Mandarin Chinese wh-in-situ argument–adjunct asymmetry in island sensitivity: Evidence from a formal judgment study

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Unlike adjunct wh’s-in-situ, argument wh’s-in-situ do not seem to be subject to island constraints in Chinese and other East Asian languages. This difference in island sensitivity between argument and adjunct wh’s-in-situ is known as argument–adjunct asymmetry in the theoretical literature. Recently, this long-established asymmetry is challenged by a formal judgment study. It was claimed in the study that this asymmetry is an illusion and both argument and adjunct wh’s-in-situ are subject to island constraints. The present study demonstrates that such a claim is not convincing because it is based on problematic experimental design. We designed two experiments to test the island effects on Chinese wh’s-in-situ. The results reaffirm that the argument–adjunct asymmetry in Chinese wh’s-in-situ is indeed present, contrary to the findings of previous formal judgment study, and they also corroborate our assumption that when object wh’s-in-situ like shénme ‘what’ are located inside a relative clause, they are subject to a pragmatic constraint, suggesting that the VP (formed by a verb and its wh-object) in the relative clause tends to describe the prominent/salient feature of the relativized nominal head.

KEYWORDS
island, wh-in-situ, argument–adjunct asymmetry, experimental syntax, acceptability judgment, pragmatic constraint

Introduction

In English and many other languages of Indo-European origin, a wh-phrase generally moves overtly to a clause-initial position in wh-interrogative sentences. As is well known, such a movement cannot cross islands, namely, the structures out of which a constituent cannot be extracted. One of the famous islands is the complex NP island, where the complex NP refers to the NP modified by a clause (Bošković, 2016). The complex NP island/constraint requires that extraction from a complex NP is not allowed (Ross, 1967). For example, the clauses ‘that wrote’ and ‘that John wrote’ modify the NP ‘the book’ in (1a) and (1b), respectively. They are islands. After who in (1a) moves out of the relative clause ‘that wrote’, the complex NP island/constraint will be violated, and the derived sentence will be ungrammatical. The same is true of (1b).
(1) a. "Who do you like the book, that [he] wrote?"
   b. "Why do you like the book, that John [wrote]?"

However, in Mandarin Chinese (hereafter ‘Chinese’) and other East Asian languages, wh-elements stay in situ. Furthermore, different from adjunct wh’s-in-situ, argument wh’s-in-situ do not seem to be subject to island constraints, as (2) shows.

(2) a. 

   'Who is the person x such that you like the book that (he/she) wrote?'

   You like who write Rel book.

   'Who is the person x such that you like the book that Zhangsan why write Rel shù?'

   book.

   'What is the reason x such that you like the book [that Zhangsan wrote for x]?'

This difference in island sensitivity between argument and adjunct wh’s-in-situ is known as argument–adjunct asymmetry in the literature. This phenomenon has drawn the interest of many scholars, and many influential hypotheses have been advanced to account for it (see Huang, 1982a,b; Lasnik and Saito, 1992; Aoun and Li, 1993a; Tsai, 1999; Cheng, 2009, among many others).

Inspired by the studies of Sprouse (2007), Sprouse et al. (2012), Sprouse and Hornstein (2013), Lu et al. (2020) used the acceptability judgment paradigm to investigate wh’s-in-situ in Chinese. They report that both argument wh’s-in-situ and adjunct ones are sensitive to the Complex NP Island. This study is interesting because if it is proved to be true, we would need to reconsider the existing theory of wh’s-in-situ that has been established based on the argument–adjunct asymmetry for wh’s-in-situ. Nevertheless, in this study we will point out that Lu et al.’s (2020) experimental design has some drawbacks, which make their findings unreliable. We critically note that when object wh’s-in-situ like shénme ‘what’ are located inside a relative clause, they are subject to a pragmatic constraint, suggesting that the VP (formed by a verb and its wh-object) in the relative clause tends to describe the prominent/salient feature of the relativized nominal head. Improving on the design in experimental materials, we conducted two experiments on Chinese wh’s-in-situ. The results of the experiments show that unlike adjunct wh’s-in-situ, argument wh’s-in-situ are not sensitive to island constraints, which is in line with the long-established findings on the issue at stake.

The logic of factorial design for isolating the island effects and the previous formal judgment study into wh-in-situ

Let us first expound the logic of the factorial design for isolating island effects, on which the previous formal judgment study into wh-in-situ, namely Lu et al. (2020) is based. Sprouse and his colleagues argue that the lower acceptability of island violating sentences results not only from the violation of a grammatical constraint, but also from such (non-grammatical) processing factors as dependency length and structure. In other words, the processing of dependency length and complex structure also contributes to the low acceptability of island violating sentences. With the dependency length in a sentence becoming longer, the processing load of the sentence will increase and its acceptability will decrease. Likewise, the complex structure (i.e., the structure containing island) is more difficult to process than the simple one (i.e., the structure without an island). Given this, Sprouse and his colleagues developed a factorial experiment design to isolate island effects, which has been fruitfully adopted by many researchers to study island effects in various languages (Sprouse, 2007; Sprouse et al., 2011, 2012, 2016; Almeida, 2014; Michel, 2014; Atkinson et al., 2016; Kush et al., 2018, 2019; Stepanov et al., 2018; Keshev and Meltzer-Asscher, 2019; Pañeda et al., 2020; Kush and Dahl, 2022). The first factor in such an experiment paradigm is Dependency Length, which has two levels: long and short. In the short condition, a wh-phrase moves from a position in the matrix clause to the sentence-initial position, and in the long condition a wh-phrase moves from a position within the embedded clause to the sentence-initial position. The second factor is Structure, which also has two levels: island and non-island. The island condition contains an island, and the non-island condition does not. After the two levels of each factor are crossed, four conditions are created, as is demonstrated with a complex NP island below.

(3) a. Who __ heard that Jeff baked a pie? (Non-island + short)
   b. What did you hear that Jeff baked __? (Non-island + long)
   c. Who __ heard [the statement that Jeff baked a pie]? (Island + short)
   d. What did you [hear the statement that Jeff baked __]? (Island + long)

   (Sprouse et al., 2016, p. 318)

The island effect can be isolated with the logic of subtraction. First, the total effect is quantified by calculating the difference between (3a) and (3d) (i.e., [3a − 3d]), and then the effect of dependency length can be captured by calculating the difference between (3a) and (3b) (i.e.,
and the effect of structure can be isolated by calculating the difference between (3a) and (3c) (i.e., [3a − 3c]). The island effect can now be obtained by subtracting the effect of dependency length and that of structure from the total effect. Put differently, the island effect can be quantified with the following formula: island effect = [3a − 3d] − [3a − 3b] − [3a − 3c]. If there is no island effect, the score for the island effect will be zero (in mathematic terms, [3a − 3d] = [3a − 3b] + [3a − 3c]). By contrast, if there is an island effect, the score for the island effect will be larger than zero. In other words, if the island effect is present, the total effect will be greater than the sum of the dependency length effect and the structure effect (in mathematic terms, [3a − 3d] > [3a − 3b] + [3a − 3c]), and the island effect is reflected by the super-additive effect. The island/super-additive effect can be identified statistically. If the island effect is present, there will be a significant interaction effect between the two factors: Dependency Length and Structure.

The formula for the island effect also has an equivalence like ‘island effect = [3d − 3c] − [3b − 3a].’ The formula can be interpreted as follows. [3b − 3a] can capture the effect of dependency length. If there is an island/super-additive effect, the difference between (3c) and (3d) should be greater than the difference between (3a) and (3b) though (3c) and (3d) appear to be different only by dependency length (Keshev and Meltzer-Asscher, 2019).

Inspired by the experimental paradigm in studying island effects, Lu et al. (2020) adopted a 2 × 2 × 2 factorial experiment design, involving the three factors such as Dependency Length (short vs. long), Structure (non-island vs. island) and Wh-Category (argument vs. adjunct). This gave the following eight conditions: (i) short + non-island + argument, (ii) long + non-island + argument, (iii) short + island + argument, (iv) long + island + argument, (v) short + non-island + adjunct, (vi) long + non-island + adjunct, (vii) short + island + adjunct, (viii) long + island + adjunct.

Consider the following sentences cited from their experiment, representing one set of their stimuli.

(4) Yuèhàn xiǎngzhídào shuí shuò nǎhái
John wonders who say girl
chi-le shouzi. (sh + nonisl + arg)
eat-Asp sushi.
'John wonders who said that the girl ate.'

(5) Yuèhàn xiǎngzhídào bièr shuò nǎhái
John wonders Bill say girl
chi-le shénme. (lo + nonisl + arg)
eat-Asp what.
'John wonders what Bill said that the girl ate.'

(6) Yuèhàn xiǎngzhídào shuí jiàn-le chi shōusi
John wonder who meet-Asp say girl
de nǎhái. (sh + isl + arg)
Rel girl.
'John wonders who met the girl that ate sushi.'

(7) Yuèhàn xiǎngzhídào bièr jiàn-le chi shénme
John wonder Bill meet-Asp eat what
de nǎhái. (lo + isl + arg)
Rel girl.
'John wonders what Bill met the girl that ate.'

(8) Yuèhàn xiǎngzhídào bièr wéishénme shuò nǎhái
John wonders Bill why say girl
chi-le shōusi. (sh + nonisl + adj)
eat-Asp sushi.
'John wonders why Bill says that the girl ate sushi.'

(9) Yuèhàn xiǎngzhídào bièr shuò nǎhái wéishénme
John wonders Bill say girl why
chi-le shōusi. (lo + nonisl + adj)
eat-Asp sushi.
'John wonders why Bill says that the girl ate sushi t.'

(10) Yuèhàn xiǎngzhídào bièr wéishénme jiàn-le chi
John wonder Bill why meet-Asp eat shōusi de nǎhái. (sh + isl + adj)
sushi Rel girl.
'John wonders why Bill met the girl that ate sushi.'

(11) Yuèhàn xiǎngzhídào bièr jiàn-le wéishénme chī
John wonder Bill meet-Asp why eat shōusi de nǎhái. (lo + isl + adj)
sushi Rel girl.
'John wonders why Bill met the girl that ate sushi.'

In these sentences, the verb xiǎngzhídào ‘wonder’ takes an interrogative clause as its complement. For the sake of exposition, we will name the complement of xiǎngzhídào ‘wonder’ as CP1. In the short condition, SpecCP1/C and the wh-phrase form mono-clausal dependency. If the wh-phrase is to move covertly to SpecCP1, such a movement in (4), (6), (8), and (10) will be a short-distance one. By contrast, in the
long condition, SpecCP₁/C₁ and the wh-phrase form bi-clausal dependency. If the wh-phrase is to move covertly to SpecCP₁, such a movement in (5), (7), (9), and (11) will be a long-distance one. The factor Structure controls for whether the complement of xiǎngzhīdào ‘wonder' contains an island (the island condition) or not (the non-island condition). The factor Wh-Category controls for whether the wh-phrase at hand serves the role of an argument or an adjunct.

There were 24 target items and 72 filler sentences for the experiment. The participants were instructed to rate the naturalness of sentences on a seven-point Likert scale, with 1 being completely unnatural and 7 being completely natural. Their findings show that for both argument and adjunct wh’s-in-situ, there was a significant super-additive interaction effect of Dependency Length × Structure. This is an intriguing result because if proved to be true, their findings pose a challenge to the long-standing generalization on argument–adjunct asymmetry in wh’s-in-situ. That is, argument wh’s in Chinese are not subject to island constraints, whereas adjunct whs are (see, for example, Tsai, 1999). However, a careful inspection of Lu et al.’s (2020) experiment design indicates that we cannot be highly positive about the significance of their experiment because there are some drawbacks with their study. First, argument wh’s-in-situ can occur in both subject and object positions. In their design, they used two argument wh’s-in-situ, namely shéi ‘who’ and shénme ‘what.’ Shéi ‘who’ occurred in the short condition, serving as a subject, while shénme ‘what’ occurred in the long condition, serving as an object. But only shénme ‘what’ was manipulated to occur inside an island (i.e., only the island effects on the object shénme ‘what’ was tested). With the Complex NP Island as a test case, they argued that both argument and adjunct whs are subject to island constraints. This conclusion was too hastily drawn because the subject shéi ‘who’ was placed outside an island in their design (i.e., the island effects on the subject shéi ‘who’ were not tested), and there is no compelling evidence that object wh’s-in-situ are a typical case for testing island sensitivity. Without a detailed study of island effects on subject wh’s-in-situ, it would be particularly inappropriate to jump to the conclusion that both wh-argument and wh-adjunct elements are sensitive to island constraints. Second, when the object wh-in-situ in the relative clause is shénme ‘what,’ the interpretation of the construction is susceptible to factors not bearing on island constraints. One of the factors is that when object wh’s-in-situ are in a relative clause, the construction is subject to a pragmatic constraint, suggesting that the VP (formed by a verb and its wh-object) in the relative clause tends to characterize the prominent feature of the relativized nominal head. To illustrate the point, consider (7). Its alleged low acceptability might be caused by pragmatic inappropriateness rather than by a violation of an island constraint. To be exact, (7) is taken to be unacceptable because—without a proper context—eating a certain thing is not the prominent feature of a girl. On the other hand, if we provide an appropriate context, (7) will become acceptable. Suppose that there are three girls in a street eating different kinds of things: One girl is eating a hamburger, another girl, an omelet, and the third girl, fried chicken. If both the speaker and the hearer share this common ground, (7) will be acceptable because, in this context, eating a certain thing is the characteristic feature of the girls at issue, and it is natural to ask what the girl that Bill met ate.

The argument to the effect of displaying the role of a pragmatic factor in the interpretation of an island-internal object wh-in-situ is that when we replace the lexical item in (7) with other appropriate ones, the resulting sentences such as (12)–(14) will become acceptable too.

(12) Yuèhàn xiǎngzhīdào bǐér qū-le yí-gè xiánhuan chí shènme de nǚhái. ‘John wonders what is the thing x such that Bill married the girl who likes eating x.’

(13) Yuèhàn xiǎngzhīdào bǐér mái-le yì-bēn guányǔ shènme de shū. ‘John wonders what is the thing x such that Bill bought a book that is about x.’

(14) Yuèhàn xiǎngzhīdào bǐér yǔdào-le jiào shènme de lǎoshī. ‘John wonders what is the thing x such that Bill met the teacher that taught x.’

For example, in the context of (12), the girl’s eating habit is important because after she and Bill got married, this would...

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3 We do not suggest that test sentences should be multiple questions, containing both subject and object wh’s-in-situ or that subject shéi ‘who’ should be placed in an island in the short + island + argument condition. We only argue that in Lu et al.’s (2020) experiment there should be one condition in which the subject wh-phrase shéi ‘who’ rather than the object wh-phrase shénme ‘what’ is manipulated to occur inside an island so that the island effect on the subject wh-phrase can be tested.

4 Pragmatic considerations are not relevant to the English counterpart of (7) because wh-phrases in English undergo overt movement, and their overt movement out of a relative clause violates the syntactic island constraint. Of course, it can be said that pragmatic factors help to reduce the acceptability of sentences like (i), but they, not being a main factor, can be ignored.

5 ‘What did Wallace meet a woman that hates? ’ One piece of evidence in support of our assumption that the ungrammaticality of (i) results from a syntactic constraint rather than a pragmatic constraint is that we cannot provide an appropriate context to make (i) acceptable, which is different from (7). See also Sichel (2018).
affect their relationship. Perhaps it will also affect John if he knows Bill. On this condition, it is natural to ask what the girl likes eating. The same kind of construal applies to (13). The content is a prominent feature of a book because in most cases whether the book can attract a person or not is dependent on its content. Consequently, it is valid to ask what the book that Bill bought is about. Likewise, teaching is the prominent feature of a teacher as the primary duty of a teacher is to teach. Given this, it is natural to ask what he taught, as in (14). However, Lu et al. (2020) fail to put the above pragmatic confounding factor under control.

To sum up, although Lu et al.’s (2020) results are intriguing, their experiment design still has at least two drawbacks: one is that they fail to study the island effects of subject wh’s-in-situ, and the other is that when studying the island effects of object wh’s-in-situ, they fail to put the pragmatic confounding factor under control. These drawbacks undermine their conclusions that argument wh’s-in-situ in Chinese are subject to an island constraint, and that there is no argument–adjunct asymmetry in wh’s-in-situ. In the next section, we will introduce our two experiments, in which the weaknesses of Lu et al. (2020) were resolved. In one experiment, the island sensitivity of subject wh’s-in-situ was tested, and in the other one, the island sensitivity of object wh’s-in-situ was tested with the pragmatic confounding factor under control.

Our experiments

Experiment 1: Island sensitivity of subject wh’s-in-situ

Participants

Ninety-six participants were recruited from a university in China, and each of them was paid 15 Yuan for taking part in the experiment.

Materials and methods

Correcting the potential problems with Lu et al.’s (2020) experimental design, we conducted an analogous experiment on the effects of the Complex NP island on wh’s-in-situ. Just as in Lu et al. (2020), the current experiment used a $2 \times 2 \times 2$ factorial design, based on the following three factors: Dependency Length (short vs. long), Structure (non-island vs. island), and Wh-Category (argument vs. adjunct). Hence, this yielded eight conditions. The following examples are one set of the eight conditions constructed.

(15) Zhántāo xiǎngzhídào shéi juéde Zhūlíng huì mài píngguǒ. (sh + nonisl + arg)

Zhangtao wonder who think Zhuling will buy apple.

‘Zhangtao wonders who thinks that Zhuling will buy apples.’

(16) Zhántāo xiǎngzhídào Zhūlíng juéde shéi hui mài píngguǒ. (lo + nonisl + arg)

Zhangtao wonder think who will buy apple.

‘Zhangtao wonders who Zhuling thinks will buy apples.’

(17) Zhántāo xiǎngzhídào shéi hui chī Zhūlíng mài de píngguǒ. (lo + isl + arg)

Zhangtao wonder who will eat Zhuling buy Rel apple.

‘Zhangtao wonders who will eat the apples that Zhuling bought.’

(18) Zhántāo xiǎngzhídào Zhūlíng hui chì shéi mài píngguǒ. (lo + isl + arg)

Zhangtao wonder Zhuling think who will buy Rel apple.

‘Zhangtao wonders who Zhuling thinks will buy apples.’

(19) Zhántāo xiǎngzhídào ni wèishénme juéde Zhūlíng hui mài píngguǒ. (lo+nonisl+adj)

Zhangtao wonder you why think Zhuling will buy apple.

‘Zhangtao wonders why you think that Zhuling will buy apples.’

(20) Zhántāo xiǎngzhídào ni juéde Zhūlíng wèishénme hui mài píngguǒ. (lo+nonisl+adj)

Zhangtao wonder you think Zhuling why will buy apple.

‘Zhangtao wonders what is the reason you think that Zhuling will buy apples for x.’

(21) Zhántāo xiǎngzhídào ni wèishénme hui chì Zhūlíng wèishénme mài de píngguǒ. (sh+isl+adj)

Zhangtao wonder you think Zhuling why think buy Rel apple.

‘Zhangtao wonders why, you think Zhuling bought.’

(22) Zhántāo xiǎngzhídào ni hui chī Zhūlíng wèishénme mài de píngguǒ. (lo+isl+adj)

Zhangtao wonder you will eat Zhuling why buy Rel apple.

‘Zhangtao wonders what is the reason x such that you will eat the apples that Zhuling bought for x.’

In total, there were 24 target items in this experiment, and each item consisted of the eight conditions listed above. We
thus had 192 target sentences. Using Latin Square, we assigned all of these sentences to eight lists. Consequently, each list had 24 test/target sentences and 72 filler sentences. With four practice sentences, each list had 100 sentences in total. Each list was pseudo-randomized, so that the sentences of the same experimental condition would not be adjacent. After that, each list was counterbalanced into four orders in order to remove the confounding factor of order.

Just like Lu et al. (2020), our test was administered with paper questionnaires. The participants were instructed to rate the naturalness of the sentences on a seven-point Likert scale, with 1 being completely unnatural and 7 being completely natural. As can be seen, our design was similar to that of Lu et al. (2020). Nevertheless, there were some crucial differences between our experiment and theirs. In our experiment we only employed shéi ‘who’ for the argument whs-in-situ. In the condition of short dependency, shéi ‘who’ served as the subject of the first embedded clause, and in the condition of long dependency, shéi ‘who’ served either as the subject of the second embedded clause or as that of the relative clause/CNP. In other words, the grammatical roles of argument whs-in-situ were held constant across conditions, which helped to exclude the confounding factors such as thematic role and word order. In addition, we carefully selected the words to ensure that in all the conditions, wh-phrases in long dependency were placed two words/four syllables further away from xiángzhídào ‘wonder’ than those in short dependency, which ensured that the effect of Dependency Length could be subtracted from the results.

Since wèishénme ‘why’ is ambiguous, the participants were told at the very beginning of the experiment that wèishénme ‘why’ in all the experimental sentences was to question the reason of an action/event, which is similar to the English counterpart why rather than for what. This was intended to prevent an unnecessary processing load caused by ambiguity resolution. To check whether the participants correctly understood the instructions, we asked them to provide answers to the experiment items. To be exact, they were told that xiángzhídào ‘wonder’ takes an interrogative clause as its complement. They were asked to provide an answer to the interrogative clause containing wèishénme. Their answers were supposed to be based on their interpretation of the wh-phrase in making the acceptability judgment—that is, whether under such an interpretation the relevant interrogative clause is unacceptable or not. If the participant’s answer to the question containing wèishénme is yīnwèi… ‘because…’ or yóuyú… ‘since…’, etc, it would indicate that he/she understood the instructions correctly. By contrast, if his/her answer to wèishénme is wèile… ‘for the purpose of…’, all his/her scores would be excluded from the data because he/she would have failed to understand our instructions.

As noted by Tsai (2008), when interpreted as ‘why’, wèishénme can only be used in front of the future modal hui. If preceded by the future modal hui as in (23a), it cannot be interpreted as ‘why’. However, if in this context it is interpreted as ‘for what’, as wèile shénme is in (23b), then the sentence will be acceptable. Based on Tsai (2008), we added some filler items like (23). If a participant’s mean acceptability score for fillers like (23a) is higher than 5, then all his/her rating scores would be removed from the resulting data even if his/her answer to wèishénme is yīnwèi… ‘because…’ or yóuyú… ‘since…’. The reason is that giving such a high score might indicate that the participant unconsciously interpreted wèishénme as ‘for what’, defiance of our instruction.

(23) a. Zhăngsăn xiángzhídào Lǐsī hui wèishénme cídiào nàfèn gōngzuò. 
ZHANGSAN wonder LISHI two whs-question what part work.
Zhăngsăn wonder Lǐsī wèishénme cídiào nàfèn gōngzuò. 
Zhangsan wonder Lisi why question what part work.
why quit that job.
‘Zhăngsăn wonders why Lisi will quit that job.’

b. Zhăngsăn xiángzhídào Lǐsī hui wèile shénme cídiào nàfèn gōngzuò. 
Zhangsan wonder Lisi two wh-s-question what part work.
what quit that job.
‘Zhăngsăn wonders what part Lisi will quit that job.’

Predictions
If Lu et al. (2020) are on the right track, we expect that there should be no difference between argument and adjunct whs-in-situ in terms of island effects. Put differently, there should be a super-additive interaction, or a super-additive effect between Structure and Dependency Length factors for both argument and adjunct whs-in-situ. If this is true, we should also expect no three-way interaction of Structure × Wh-Category × Length. On the contrary, provided that argument and adjunct whs-in-situ are different in terms of island effects, we should expect to find a significant three-way interaction in Structure × Wh-Category × Length.

Results
We found that wèishénme was correctly interpreted by all the participants. Then, following Sprouse et al. (2012) and Kush et al. (2018), among others, we built a regression model to analyze the acceptability rating scores. Using the Lme4 package in R (R Core Team, 2021), we constructed linear mixed-effects models, with Structure, Dependency Length, WH-category, and their interactions as the fixed effects. Each model was initially built with maximum random intercepts and random slopes for participants, and the random slope was eliminated stepwise if the model failed to converge. We calculated p-values for the main effects of Structure, Dependency length, WH-category, and their interactions using the lmerTest package.
The results showed a significant main effect of Structure ($\beta = 1.87$, SE = 0.14, $t = 13.69, p < 0.001$), of Length ($\beta = 4.34$, SE = 0.11, $t = 40.01, p < 0.001$), and of Wh-Category ($\beta = 3.94$, SE = 0.12, $t = 31.88, p < 0.001$). Contrary to the findings of Lu et al. (2020), there were significant effects of two-way interactions such as Structure $\times$ Length ($\beta = -2.46$, SE = 0.15, $t = -16.02, p < 0.001$), Structure $\times$ Wh-Category ($\beta = -3.26$, SE = 0.17, $t = -19.23, p < 0.001$), and Length $\times$ Wh-Category ($\beta = -3.91$, SE = 0.15, $t = -25.52, p < 0.001$). Furthermore, we did find that there was a significant interaction in Structure $\times$ Wh-Category $\times$ Length ($\beta = 2.23$, SE = 0.22, $t = 10.29, p < 0.001$). See also the Supplementary material for the complete model results.

On a par with Lu et al. (2020), we also put Structure $\times$ Length under the levels of Wh-Category to examine the island sensitivity effect of each wh-category. The result showed that as for the wh-adjunct wěishénme, there was a significant super-additive interaction effect between Structure and Dependency Length ($\beta = -2.46$, SE = 0.19, $t = -12.81, p < 0.001$). As for the wh-argument shéi in subject position, however, no super-additive effect was observed ($\beta = -0.23$, SE = 0.15, $t = -1.52, p = 0.13$). In other words, the wh-argument and the wh-adjunct exhibited a significant difference regarding island effects. This can be seen clearly in Figure 1 where the left panel shows the interaction plot for argument wh-in-situ and the right panel presents the interaction plot for adjunct wh-in-situ.

The mean acceptability scores are presented in Figure 2, with the error bars representing the standard errors.

As can be seen from Figure 2, it is not the case that the argument wh-in-situ is generally rated to be better than the adjunct wh-in-situ, contrary to the findings of Lu et al. (2020). In the short + island condition, the argument and the adjunct wh-in-situ exhibit no significant difference in acceptability. Notably, in the short + non-island condition, the adjunct wh-in-situ is generally rated to be better than the argument wh-in-situ. However, it is in the long + island condition that the adjunct wh-in-situ is significantly worse than the argument wh-in-situ, with their mean rating scores being 2.20 and 6.14, respectively.

**Experiment 2: Island sensitivity of object wh’s-in-situ**

It is pointed out in Section “The logic of factorial design for isolating the island effects and the previous formal judgment study into wh-in-situ” that when the object wh-in-situ shénme ‘what’ is in a relative clause island, its interpretation
is susceptible to factors not bearing on the Complex NP Constraint. Specifically, the object wh-in-situ in the relative clause is subject to a pragmatic constraint, such that the VP (formed by a verb and the following wh-object) in the relative clause is bound to characterize the prominent feature of the relativized nominal head. In this experiment, putting this pragmatic confounding factor under control, we intend to ascertain whether there is argument-adjunct asymmetry in island sensitivity of wh-in-situ.

Participants
Another group of 64 participants were recruited from a university in China, and each of them was paid 15 Yuan for taking part in Experiment 2.

Materials and methods
Just like Lu et al.'s (2020) experimental design, the current experiment also employed a 2 × 2 × 2 factorial design, based on the following three factors: Dependency Length (short vs. long), Structure (non-island vs. island), and Wh-Category (argument vs. adjunct). Therefore, this yielded the eight conditions. Similar to Lu et al.’s (2020) experimental design, but different from our Experiment 1, the wh-in-situ in the short condition is served by shéi ‘who,’ and the one in the long condition is served by shénme ‘what.’ The following examples are one representative set of the eight conditions constructed.

| Condition | Example |
|-----------|---------|
| (24) short nonisl arg | Zhōuyōng xiǎngzhīdào shéi juéde lièrén huì bǔshā jǐngyú. (sh + nonisl + arg) | Zhouyong wonder who think hunter will kill whale 'Zhouyong wonders who thinks that the hunter will kill whales.' |
| (25) long nonisl arg | Zhōuyōng xiǎngzhīdào zhèngfǔ juéde lièrén huì bǔshā shénme. (lo + nonisl + arg) | Zhouyong wonder government think hunter will kill what ‘Zhouyong wonders what the government thinks that the hunter will kill.’ |
| (26) short isl arg | Zhōuyōng xiǎngzhīdào shéi huì chéngfá bǔshā jǐngyú de lièrén. (sh + isl + arg) | Zhouyong wonder who will punish whale Rel hunter ‘Zhouyong wonders who will punish the hunter that kills whales.’ |
| (27) long isl arg | Zhōuyōng xiǎngzhīdào zhèngfǔ hui chéngfá bǔshā shénme de lièrén. (lo + isl + arg) | Zhouyong wonder government will punish what Rel hunter ‘Zhouyong wonders what is the thing x such that the government will punish the hunter who kills x.’ |

7 In this experiment, we recruited 64 participants rather than 96 participants because this can make the number of participants close to the one in Lu et al.’s (2020) experiment. In so doing, we are able to demonstrate that the number of participants is not a factor that leads to the lack of argument/adjunct asymmetry in Lu et al.’s (2020) experiment.
Zhouyong wonders why the government thinks that the hunter will kill whales.

Zhouyong wonders what is the reason x such that the government thinks that the hunter will kill whales for x.

Zhouyong wonders why the government will punish the hunter who kills whales.

Zhouyong wonders what is the reason x such that the government will punish the hunter [who kills whales for x].

Another set of three experimental sentences for the long + island + argument condition is shown below to demonstrate how the pragmatic confounding factor is controlled for.

As can be seen in (32)–(34), all the verbs in the relative clauses are related to the prominent features of the relativized nominal heads. To illustrate this point, consider (32). The relativized nominal head jǐngchá ‘policeman’ has different kinds of features. He can engage in different kinds of actions. For example, a policeman can drink water, watch TV, read books, inspect something, etc. In the context of (32), the feature like ‘inspect something’ becomes prominent because after reading ‘Yánliàng will bribe the policeman, ’ one expects to know something associated with this policeman’s duty. Put differently, the use of the verb jǐanchá ‘inspect’ can render the whole sentence coherent. By contrast, if we change this verb to chī ‘eat’ or hē ‘drink,’ the acceptability of the sentence such as (35) will decrease substantially because ‘eat something’ and ‘drink something’ are not prominent actions or features associated with jǐngchá ‘policeman.’

Consider also (33). When one wants to recruit a salesperson, he will pay attention to the person’s ability or specialty. Therefore, being good at something will be one of the prominent features of this person. The same is true of (27) and (34). The main activity associated with a hunter is to capture and kill something, and the main function of news is to report something. In other words, būshā ‘capture and kill’ and bào ào ‘report’ are used to describe the prominent features of the corresponding relativized nominal heads. For more discussion about the notion of prominence adopted in this study, see Ariel (2019) and references therein, among others.

Other designs of this experiment are similar to those of Experiment 1. For example, just like Experiment 1, we also
used four lexicalizations of the sentence type in (23a) (repeated as (36)) as part of our filler items. If a participant's mean acceptability score for sentences like (36) was more than 5, all his/her scores would be removed. For the sake of space and simplicity, we will not reiterate the introduction of the experiment design.

(36) 'Zhangsan wonders why Lisi will quit that job.'

Predictions

If Lu et al. (2020) are on the right line, we expect that there should be no difference between argument and adjunct whs-in-situ in terms of island effects. In other words, there should be a super-additive interaction, or a super-additive effect between Structure and Dependency Length factors for both argument and adjunct whs-in-situ. Along this line, we should also expect no three-way interaction of Structure × Wh-Category × Length. Unlike Lu et al. (2020), however, we argue that the low acceptability score of experimental items containing argument whs-in-situ in relative clause islands, reported by Lu et al. (2020), is suspected to stem from pragmatic inappropriateness due to the constructional idiosyncrasy of relative clauses. Put differently, the reported lack of argument-adjunct asymmetry in Lu et al. (2020) is taken to result from the confounding effect of a pragmatic constraint at work for object whs-in-situ. If our assessment of Lu et al. (2020) is correct, after fixing the experimental materials so that the pragmatic confounding effect is controlled for or eliminated, we expect that the result will be different from theirs in light of argument vs. adjunct asymmetry of island effects, and we should thus expect of our experiment a significant three-way interaction in Structure × Wh-Category × Length.

Results

The rating scores of two participants were removed from subsequent analysis because both rated all the sentences like (36) as 7, which indicates that they did not follow our instruction and interpreted wèishénme as ‘for what’ rather than ‘why’.8 Then, the acceptability rating scores were analyzed with same method as that of Experiment 1. The results showed significant main effects of Structure ($\beta = 2.74$, SE = 0.17, $t = 16.03$, $p < 0.001$), of Length ($\beta = 4.58$, SE = 0.13, $t = 34.48$, $p < 0.001$), and of Wh-Category ($\beta = 4.05$, SE = 0.14, $t = 29.35$, $p < 0.001$). Contrary to the findings of Lu et al. (2020), however, there were significant effects of two-way interactions such as Structure × Length ($\beta = -2.99$, SE = 0.17, $t = -17.91$, $p < 0.001$), Structure × Wh-Category ($\beta = -3.01$, SE = 0.18, $t = -16.48$, $p < 0.001$), and Length × Wh-Category ($\beta = -4.17$, SE = 0.17, $t = -24.91$, $p < 0.001$). Furthermore, there was a significant interaction in Structure × Wh-Category × Length ($\beta = 2.74$, SE = 0.24, $t = 11.59$, $p < 0.001$).

On a par with Lu et al. (2020) and Experiment 1, we also put Structure × Length under the level of Wh-Category to examine the island sensitivity effects of each wh-category. The result showed that as for the wh-adjunct wèishénme ‘why’, there was a significant super-additive interaction effect between Structure and Dependency Length ($\beta = -2.99$, SE = 0.17, $t = -17.99$, $p < 0.001$). As for the wh-arguments, however, no super-additive effect was observed ($\beta = -0.25$, SE = 0.16, $t = -1.62$, $p = 0.11$). Put differently, the wh-arguments and the wh-adjuncts exhibited a significant difference in island effects. This can be seen clearly in Figure 3 where the left panel shows the interaction plot for argument wh-in-situ and the right panel presents the interaction plot for adjunct wh-in-situ.

The mean acceptability scores are presented in Figure 4, with the error bars representing the standard errors.

As can be observed, just like those of Experiment 1, the mean acceptability scores in Figure 4 exhibit different patterns from those of Lu et al. (2020). It is not the case that the argument whs-in-situ are generally rated to be better than the adjunct wh-in-situ. Notably, in the short + non-island condition the adjunct wh-in-situ is better than the argument wh-in-situ shéi ‘who’. Moreover, in the short + island condition the adjunct wh-in-situ is slightly better than the argument wh-in-situ shéi ‘who’. It is worth noting that in the long + island condition the adjunct wh-in-situ is significantly worse than the argument wh-in-situ shènme ‘what’, with their mean rating scores being 2.10 and 6.15, respectively.

General discussion

This study brings to light several important findings. First, a significant three-way interaction effect of Structure × Wh-Category × Dependency Length was observed. In this regard, our study renders reinforcing support to the long-standing generalization concerning the argument–adjunct asymmetry in whs-in-situ in Chinese (Huang, 1982a,b; Tsai, 1999; Cheng, 2009), contrary to the findings of Lu et al. (2020). In accordance with Sprouse (2007), Sprouse and Hornstein (2013), and Sprouse et al. (2016), to name a few, syntactic island effects can be measured systematically using the factorial design, and they are represented by the super-additive effects that stem from combining both the effects of Structure and those of Dependency Length. Adopting this experimental paradigm, we have demonstrated that the wh-adjunct wèishénme in
the current study displays island effects as there arises a significant Structure $\times$ Dependency Length interaction giving rise to the super-additive effect. This, in turn, supports the well-acknowledged claim that wh-adjuncts are sensitive to island constraints (Huang, 1982a,b), or that covert (operator) movement is involved in the derivation of wh-adjuncts (Aoun and Li, 1993a; Tsai, 1999). By contrast, in the current study no super-additive effect is observed for wh-arguments, which counters the findings of Lu et al. (2020). This means that the traditional generalization should be re-endorsed—that is, wh-arguments in Chinese are not sensitive to island constraints. The underlying reason behind this re-endorsement
is that wh-arguments are derived by unselective binding (Tsai, 1994, 1999), or that an operator licensing them is base-generated in a position external to islands (Aoun and Li, 1993a). Put differently, the significant difference between the adjunct wh's-in-situ and the argument wh's-in-situ in the long + island condition reflects the different syntactic properties of the adjunct wh's-in-situ and the argument wh's-in-situ. The argument wh's-in-situ do not undergo covert movement. Without violating the island constraint, the relevant sentences are rated to be natural. By contrast, the adjunct wh's-in-situ undergo covert movement, violating the island constraint. Consequently, the relevant sentences are rated to be unnatural.9

Second, Lu et al.’s (2020) experiment result shows that although the mean acceptability rating score of the long + island + argument condition is low, it is still a little higher than that of the long + island + adjunct condition. Given this, they acknowledge that Huang (1982a,b) and Tsai (1994, 1999) are correct in noting that argument wh's-in-situ in islands are higher in acceptability than adjunct wh's-in-situ in islands. Nevertheless, they argue that it does not support the argument-adjunct asymmetry in that it may be a reflection of the main effect of Wh-Category. They further argue that there is no real argument-adjunct asymmetry in wh's-in-situ in terms of island sensitivity. The argument-adjunct asymmetry in wh's-in-situ reported in the literature is attributed to the methodology of acceptability judgment. In their opinion, while making judgments, linguists implicitly construct minimal pairs, i.e., they implicitly employ a minimal-pair experiment design. In the experiment employing such a design, the preference for wh-arguments in situ rather than wh-adjuncts in situ would be a reflection of the main effect of Wh-Category (argument vs. adjunct) rather than wh-adjuncts’ sensitivity to island constraints. Our two experiments have demonstrated that the validity of their claim needs to be re-evaluated. Recall the results of Experiment 1 and Experiment 2. They reveal that the wh-arguments were not always rated to be better in acceptability than the wh-adjunct, which is different from the findings made in Lu et al. (2020). Particularly, our two experiments have found that in the short + non-island condition, the wh-adjunct was judged to be more acceptable than the wh-arguments. Further, no significant difference between the wh-argument and the wh-adjunct was observed in the short + island condition of Experiment 1, and the wh-adjunct was slightly better than the wh-argument in the same condition of Experiment 2.10 Based on the findings in our study, we can conclude that even if Lu et al.’s (2020) assumption is reasonable that while making judgments, linguists implicitly employ a minimal-pair experiment design, the preference for argument wh's-in-situ in the island condition cannot be attributed to the effects of Wh-Category.

In addition, it is worth noting that previous studies often focus only on island effects that arise on adjunct wh's-in-situ, without explicit reference to minimal pairs involving both adjunct wh's-in-situ and argument wh's-in-situ. It is, then, implausible to claim that the participants in these studies always implicitly construct a minimal pair, which—as Lu et al. (2020) claim—leads to argument–adjunct asymmetry in island sensitivity.

Perhaps, at this moment one may wonder why the wh-adjunct in the short + non-island condition was judged to be more acceptable than the wh-argument in our experiments and why there was a difference in this regard from Lu et al. (2020). As to the first question, we think the answer might lie in different sensitivity to dependency length between argument wh's-in-situ and adjunct wh's-in-situ. As can be seen from the two interaction plots of our experiments, the dotted lines for argument wh's-in-situ in the left panels are almost flat, and the dotted ones for adjunct wh's-in-situ in the right panels slope downward visibly. The identical result is also found in Lu et al. (2020). This suggests that adjunct wh's-in-situ are more sensitive to dependency length than argument wh's-in-situ. Therefore, it is highly likely that the mean acceptability rating score for wh-adjuncts is higher than or approximately equal to that of wh-arguments (when the processing difference between adjunct wh's-in-situ and argument wh's-in-situ is small) in short dependency condition, and the rating score for wh-adjuncts is lower than that of wh-arguments in long dependency condition. Given this, it will be unsurprising that in the short + non-island condition,
wh-adjuncts were judged to be more acceptable than wh-arguments.

If we continue to investigate why there is a difference in sensitivity to dependency length, we speculate that the reason might be that wh-adjuncts and wh-arguments establish dependency in different ways: wh-adjuncts establish dependency through LF movement and wh-arguments through unselective binding (Tsai, 1999). It will be a very interesting topic to study whether varying degrees of sensitivity to dependency length can be used as a criterion for determining how dependency is established. We leave this topic for future study.

As to the question why argument wh’s-in-situ are preferred over adjunct wh’s-in-situ in the short + non-island condition in Lu et al.’s experiment, a result different from ours, we speculate that one reason lies in the choice of an embedded subject. The embedded subject in the adjunct + short + non-island condition of their experiment is a proper noun, as in (8). It has been reported in the literature that a proper noun/definite phrase provokes a higher processing cost (Warrena and Gibson, 2002; Hofmeister and Sag, 2010), which will reduce the acceptability of this type of sentence. Therefore, it is reasonable that the mean rating score for argument wh’s-in-situ is greater than that of adjunct wh’s-in-situ in Lu et al.’s experiment. In contrast to the stimuli in Lu et al.’s experiment, the embedded subject in the adjunct + short + non-island condition of our experiment is a pronoun, as in (19). The embedded subject may thus not have induced any additional processing cost. This may have resulted in the explicit short dependency effect of adjunct wh’s-in-situ. Consequently, the mean rating score for adjunct wh’s-in-situ is greater than that of argument wh’s-in-situ.

Third, we suspect, as pointed above, that the low acceptability score reported by Lu et al. (2020) concerning wh-arguments in the long + island condition results from pragmatic inappropriateness of their experimental items rather than the island constraint at stake. In other words, we propose that when the object wh’s-in-situ is in a relative clause/an island, the processing of such a sentence is susceptible to an additional pragmatic constraint. This is confirmed by Experiment 2, in which the experiment items were carefully designed so that the pragmatic confounding factor could be removed. The results of this experiment have shown that once the pragmatic confounding factor is under control, the acceptability score for the object wh’s-in-situ in the long + island condition is very high.

Moreover, a comparison of the results of Experiment 1 and Experiment 2 also suggests that we should be on the right track in assuming that when the object wh’s-in-situ is in a relative clause/an island, it is subject to an additional pragmatic constraint, and the low acceptability score reported by Lu et al. (2020) concerning wh-arguments in the long + island condition results from pragmatic inappropriateness. The results of Experiment 1 and Experiment 2 have revealed that the subject wh’s-in-situ and the object wh’s-in-situ behave almost in the same way. For example, in the long + island condition, both the subject wh’s-in-situ and the object wh’s-in-situ are judged to be better than the adjunct wh’s-in-situ, and in the short + non-island condition, both the subject wh’s-in-situ and the object wh’s-in-situ are considered to be worse than the adjunct wh’s-in-situ. Their parallel behaviors are well expected because both subject and object wh’s-in-situ serve as arguments. Unlike Experiment 2, Lu et al. (2020) left the pragmatic confounding factor untouched. As a result, they reported that both the object wh’s-in-situ and the adjunct wh’s-in-situ in the long + island condition are rated to be very low in acceptability. If their findings are reasonable, then object wh’s-in-situ and adjunct wh’s-in-situ are distinguished in acceptability from the subject wh’s-in-situ in the long + island condition. Such a difference is surprising given that both subject wh’s-in-situ and object wh’s-in-situ are arguments. After fixing the experimental materials so that the pragmatic confounding effect is controlled for or eliminated, Experiment 2 has shown that the object wh’s-in-situ exhibits the same characteristics as the subject wh’s-in-situ does. This argues strongly in favor of our claim that it is the pragmatic confounding factor that prevents Lu et al. (2020) from uncovering the real nature of object wh’s-in-situ. Put differently, under the impact of the pragmatic confounding factor, their result shows that just like adjunct wh’s-in-situ, there is also a significant Structure × Dependency Length interaction for argument wh’s-in-situ. Consequently, they fail to find a significant three-way interaction of Structure × Wh-Category × Length. Actually, the significant Structure × Dependency Length interaction for argument wh’s-in-situ in Lu et al. (2020) is a reflection of pragmatic constraint rather than syntactic island constraint.

Our claim can also explain the practice that theoretical linguists in Chinese generally rely on: when intending to show that argument wh’s-in-situ in this language are not sensitive to island constraints, they usually use subject wh’s-in-situ as in (37) rather than object wh’s-in-situ as a test case.11

(37) Ni xihuan shêi xié de shù?  
You like who write Rel book.  
‘Who is the person x such that you like the book that (he/she) wrote?’

11 To ascertain what kind of examples are adduced to support the assumption that argument wh’s-in-situ are not subject to island constraints, we examined all the examples used in Aoun and Li (1993a), Tsai (1999), Huang et al. (2009), and Huang (2010), four classic and influential books that perform detailed studies of wh’s-in-situ. In these books, there are some examples repeated for sake of exposition. After the repeated examples were excluded, we collected 26 acceptable sentences where an argument wh’s-in-situ is located in a relative clause island/complex NP island, and among these sentences, 21 sentences involve subject wh’s-in-situ.
According to the findings of our experiments, the reason lies in that unlike subject whs-in-situ, when object whs-in-situ occur in a relative clause, namely an island, they are more likely subject to an additional pragmatic constraint. Therefore, it is must easier to create sentences with appropriate subject whs-in-situ than sentences with object whs-in-situ to examine the island sensitivity of argument whs-in-situ.

Conclusion

Different from their counterparts in English, wh-elements in Chinese remain in situ in question sentences. Argument whs-in-situ in Chinese are insensitive to island constraints, unlike adjunct whs-in-situ. This has led to the celebrated generalization regarding the argument and adjunct asymmetry in whs-in-situ in this language. With the acceptability judgment experiment, Lu et al. (2020) challenge this long-established generalization. They argue that this asymmetry is an illusion, and that both the adjunct wh-in-situ and the argument whs-in-situ are subject to island constraints. In this study, we point out that their results are not convincing because their experimental design has some drawbacks. We redesigned the experimental materials in question to examine island effects on wh-elements in situ in Chinese. The results of the two experiments in this study show that the argument versus adjunct asymmetry in whs-in-situ is present. Furthermore, the argument–adjunct asymmetry at issue cannot be attributed to the main effect of Wh-Category.

On top of supporting the traditional theoretical generalization on Chinese whs-in-situ, this study also discovers that when object whs-in-situ are located inside a relative clause, they are subject to a pragmatic constraint, suggesting that the verb phrase in the relative clause tends to describe the prominent/salient feature of the relativized nominal head. This contributes to the understanding of the processing of relative clauses and wh-in-situ sentences.

Finally, it will be much fair to point out that although Lu et al.’s (2020) findings are not supported by our experiments, their research is very enlightening. Inspired by their study, in the future we will examine whether the argument-adjunct asymmetry is also observed in other island environments and whether our findings in this study may shed some light on other theories related to asymmetry in unselecting binding, covert LF movement, ECP, etc.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

QT conceived and designed the study, implemented the experiments, analyzed the data, drafted, and revised the manuscript. M-KP provided theoretical guidance when necessary and made revisions to the manuscript. XY participated in the conception of the study, statistical analysis, as well as the revision of part of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.954175/full#supplementary-material
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