Subjacency makes a distinction between islands and non-islands; CED makes a distinction between strong islands and weak islands; ECP makes a distinction between *wh*-objects on the one hand, and, *wh*-subjects and *wh*-adjuncts on the other hand. Sentences that violate one of the three principles are odd; those that violate two of them are ungrammatical and unacceptable; those that violate all of the three are extremely bad.

			ECP						
			Object			Subject/ Adjunct			
			S-j	ECP	CED	S-j	ECP	CED	
S-j	Islands	Strong	<i>Relative</i>	✗	✓	✗	✗	✗	✗
			<i>Sentential subject</i>	✗	✓	✗	✗	✗	✗
			<i>Adjunct clause</i>	✗	✓	✗	✗	✗	✗
	Weak	<i>Wh-island</i>	✗	✓	✓	✗	✗	✓	
		<i>Complement of noun</i>	✗	✓	✓	✗	✗	✓	
	Non-islands	<i>Complement of verb</i>	✓	✓	✓	✓	✓	✓	

Table 2 Locality conditions

3.3 Research questions

Languages like Mandarin Chinese show evidence of the *wh*-in-situ property: *wh*-word never moves to [Spec, CP] to form a *wh*-question at the level of overt syntax. In English, *wh*-in-situ is also observed in multiple *wh*-questions: only one *wh*-word is allowed to move to [Spec, CP] with the others staying in their original positions, as shown in (12).

(12) [_{CP} Which book_j [_{C'} [_{C°} did] [_{TP} which lady read t_j]]]?

Then, the question is how to account for *wh*-in-situ. In general linguistics, a close relationship has been observed between indefinites and in-situ *wh*-words. From the 70s onwards, formal mechanisms which have been proposed to account for *wh*-in-situ are very much inspired by those proposed to interpret indefinites, as shown in Table 3.

	Indefinites	<i>Wh</i>-in-situ in English	<i>Wh</i>-in-situ in Chinese
QR/LF-Movement	Chomsky (1977)	Higginbotham & May (1981)	Huang (1982)
Clausal Typing			Cheng (1991)
QU-operator			Aoun & Li (1993)
Unselective binding	Heim (1982)	Baker (1970) Pesetsky (1987)	Tsai (1994)
Choice functions	Reinhart (1997)	Reinhart (1998)	

Table 3

Prosodic licensing as an interface strategy was used to interpret focus shifting structures in English by Reinhart (2006), French *wh*-in-situ by Cheng and Rooryck (2000) and Chinese *wh*-in-situ by Pan (2011b, 2019b), as shown in Table 4.

	Focus shift	<i>Wh</i>-in-situ in French	<i>Wh</i>-in-situ in Chinese
Prosodic licensing	Reinhart (2006)	Cheng & Rooryck (2000)	Pan (2011b, 2019b)

Table 4

In the following sections, I will present several important analyses of *wh*-in-situ in Chinese. *Wh*-phrases are considered as operators in English; an operator must be raised either overtly at syntax or covertly at LF. Such a consideration leaves only two options to account for *wh*-in-situ in Chinese. An *in-situ wh*-phrase can be

treated either as an operator which is only raised at LF. This is the proposal of Huang (1982). An *in-situ wh*-phrase can also be treated as a variable bound by an implicit operator located at CP, and this is the proposal of Tsai (1994). I will present these two analyses in sections 4 and 5.

4. LF-movement approach

Based on Quantifier Raising, Huang (1982) accounts for *wh*-in-situ in Chinese by assuming that in-situ *wh*-words are raised at LF. He provides two important arguments in favor of this analysis: one is based on Selectional Restrictions required by the verb of the main clause and the other is based on crossover effects.

4.1 Argument 1 for LF-movement: Selectional Restrictions

Verb can select the type of its complement clause in term of [$\pm wh$] features. Verbs like *ask* obligatorily select a C head bearing [+wh], as illustrated in (13). Verbs like *think* obligatorily select a clause with [-wh] as its complement (cf. 14). Verbs like *know* select either a C [+wh] or a C [-wh] as its complement, as shown in (15). All of these requirements are satisfied by moving the relevant *wh*-word either to the [Spec, CP] of the subordinate clause or to the [Spec, CP] of the main clause at S-S.

- (13) a. He *asked* me [_{CP} [+WH] what_i [_{TP} you bought t_i]].
 b. * [_{CP1} What_i did [_{TP1} [-WH] he *ask* [_{TP2} you Mary bought t_i]]]?
- (14) a. [_{CP1} What_i does [_{TP1} he *think* [_{CP2} [-WH] [_{TP2} you bought t_i]]]] ?
 b. * [_{TP1} He *thinks* [_{CP} [+WH] what_i [_{TP2} you bought t_i]]] .
- (15) a. [_{CP1} What_i does [_{TP1} he *know* [_{CP2} [-WH] [_{TP2} you bought t_i]]]] ?
 b. [_{TP1} He *knows* [_{CP} [+WH] what_i [_{TP2} you bought t_i]]] .

Huang (1982) shows that these selectional restrictions are also observed in Chinese. (16) is obligatorily interpreted as a declarative sentence containing an indirect question to which one cannot answer; (17) is obligatorily interpreted as a direct question which requires an answer; (18) is interpreted either as a direct question or as a declarative sentence containing an indirect question.

(16) 张三问我李四买了什么。

Zhangsan **wen** wo [Lisi mai-le shenme]

Zhangsan ask I Lisi buy- Perf what

a. ‘Zhangsan asks me what Lisi bought.’

b. * ‘What does Zhangsan ask me Lisi bought?’

(17) 张三相信李四买了什么？

Zhangsan **xiangxin** [Lisi mai-le shenme]

Zhangsan believe Lisi buy- Perf what

a. ‘What does Zhangsan think that Lisi bought?’

b. * ‘Zhangsan thinks what Lisi bought.’⁴

(18) 张三知道谁买了书

Zhangsan **zhidao** [shei mai-le shu]

Zhangsan know who buy-Perf book

a. ‘For which x, x person, such that Zhangsan knows that x bought a book?’

b. ‘Zhangsan knows who bought a book.’

Based on the interpretation of these sentences, Huang assumes that selectional restrictions are satisfied by moving the relevant *wh*-words to appropriate [Spec, CP] positions at LF, as shown in (19-21).

(19) Zhangsan *wen* wo [CP [+WH] **shenme**_i [TP Lisi mai-le **t**_i]]?

Zhangsan ask I what Lisi buy-Perf

(20) [CP₁ **Shenme**_i [TP₁ Zhangsan *xiangxin* [CP₂ [-WH] **t**_i'

what Zhangsan believe

[TP₂ Lisi mai-le **t**_i]]]]?

Lisi buy- Perf

(21) a. [CP₁ **Shei**_i [TP₁ Zhangsan *zhidao* [CP₂ [-WH] **t**_i'

who Zhangsan know

[TP₂ **t**_i mai-le shu]]]]?

buy- Perf book

⁴ Note that we only talk about the interrogative reading of *shenme* ‘what’ in direct and indirect questions; thus, the indefinite (i.e. existential) reading of *shenme* ‘what’ is not concerned here. Therefore, another possible reading where *shenme* is interpreted as an indefinite is that ‘Zhangsan believes that Lisi bought something.’

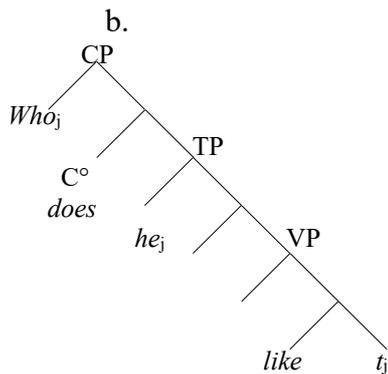
- b. [_{TP1} Zhangsan *zhidao* [_{CP} [+WH] **shei**_i [_{TP2} **ti** *mai-le* *shu*]]].
 Zhangsan know who buy-Perf book

4.2 Argument 2 for LF-movement: Crossover effects

In this section, I will present an argument in support of the existence of LF-movement, i.e. crossover effects. Crossover effects describe that a *wh*-movement cannot cross a pronoun which bears the same index as the moved category. There are two types of crossover effects: weak crossover (WCO) and strong crossover (SCO).

(22) Strong crossover effects at S-S

- a. * Who_j does he_j like t_j ?



The configuration in (22) illustrates strong crossover effects. The movement of *who* crosses the pronoun *he* that bears the same index *j*. Such a configuration is called “strong” crossover because the pronoun *he* c-commands the trace of *who*. This binding violates two principles: condition C of the Binding theory and the constraint on bound anaphora construal (Reinhart 1983).⁵ The pronoun *he* cannot get a bound variable reading since it is not c-commanded by the trace *t_j* of the raised quantifier *who_j*. The following sentence illustrates the configuration of weak crossover effects where the pronoun does not c-command the trace of the

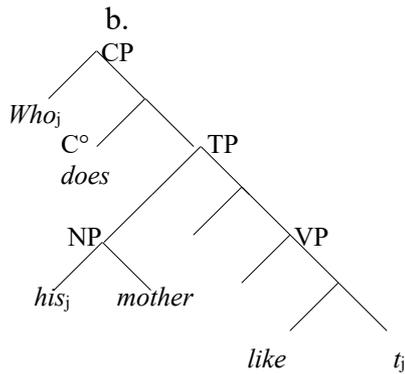
⁵ Constraint on bound anaphora (Reinhart 1983) states that a pronoun can get a bound variable reading if and only if it is c-commanded by the trace of a quantifier. For instance, in the following sentence, the pronoun *he* gets a bound variable reading because it is c-commanded by the trace *t_j* of the quantifier *everyone* after its raising at LF.

(i) Everyone_i *t_j* thinks that he_j is smart.

moved *wh*-word *who*. In this situation, condition C is not violated but the constraint on bound anaphora is violated.

(23) Weak crossover effects at S-S

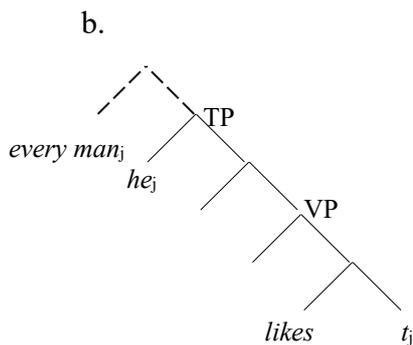
a. ?* *Who_j does his_j mother like t_j?*



Crossover effects have been used as diagnostic tests for movement at S-S. When we apply crossover configurations to a sentence containing quantifiers, if the relevant sentence is ungrammatical we can conclude that LF-movement is involved in the derivation; by contrast, if the sentence remains grammatical, LF-movement is not involved. For instance,

(24) Strong crossover effects at LF

a. * *He_j likes every man_j.*

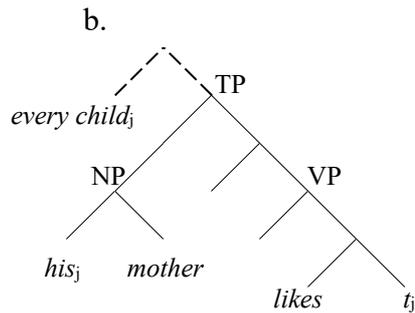


A possible way to rule out (24) is by assuming that the universal expression *every man* raises to the scope position at LF. Such a covert movement crosses the pronoun *he* which bears the same index *j* and therefore gives rise to strong

crossover effects. In other words, the fact that (24) is ungrammatical suggests that LF-movement is involved. Similarly, the ungrammaticality of (25) is due to the weak crossover configuration at LF.

(25) Weak crossover effects at LF

a. ?* His_i mother likes every child_j.



Back to LF-movement analysis of *wh*-in-situ in Chinese. Since crossover effects are considered as an argument in favor of LF-movement, Huang (1982) uses these effects in support of his analysis. As he points out, *wh*-in-situ also gives rise to crossover effects. In (26), the LF-movement of *shei* ‘who’ crosses the pronoun *ta-de* ‘his’ which bears the same index *i*, and this triggers weak crossover effects.

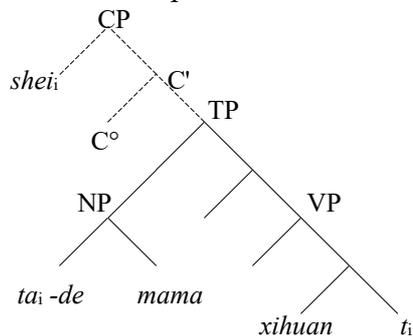
(26) a. * 他_i的妈妈喜欢谁_i?

* [CP [TP [NP **Ta_i-de** mama] xihuan **shei_i]] ?**

he-DE mother like who

(* ‘Whom_i does his_i mother like t_i?’)

b. LF representation



In other words, the ungrammaticality of (26) shows that LF-movement is involved in the derivation.

4.3 Conditions on LF-movement of *wh*-in-situ

In this section, we will examine whether all of the three locality conditions, Subjacency, ECP and CED, apply to LF-movement. (27-31) show that *wh*-arguments never give rise to island effects in Chinese in that extraction of a *wh*-object/subject out of islands (strong or weak) does not make the relevant sentences ungrammatical.

(27) *Wh*-island

张三想知道谁去了哪里

[_{CP1} [_{TP1} Zhangsan xiang zhidao [_{CP2} [_{TP2} shei qu-le nali]]]]
 Zhangsan wonder who go-Perf where

(i) ‘For which person *x*, such that Zhangsan wonders where *x* went?’

LF: [_{CP1} *shei_j* [_{TP1} Zhangsan xiang zhidao
 who Zhangsan wonder
 [_{CP2} *nali_k* [_{TP2} *t_j* qu-le *t_k*]]]]
 where go- Perf

(ii) ‘For which place *y*, such that Zhangsan wonders who went to *y*?’

LF: [_{CP1} *nali_k* [_{TP1} Zhangsan xiang zhidao
 where Zhangsan wonder
 [_{CP2} *shei_j* [_{TP2} *t_j* qu-le *t_k*]]]]
 who go- Perf

(28) Complement clause of noun

你相信李四买了什么的说法?

[_{CP1} [_{TP1} Ni xiangxin [_{NP} [_{CP2} [_{TP2} Lisi mai-le
 you believe Lisi buy-Perf
 shenme] de] shuofa]]]?
 what DE rumor

‘For what *x*, *x* an object, such that you believe the rumor that Lisi bought *x*?’

LF: [CP1 *shenme*_i [TP1 Ni xiangxin [NP [CP2 *t*'_i
 what you believe
 [TP2 Lisi mai-le *t*_i] de] shuofa]]] ?
 Lisi buy- Perf DE rumor

(29) Relative clause

你喜欢谁写的书?

[CP1 [TP1 Ni xihuan [NP [CP2 [TP2 shei xie] de] shu]]]?
 you like who write DE book

'For which person x, such that you like the books that x wrote?'

LF: [CP1 *shei*_j [TP1 Ni xihuan [NP [CP2 *t*'_j
 who you like
 [TP2 *t*_j xie] de] shu]]] ?
 write DE book

(30) Sentential subject

妈妈做什么最好吃?

[CP1 [TP1 [NP [CP2 [TP2 Mama zuo shenme]]] zui haochi]]]?
 mother cook what most delicious

'What dish is the one that Mum cooks best?'

LF: [CP1 *shenme*_j [TP1 [NP [CP2 *t*'_j [TP2 Mama
 what mother
 zuo *t*_j]]] zui haochi]]]?
 cook most delicious

(31) Adjunct clause

李四因为读过哪本书很想去巴黎?

[CP1 [TP Lisi [CP2 yinwei du-guo na-ben
 Lisi because read-Exp which-CL
 shu] hen xiang qu Bali]]?
 book very want go Paris

'For which book x, such that Lisi wants to go to Paris because he read x?'

LF: [CP1 *na-ben shu*_j [TP Lisi [CP2 yinwei du-guo *t*_j]
 which-CL book Lisi because read-Exp
 hen xiang qu Bali]]]?
 very want go Paris

Recall that English counterparts of the above sentences are all ungrammatical due to the violation of Subjacency. Under the assumption that *wh*-words undergo LF-movement in Chinese, the fact that sentences in (27-31) are grammatical suggests that Subjacency does not apply at LF. We also notice that islands in (27-28) are weak islands and those in (29-31) are strong islands. Since Subjacency does not apply at LF, CED does not apply either. This is because no contrast is observed between (27-28) on the one hand and (29-31) on the other.

Let us examine whether ECP applies at LF. Sentences in (32-36) show that *wh*-adjuncts give rise to island effects.

(32) *Wh*-island

张三想知道谁为什么去了巴黎

* [CP₁ [TP₁ Zhangsan xiang zhidao [CP₂
Zhangsan wonder
[TP₂ shei weishenme qu-le Bali]]] ?
who why go-Perf Paris

(i) ('For which person x, such that Zhangsan wonders why x went to Paris?')

LF: * [CP₁ shei_j [TP₁ Zhangsan xiang zhidao
who Zhangsan wonder
[CP₂ weishenme_k [TP₂ t_j t_k qu-le Bali]]]]
why go-Perf Paris

(ii) ('For which place y, such that Zhangsan wonders who went to y?')

LF: * [CP₁ weishenme_k [TP₁ Zhangsan xiang zhidao
why Zhangsan wonder
[CP₂ shei_j [TP₂ t_j t_k qu-le Bali]]]]
who go-Perf Paris

(33) Complement clause of noun

* 你相信李四为什么买了电脑的说法?

* [CP₁ [TP₁ Ni xiangxin [NP [CP₁ [TP₂ Lisi weishenme
you believe Lisi why
mai-le diannaoh] de] shuofa]] ?
buy-Perf computer DE rumor

('For which reason x, such that you believe the rumor that Lisi bought a computer for x?')

LF: * [CP1 *weishenme*_i [TP1 Ni xiangxin [NP [CP2 *t*'_i
 why you believe
 [TP2 Lisi *t*_i mai-le diannaol] de] shuofa]]] ?
 Lisi buy-Perf computer DE rumor

(34) Relative clause

* 你喜欢鲁迅为什么写的书?

* [CP1 [TP1 Ni xihuan [NP [CP2 [TP2 Lu Xun
 you like Lu Xun
 weishenme xie de] shu]]]] ?
 why write DE book

(‘For which reason x, such that you like the books that Lu Xun wrote for x?’)

LF: * [CP1 *weishenme*_j [TP1 Ni xihuan [NP [CP2 *t*'_j
 why you like
 [TP2 Lu Xun *t*_j xie de] shu]]]] ?
 Lu Xun write DE book

(35) Sentential subject

* [妈妈为什么做牛肉]最好吃?

* [CP1 [TP1 [NP [CP2 [TP2 Mama weishenme zuo
 mother why cook
 niurou]]] zui haochi]] ?
 beef most delicious

(‘For which reason x, such that Mum cooks the beef for x best?’)

LF: * [CP1 *weishenme*_j [TP1 [NP [CP2 *t*'_j [TP2 Mama *t*_j zuo
 why mother cook
 niurou]]] zui haochi]] ?
 beef most delicious

(36) Adjunct clause

* 李四[为什么看过这部电影之后]很想去巴黎?

* [CP1 [TP Lisi [CP2 weishenme kan-guo zhe-bu
 Lisi why see-Exp this-CL
 dianying zhihou] hen xiang qu Bali]] ?
 movie after very want go Paris

(‘For which reason *x*, such that Lisi wants to go to Paris very much [after he saw this movie for *x*]?’)⁶

LF: [_{CP1} *weishenme*_j [_{TP} Lisi [_{CP2} *t_j* kan-guo zhe-bu
 why Lisi see-Exp this-CL
 dianying zhihou] hen xiang qu Bali]]?
 movie after very want go Paris

The ungrammaticality of the sentences in (32-36) suggests that LF-movement is involved in their derivation and that extraction of a *wh*-adjunct out of islands (strong or weak) makes the relevant sentence ungrammatical. Based on these tests, we can see that a contrast exists between *wh*-arguments (cf. 27-31) and *wh*-adjuncts (cf. 32-36) in Chinese. In other words, ECP applies at LF. Let me summarize the observation in the following table.

	Extraction of a <i>wh</i> -argument	Extraction of a <i>wh</i> -adjunct
<i>Chinese</i>	✓	✗
<i>English</i>	✗	✗

Table 5

Based on this table, we can have the following generalization:

- (i) Differences between English and Chinese
 - (a) A *wh*-argument cannot be extracted out of islands (strong or weak) in English.
 - (b) A *wh*-argument can be extracted out of islands (strong or weak) in Chinese.
 - ➔ Subjacency and CED only apply to *wh*-movement at S-S and they do not apply at LF.
- (ii) Common properties between English and Chinese:
 - A *wh*-adjunct cannot be extracted out of islands (strong or weak).
 - ➔ ECP applies at LF.

The following table shows how these three constraints work in English and in Chinese.

⁶ Note that in this reading, *weishenme* ‘why’ is embedded within the adjunct clause and qualifies the verb *kan* ‘see’. The impossible reading is ‘why did Lisi see that movie’ where *weishenme* ‘why’ gets the matrix scope, and this shows that *weishenme* cannot undergo *wh*-movement to the root CP due to the presence of an adjunct island.

<i>Movement</i>	<i>Language</i>	<i>Subjacency</i>	<i>ECP</i>	<i>CED</i>
at S-S	<i>English</i>	✓	✓	✓
at LF	<i>Chinese</i>	✗	✓	✗

Table 6

4.4 Problems with LF-movement analysis

As pointed out by Aoun & Li (1993) and Tsai (1994), one of the problems with the LF-movement of *wh*-in-situ is that it is not always reasonable to treat *wh*-elements as quantifiers in Chinese. This is because *wh*-words can be interpreted as variables in certain contexts and they can have existential reading, interrogative reading and universal reading when bound by different operators, as shown in (37).

- (37) a. 他吃了什么吗? Yes-no question
Ta chi-le shenme ma?
3SG eat-Perf what Q
‘Did he eat anything?’ (∃)
- b. 如果你想吃什么就告诉我。 If-conditional
Ruguo ni xiang chi shenme jiu gaosu wo.
if you want eat what then tell I
‘If you want to eat anything, tell me then!’ (∃)
- c. 他什么都吃。 Universal quantification
Ta shenme dou chi.
he what all eat
‘He eats everything.’ (∀)
- d. 他没吃什么 Negation
Ta mei chi shenme
he non eat what
(i) ‘What didn’t he eat?’ (Q)
(ii) ‘He did not eat anything.’ (∃)
- e. 张三认为李四买了什么 Non-factive verbs
Zhangsan renwei Lisi mai-le shenme
Zhangsan think Lisi buy-Perf what
(i) ‘What does Zhangsan think Lisi bought?’ (Q)

(ii) ‘Zhangsan thinks that Lisi bought something.’ (∃)

5. Unselective binding approach and choice functions

5.1 Problems with QR

The analysis based on an LF-movement of *wh*-in-situ in Chinese is greatly inspired by the QR mechanism which is adopted to interpret indefinites in English; however, serious problems with the use of QR to interpret indefinites were revealed by Reinhart (1997, 1998, 2006). For instance, on the one hand, the wide scope reading of indefinites can violate all of the locality constraints as shown in (38), and on the other hand, QR is supposed to be a very locally bound operation. Therefore, this wide scope reading cannot be interpreted by QR.

- (38) Most guests will be offended if we don’t invite *some philosopher*.
= There is a philosopher *x*, such that most guests will be offended [if we don’t invite *x*].
= $\exists(x)$, *x* a philosopher, most guests will be offended [if we don’t invite *x*]

(38) has a reading in which the \exists expression *some philosopher* has a wide scope reading over the \forall expression *most guests* even if the former is embedded within a strong island (i.e. *if*-conditional is an adjunct island). The fact that the relevant sentence is fully grammatical suggests that no locality violation occurs. Logically, this reading cannot be derived by QR.

Another problem with using QR to interpret indefinites is that it is not correct to treat indefinites as quantifiers in that they do not possess any inherent quantificational force. Heim (1982) shows that the interpretation of an indefinite depends on some other operator in the same sentence. For instance, (39) is ambiguous between two possible readings. In (i), the quantificational adverb *always* is a selective binder which only binds a specific type of variable (i.e. the time variable *t*), which yields a reading where the existence of a fireman does not depend on *always*. By contrast, in (ii), *always* is an unselective binder that binds all of the variables of different types without distinguishing them. Under such an unselective binding mechanism, the existence of *firemen* depends on *always* and yields a universal reading of *firemen*.

- (39) A fireman is always available.
(i) A specific fireman is always available. (Selective operator)
Always *t* (*t* : a time interval), $\exists x$ (*x*: a fireman) & *x* is available at *t*

- (ii) All of the firemen are always available. (Unselective operator)
 (= At any time of the whole day, there are always firemen who are available.)
Always t, x (t : a time interval & x : a fireman) x is available at t

In fact, a similar mechanism had already been used by Baker (1970) to interpret *wh*-in-situ in multiple *wh*-questions in English.

(40) $Q_{\langle i, j \rangle}$ [[Which woman] _{i} read [which book] _{j}] ?

In (40), an interrogative morpheme Q with a null form is introduced in the scope position to simultaneously bind the *wh*-subject *which woman* and the *wh*-object *which book*. This Q -morpheme takes two indices i and j . Since this Q -morpheme does not choose a specific *wh*-element to bind, the mechanism can also be regarded as an unselective binding.

5.2 Problems with unselective binding

Using the unselective binding mechanism to interpret indefinites is not without problems, as argued by Reinhart (1997, 2006). Such a mechanism introduces a very “dangerous” semantic problem which is called the “Donald Duck problem”, as illustrated in (41).

- (41) a. Who will be offended if we invite which philosopher?
 b. # For which pair $\langle x, y \rangle$, **if** [we invite y and y is a philosopher], then x will be offended?
 c. # $\{P \mid (\exists \langle x, y \rangle) P = \wedge ((\text{we invite } y \ \& \ \text{philosopher}(y)) \rightarrow (x \text{ will be offended} \ \& \ \text{true}(P)))\}$
 d. # Lucie will be offended if we invite Donald Duck.

In (41a), the *wh*-phrase *which philosopher* is embedded within an island constructed by a conditional clause. However, this sentence can be interpreted with a wide scope reading of *which philosopher* and the question is what mechanism can properly interpret this wide scope reading without violating locality constraints. There are two potential candidates: QR and unselective

binding. As mentioned in section 3, being a very locally bound operation, QR cannot extract an in-situ *wh*-phrase out of any island and therefore, QR does not apply here. The other choice is the unselective binding mechanism as illustrated in (41b, c), where a null interrogative operator binds two *wh*-variables unselectively. In this case, the *wh*-phrase *which philosopher* is embedded within a conditional clause which is interpreted as an assumption in semantics. However, when the nominal restriction (i.e. *y is a philosopher*) is embedded within the conditional, thus within an assumption, it will generate false answers, as indicated in (41d). Representations in (41b, c) roughly say that if we invite an individual *y* and if *y* is a philosopher, Lucie will be offended. Even if Donald Duck is not a philosopher, it can satisfy the truth condition of the logical representations in (41b, c) because such representations cannot ensure that the person who will be invited is obligatorily a philosopher. Technically, as Reinhart (1997, 2006) states, leaving the nominal restriction of a *wh*-phrase in-situ is very dangerous. The difficulty is that on the one hand, QR cannot extract the nominal restriction out of an island because QR is locally bound and on the other hand, we cannot leave the nominal restriction interpreted in-situ under the unselective binding approach due to the Donald Duck problem. Therefore, another interpretation mechanism is needed and the correct interpretation of (41a) should be as follows, cf. (42).

- (42) a. For which pair $\langle x, y \rangle$, *y* is a philosopher, **if** [we invite *y*], then *x* will be offended?
- b. $\{P \mid (\exists \langle x, y \rangle) (\text{philosopher}(y) \ \& \ P = \wedge ((\text{we invite } y) \rightarrow (x \text{ will be offended}) \ \& \ \text{true}(P)))\}$

5.3 Choice functions

Reinhart (1997, 2006) proposes a mechanism based on choice functions to interpret indefinites and *wh*-in-situ. Such a mechanism is based on an existential quantification over choice functions, which ensures the existence of a choice function which applies to an *in-situ* nominal set, as illustrated in (43).

- (43) a. Who will be offended if we invite which philosopher?
- b. For which pair $\langle x, f \rangle$, **if** [we invite $f(\text{philosopher})$], then *x* will be offended?

- c. $\{P \mid (\exists \langle x, f \rangle) (CH(f) \wedge P = \wedge (\text{we invite } f(\text{philosopher}) \rightarrow x \text{ will be offended}) \& \text{true}(P))\}$

Even if the in-situ nominal restriction is still embedded within a conditional clause (i.e. assumption), there will be no Donald Duck problem because the existence of such a function is already ensured outside the conditional clause. The variable x can only be chosen from the nominal set restricted by “philosopher”. Any individual who is not philosopher will not be a licit answer to the question and will not satisfy the truth condition of the sentence.

5.4 Advantage of choice functions

One of the advantages of the analysis of *wh*-in-situ based on the choice function mechanism is that the ECP asymmetry can be nicely accounted for. Recall that ECP reveals an asymmetry between *wh*-arguments and *wh*-adjuncts. However, Reinhart (1998) argues that such an asymmetry is in fact a much more general one existing between *wh*-nouns and *wh*-adverbs, as shown in (44).

(44) a. * Who cried when you behaved how?

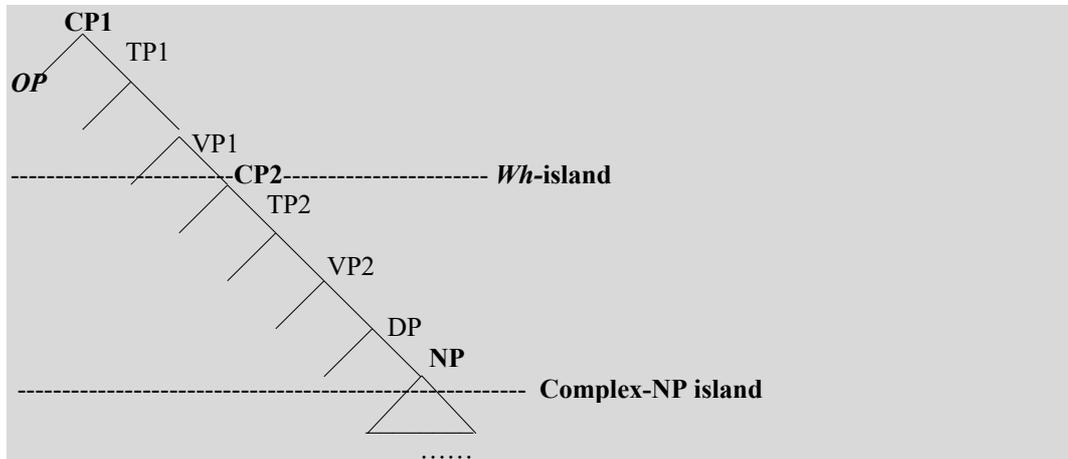
b. Who cried when you behaved in what way?

(44a) illustrates an ECP effect: the trace of the *wh*-adjunct *how* after an LF-movement is not properly governed by its antecedent because it is embedded within a *wh*-island. However, Reinhart shows that if *how* is replaced by a nominal phrase such as *what way*, the sentence becomes fully grammatical, as shown in (44b). The contrast between (44a) and (44b) shows that what ECP reveals as asymmetry should not exist between arguments and adjuncts but between nouns and adverbs. Such an asymmetry can be accounted for under the choice function mechanism in that only nouns but not adverbs can apply to a nominal N-set from which a choice function can pick up a member. Choice functions cannot interpret *wh*-adverbs, which is why (44a) is ungrammatical. In the next section, I will present Tsai’s (1994) analysis of *wh*-in-situ in Chinese based on unselective binding mechanism and choice functions.

5.5 Tsai’s (1994) typology of *wh*-dependency

Recall that Huang’s (1982) generalization forces the three locality conditions to apply at different levels and that it is the level of representation that is

(48) Chinese



An argument in support of such an analysis is that the universal quantification over *wh*-variables in bare conditionals also works at the sentential level in Chinese.

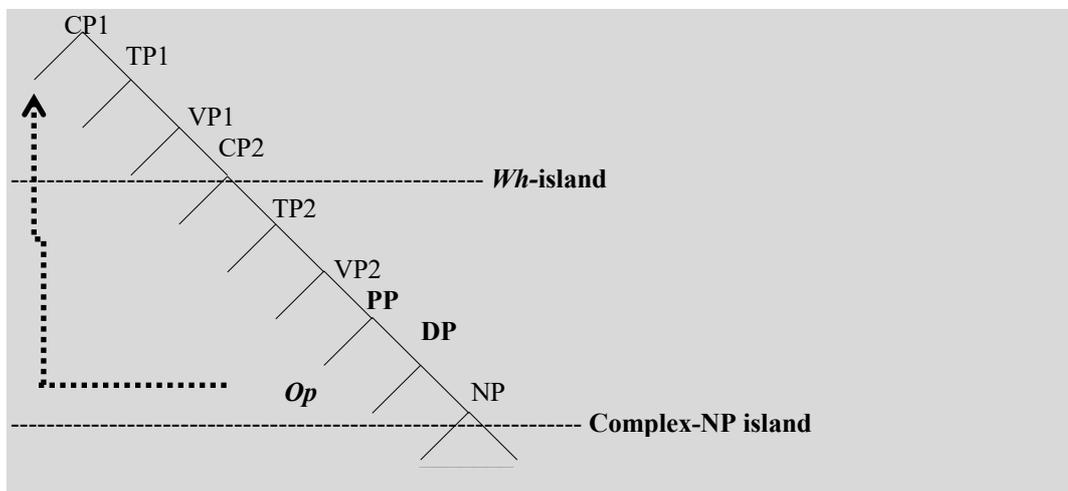
- (49) a. 谁先来谁先吃
Shei xian lai, shei xian chi.
who first come who first eat
'For every *x*, *x* person, if *x* comes first, *x* eats first.'
- b. \forall_x [*x* a person & *x* comes first] (*x* eats first)

In (49), the two *wh*-words are separated by two clauses and the entire sentence can get a conditional reading in spite of the absence of conditional markers. Conditional clauses of this type are called bare conditionals. Importantly, both *wh*-words can get an identical universal reading. Tsai assumes that a necessity operator, which is the equivalent of a universal quantifier, is generated at the highest position. Since this operator scopes over the entire sentence, it unselectively binds both *wh*-words as variables and gives them an identical universal reading. This example shows that unselective binders are located at the sentential level in Mandarin.

(ii) Japanese

Recall that Japanese gives rise to *wh*-island effects but not to complex-NP island effects. Based on Nishigauchi (1986) and Watanabe (1992), Tsai assumes that the null interrogative operator *Op* is generated at the phrasal level (i.e. NP/DP level). Therefore, *Op* is higher than complex-NP islands but lower than *wh*-islands. When *Op* moves to the matrix CP, it does not cross any complex-NP island but it crosses *wh*-islands, as illustrated in (50).

(50) Japanese



Japanese behaves like Chinese in that *wh*-words can have an existential reading and a universal reading when bound by different operators. Let me just cite a simple example to show that the universal quantification works at the phrasal level in Japanese. When the morpheme *-mo* is attached to a *wh*-word, such a *wh*-word can get a universal reading. Nishigauchi (1986) shows that *-mo* is a universal quantifier located at the DP level and that it can even be attached to a complex-NP (cf. 51a). However, *-mo* cannot be stranded *in-situ* when *dare* ‘who’ is fronted (cf. 51b). This shows that in contrast to *dou* ‘all’ in Chinese, *-mo* in Japanese is not generated at the sentential level.

- (51) a. [Dare-ga ki-te]-**mo**, boku-wa aw-a-nai.
who-Nom come all I-TOP meet.not
‘For all x, x a person, if x comes, I will not meet x.’

b. *Dare_i dare-ka-ga t_i -mo-o aisi-te-iru.
 who who-ever-NOM all-ACC love-be

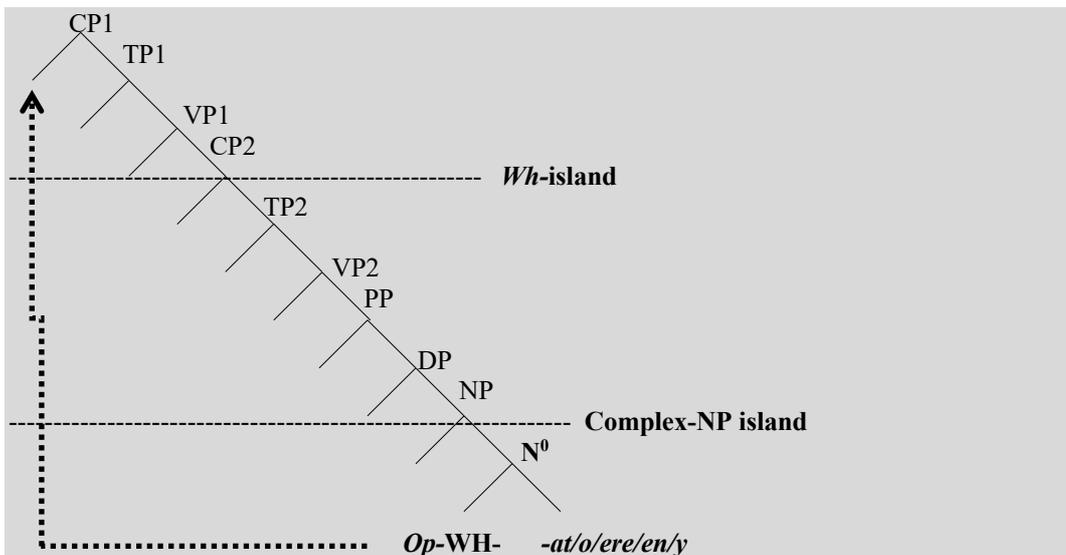
(iii) English

Tsai also proposes that unselective binders in English are located at the word level as one part of a *wh*-word itself, as shown in (52).

(52) wh-o wh-en wh-om wh-ere wh-at
 wh-o-ever wh-en-ever wh-om-ever wh-er(e)-ever wh-at-ever

Under such a consideration, the movement of Op will force the morphological form of the whole *wh*-word to move together and such a movement will necessarily cross *wh*-islands and complex-NP islands, as illustrated in (53).

(53) English



One of the advantages of Tsai's (1994) analysis is that Subjacency applies at S-S universally in Chinese, Japanese and English, which is also the most important difference between the unselective binding approach and the LF-movement approach.

5.5.2 ECP as a general asymmetry between nouns and adverbs

Recall that ECP effects are still observed in Chinese, as shown in (32-36). However, following Reinhart's (1998) observation, Tsai (1994, 1999) also confirms that ECP illustrates an asymmetry between *wh*-nouns and *wh*-adverbs in general but not between *wh*-arguments and *wh*-adjuncts. In Chinese, *zenmeyang* 'how' is ambiguous between a nominal instrumental reading and an adverbial manner reading. In an island context, only nominal reading can survive, as illustrated in (54).

- (54) 你最喜欢她怎么样炖的牛肉
Ni zui xihuan [NP [CP Op_i [TP ta
you most like she
zenmeyang dun t_i]] de niurou_i]?
how stew DE beef
a. What is the means x such that you like best [beef [which she stewed
by x]]?
b. # What is the manner x such that you like best [beef [which she stewed
in x]]?

Based on such an observation, Tsai maintains an LF-movement analysis for *wh*-adverbs by claiming that they are intrinsically quantifiers and that they undergo LF-movement. In the next section, I will present two other analyses of *wh*-in-situ in Chinese based on an interface approach.

6. An interface strategy

6.1 Clausal Typing Hypothesis

Cheng (1991) proposes a Clausal Typing Hypothesis to capture the one-to-one mapping between *wh*-question forms and the interrogative interpretation. Every clause type must be overtly indicated; a *wh*-question can be typed either by an overt movement, such as in English, or by a morphological interrogative particle, such as 呢 *ne* in Chinese. This hypothesis is very important since it states correctly that ambiguity is not permitted at interfaces and that the mapping between form and meaning must be strictly one-to-one. The particle *ne* is also treated as the overt counterpart of the null operator *Op* in Tsai's analysis. However, Boya Li (2006) points out that *ne* in Chinese is not a typing particle in the strict sense in that crucially, *ne* can be used in non-interrogative contexts. She

also points out that being a pragmatic/discourse particle, *ne* is used to attract the attention of the co-speaker to a particular or an unusual point during a conversation. Leaving aside the precise pragmatic function of *ne*, if *ne* is not a true typing particle, then how is a *wh*-in-situ question typed correctly in Chinese?

6.2 Prosodic licensing of *wh*-in-situ

Pan (2011b, 2019b) proposes that *wh*-words in Chinese such as *shenme* ‘what’ in (55) inherently bear an interrogative feature, noted as [+Q]. The fact that this [+Q] value is activated in a simple *wh*-question context without any overt licenser suggests that the interrogative reading is a kind of default reading of *shenme* ‘what’.

- (55) 你喜欢什么?
Ni xihuan shenme?
you like what
‘What do you like?’

It has also been observed that in contexts like *yes-no* question, *A-not-A* question, *if*-conditional and *dou*-quantification, *wh*-word receives non-interrogative readings and takes the non-interrogative [-Q] value (cf. section 4.4). Based on this observation, Pan (2011b, 2019b) assumes that *wh*-words in Chinese are inherently bi-value [\pm Q] elements in the sense that they are underspecified. However, the positive value [+Q] is their default reading because in a very simple sentence without the presence of any overt interrogative marker, without any special prosodic contour, without any licensing context, a *wh*-word gets an unambiguous interrogative reading (cf. 55). However, the [+Q] value is “weak” in the sense that it can be overruled in certain licensing contexts. *Wh*-words do not behave uniformly in different contexts: they are ambiguous in certain ones but not in the others. Therefore, licensing contexts do not have the same status with regard to *wh*-in-situ in Chinese.

In fact, licensing contexts are more general than those where polarity items appear. Roughly, these contexts can be divided into two different categories: unambiguous licensing contexts and ambiguous licensing contexts. A *wh*-word has only one possible reading in former ones and has several readings in latter ones. In ambiguous contexts, every different reading needs a specific intonation contour (combined with/without a stress on certain elements). Pan (2011b, 2019b) examines the existential, interrogative, universal, exclamative, rhetorical question and echo question readings of *wh*-words in different contexts. Here is an example

to illustrate how prosodic licensing works. Progressive aspect creates an ambiguous context.

(56) 他在吃着什么

- a. Ta zai chi-zhe shenme?
 he Prog eat-Dur what
 (no stress on the verb; no stress on the *wh*-word but a slight rising intonation at the end of the sentence.)
 ‘What is he eating?’ (*Interrogative reading*)
- b. Ta zai **CHI**-zhe shenme.
 he Prog eat-Dur what
 (a stress on the verb *chi* ‘eat’ and a falling intonation or a neutral intonation at the end of the sentence.)
 ‘He is eating something.’ (*Existential reading*)
- c. Ta zai chi-zhe **SHENME!**
 he Prog eat-Dur what
 (a stress on the *wh*-word and a falling intonation at the end of the sentence.)
 ‘What he is eating! (It smells bad!)’ (*Exclamative reading*)
- d. **TA** zai chi-zhe shenme?!
 he Prog eat-Dur what
 (a stress on the subject *he* and a falling or a neutral intonation at the end of the sentence.)
 ‘What is HE eating?! = He is eating nothing!’ (*Rhetorical question*)

The mapping between syntax and semantics in (56) is not tight enough to disambiguate the *wh*-word in an ambiguous licensing context. That is to say, a specific syntactic form is not sufficient to give a unique output at LF. In actual contexts when different combinations of stress with intonation are put on the relevant sentence, it is no longer ambiguous. The sentence in (56) is only ambiguous on its syntactic representation and when this syntactic form is associated with different specific prosodic contours, it can get an unambiguous output at LF. Crucially, a target reading is only associated with a specific prosodic

pattern and a specific prosodic pattern is only associated with a single corresponding reading. In this sense, the mapping between prosody and interpretation is strictly one-to-one. In fact, all of the ambiguous cases presented in (56) can be systematically disambiguated by prosody, as will be detailed in the next section. One general consideration is that the illocutionary force of a sentence should be indicated overtly in the case of ambiguity; otherwise, the output of the computational system is still ambiguous for the co-speaker, which is not a desirable situation. This consideration is based on Clausal Typing hypothesis, according to which every clause must be typed and each clause-type is only associated with a single illocutionary force (Cheng 1991). However, an important difference between the prosody-based proposal and the original Clausal Typing hypothesis is that the clausal typing in Cheng's sense is only realized by means of morpho-syntax. Typologically, morphological typing and syntactic typing are two alternative ways to type a *wh*-question. In this sense, they are equal and have the same status. However, prosodic typing of *wh*-in-situ in this analysis does not have the same status as the morpho-syntactical typing in that prosodic elements can only indicate the illocutionary force of an ambiguous sentence when morpho-syntax fails to properly type such a sentence, which still remains ambiguous at interfaces. Recall that prosodic licensing is only activated when syntax is not sufficient to generate different interpretations in different contexts. This is the reason why in a simple unambiguous context, such as in (55), no prosodic form is needed. From this point of view, prosodic marking only works as a last resort, which confirms the assumption that the output of the computational system should not be ambiguous and that illocutionary force must be overtly realized in actual conversational situations.

Another technical question is how to treat these prosodic forms in formal mechanisms. One possible way is to treat them either as an overt realization of the related operators that bind *wh*-words as variables (i.e. the QU-operator in the sense of Aoun & Li 1993 or unselective binders in sense of Tsai 1994) or as the triggers that activate these operators. However, this view of things gives another technical difficulty. In the so-called T-model of the representation, the PF (Phonetic Form) branch and the LF (Logical Form) branch are separated after Spell-Out and prosodic forms are only realized after Spell-Out at the PF side. Technically, there is no direct interaction between these two branches after Spell-Out. Thus, one question is how prosodic elements located at PF influence the interpretation at LF. A possible solution is to allow different prosodic forms to be generated in the Lexicon as phonetic features before the numeration process begins. During the computation process, even after the operation Transfer, these prosodic elements are still combined with lexical items at LF. Therefore, it is

reasonable to treat them as the realization of the relevant operators which bind in-situ *wh*-words as variables and give them corresponding readings. Different combinations of the word stress with the intonation construct Referent-sets in the sense of Reinhart (2006) and each referent-set corresponds to one and only one specific semantic interpretation, and this guarantees a single output at interfaces. In this sense, word stress and sentential intonation enter into the numeration as a part of the Lexicon in the computational system. Let us take (56) for example. The four referent-sets are given below.⁷

- (57) a. {ta, zai, chi, zhe, shenme, ↑} → Q (=56a)
 b. {ta, zai, CHI, zhe, shenme, →} → ∃ (=56b)
 c. {ta, zai, chi, zhe, SHENME, ↓} → ! (=56c)
 d. {TA, zai, chi, zhe, shenme, ↓} → Q! (=56d)

(57a-d) represent four different sets of Lexicon and after Spell-Out, prosodic elements, such as ↑, → or ↓, combined with the phonetic form of the lexicon are transferred to the PF branch. Each output at LF corresponds to a single fixed PF output, and this ensures that the output of the computational system is no longer ambiguous at interfaces.

Every ambiguous licensing context has its key element; only when a *wh*-word appears in the c-command domain of this element is the former considered to be within such a context. From this perspective, *wh*-subjects, *wh*-direct objects and *wh*-adverbials do not behave uniformly. For instance, in an ambiguous context constructed by probability adverbs, the *wh*-adverbial *shenme difang* ‘where’ can have an existential reading because it is c-commanded by probability adverbs (cf. 58); whereas the *wh*-subject *shei* ‘who’ cannot get a ∃-reading because it is located outside the c-command domain of these adverbs (cf. 59).

(58) *probably* > *wh*-element

a. 她一个人大概会去什么地方

Ta yi-ge ren **dagai** hui qu shenme difang

she one-CL person probably would go what place

‘She would probably go somewhere alone (for relaxing...)’ (∃) with prosody

‘Where would she probably go alone?’ (Q) with prosody

⁷ Capitalized words are stressed; ↑ = rising intonation; → = neutral intonation; ↓ = falling intonation.

b. 她可能会在什么地方哭

Ta **keneng** hui zai shenme difang ku
she probably would at what place cry
'She is probably crying somewhere.' (∃) with prosody
'Where is she probably crying?' (Q) with prosody

(59) *wh*-subject > *probably*

谁 {肯定 / 也许 / 可能} 会来?

Shei { **kending** / **yexu** / **keneng** } hui lai?
who certainly/ maybe/ probably will come

'Who will {certainly/ maybe/ probably} come?' (Q) without prosody

* 'Someone will {certainly/ maybe/ probably} come.' (*∃)

Let me summarize the distribution of the existential reading and the interrogative reading in an ambiguous licensing context. For the \exists -reading, if the *wh*-element is generated within the scope of the key-element of an ambiguous licensing context, it is possible for the relevant *wh*-word to get an existential reading and such a \exists reading is always obligatorily licensed by a prosodic contour. In this case, the negative value [-Q] of this *wh*-word is taken. By contrast, if the *wh*-word is generated outside the scope of the key-element, it cannot get an \exists -reading. As for the Q-reading, if the *wh*-element is generated within the scope of the key-element, it is possible for this *wh*-word to get an interrogative reading and this Q-reading requires a specific prosodic contour. If the *wh*-word is generated outside the scope of the key-element, it can also get an interrogative reading; however, the Q-reading in this case is the inherent default interrogative reading of the *wh*-word and no special prosodic form is required and the positive value [+Q] of this *wh*-word is taken. In other words, if and only if the relevant *wh*-word is generated within the scope of the key-element of an ambiguous licensing context, it is considered to be within this context and the *wh*-word keeps its underspecified bi-values [\pm Q]. In this case, both \exists -reading and Q-reading are possible under the prosodic licensing. However, when the relevant *wh*-word is generated outside the scope of the key element, it is thus not within this licensing context; instead, it is considered to be in a simple context. In this case, only the weak default positive value [+Q] is activated. Note that certain islands, such as the complement clause of noun in (60) behave exactly like ambiguous licensing contexts.

- (60) 张三打死了什么人的谣言是真的
 Zhangsan da-si-le shenme ren de
 Zhangsan hit-die-Perf what person DE
 yaoyan shi zhende
 rumor is true
 ‘For what person x, the rumor that Zhangsan hit x to death is true?’ (Q)
 ‘The rumor that Zhangsan hit someone to death is true.’ (∃)

6.3 Theoretical consequences

6.3.1 Cases that prosodic licensing does not look into

When the *wh*-adjunct *weishenme* ‘why’ is embedded within a complex-NP island, the relevant sentence is ungrammatical. As suggested by Tsai (1994), a *wh*-adverb is itself an operator and undergoes LF-movement to the scope position and this movement cannot cross island boundaries. In the prosodic licensing analysis, a *wh*-adverb does not bear underspecified features but bears a single feature with a positive interrogative value [+Q]. In any type of licensing context, ambiguous or unambiguous, it is always the default interrogative reading of the *wh*-adverb that is activated. This Q-reading is either interpreted correctly when the locality constraint is obeyed or is blocked when islands intervene.

6.3.2 Interface repairing strategy

As the reader will notice, prosodic licensing is costly in terms of the Economy Principle in the Minimalist Program. How come can the computational system tolerate such a mechanism? Pan’s (2011b) answer to this question is inspired by the notion of “repair system” proposed by Reinhart (2006). Her main idea is that when a syntactic form is not sufficient to generate different semantic interpretations at LF, some other mechanisms will be activated to disambiguate the sentence and these mechanisms are treated as repair system. For instance, Main Stress Shift is an operation which creates different stress patterns that construct Reference-sets. Each pattern corresponds to one and only one specific focus structure, and each focus structure corresponds to one and only one specific semantic reading. These repair mechanisms are costly in the sense of the economy principle; however, the computational system still tolerates them since they do not create any interpretation redundancy. Similarly, in Pan’s analysis, different prosodic elements combined with sentence intonation and word stress generate different semantic interpretations at LF. Prosodic elements can trigger the relevant

operators, such as the interrogative operator, the existential quantifier and etc., to bind in-situ *wh*-variables by providing them with corresponding readings. The mapping between prosodic patterns and semantic interpretations is strictly “one-to-one”. There are no two different prosodic forms which give the same semantic output. When a certain prosodic form is used, it ensures that one and only one semantic interpretation is obtained at interfaces. During this process, no interpretive redundancy is created, and the economy principle is not violated. Therefore, such a repair mechanism is tolerated by the computational system.

7. Concluding remarks

This paper presents a historical review on the analyses of *wh*-in-situ in Chinese. We start from QR and LF-movement analysis of *wh*-in-situ proposed by Huang (1982). This analysis essentially treats *wh*-phrases in Chinese as quantifiers. By contrast, the unselective Op-binding approach of Tsai (1994) takes a different point of view. The in-situ *wh*-nominals are systematically bound by a null Op which is located at the sentential level (i.e. the CP level) and *wh*-adverbs are intrinsically operators and undergo LF-movement. Based on the Clausal Typing Hypothesis of Cheng (1991), Pan (2011b, 2019b) suggests that in addition to the morpho-syntactic typing, the prosodic typing should also be taken into consideration with regard to Clausal Typing. If we take the combination of the word stress with the sentence intonation contour as a part of the Lexicon before the numeration, then the corresponding prosodic form behaves exactly like a sentence type in the original sense of Cheng (1991). Therefore, in an ambiguous licensing context, a sentence containing an in-situ *wh*-nominal can be typed by prosody either as a question or as a normal declarative sentence with an existential reading of such a *wh*-word. The analysis based on the prosodic licensing of *wh*-in-situ in Chinese is also theoretically supported by the intonation morpheme licensing of *wh*-in-situ questions in French proposed in Cheng & Rooryck (2000). Prosodic licensing mechanism only deals with ambiguous cases in which the same syntactic form corresponds to several possible semantic interpretations. What a specific prosodic form does is to save the undesirable situation in which the potential output of the computational system is still ambiguous at interfaces. Another way to look at the Clausal Typing is to treat it as some kind of filter at interfaces. Any sentence that is not “typed” is not going to be properly interpreted at interfaces. Thus, the prosodic licensing of *wh*-in-situ in Chinese can be regarded as a necessary component which is required by the computational system. The computational system will activate prosody as a repair system in order to ensure that only one possible interpretation is obtained as the unique

output at LF; otherwise, the computational system will filter the uninterpretable ambiguous *wh*-sentences.⁸

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⁸ For a detailed analysis of *wh*-in-situ in Chinese and further related issues, such as *wh*-ex-situ, different types of A'-dependencies, the reader can refer to Pan (2011a; 2014; 2015 a, b; 2016 a, b), Pan & Paul (2016) and Paul & Pan (2017).

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