

**“Who wrote a thesis that is on what”: Examining island  
constraints on wh-in-situ**

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## Summary

This study aims to examine the long-standing generalization in syntax literature that argument wh-in-situ is insensitive to island effects (Huang 1982a, 1982b; Tsai 1994a, 1994b, 1999; Cheng 2009). Two acceptability judgment experiments were conducted. In experiment 1, we tested if there is an asymmetry in sensitivity to complex-NP island between argument and adjunct wh-in-situ in Mandarin Chinese. In experiment 2, we tested if argument wh-in-situ in English multiple wh-question show insensitivity to complex-NP island constraint. Our results show that: (a) there is no argument-adjunct asymmetry in Chinese wh-in-situ island sensitivity, and (b) argument wh-in-situ is sensitive to complex-NP island constraint in both Chinese and English.

## 1. Introduction and Background

It has long been assumed in the syntax literature that argument wh-in-situ is not sensitive to complex-NP island constraints (Huang 1982a, 1982b; Tsai 1994a, 1994b, 1999; Cheng 2009).<sup>1</sup> Based on two formal acceptability rating experiments (Sprouse 2007; Sprouse, Wagers, and Phillips 2012; Sprouse and Hornstein 2013) examining island sensitivity of wh-in-situ in Mandarin Chinese and English, this paper argue that contrary to long standing generalizations, argument wh-in-situ are sensitive to complex-NP islands (Ross 1967). We argue that our finding is most compatible with the theory of wh-in-situ where both argument and adjunct wh-phrases undergo the similar movement process, namely phrasal movement.

Studies of wh-in-situ in Chinese have identified the following generalization, known as the argument-adjunct asymmetry: argument wh-in-situ (e.g., *shenme* ‘what’, *shei* ‘who’) is not sensitive to islands, but adjunct wh-in-situ (e.g., *weishenme* ‘why’, *zenmeyang* ‘how’) is severely constrained by islands (Huang 1982a, 1982b; Tsai 1994a, 1994b, 1999; Lasnik and Saito 1992; Xu 1990). For example, in (1), a wh-DP *shenme*, ‘what’ in (1a), and a wh-adjunct *weishenme*, ‘why’ in (1b), are embedded within a relative clause (the complex-NP constraint: Ross 1967).<sup>2</sup> It has been reported that (1a) is more acceptable than (1b) (Tsai 1999, 42-43).<sup>3</sup>

(1) a. Argument

Akiu kan-bu-qi [<sub>NP</sub>[<sub>CP</sub> e<sub>i</sub> zuo shenme de] ren<sub>i</sub>]?

Akiu look-not up [<sub>NP</sub>[<sub>CP</sub> e<sub>i</sub> do what REL] person<sub>i</sub> ]?

“What is the thing/job x such that Akiu despises [people [who do x]]?”

b. Adjunct

\* Akiu xihuan [<sub>NP</sub>[<sub>CP</sub> Luxun weishenme xie e<sub>i</sub> de] shui<sub>i</sub>]?

Akiu like [<sub>NP</sub>[<sub>CP</sub> Luxun why write e<sub>i</sub> REL] book<sub>i</sub>]?

“What is the reason x that Akiu likes [books [that Luxun wrote for x]]?”

Similar to wh-in-situ in Chinese, the lack of island constraint on argument wh-in-situ has also been reported in English multiple wh-questions (Kuno and Robinson 1972) through informal judgment (Huang 1982a). In example (2a), the argument wh-in-situ *what* is embedded within a complex-NP construction. It is considered to be more acceptable comparing to its overt movement counterpart as shown in (2b), and similar results have been reported in formal judgment experiments (Sprouse, Fukuda, Ono, and Kluender 2011).

- (2) a. Who told the train conductor about [<sub>NP</sub> the girl [<sub>CP</sub> that lost what]]?  
b. \*What did the train conductor hear about [<sub>NP</sub> the girl [<sub>CP</sub> that lost \_\_ ]]?

There are several approaches to the lack of island constraint on argument wh-in-situ. One approach attributes the contrast in (1) to the Empty Category Principle (ECP) (Chomsky 1981, 1986; Lasnik and Saito 1984, 1992; Huang 1982b; Cheng 2009). It has been suggested that the subadjacency condition (Chomsky 1977, 1981, 1986) is an S-structure condition (or a constraint on overt phrasal movement), whereas ECP is an LF condition (or a constraint on covert movement) (Lasnik and Saito 1984, 1992). Since Chinese wh-in-situ does not undergo overt wh-movement, subadjacency condition should not be in effect. However, Chinese wh-in-situ should be sensitive to the ECP condition if it undergoes movement in LF. Under the ECP-based explanation, the trace left by an adjunct wh-element is not properly governed (specifically, an intermediate trace is not antecedent governed: see Chomsky 1981, 1986; Lasnik and Saito 1992) and thus violates ECP (Huang 1982a, 1982b; Lasnik

and Saito 1984, 1992). Following this argument, we would expect adjunct but not argument wh-in-situ to be sensitive to islands.<sup>4</sup> Following the similar reasoning, we can also explain the contrast in (2). In English multiple wh-question, wh-in-situ undergoes covert phrasal movement to Spec\_CP, and gets interpreted at Spec\_CP (Karttunen 1977; Huang 1982a, 1982b; Hornstein 1995; Pesetsky 2000). The two wh-elements can undergo a process called “Absorption” (Higginbotham and May 1981) during which two quantifiers can form a single “absorbed” binary quantifier on LF level. Therefore, the LF-level movement of wh-in-situ should be insensitive to subjacency condition, but overtly moved wh-elements should be constrained by subjacency condition, thus giving rise to the contrast in (2). This approach is also supported by the observation that an analog of “that-trace effect” (Perlmutter 1968), which is understood as an ECP violation (Lasnik and Saito 1984, 1992), applies to wh-in-situ in English multiple wh-questions, as shown in example (3) (Kuno and Robinson 1972):

- (3) a. \*I don’t know who expects that who will marry Mary.  
 b. I don’t know who expects who to marry Mary.

The contrast shown in (3) supports that ECP effect is at work in covert movements, while the reported acceptable status of (2a) supports that subjacency does not apply to covert movements.

More recent studies have suggested that argument wh-in-situ does not undergo movement and is therefore immune from island effects, whereas adjunct wh-in-situ undergoes covert movement and is thus sensitive to islands (Aoun and Li 1993; Chomsky 1995; Reinhart 1998; Stepanov and Tsai 2008; Tsai 1999). Reinhart (1998) proposed that wh-DPs can be interpreted in-situ via “choice function” (functions that

pick out a member of a non-empty set). Wh-adverbs, in contrast, do not specify an N-set and thus cannot be interpreted in-situ by choice function and have to move to Spec\_CP. Under this analysis, the so-called “argument-adjunct asymmetry” should be more precisely named “DP-Adverb asymmetry”, which is in-line with the observation that some non-adverbial adjunct wh-in-situ like “(for) what reason” are insensitive to island constraint. Similarly, Tsai (1999) formulated that wh-DPs are subject to unselective binding whereas wh-PPs are not. Thus, wh-DPs can create operator-variable pairs by means of unselective binding without resorting to wh-movement. Wh-PPs, on the other hand, cannot create operator-variable pairs by means of unselective binding and must undergo movement to do so. Stepanov and Tsai (2008) further proposed a distinction between two interpretations of the Chinese wh-element *weishenme* (the purpose-why/ ‘for what’ and the reason- why/ ‘why’) and claimed that unselective binding is available for ‘for what’ but not ‘why’. Therefore, certain interpretation of *weishenme* prompts movement of the wh-element, to which island constraint should apply. As in English multiple wh-question, this approach states that the argument wh-in-situ can be interpreted in its original position without movement (Baker 1970; Aoun and Li 1993; Reinhart 1997; Cheng 2009; Kotek 2016), and thus would not be affected by islands.

Other proposals based on analysis of multiple wh-questions stipulate that covert movement of wh-in-situ is local and thus is insensitive to islands (Dayal 1996; Abels and Dayal 2016). Following this analysis, long-distance pair-list reading in multiple wh-questions, which seemingly violates island constraint, can be achieved through pairing of individuals to higher-order propositions (e.g. island construction containing wh-in-situ is pie-piped to CP-periphery on LF). As a result, we would not



expect wh-in-situ to have any island sensitivity since there is no covert movement crossing island boundary.

Some studies explained the island sensitivity of wh-in-situ by introducing movements of a question feature, formulated either as a “wh-feature” (Pesetsky 2000), a possibly null question particle that undergoes “Q-movement” in overt syntax (Watanabe 1992; Hagstrom 1998), or a “Qu-operator” base-generated in a “Qu-projection” and bound by wh-in-situ (Aoun and Li 1993). The movement of such question particles (or features) to the Spec\_CP position is not constrained by (strong) islands (Lasnik 1995, Chomsky 1995, Ochi 2015). More specifically, it has been proposed that question particles adjacent to argument wh-in-situ can migrate to the island boundary before undergoing a second-step movement to Spec\_CP (Hagstrom 1998), or that adjunct wh-in-situ requires a local Qu-operator whereas argument wh-in-situ does not (Aoun and Li 1993). Therefore, argument wh-in-situ in Chinese and English involve only feature movement and are immune to island effect.

We should note that all the theoretical suggestions on the covert movement (or the lack thereof) of wh-in-situ are motivated by the contrasts illustrated by (1) and (2). First of all, contrast in (1) is mostly supported by informal judgment data points. Based on informal judgments, it seems that adjunct wh-in-situ in an RC island is indeed less acceptable than argument wh-in-situ.<sup>5</sup> However, it is not so clear whether this difference in acceptability arises because different wh-phrases are sensitive to different constraints. To the best of our knowledge, no experimental study of the syntax of Chinese wh-in-situ has offered a systematic examination of the argument-adjunct asymmetry. Furthermore, the contrast in English multiple wh-question as shown in (2) has been attested by formal acceptability judgment experiments

(Sprouse, Fukuda, Ono, and Kluender 2011), the details of which will be discussed in section 4.1.

An account of the argument-adjunct asymmetry shown in (1) requires a consideration of various factors that could potentially control the acceptability of wh-interrogative constructions. For example, argument and adjunct wh-elements, with different functions and meanings, could exert different effects on acceptability, regardless of island effects. Furthermore, to examine whether the argument-adjunct asymmetry shown in (1) is indeed due to wh-elements moving across island boundaries, examples like (1) should be compared to ones that lack island structures.

## **2. Systematic Test of Island Sensitivity**

Recent experimental syntax studies have established a methodology that can be used to examine island effects systematically (Sprouse 2007; Sprouse, Wagers, and Phillips 2012; Sprouse and Hornstein 2013; Dillon and Hornstein 2013; Kush, Lohndal, and Sprouse 2017). As Sprouse, Wagers, and Phillips (2012) showed, island effects can be characterized as super-additive interaction effects between the factor of dependency length and the presence or the absence of island structures. Sentences containing island structures are generally rated worse than sentences that do not contain island structures, and longer dependencies are generally rated worse than shorter dependencies that do not span embedded clause boundaries. Sprouse, Wagers, and Phillips (2012) showed that long-distance dependencies that span island boundaries results in greater acceptability decrease than what would be expected from the simple addition of the dependency length factor and the embedded structure factor; rather, the long-distance extraction from within an island structure exhibits a super-additive effect (see Kush, Lohndal, and Sprouse 2017 for a detailed discussion).

Following the same logic, if there is an difference in island sensitive between different wh-in-situ types, we would expect an extra layer of super-additive interaction between wh-category and island effect size, thereby leading to a three-way interaction of wh-category, dependency length, and embedded structures.

To test the island effects in wh-in-situ constructions, we can employ formal experimental syntax methodology. Simply put, if wh-in-situ is sensitive to islands, we can expect such super-additive interaction effects in an acceptability rating experiment. Furthermore, if adjunct wh-in-situ is more sensitive to islands, we can expect a three-way interaction of wh-element grammatical status, dependency length, and presence or absence of island structures.

### 3. Experiment 1

#### 3.1 Experimental Design

Experiment 1 aims to test the island sensitivity of Chinese wh-in-situ. We employed a  $2 \times 2 \times 2$  factorial design with *Dependency Length* (short vs. long), *Embedded Structure* (non-island vs. island), and *Wh-Category* (argument [who/what] vs. adjunct [why]) as independent factors. A sample set of stimuli with all 8 conditions is shown in table 1.

As shown in table 1, to make the scope of wh-questions explicit and unambiguous, we constructed embedded wh-questions with embedding verbs that take an interrogative clause as a complement, such as *xiangzhidao* ‘wonder’. Since previous literature concerning Chinese wh-in-situ argument-adjunct asymmetry most widely reported and discussed data points involving complex-NP islands, we used complex-NP island in our +island stimuli.<sup>6</sup> There were 24 items in total, and each item tested all eight of the conditions listed above.<sup>7</sup> All test sentences were distributed

to eight lists following a Latin square. Each list contained 24 test sentences and 72 filler sentences.<sup>8</sup> All lists were pseudo-randomized so that sentences of the same condition were not adjacent. Participants were instructed to rate the naturalness of the given sentences on a scale from 1 to 7, with 1 being unnatural and 7 being perfectly natural. A total of 56 native Chinese speakers living in the greater Chicago area were recruited as participants.

	Non-Island	
	Argument	Adjunct
Short	Yuehan xiangzhidao <b>shei</b> shuo nyuhai chi le shousi John wonders <b>who</b> say girl eat ASP sushi "John wonders who said that the girl ate sushi."	Yuehan xiangzhidao Bier <b>weishenme</b> shuo nyuhai chi le shousi John wonders. Bill <b>why</b> say girl eat ASP sushi "John wonders why Bill says t that the girl ate sushi."
	Yuehan xiangzhidao Bier shuo nyuhai chi le <b>shenme</b> John wonders Bill say girl eat ASP <b>what</b> "John wonders what Bill said that the girl ate."	Yuehan xiangzhidao Bier shuo nyuhai <b>weishenme</b> chi le shousi John wonders Bill say girl <b>why</b> eat ASP sushi "John wonders why Bill says that the girl ate sushi t."
	Island	
	Argument	Adjunct
Short	Yuehan xiangzhidao <b>shei</b> jianle chi shousi de nyuhai John wonders <b>who</b> meet ASP eat sushi REL girl "John wonders who met the girl that ate sushi."	Yuehan xiangzhidao Bier <b>weishenme</b> jian le chi shousi de nyuhai John wonders Bier <b>why</b> meet ASP eat sushi REL girl "John wonders why Bill met the girl that ate sushi."
	Yuehan xiangzhidao Bier yudao le chi <b>shenme</b> de nyuhai John wonders Bill meet ASP eat <b>what</b> REL girl "John wonders what Bill met the girl that ate."	Yuehan xiangzhidao Bier jian le <b>weishenme</b> chi shousi de nyuhai John wonders Bier meet ASP <b>why</b> eat sushi REL girl "John wonders why Bill met the girl that ate sushi."

Table 1: Example Set of Stimuli for Experiment 1

### 3.2 Predictions

As we have noted, it has been demonstrated that the island effect is characterized as the super-additive interaction effect of *Dependency Length*  $\times$  *Embedded Structure* (Sprouse, Wagers, and Phillips 2012). Therefore, if wh-in-situ is island sensitive, we would expect a super-additive interaction effect of *Dependency Length*  $\times$  *Embedded Structure*. We further manipulated the category of wh-phrases (the *Wh-Category* factor). If, as previous studies suggested (Huang 1982a, 1982b; Tsai 1994b, 1999), adjunct wh-in-situ exhibits greater island sensitivity than argument wh-in-situ, this greater sensitivity should be observed as a significant super-additive interaction. Thus,

we would expect a significant interaction of *Dependency Length*  $\times$  *Embedded Structure*  $\times$  *Wh-Category*. On the other hand, if adjunct wh-in-situ is not more sensitive to islands than argument wh-in-situ, we would not expect such three-way interaction, and we should observe a main effect of *Embedded Structure*.

### 3.3 Results

Acceptability rating scores were recorded and analyzed using a standard ordinal regression model (Christensen 2014). Acceptability rating (1 to 7) was treated as ordered variable predicted from the main effects and all two-way and three-way interactions of *Embedded Structure*, *Length*, and *Wh-category*. Random slopes and intercepts by subject and item were included. We found a significant main effect in *Embedded Structure* ( $\beta=2.20$ , SE  $\beta=0.371$ ,  $p<0.001$ ), *Length* ( $\beta=3.60$ , SE  $\beta=0.315$ ,  $p<0.001$ ), and *Wh-Category* ( $\beta=1.21$ , SE  $\beta=0.281$ ,  $p<0.001$ ). Sentences of +island conditions have lower ratings than those of -island conditions; sentences with long dependencies have lower ratings than those with short dependencies; sentences with adjunct wh-in-situ have lower ratings than those with argument wh-in-situ. There is also a significant interaction of *Embedded Structure*  $\times$  *Length* ( $\beta=2.15$ , SE  $\beta=0.393$ ,  $p<0.001$ ). We found no significant interaction in *Embedded Structure*  $\times$  *Wh-Category* ( $\beta=0.319$ , SE  $\beta=0.476$ ,  $p=0.503$ ) or *Length*  $\times$  *Wh-Category* ( $\beta=0.066$ , SE  $\beta=0.363$ ,  $p=0.855$ ). We found no significant three-way interaction of *Embedded Structure*  $\times$  *Wh-Category*  $\times$  *Length* ( $\beta=0.871$ , SE  $\beta=0.516$ ,  $p=0.091$ ). Mean acceptability rating scores for all conditions are shown in Figure 1.

To study island sensitivity of each *wh-category*, we then nested *Embedded Structure*  $\times$  *Length* within the levels of *Wh-Category*. We found significant interaction of *Embedded Structure*  $\times$  *Length* for both adjunct wh-in-situ ( $\beta=1.81$ , SE

$\beta=0.286$ ,  $p<0.001$ ) and argument wh-in-situ ( $\beta=2.47$ ,  $SE \beta=0.291$ ,  $p<0.001$ ). As shown in Figure 2, for both wh-in-situ categories, island conditions exhibit a greater degradation in acceptability compared to non-island conditions when Dependency Length changes from short to long.

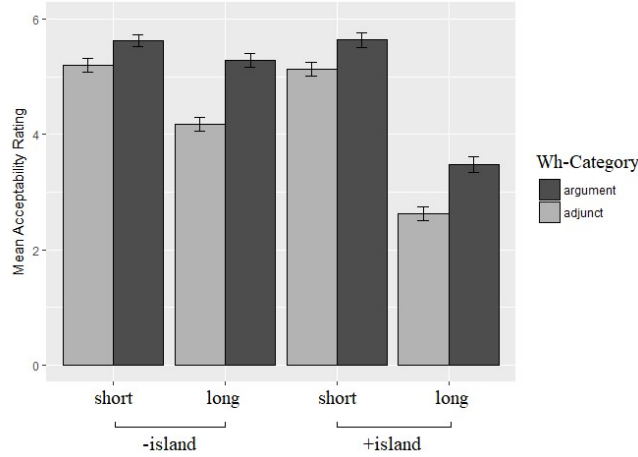


Figure 1: Mean Acceptability Rating Scores for Experiment 1

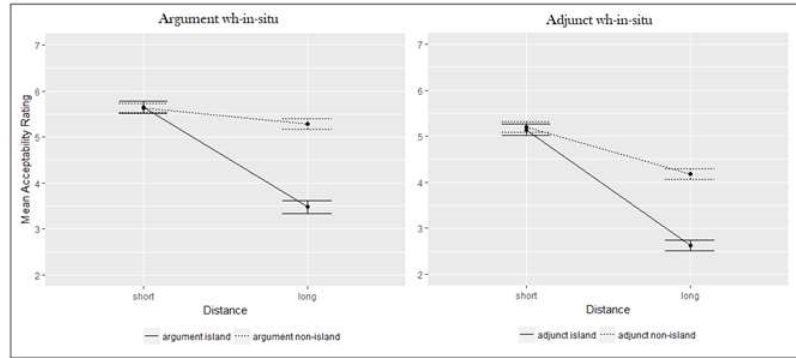


Figure 2: Interaction Plot for Experiment 1

### 3.4. Discussion

This study offers several findings. First, we observed a main effect in *Dependency Length*, where wh-in-situ located further away from scope position results in lower acceptability rating. This is consistent with findings in sentence processing literature, where Chinese wh-in-situ is found to be processed similarly to filler-gap

dependencies (Xiang, Dillon, Wagers, Liu, and Guo 2014). Second, both adjunct and argument wh-in-situ show significant interaction of *Embedded Structure*  $\times$  *Length*. That is, argument wh-in-situ exhibits RC-island effect, just like adjunct wh-in-situ.<sup>9</sup> Along with the length effect we detected, the island effect detected suggest that our experiment effectively excludes the echo question interpretation of wh-in-situ. We will see in experiment 2 how excluding echo question reading is not trivial. Third, adjuncts are not more sensitive to islands than arguments, and the cause of the observed argument-adjunct asymmetry shown in (1) is a *Wh-category* main effect.

Our result in experiment 1 raises an intriguing question: what led researchers to the generalization of argument-adjunct asymmetry in Chinese wh-in-situ island sensitivity in the past literature? It is important to note that the original observations by Huang (1982a, 1982b) and Tsai (1994a, 1994b) are by no means incorrect. The two example sentences in (1), cited from these works, refer to argument/+island/long condition and adjunct/+island/long condition in our design respectively. As shown in figure 1, argument/+island/long condition indeed has a higher acceptability rating than adjunct/+island/long condition. Thus, the argument-adjunct difference reported in (1) does exist. However, basing the claim that only adjunct wh-in-situ is sensitive to complex-NP solely on this data point is potentially problematic, as this observation can very well be referring to a wh-Category main effect rather than adjunct's extra-sensitivity to islands. Acceptability judgment of minimal pairs can point to the relevant main effects, but such methodologies are not designed to detect two-way or three-way interactions of factors. Thus, we speculate that the specific design of the judgment of minimal pairs experiment on the subject matter led to the generalization of argument-adjunct asymmetry in terms of island sensitivity over decades.

Another question our results may raise is why *weishenme* ‘why’ is judged worse than argument wh-in-situ in general. There are many possible reasons, but we tentatively suggest that it is because *weishenme* has multiple meanings (the *reason why* and the *purpose why*: see Stepanov and Tsai (2008) for detailed) and resolving this ambiguity might cause some difficulty. This point clearly requires more systematic investigation.

## **4. Experiment 2**

### **4.1. Sprouse et al. (2011)**

As mentioned earlier, Sprouse et al. (2011) tested the island sensitivity of wh-in-situ in the multiple wh-question context in English. As one of their many results, they found that wh-in-situ in English is not sensitive to complex-NP islands. However, their experimental design is not free of caveats, which motivate a slightly different design employed in experiment 2. In this section, I would like to review Sprouse et al. (2011) and address certain problems in their experimental design.

Sprouse et al. (2011) used a formal acceptability judgment study to show that argument wh-in-situ is insensitive to complex-NP island in English multiple wh-questions. The design has two caveats: first, multiple wh-questions as in (2a) can be interpreted in two ways. One is multiple wh-question interpretation where both of the wh-phrases are used to seek new information (or answers). Typically, the intended answer for the multiple wh-questions is in the form of multiple pairs as illustrated in (4) (Bechthoffer 1976; Erteschik-Shir 1986; Dayal 2002). On the other hand, (2a) can be interpreted as a single wh-question with an echo question. In this case, only the first wh-phrase is used to seek new information, and the other wh-phrase is used as



non-new-information-seeking echo question, and the intended answer is thus not a multiple pairwise answer (Sobin 1990; Kotek 2014). Since no question-answer pair or contextual information was provided along with the stimuli items in Sprouse et al. (2011), it is not certain whether participants are assuming wh-in-situ as taking matrix scope, or they are simply interpreting targets as echo questions. If the latter is true, island sensitivity would not be detected because there would be no movement on the LF level (Kotek 2014). To address this issue, we should note that multiple pairwise answers has been proposed as a diagnostic for multiple wh-questions (Dayal 2002; Kotek 2014). For example, the pairwise answer in example (4) would eliminate echo question interpretation:

(4) Q: Who ate what?

A: John ate an apple, and Mary sushi.

Thus, incorporating multiple pairwise answers in item design would eliminate potential confounds introduced by echo question interpretations of English multiple wh-questions.

Another issue about Sprouse et al. (2011) lies in its factorial design and is more subtle. Instead of using super-additive interaction of *Embedded Structure* and *Dependency Length* as a probe for island effect, Sprouse et al. (2011) manipulated *Embedded Structure* and *Question Type* (Single vs. Multiple wh-question) as independent factors. An example set of stimuli from their design that involves complex-NP islands is listed below:

(5) Example set of Stimuli (Sprouse et al. 2011)

a. Who heard that Jeff baked what? (-island/double-wh)

b. Who heard the statement that Jeff baked what? (+island/double-wh)

c. Who heard that Jeff baked a pie? (-island/single-wh)

d. Who heard the statement that Jeff baked a pie? (+island/single-wh)

This is a rather indirect test of island effect comparing to Sprouse et al. (2013). We should note that for +island/double-wh and -island/double-wh conditions (sentences (5a) and (5b)), wh-in-situ's are both situated within the embedded clause. In other words, these two conditions both have long dependency distance between wh-in-situ and Spec\_CP that spans clausal boundary of the embedded clause. Therefore, if we still adopt the definition of island effect as super additive interaction of *Embedded Structure*  $\times$  *Dependency Length*, the set of items presented in (5) would not suffice in testing for island effect.

#### 4.2. Experimental Design

Experiment 2 aims to test the island sensitivity of argument wh-in-situ in English multiple wh-questions. We employed a 2 $\times$ 2 factorial design with *Dependency Length* (short vs. long), and *Embedded Structure* (non-island vs. island) as independent factors. A sample set of stimuli with all 4 conditions is shown in table 2.

	Island	Non-island
<b>Short</b>	<p><b>Context:</b> John and Bill are chatting about some girls that ate something. A bus driver and a train conductor are curious about their conversation. John told the bus driver that a girl ate a cheeseburger, and Bill told the train conductor the same thing.</p> <p><b>Target:</b> Who told who about the girl that ate a cheeseburger?</p>	<p><b>Context:</b> John and Bill are chatting about some girls that ate something. A bus driver and a train conductor are curious about their conversation. John told the bus driver that a girl ate a cheeseburger, and Bill told the train conductor the same thing.</p> <p><b>Target:</b> Who told who that the girl ate a cheeseburger?</p>
<b>Long</b>	<p><b>Context:</b> John and Bill are chatting about some girls that ate something. A bus driver is curious about their conversation. John told the bus driver that one of the girls ate a cheeseburger, and Bill told him that a different girl ate sushi.</p> <p><b>Target:</b> Who told the bus driver about the girl that ate what?</p>	<p><b>Context:</b> John and Bill are chatting about some girls that ate something. A bus driver is curious about their conversation. John told the bus driver that one of the girls ate a cheeseburger, and Bill told him that a different girl ate sushi.</p> <p><b>Target:</b> Who told the bus driver that the girl ate what?</p>

Table 2: Example Set of Stimuli for Experiment 2

As shown in table 2, each target sentence is coupled with a preceding context paragraph. The context paragraphs are designed so that only pair-list answers are felicitous answers to the target questions. In this way, we can reduce echo question interpretations of our target sentences.

Same as in experiment 1, we used complex-NP island in our +island stimuli. There were 36 test items in total, and each item tested all four of the conditions listed in Table 2. All test sentences were distributed to four lists following a Latin square. Each list contained 36 context-target pairs and 64 context-target pairs. All lists were randomized and presented to participants on computer screens using Ibex Farm. Participants were instructed to read the context paragraphs and then rate the naturalness of the given target sentences on a scale from 1 to 7, with 1 being unnatural and 7 being perfectly natural. A total of 76 participants were recruited on Amazon Mechanical Turk as participants. All participants are self-reported native English speakers.

### **4.3. Predictions**

If argument wh-in-situ in English multiple wh-questions is sensitive to complex-NP island constraint, we would observe a significant interaction of *Embedded Structure* and *Length*. Otherwise, we would not observe a significant interaction of *Embedded Structure* and *Length*.

### **4.4. Results**

Acceptability rating scores were recorded through Ibex Farm and analyzed in the same way using a standard ordinal regression model as in Experiment 1. Acceptability rating (1 to 7) was treated as ordered variable predicted from the main effects and interactions of *Embedded Structure* and *Length*. Random slopes and intercepts by

subject and item were included. We found a significant main effect in *Embedded Structure* ( $\beta=0.38$ , SE  $\beta=0.099$ ,  $p<0.001$ ) and *Length* ( $\beta=1.18$ , SE  $\beta=0.103$ ,  $p<0.001$ ). Sentences of +island conditions have lower ratings than those of -island conditions; sentences with long dependencies have lower ratings than those with short dependencies. The interaction of *Embedded Structure*  $\times$  *Length* is also found to be significant ( $\beta=0.28$ , SE  $\beta=0.142$ ,  $p=0.045$ ). Mean acceptability rating scores for all conditions are shown in Figure 3. The significant interaction of *Embedded Structure*  $\times$  *Length* can be visualized in the interaction plot shown in Figure 4.

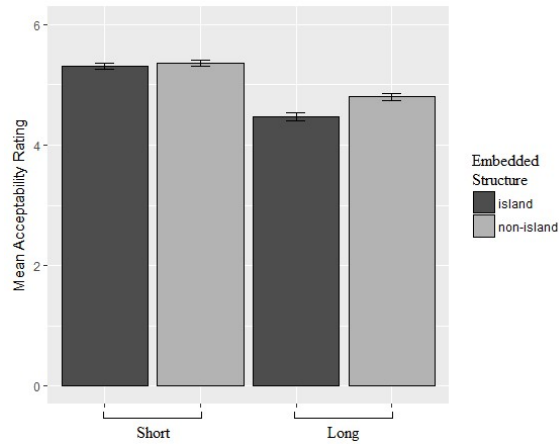


Figure 3: Mean Acceptability Rating Scores for Experiment 2

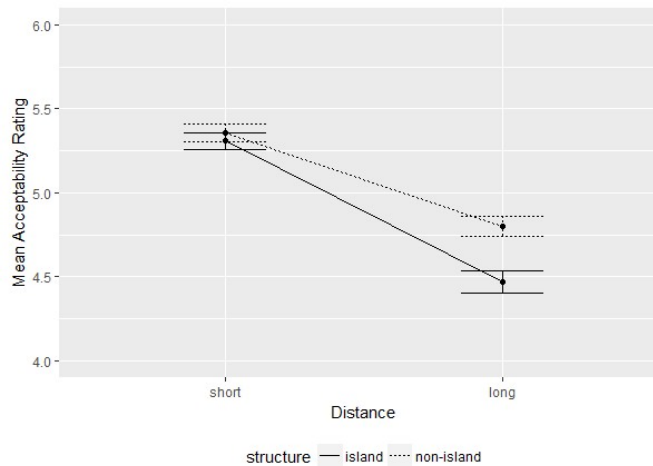


Figure 4: Interaction Plot for Experiment 2

#### 4.5. Discussion

There are two main findings in Experiment 2. First, there is a significant *Dependency Length* main effect. This is analogous to our finding in experiment 1 and is compatible with a covert-movement analysis of English wh-in-situ. Second, there is a significant interaction of *Embedded Structure*  $\times$  *Dependency Length*. This suggests that contrary to the arguments made in previous studies (Huang 1982a, 1982b, Sprouse et al. 2011), argument wh-in-situ in English multiple wh-question is sensitive to complex-NP islands.

We should note that the island effect detected in this experiment resembles the “subliminal island effect” reported by Almeida (2014) in terms of its small effect size and overall high acceptability rating of all conditions. A previous study on subliminal wh-islands reported that merely having one extra long-distance dependency in a sentence already containing a long-distance dependency would create a super-additive interaction effect (Keshev and Meltzer-Asscher 2018). This will not suffice as an explanation for our observation, since all conditions we tested are consistently multiple wh-questions with no difference in how many long dependencies they contain.

Why did Sprouse et al. (2011) failed to detect such island effect? As discussed in section 4.1, one possible reason is that they did not control for echo question interpretation of multiple wh-questions. Another possible reason is that *Question Type* rather than *Dependency Length* was included as an independent factor in Sprouse et al. (2011). It is also possible that they did not have enough item numbers and participants to detect this effect, given its small effect size.

## 5. General Discussion

Contrary to previous generalizations, results from Experiment 1 and 2 suggest that argument wh-in-situ is sensitive to complex-NP island constraint in both Chinese wh-questions and English multiple wh-questions. Furthermore, Experiment 1 also show that there is no argument-adjunct asymmetry in wh-in-situ island-sensitivity. We can draw the following theoretical implications.

Theories that states subjacency as an S-structure condition and ECP as an LF condition (Huang 1982a, 1982b; Lasnik and Saito 1984, 1992) predict a difference in island sensitivity between wh-Adverbs and wh-DPs in Chinese. These theories would also predict a lack of island effect in argument wh-in-situ in English. These predictions do not conform with our results from experiment 1 and 2. If we adopt the concept of island effect as super-additive interaction of Embedded Structure  $\times$  Dependency Length proposed by Sprouse et al. (2013), difference in island sensitivity should manifest significant three-way interaction of *Embedded Structure*  $\times$  *Wh-category*  $\times$  *Length*. More importantly, a larger magnitude in *Embedded Structure*  $\times$  *Length* interaction is predicted for wh-Adverbs than wh-DPs. However, no significant three-way interaction was found in experiment 1. Although the p-value for the three-way interaction is arguably small and might indicate marginal significance ( $p=0.091$ ), we should note that the direction of the effect underlying this marginal significance is numerically opposite from what Huang (1982a, 1982b) and Lasnik & Saito (1984, 1992) would predict. The *Embedded Structure*  $\times$  *Wh-category* interaction is found to be larger in magnitude for Wh-DPs. In addition, the significant main effect in *wh-category* indicates that wh-adverbs are indeed worse than wh-DPs in the complex-NP island context, but it is not due to a higher island sensitivity. Rather, wh-Adverbs are

judged worse than wh-DPs across the board, whether within an island or not.

Furthermore, the existence of a significant *Embedded Structure*  $\times$  *Length* interaction in experiment 2 is also not explained by these theories. To account for the island sensitivity of argument wh-in-situ in both Chinese and English, we would have to extend subjacency condition to the LF level so that it can affect covert movements.

We should note that the effect size of *Embedded Structure*  $\times$  *Length* interaction found in experiment 2 is arguably small comparing to what have been observed in single wh-question island extraction (Sprouse, Fukuda, Ono, and Kluender 2011; Sprouse and Hornstein 2013). We propose two possible explanation here. First, it is possible that even with supporting context favoring multiple wh-question reading, the echo-question reading is still available to the participants, and thus reducing the overall *Embedded Structure*  $\times$  *Length* super-additive interaction effect size. There are two ways such effect can play out. First, the target sentences are ambiguous between echo-question and multiple wh-question to the participants despite the supporting context. Second, the supporting context succeeds in disambiguating the target sentences. However, since there are grammatical echo-questions that are superficially identical to our target items, the acceptability in target items can be boosted in a way similar to the acceptable yet ungrammatical “Montalbetti sentences” (Montalbetti 1984). One famous example of an acceptable yet ungrammatical sentence is “More people have been to Russia than I have”, where a “grammaticality illusion” exists due to the sentence’s superficial resemblance of grammatical ones (Phillips, Wagers and Lau 2011).

Another explanation for a small *Embedded Structure*  $\times$  *Length* interaction effect size is that context can boost acceptability rating of a sentence whose meaning

is appropriate in the given context (Schütze 1996; Sprouse 2007). In experiment two, the contextual information made multiple wh-questions (target sentences) more plausible, and thus leading to a boost in acceptability rating which makes the island effect less obvious.

Our findings give rise to several theoretical implications. Theories that suppose that argument wh-in-situ does not move (Tsai 1994a, 1994b, 1999) predict no interaction of *Dependency Length*  $\times$  *Embedded Structure* for wh-DP. This is not supported by our finding in either experiment 1 or 2. Super-additive *Dependency Length*  $\times$  *Embedded Structure* interactions have been found in both Chinese and English argument wh-in-situ (see Figure 2 and 4). Other theories proposing the movement of a question particle (or feature) in the case of wh-in-situ would also be challenged: with no difference in island sensitivity across wh-categories, the claims that question particles adjacent to argument wh-in-situ can avoid island constraints by migrating to island boundaries (Hagstrom 1998) or by originating outside islands (Aoun and Li 1993) would also be unsupported by our findings.

Our findings challenge the long-standing generalizations that adjunct wh-in-situs in Chinese are sensitive to island while argument wh-in-situs are not, and that argument wh-in-situs are not island-sensitive in English multiple wh-questions. Thus, we can challenge the theories that capture such “argument-adjunct asymmetry” in wh-in-situ island-sensitivity. In other words, we can potentially discard the stipulation that subjacency condition is only a constraint for overt movements (Huang 1982a, 1982b), or that wh-DPs do not undergo covert movement while wh-Adverbs do (Tsai 1994a, 1994b, 1999), and thus attribute the island constraint on wh-in-situ solely to subjacency effects<sup>10</sup>. If subjacency effects are explained by phrasal movement, our



results should also suggest that both argument and adjunct wh-in-situ undergo phrasal movement.<sup>11</sup> In more modern frameworks of syntax, islands can be understood as spell-out domains (Uriagereka 1999; Nunes and Uriagereka 2000; Chomsky 2008), and once a domain is spelled-out the elements contained within are not accessible for further syntactic operations. In such framework, our results suggest that both argument and adjunct wh-elements are inaccessible after spell-out.

We have to note that the current study is limited to complex-NP island. To make a more generalized argument for or against argument-adjunct asymmetry, we should test other island types (e.g. adjunct island, subject island, etc.) adopting similar methodology. Specifically, we would consider investigating wh-islands as an important next step. It has been suggested that wh-in-situ in Chinese and Korean/Japanese show differences in terms of wh-island sensitivity (Watanabe 1992; Aoun and Li 1993). Sensitivity to wh-island has been taken as a key property to distinguish the two types of wh-in-situ. The experimental methodology that we employed in this study can be particularly useful to examine whether or not wh-in-situ in these languages show asymmetry in wh-island sensitivity.

## **6. Conclusion**

Through two acceptability judgment experiments in Chinese and English, we found that argument wh-in-situ show complex-NP island sensitivity. We also found that there is no argument-adjunct asymmetry in Chinese wh-in-situ island sensitivity. A covert (LF) movement analysis of wh-in-situ is thus supported, and we further propose that subjacency condition may apply to both covert (LF) and overt wh-movements.

## Endnotes:

<sup>1</sup>In this study, we restrict our attention to Chinese wh-in-situ, and we avoid investigating wh-in-situ in other languages and wh-in-situ in the multiple wh-questions (see Cheng 2009 for a survey of the syntax of wh-in-situ in a broader context). This limitation is due mainly to the lack of experimental data for wh-in-situ in other contexts, within Chinese or elsewhere, as a result of which we can develop experimental conclusions only about Chinese wh-in-situ of the type illustrated in (1). We will discuss broader issues with respect to wh-in-situ in Section 3.

<sup>2</sup> To keep the terminology theory-neutral, we call such islands “relative clause islands” (RC islands for short).

<sup>3</sup> In previous literature, Chinese argument wh-in-situ island insensitivity has been mostly presented in the context of relative clause islands like in example (1) (Huang 1982a, 1982b; Tsai 1994a, 1994b; Cheng 2009). Other studies also presented or cited examples with complex-NP islands as important data points among examples with other island types (Aoun and Li 1993; Watanabe 1992). Thus, we cited example (1) to illustrate previous arguments for asymmetry in Chinese adjunct/argument wh-in-situ island sensitivity.

<sup>4</sup> Notably, Lasnik and Saito's (1984, 1992) explanation included the possibility of deleting traces in LF, which is crucial to explaining the argument-adjunct asymmetry shown in (1). Because this study does not address the ECP per se, we do not explore the issue of trace deletion any further.

<sup>5</sup> Note that we are not claiming that the argument wh-in-situ is perfectly acceptable within RC islands. Cheng (2009, 769) put “??” to the example of the

argument wh-in-situ in English multiple wh-question context, suggesting that the argument wh-in-situ in a complex NP island is not perfectly acceptable.

(i) ??Who believe the claim that John said Mary saw who? (Cheng 2009, 769).

The same could hold true for Chinese wh-in-situ, even though native speakers of Chinese judge examples like (1a) as quite acceptable and detect a clear difference between (1a) and (1b). The most important point for us is that argument wh-in-situ is judged as better than adjunct wh-in-situ within the island context.

<sup>6</sup> Huang (1982a, 1982b), Tsai (1994a, 1994b), and Cheng (2009) all presented and discussed data points of Chinese argument-adjunct asymmetry involving complex-NP islands. Aoun and Li (1993) cited data points involving subject islands, adjunct islands, and complex-NP islands. Watanabe (1992) presented data points involving wh-islands and complex-NP islands.

<sup>7</sup> In the experiment, all the stimuli were shown in Chinese characters. Here, for the sake of readability, we show the Romanized examples.

<sup>8</sup> Filler items are sentences chosen to be apparently acceptable or unacceptable in Chinese. The 36 sentences include simple SVO sentences joined by conjunctions, subject and relative clause constructions, cleft and pseudo-cleft constructions, and double object constructions. Unacceptable sentences include the same constructions as acceptable sentences, but with all copulas replaced by aspect markers, and aspect markers replaced by copulas. Filler items are matched in terms of average length and complexity (number of verbs per sentence).

<sup>9</sup> An anonymous reviewer raised a point that the acceptability degradation observed in -island conditions is possibly caused by interpretive ambiguity in -island/adjunct conditions but not from island sensitivity. In order to make sure

whether there is such an interpretive ambiguity, we have interviewed 5 native speakers of Chinese and asked whether they can detect ambiguity in any of the sentences we used in our experiment. According to the five native Chinese speakers, in -island/adjunct/long condition the word *weishenme* ‘why’ unambiguously modifies the embedded clause verb; in -island/adjunct/short condition, the word *weishenme* ‘why’ unambiguously modifies the matrix verb. Thus, we are confident that there is no interpretive ambiguity involved in the adjunct/-island conditions.

<sup>10</sup> In Huang (1982b), the observation of argument-adjunct asymmetry also motivated the distinction between two instances of Move  $\alpha$ : FOCUS and Move WH. Focus movement, or operation FOCUS, does not show argument-adjunct asymmetry in island sensitivity. Given our findings, we might also have to rethink if the distinction between FOCUS and Move WH operations is still motivated.

<sup>11</sup> By “covert movement”, we mean that in Chinese both wh-DP and wh-Adverb undergo the similar type of movement and they do not go through different processes of forming operator-variable pairs (as in phrasal movement vs feature movement). There are multiple possible analyses of movement, including copy theories (Chomsky 1995; Nunes 2001, 2004) and multidominance theories (Epstein, Groat, Kawashima, and Kitahara 1998; Gärtner 2002; Johnson 2010). In this study, however, we are not making claims favoring any of the specific analyses of movement.

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