

The Role of Individual Differences  
in the Acceptability of Island Violations in Native and Non-native Speakers

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Submitted to the graduate degree program in  
Linguistics and the Graduate Faculty of the University  
of Kansas in partial fulfillment of the requirements for  
the degree of Doctor of Philosophy.

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Date approved: May 5<sup>th</sup> 2015

## ABSTRACT

This study examines the acquisition of syntactic island constraints on *wh*-movement in English by native speakers of Najdi Arabic to test whether it is possible for second language learners (L2) to acquire syntactic constraints that are not present in their first language (L1). According to the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), L2 properties are potentially acquirable by adult L2 learners regardless of L1. However, according to the Interpretability Hypothesis (Tsimpili & Dimitrakopoulou, 2007), adult L2 learners cannot acquire uninterpretable features in the L2 if those features were not selected in the L1 during the critical period. The study tested 82 English native speakers and 72 Arabic learners of English, using a grammaticality judgment task. The results showed that Arabic learners, like English native speakers, were sensitive to syntactic island constraints on *wh*-movement as reflected in their lower acceptability judgments of ungrammatical island violation sentences (*e.g.*, *\*what does the worker worry if the boss leaves\_\_?*), supporting the Full Transfer/ Full Access Hypothesis.

This study also investigates the source of island effects that cause low acceptability judgments of ungrammatical island violation sentences. Under grammatical syntactic theories, island effects are due to violations of syntactic constraints that prohibit *wh*-extraction from islands. Under the resource-limitation theory (Kluender & Kutas, 1993; Hofmeister & Sag, 2010), however, island effects are due to processing difficulty because islands are complex and require additional processing resources that are beyond the capacity of most native speakers. To tease apart these contrasting theories of island effects, the present study, like Sprouse et al. (2012), focused on individual differences in processing resources, which play a crucial role in sensitivity to island effects under the resource-limitation theory but not under grammatical

theories of island effects. Specifically, this study tests the relationship between working-memory capacity and sensitivity to island effects by using two measures for each individual, a measure of working-memory capacity (*i.e.*, the operation span scores) and a measure of sensitivity to island effects (*i.e.*, the DD scores). Neither English native speakers nor learners provided evidence of a relationship between operation span scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects, contrary to the prediction of the resource-limitation theory. These results suggest that island effects are not driven by limited processing resources and are more likely due to syntactic constraints.

## **ACKNOWLEDGEMENT**

I would like to thank all of the people who have supported me in one way or another in completing my research project. I particularly wish to thank my advisor, Dr. Alison Gabriele, for her patience, supervision, comments, encouragement and guidance. I appreciate all that she has done for me. I also would like to thank the members of my dissertation committee, Dr. Robert Fiorentino, Dr. Allard Jongman, Dr. Harold Torrence, and Dr. Yan Li for their helpful comments and continuing support. Special thanks to Dr. Fiorentino for the inspiration he provided in his psycholinguistics course, which sparked my interest in my research topic and which continues to motivate me to explore this topic further. I am also grateful for the support and feedback my colleagues and professors provided in the weekly sessions of Research in Language Acquisition and Processing (RAP). Your suggestions were invaluable. I also wish to thank all of the people who facilitated and participated in my project. Their contributions and availability were crucial in the completion of my research. Finally, I would like to thank my wife, who stood by me through the good times and bad.

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## 1. Introduction

The present study examines whether it is possible for second language (L2) learners to acquire syntactic constraints that are not present in their native language (L1). More specifically, the study investigates the acquisition of syntactic constraints on *wh*-movement in English by speakers of Najdi Arabic, a language that does not have *wh*-movement. In English, for example, *wh*-questions (1a) and relative clauses (1b) have syntactic *wh*-movement (Chomsky 1981, 1986). In (1a), the *wh*-phrase ‘*who*’ originates in the object *position* after the verb ‘*see*’ and moves to the specifier of the complementizer phrase, leaving a trace.

- (1)
- |    |   |                 |
|----|---|-----------------|
| a. | [ <sub>CP</sub> Who <sub>i</sub> [ <sub>IP</sub> did you see <i>t<sub>i</sub></i> ] ]?                              | WH-QUESTION     |
| b. | The book <sub>i</sub> [ <sub>CP</sub> which <sub>i</sub> [ <sub>IP</sub> he took <i>t<sub>i</sub></i> ] ] is there. | RELATIVE CLAUSE |

However, it has been observed that movement of *wh*-phrases in English is subject to specific syntactic constraints. That is, *wh*-phrases cannot move out of certain syntactic constituents, called islands (Ross, 1967). These islands include, but are not limited to, adjunct clauses (2a), relative clauses (2b), complex NPs (2c), and embedded questions, which are referred to as *wh*-islands (2d).

- (2)
- |    |  |                 |
|----|--|-----------------|
| a. | * <b>What<sub>i</sub></b> did Tom read the book [ <b>before Bill saw <i>t<sub>i</sub></i></b> ]? | ADJUNCT CLAUSE  |
| b. | * <b>What<sub>i</sub></b> does Tom like [ <b>the woman who wears <i>t<sub>i</sub></i></b> ]?     | RELATIVE CLAUSE |
| c. | * <b>What<sub>i</sub></b> did Tom hear [ <b>the fact that Jon won <i>t<sub>i</sub></i></b> ]?    | COMPLEX NP      |
| d. | * <b>What<sub>i</sub></b> does Tom wonder [ <b>why the boy bought <i>t<sub>i</sub></i></b> ]?    | WH-ISLAND       |

In Najdi Arabic, however, *wh*-questions and relative clauses do not have *wh*-movement (Aldwayan, Fiorentino, & Gabriele, 2010). In (3), for example, the *wh*-phrase *wish* ‘what’





violation sentences are due to a violation of syntactic constraints that prohibit *wh*-extraction from islands. That is, speakers avoid positing a gap inside islands because they respect grammatical syntactic island constraints.

However, according to the resource-limitation theory, first proposed by Kluender and Kutas (1993) and expanded in Hofmeister and Sag (2010), island constraints are not part of a native speaker's mental grammar. Under the resource-limitation theory, the low acceptability judgments of ungrammatical island violation sentences as in (2) are due to processing difficulty. That is, islands are rejected because they are complex and require additional processing resources, beyond the capacity of most native speakers.

The present study attempts to tease apart the resource-limitation theory and grammatical syntactic theories with respect to the cause of low acceptability of ungrammatical island violation sentences. The study seeks to provide evidence not only from native speakers but also from L2 learners, a population that has not yet been examined from this perspective. The study builds on Sprouse, Wagers and Phillips (2012), which tested only English native speakers to investigate this issue.

Thus, the present study aims to answer two questions. The first question is whether adult Najdi learners of English can show sensitivity to syntactic island constraints on *wh*-movement, a syntactic operation that is not instantiated in Najdi Arabic. If Najdi learners show sensitivity to syntactic island constraints on *wh*-movement as English native speakers do, this introduces the second question of whether this sensitivity to syntactic island constraints exhibited by learners and English native speakers is due to syntactic constraints or processing difficulty.

The present study is organized as follows. In the literature review below, I first review the previous studies that used acceptability judgment tasks to examine L2 acquisition of syntactic

island constraints on *wh*-movement. Then, I review the previous studies that used online tasks to examine whether L2 learners are sensitive to syntactic island constraints on *wh*-movement during online sentence processing. Next, I review the previous studies that tested the predictions of the resource-limitation theory and grammatical syntactic theories with respect to the source of island effects. Finally, I discuss the present study and its experimental design.

## 2. Literature review

### 2.1 L2 acquisition of syntactic island constraints on *wh*-movement

Chomsky (1973) attempted to account for all types of syntactic island constraints on *wh*-movement in a uniform way by proposing the subjacency principle, which states that a *wh*-phrase cannot cross more than one bounding node, IP or DP, in each single movement. In (4), for example, the sentences are ungrammatical because the *wh*-phrase ‘*what*’ in each sentence crosses more than one bounding node, DP or IP, in each single movement.

- (4)
- a. \*What<sub>i</sub> did [<sub>IP</sub> Tom read the book [<sub>PP</sub> before [<sub>IP</sub> Bill saw *t<sub>i</sub>*]]]? ADJUNCT CLAUSE
  - b. \*What<sub>i</sub> does [<sub>IP</sub> Tom like [<sub>DP</sub> the woman [<sub>CP</sub> who wears *t<sub>i</sub>*]]]? RELATIVE CLAUSE
  - c. \*What<sub>i</sub> did [<sub>IP</sub> Tom hear [<sub>DP</sub> the fact [<sub>CP</sub> *t<sub>i</sub>* that [<sub>IP</sub> Jon won *t<sub>i</sub>*]]]]]? COMPLEX NP
  - d. \*What<sub>i</sub> does [<sub>IP</sub> Tom wonder [<sub>CP</sub> why [<sub>IP</sub> the boy brought *t<sub>i</sub>*]]]]]? WH-ISLAND

Under this version of island constraints, as noted by Belikova and White (2009), L2 learners are expected to treat all types of islands similarly. However, previous L2 studies like Johnson and Newport (1991), Schachter (1990), and Li (1998), which adopted this version of island constraints, found that learners treated specific island types differently.

Johnson and Newport (1991), for example, tested the Critical Period Hypothesis by investigating the acquisition of the subjacency principle in English by Chinese advanced learners

who arrived in the USA after the age of 17. Chinese is a language that does not have *wh*-movement. According to the Critical Period Hypothesis, linguistic universal principles, like the subjacency principle, cannot be fully accessible to learners starting their L2 after puberty. The study tested ungrammatical *wh*-questions violating the subjacency principle and their grammatical counterparts. The ungrammatical *wh*-questions involved *wh*-movement out of relative clauses (5a), complex NPs (5b) and *wh*-islands (5c).

(5) RELATIVE CLAUSE

- a. \***Who<sub>i</sub>** should [**the policeman who found  $t_i$** ] get a reward?  
What<sub>i</sub> should the policeman who found Cathy get  $t_i$ ?

COMPLEX NP

- b. \***What<sub>i</sub>** did the teacher know [**the fact that Janet liked  $t_i$** ]?  
What<sub>i</sub> did the teacher know that Janet liked  $t_i$ ?

WH-ISLAND

- c. \***What<sub>i</sub>** did Sally watch [**how Mrs. Gomez makes  $t_i$** ]?  
Who<sub>i</sub> did Sally show  $t_i$  how Mrs. Gomez makes her cookies?

The study used a grammaticality judgment task where participants were asked to listen to each test sentence and circle ‘yes’ if the sentence was fine and ‘no’ if it was not fine. If they were unsure, they were asked to guess.

The results showed that the English control group correctly rejected 97% of ungrammatical subjacency violation sentences and correctly accepted 90% of grammatical control sentences. The adult Chinese learners, on the other hand, correctly rejected only 60% of ungrammatical subjacency violation sentences and correctly accepted only 67% of grammatical control sentences. Johnson and Newport (1991) argued that these results suggest that the performance of Chinese advanced learners on subjacency principle was influenced by a sensitive

period for language acquisition. Johnson and Newport claimed that L2 learners who start their acquisition after puberty do not have full access to UG.

However, when the results of the three types of island structures were analyzed individually, the results showed that Chinese learners treated these three structures differently. They performed more accurately on the relative clause structure than on the complex NP and *wh*-island structures. That is, they correctly rejected 79% of ungrammatical relative clause sentences, while they rejected only 54% and 50% of ungrammatical complex NP and *wh*-island sentences respectively.

The L2 acquisition of the subjacency principle was also investigated by Schachter (1990) to test the Incompleteness Hypothesis, which claims that if a universal principle like subjacency is not instantiated in the L1 during the critical period, this principle will never be acquired in adult L2 acquisition. This claim is similar to the claim made by the Fundamental Difference Hypothesis (Bley-Vroman, 1990), which argues that adult L2 learners have access to UG only through their L1. Schachter investigated the acquisition of the subjacency principle in English by Dutch, Korean, Chinese, and Indonesian advanced learners of English. Dutch has *wh*-movement and constraints on movement similar to English. However, Korean, Chinese, and Indonesian differ from English in that they have only limited *wh*-movement and subjacency effects<sup>1</sup>.

The study used a grammaticality judgment task that tested ungrammatical *wh*-questions with subjacency violations. The ungrammatical *wh*-questions involved *wh*-movement out of four constructions: sentential subjects (6a), complex NPs (6b), relative clauses (6c), and *wh*-islands (6d). The task also included grammatical declarative sentences to ensure that participants knew

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<sup>1</sup> Schachter argues *wh*-questions and relative clauses in Indonesian allow movement of subject but not object *wh*-phrases. Thus, subjacency effects are limited to movement of subject *wh*-phrases. In Chinese, although relative clauses and topicalization are derived by movement, *wh*-questions are not formed via movement, which suggests that Chinese has limited subjacency effects. In Korean, *wh*-questions, relative clauses, and topicalization are not formed via movement. Thus, Korean has no subjacency constraints.

the constructions tested. Participants were asked to read each sentence and judge it as (a) clearly grammatical, (b) probably grammatical, (c) probably not grammatical, or (d) clearly ungrammatical.

(6) SENTENTIAL SUBJECT

- a. That oil prices will rise again this year is nearly certain.  
\*Which party<sub>i</sub> did [for Sam to join  $t_i$ ] shock his parents?

COMPLEX NP

- b. The judge rejected the evidence that the student committed the crime.  
\*What did they have to accept [the idea that they couldn't operate  $t_i$ ] by themselves?

RELATIVE CLAUSE

- c. The theory we discussed yesterday will be on the exam next week.  
\*What<sub>i</sub> did Susan visit [the store that had  $t_i$ ] in stock?

WH-ISLAND

- d. The dorm manager asked me who I wanted to have as a roommate.  
\*Who<sub>i</sub> did the Senator ask the President [where he would send  $t_i$ ]?

The results showed that all learner groups behaved like the English control group in correctly accepting grammatical sentences. More specifically, the English, Indonesian, and Chinese groups correctly accepted 88% of grammatical sentences. The Dutch and Korean groups correctly accepted 92% and 79% of grammatical sentences respectively. However, only speakers of Dutch, which has *wh*-movement, were similar to the English group in that they rejected 88% of subjacency violation sentences. The speakers of Chinese, Indonesian, and Korean, which do not have *wh*-movement, rejected only 71%, 63%, and 50% of subjacency violation sentences respectively. Schachter (1990) argued that these results support the Incompleteness Hypothesis, which claims that a universal principle cannot be acquired in L2 if it is not activated in the L1.

However, further examination of the results by structure, as noted by Belikova and White (2009), showed that Korean learners treated the four types of island structures differently. They performed more accurately on the sentential subject and relative clause structures than on complex NP and *wh*-island structures. That is, they correctly rejected 63% of ungrammatical sentential subject sentences and 56% of ungrammatical relative clause sentences. However, they rejected only 43% of ungrammatical complex NP sentences and 43% of ungrammatical *wh*-island sentences<sup>2</sup>.

Hawkins and Chan (1997) also examined the L2 acquisition of syntactic island constraints on *wh*-movement to argue for the Failed Functional Features Hypothesis, which claims that a functional feature, *e.g.*, [+*wh*], cannot be acquired by adult L2 learners if it is not instantiated in their L1 during the critical period. Hawkins and Chan tested the predictions of this hypothesis by investigating the acquisition of *wh*-movement in English relative clauses by Chinese and French speakers. Similar to English, relative clauses in French have *wh*-movement. However, Hawkins and Chan assumed that relative clauses in Chinese do not involve *wh*-movement. They made their assumption based on a combination of ideas drawn from Huang (1980, 1995), Xu (1986), and Xu and Langendoen (1985). Instead of *wh*-movement, as assumed by Hawkins and Chan, a null topic is generated in situ in CP and binds a pronominal in the embedded clause that can be null, *i.e.*, *pro* or a resumptive pronoun, as shown in (7).

RELATIVIZED OBJECT

- (7) [<sub>CP</sub> Top<sub>i</sub> [<sub>IP</sub> wo xihuan pro<sub>i</sub>/ta<sub>i</sub>] de] neige nuhai<sub>i</sub>  
 null topic I like pro/her C the girl  
 ‘The girl who I like’

---

<sup>2</sup> Schachter (1990) reported the results by structure for only the Korean group. The results for the Chinese and Indonesian groups were not reported.

Moreover, relative clauses in Chinese require obligatory resumptive pronouns in all relativized positions except in subject position, where a gap is obligatory, and in object position, where there is possible alternation between a gap and a resumptive pronoun. In (8), for example, the resumptive pronoun is obligatory because it is in the indirect object position.

RELATIVIZED INDIRECT OBJECT

- (8) wo song liwu gei ta /\*ec de neige nühai  
 I gave present to her C the girl  
 ‘The girl who I gave a present to’

To examine the acquisition of the underlying structure of *wh*-movement in English, the grammaticality judgment task tested ungrammatical sentences with *wh*-movement violating a *wh*-island constraint as in (9a) and a complex NP constraint as in (9b). No grammatical control sentences were used.

(9) WH-ISLAND

- a. \*This is **the lady**<sub>i</sub> who<sub>i</sub> Richard told me [**when he will meet t<sub>i</sub>**].

COMPLEX NP

- b. \*This is **the secretary**<sub>i</sub> who<sub>i</sub> Peter heard [**the news that the boss will marry t<sub>i</sub>**].

Hawkins and Chan (1997) predicted that French speakers would acquire *wh*-movement in English because French has *wh*-movement. However, Chinese speakers were predicted not to acquire *wh*-movement in English because Chinese does not have *wh*-movement. Participants were asked to simultaneously read and listen to each sentence and judge it by writing ‘A’ for definitely correct, ‘B’ for probably correct, ‘C’ for probably incorrect, and ‘D’ for definitely incorrect.

The results showed that the French advanced learners of English correctly rejected 85% of *wh*-island sentences as in (9a) and 90% of complex NP sentences as in (9b). Hawkins and



Chan (1997) argued that French advanced learners acquired the underlying structure of *wh*-movement because they were sensitive to the subjacency constraints on *wh*-movement. Unlike the French advanced learners, the Chinese advanced learners performed poorly on rejecting subjacency violation sentences. The Chinese advanced learners rejected only 41% of *wh*-island sentences and only 38% of complex NP sentences. These results show that French advanced learners, whose L1 has *wh*-movement, but not Chinese advanced learners, whose L1 does not have *wh*-movement, were sensitive to the subjacency constraints on *wh*-movement in English. Hawkins and Chan argued that these results support the Failed Functional Features Hypothesis, which claims a functional feature, *e.g.*, a [+*wh*] feature, cannot be acquired by L2 learners if it is not activated in their L1.

Unlike Johnson and Newport (1991), Schachter (1990), and Hawkins and Chan (1997), who argued that L2 acquisition is constrained by a critical period in early life, Li (1998) argued that UG is accessible to adult L2 learners when they reach a high proficiency level in the L2. Li, using a grammaticality judgment task, investigated the acquisition of the subjacency principle in English by adult Chinese speakers who were studying English as a foreign language in China. The study tested ungrammatical *wh*-questions violating the subjacency principle. These ungrammatical *wh*-questions involved *wh*-movement out of relative clauses (10a), sentential subjects (10b), *wh*-islands (10c), and NP-islands (10d).

(10) RELATIVE CLAUSE

- a. \***What<sub>i</sub>** did that man buy [**a hat that matches  $t_i$** ] in our stores?

SENTENTIAL SUBJECT

- b. \***What<sub>i</sub>** would [**for your daughter to give up  $t_i$** ] be a pity?

WH-ISLAND

- c. \***What<sub>i</sub>** might your friend ask [**where I hid  $t_i$** ] last month?

NP-ISLAND

- d. \***What**<sub>i</sub> are you interested in [**his articles on**  $t_i$  ]?

The results of the grammaticality judgment task showed that Chinese learners correctly rejected 64% of the ungrammatical sentences that violate the subjacency principle, performing above the chance level. Based on these results, Li (1998) argued that adult Chinese learners in her study have access to UG, although they did not do as well as English native speakers, who rejected 87% of the ungrammatical sentences. Li argued that Chinese learners did not do as well because they did not have *wh*-movement in their L1 and were not taught subjacency violations in the classroom. It should be noted that although Chinese learners correctly rejected most of the subjacency violation sentences, they performed differently across island structures. They performed more accurately on the relative clause and sentential subject structures than on the NP-island and *wh*-island structures. That is, they correctly rejected 71% of ungrammatical relative clause sentences and 70% of ungrammatical sentential subject sentences. However, they rejected only 61% of ungrammatical NP-island sentences and 52% of ungrammatical *wh*-island sentences.

All the studies reviewed above—Johnson and Newport (1991), Schachter (1990), Hawkins and Chan (1997), and Li (1998)—investigated L2 acquisition of syntactic island constraints on *wh*-movement under the original formulation of subjacency proposed by Chomsky (1973). Belikova and White (2009) noted that under this version of subjacency, which does not distinguish among types of islands, L2 learners are expected to reject all types of islands similarly if we assume they have access to UG. However, the studies mentioned above show that L2 learners performed more accurately on rejecting some types of islands than others, as summarized in Table 1.

For example, Johnson & Newport (1991), Schachter (1990), and Li (1998) showed that L2 learners are more accurate in rejecting ungrammatical *wh*-extractions out of relative clauses and sentential subjects than in ungrammatical *wh*-extractions out of *wh*-islands and complex NPs. As pointed out by Belikova and White (2009), the variation in the accuracy of rejecting types of islands cannot be explained under this version of subjacency as formulated by Chomsky (1973), which does not distinguish among types of islands.

Table 1: Comparison of previous studies testing L2 acquisition of *wh*-movement

Study	L1	Island structure	Accuracy of rejection (%)
Johnson & Newport (1991)	Chinese	Relative clauses	79%
		Complex NPs	46%
		<i>Wh</i> -islands	50%
Schachter (1990)	Korean	Relative clauses	56%
		Sentential subjects	63%
		Complex NPs	43%
		<i>Wh</i> -islands	43%
Hawkins & Chan (1997)	Chinese	<i>Wh</i> -islands	41%
		Complex NPs	38%
Li (1998)	Chinese	Relative clauses	71%
		Sentential subjects	70%
		<i>Wh</i> -islands	52%
		NP-islands	61%

A later proposal was the *Barriers* system proposed by Chomsky (1986) to explain the degree of the ungrammaticality of extractions out of islands in terms of the number of barriers. A barrier is a phrasal node that is not governed by a lexical category and is not assigned a theta role. Extractions out of adjunct clauses, relative clauses, and sentential subjects that involve crossing two barriers are considered strong subjacency violations. In (11), the extraction out of an adjunct clause of the *wh*-phrase ‘*which woman*’ crosses two barriers, PP and IP, and therefore is a strong subjacency violation.

### ADJUNCT CLAUSE

- (11) \*Which woman<sub>i</sub> did [<sub>IP</sub> the bee sting the child [<sub>PP</sub> after the dog bit  $t_i$  ]]?

Extractions out of *wh*-islands and complex NPs that involve crossing one barrier are considered weak subjacency violations. In (12), the extraction out of a *wh*-island of the *wh*-phrase ‘*which parcel*’ crosses one barrier, IP, and therefore is a weak subjacency violation. The complementizer phrase (CP) is not a barrier because it is governed by the verb ‘*wonder*’.

### WH-ISLAND

- (12) \*Which parcel<sub>i</sub> did [<sub>IP</sub> Amy wonder [<sub>CP</sub> why the boy had brought  $t_i$  ]]?

As noted by Belikova and White (2009), variations in L2 learners’ performance on types of islands are better explained under the *Barriers* framework, which distinguishes among types of islands in terms of the number of barriers. The first study that investigated L2 acquisition of island constraints on *wh*-movement under the *Barriers* framework is Martohardjono (1993). Martohardjono argued that if L2 learners have access to UG, they should distinguish between strong and weak subjacency violations. That is, they should reject *wh*-movement out of adjunct clauses, relative clauses, and sentential subjects (strong violation) more strongly than *wh*-movement out of complex NPs and *wh*-islands (weak violation).

Martohardjono (1993) tested Chinese, Indonesian and Italian advanced learners of English. *Wh*-questions in Italian have *wh*-movement, but *wh*-questions in Chinese and Indonesian do not have *wh*-movement. The study used a grammaticality judgment task that tested *wh*-movement out of relative clauses (13a), adjunct clauses (13b) and sentential subjects (13c).

- (13) RELATIVE CLAUSE

- a. \*Which neighbor<sub>i</sub> did Rachel throw [**the rock that hit**  $t_i$  ]?

ADJUNCT CLAUSE

- b. \***Which man<sub>i</sub>** did the child hug the lady [**after the dog bit  $t_i$**  ]?

SENTENTIAL SUBJECT

- c. \***Which job<sub>i</sub>** did [**getting  $t_i$**  ] help the graduate student?

According to the *Barriers* system (Chomsky, 1986), *wh*-movement out of these constructions results in a strong subjacency violation. The task also tested *wh*-movement out of complex NPs (14a), *wh*-islands (14b) and that-trace constructions (14c). *Wh*-movement out of these constructions results in a weak subjacency violation.

(14) COMPLEX NP

- a. \***Which girl<sub>i</sub>** did Jon notice [**the fact that the glass had cut  $t_i$**  ]?

WH-ISLAND

- b. \***Which patient<sub>i</sub>** did Max explain [**how the poison killed  $t_i$**  ]?

THAT-TRACE

- c. \***Which medicine<sub>i</sub>** did John think [**that  $t_i$**  ] cured his illness?

During the task, participants were given a sheet of paper on which was written only a ‘base’ sentence for each experimental item. The base sentences were the declarative equivalents of the test *wh*-questions. These declarative sentences were provided to help the learners realize from which position the *wh*-phrase was extracted. In each experimental trial, participants listened to one base declarative sentence that was also presented to them in written form, followed by a set of four *wh*-questions that were presented only auditorily. The example in (15) shows one set of four *wh*-questions that were designed to test *wh*-movement out of an adjunct clause.

- (15) The child hugged the lady after the dog bit the man. BASE SENTENCE
- a. \*Which dog<sub>i</sub> did the child hug the lady after t<sub>i</sub> bit the man? SUBJ. EXTRACTION
  - b. Which child<sub>i</sub> t<sub>i</sub> hugged the lady after the dog bit the man? CONTROL
  - c. \*Which man<sub>i</sub> did the child hug the lady after the dog bit t<sub>i</sub>? OBJ. EXTRACTION
  - d. Which lady<sub>i</sub> did the child hug t<sub>i</sub> after the dog bit the man? CONTROL

In each set, the four *wh*-questions were formed from the same base declarative sentence. These four *wh*-questions included two ungrammatical sentences, one with subject *wh*-extraction and one with object *wh*-extraction, along with two grammatical control sentences.

It should be noted that all four *wh*-questions were presented to participants as a set after they listened to the one base sentence. Participants first listened to a base sentence, and then they listened to the four *wh*-questions in a randomized order. For each *wh*-question, participants were asked to judge it as a good or bad sentence in English. They also could choose ‘*not sure*’ if they were not sure or ‘*don’t understand*’ if they did not understand.

The results showed that the English group and all three learner groups distinguished between strong and weak subjacency violations, rejecting strong violation sentences more strongly than weak violation sentences, as shown in Table 2. The results by island structure are shown in Table 3.

Table 2: Mean % rejection of strong and weak subjacency violation sentences

Group	Strong	Weak
English	94%	79%
Italian	89%	61%
Indonesian	87%	42%
Chinese	76%	38%

Table 3: Mean % rejection of strong and weak subjacency violation sentences by island structure

Group	Strong violations			Weak violations		
	RC	ADJ	SS	Comp. NP	Wh-Isl	Th-Tr
English	99%	100%	52%	80%	76%	85%
Italian	91%	92%	68%	65%	59%	55%
Indonesian	87%	90%	84%	36%	56%	25%
Chinese	71%	88%	83%	38%	51%	13%

Note: RC = relative clause, ADJ = adjunct clause, SS = sentential subject, Comp. NP = complex NP, Wh-Isl = *wh*-island, and Th-Tr = that-trace construction.

Based on the results that indicate that Chinese and Indonesian learners distinguished between strong and weak violation sentences, Martohardjono (1993) argued that the pattern of results exhibited by these L2 learners whose native languages do not have *wh*-movement suggests that these L2 learners have access to UG.

However, in a recent review of the literature summarized above, Belikova and White (2009) pointed out that, although Chomsky's (1986) *Barriers* system distinguishes between strong and weak subjacency violations, it still cannot explain why many L2 learners are not able to even identify weak subjacency violation sentences as ungrammatical sentences, particularly if we assume they have access to UG. Belikova and White adopted an alternate version of island constraints under Minimalism (Chomsky, 1995), which may explain why L2 learners perform well on strong islands and perform poorly on weak ones. This alternate version is a revised version of Huang's (1982) Condition on Extraction Domains (CED), which has been proposed to account for syntactic islands across languages (*e.g.*, Horvath & Siloni, 2003; Müller, 2007).

Based on Huang's (1982) revised CED, extraction out of non-complements is not possible universally. Therefore, extraction out of strong islands (*i.e.*, adjunct clauses, relative clauses, and sentential subjects) is not possible universally because strong islands are non-complements. However, as pointed out by Belikova & White (2009), this entails that the

ungrammaticality of extraction from weak islands (*i.e.*, *wh*-islands and complex NPs) needs to be attributed to different reasons.

For example, Belikova & White (2009) noted that the ungrammaticality of extraction from *wh*-islands can be attributed to parametric variation that depends on how many landing sites are available in the specifier of CP for the extracted *wh*-phrase. In English, for example, extraction out of *wh*-islands is ungrammatical because there is only one intermediate landing site at the specifier of CP. In (16), the *wh*-phrase ‘*which patient*’ cannot land at the specifier of CP because this position is filled with the *wh*-phrase ‘*how*’.

#### WH-ISLAND

- (16) \*Which patient<sub>i</sub> did Max explain [CP how [IP the poison killed t<sub>i</sub> ] ]?

In Hebrew, however, Reinhart argued that extraction out of *wh*-islands is grammatical, as shown in (17)<sup>3</sup>, because there is more than one landing site for the moved *wh*-phrase in the specifier of CP (as cited in Belikova and White, 2009, p. 216).

#### WH-ISLAND IN HEBREW

- (17) [eize sefer]<sub>i</sub> shaxaxta CP<sup>2</sup> [[mi-mi]<sub>k</sub> CP<sup>1</sup> [t<sub>i</sub> IP [kibalta t<sub>i</sub> t<sub>k</sub>]]]?  
 Which book you forgot from whom you got  
 ‘Which book is such that you forgot from whom you got it?’

As noted by Belikova and White (2009), the fact that native speakers sometimes accept extractions out of *wh*-islands in English, as shown in Martohardjono (1993) and Johnson and Newport (1991), suggests that it is unreasonable to assume that L2 learners have no access to UG when they fail to reject such extractions.

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<sup>3</sup> The example in (17) is from Reinhart (1981, cited in Belikova and White, 2009, p. 216)



In the case of complex NPs, Belikova and White (2009) noted that it is not clear whether noun complements in complex NPs are true complements or true adjuncts. If they are true complements, extraction out of them should be fully grammatical. However, this is not the case as in (18)<sup>4</sup>.

NOUN COMPLEMENT

- (18) ?\*Which book<sub>i</sub> did John hear [<sub>DP</sub> a rumor [<sub>CP</sub> that you had read *t<sub>i</sub>*]]?

To account for the degraded grammaticality of such extractions, Chomsky argued that nouns differ from verbs in that they cannot really govern their complements for several reasons. One reason, for example, is that the complementizer ‘*that*’ can be deleted in verb complements (19a) but not in noun complements (19b)<sup>5</sup> (as cited in Belikova and White, 2009, p. 214).

(19) VERB COMPLEMENT

- a. He claimed [(that) Bill had left the party]].

NOUN COMPLEMENT

- b. \*I distrust the [claim [Bill had left the party]].

Chomsky also argued that complements of nouns are similar to adjuncts in that they are not governed. However, although extraction out of noun complements (18) is not grammatical, it is not fully ungrammatical as compared to extraction out of relative clauses (20)<sup>6</sup>, which are adjuncts. Belikova and White noted that this suggests that the status of noun complements is still not clear.

RELATIVE CLAUSE

- (20) \*Which book<sub>i</sub> did John meet [<sub>DP</sub> a child [<sub>CP</sub> who read *t<sub>i</sub>*]]?

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<sup>4</sup> The example in (18) is from Chomsky (1986, cited in Belikova and White, 2009, p. 214).

<sup>5</sup> The examples in (19) are from Stowell (1986, cited in Belikova and White, 2009, p. 215).

<sup>6</sup> The example in (20) is from Chomsky (1986, cited in Belikova and White, 2009, p. 214).

Another proposal regarding the status of noun complements was made by Stowell who distinguished between finite complements of nouns (21a) and infinitival complements of nouns (21b)<sup>7</sup>, arguing that only infinitival complements of nouns are true complements (as cited in Belikova and White, 2009, p. 215).

(21) FINITE NOUN COMPLEMENT

- a. ?\*Which book<sub>i</sub> did John hear [a rumor [that you had read  $t_i$  ] ]?

INFINITIVAL NOUN COMPLEMENT

- b. ?Which book<sub>i</sub> did John announce [a plan [to read  $t_i$  ] ]?

This proposal predicts that extraction out of infinitival noun complements is more acceptable than extraction out of finite noun complements. This prediction is supported by examples (21a) and (21b). However, as pointed out by Belikova and White (2009), extraction out of infinitival complements of nouns is not as perfectly grammatical as extraction out of CP complements of verbs as in (22).

VERB CP COMPLEMENT

- (22) Which book<sub>i</sub> did John hear [<sub>CP</sub> that Mary read<sub>o</sub>  $t_i$  ] ]?

Belikova and White (2009) argued that the difference in the degree of grammaticality between the two types of extractions needs to be explained to determine the status of noun complements. Belikova and White concluded that there is a general consensus that noun complements in complex NPs have a special status, being neither true complements nor true adjuncts.

Based on Huang's (1982) revised CED, Belikova and White (2009) proposed that L2 learners are expected to do well on wh-extractions from strong islands (*i.e.*, adjunct clauses, relative clauses and sentential subjects) because strong islands are universal constraints on

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<sup>7</sup> The examples in (21) are from Chomsky (1986, cited in Belikova and White, 2009, p. 214).

extraction. It is important to point out that although these constraints may hold in all languages, learners whose L1 does not have *wh*-movement who are acquiring a language like English will first need to learn that there is *wh*-movement in English before they apply those universal constraints in that domain. Thus, L1 effects may still be observed. In contrast to strong islands, L2 learners are expected to perform less accurately on *wh*-extractions from weak islands (*i.e.*, *wh*-islands and complex NPs) because weak islands are not covered by the revised CED. Thus, L2 learners' lower performance on *wh*-extractions from weak islands should not be surprising and does not mean that L2 learners cannot access UG, especially because some English native speakers may accept *wh*-extractions from weak islands, as shown in Martohardjono (1993) and Johnson and Newport (1991).

Martohardjono (1993) was the first study that systematically examined the L2 acquisition of the distinction between strong and weak island constraints on *wh*-movement. Building on Martohardjono (1993), Aldosari (2013) tested Belikova and White's (2009) proposal by investigating whether adult Najdi learners of English can show sensitivity to the distinction between strong and weak island constraints. Unlike English, Najdi Arabic lacks *wh*-movement. Aldosari used a revised version of Martohardjono's stimuli to test *wh*-movement out of five island structures: adjunct clauses, relative clauses, sentential subjects, *wh*-islands, and complex NPs. The first three structures are strong islands, while the last two structures are weak islands.

The test sentences were recorded by an English native speaker and were presented auditorily to participants. In Martohardjono (1993), participants in each experimental trial listened to one base declarative sentence, followed by a set of four *wh*-questions that were presented auditorily in a randomized order as in (23).

- |      |   |                  |
|------|---|------------------|
| (23) | <u><i>The child hugged the lady after the dog bit the man.</i></u>                    | BASE SENTENCE    |
| a.   | *Which dog <sub>i</sub> did the child hug the lady after t <sub>i</sub> bit the man?  | SUBJ. EXTRACTION |
| b.   | Which child <sub>i</sub> t <sub>i</sub> hugged the lady after the dog bit the man?    | CONTROL          |
| c.   | *Which man <sub>i</sub> did the child hug the lady after the dog bit t <sub>i</sub> ? | OBJ. EXTRACTION  |
| d.   | Which lady <sub>i</sub> did the child hug t <sub>i</sub> after the dog bit the man?   | CONTROL          |

Unlike Martohardjono (1993), Aldosari (2013) preceded each test sentence with a base declarative sentence, after randomizing it with other types of test sentences and fillers. This adaptation was implemented to encourage participants to judge each test sentence independently and thoughtfully, avoiding the possibility that learners may look for patterns within a set of sentences, *e.g.*, two sentences within a set must be grammatical and two must be ungrammatical, or the first sentence in the set is always grammatical and the third sentence is always ungrammatical.

Aldosari (2013) conducted a grammaticality judgment task, using the program Paradigm (Tagliaferri, 2005). Because the test sentences were long, complex, and presented only auditorily, the following steps were used in presenting each experimental trial to ensure that learners judged each test sentence without any difficulty in sentence processing. In each trial, a base sentence as shown in (24a) appeared on the computer screen for six seconds.

- |      |  |
|------|--|
| (24) | <u>BASE SENTENCE</u>   |
| a.   | <i>Paul reported the story that the glass cut the girl.</i>            |
|      | <u>TEST SENTENCE</u>   |
| b.   | <b><i>Which girl did Paul report the story that the glass cut?</i></b> |

Then, the participant listened to this same sentence while it was shown on the computer screen. Next, the participant listened to the test sentence (24b); the test sentence was presented only auditorily while the base sentence remained on the computer screen. After listening to the test

sentence, the participant was presented with a five-point rating scale ranging from ‘*least acceptable*’ to ‘*most acceptable*’. The participant was told to choose ‘*I do not know*’ if he or she could not make a judgment. The participant’s job was to judge whether the second sentence was acceptable or unacceptable in English, using the rating scale provided.

The results showed that Najdi advanced learners, like the English native speakers, distinguished between ungrammatical and grammatical *wh*-extractions. Interestingly, as predicted by Belikova and White’s proposal, this distinction in grammaticality was more pronounced in strong than in weak island constructions for both the English native speakers and L2 learners, as shown in Figures 1 and 2.

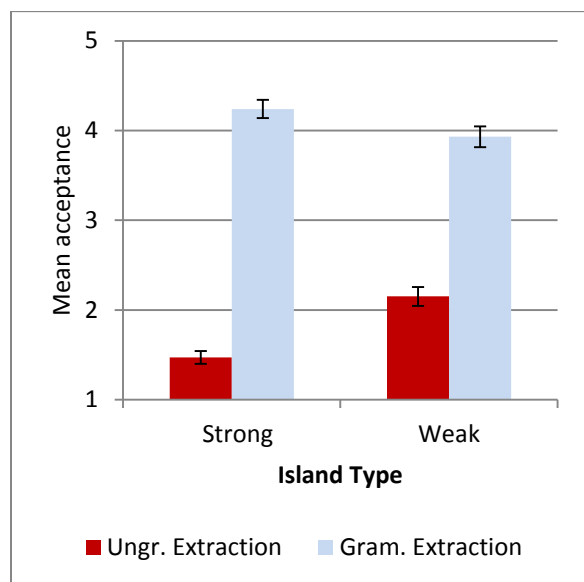


Figure 1: Natives 1 = Least accept. 5 = Most accept.

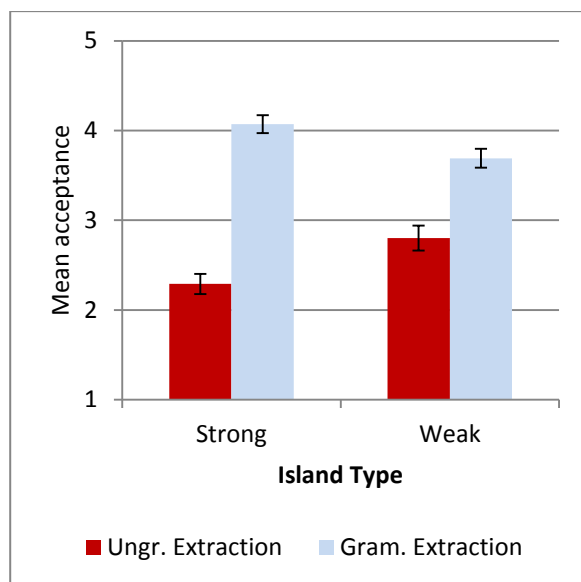


Figure 2: Learners 1 = Least accept. 5 = Most accept.

The results by construction confirmed the general pattern of results. As shown in Figures 3 and 4, Najdi advanced learners made a distinction in the right direction between ungrammatical and grammatical *wh*-extractions for each construction. Although Najdi advanced learners had difficulty rejecting ungrammatical *wh*-extractions in the sentential subject construction (strong

island), they made an accurate distinction between ungrammatical and grammatical *wh*-extractions in the adjunct clause and relative clause constructions (strong islands) as compared with their less accurate distinction in grammaticality in the *wh*-island and complex NP constructions (weak islands).

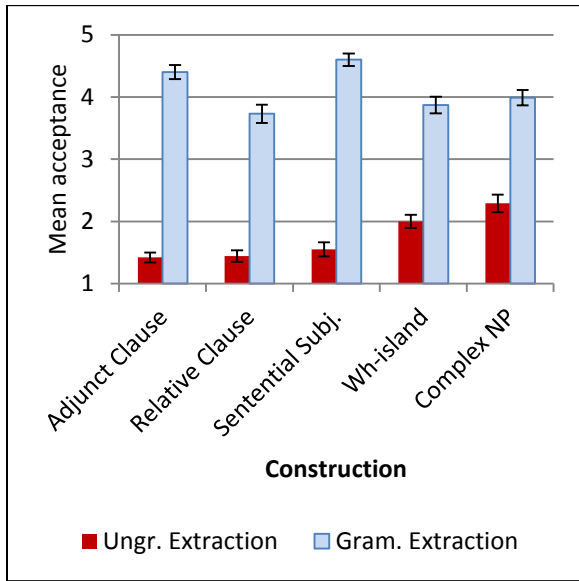


Figure 3: Natives 1 = Least accept. 5 = Most accept.

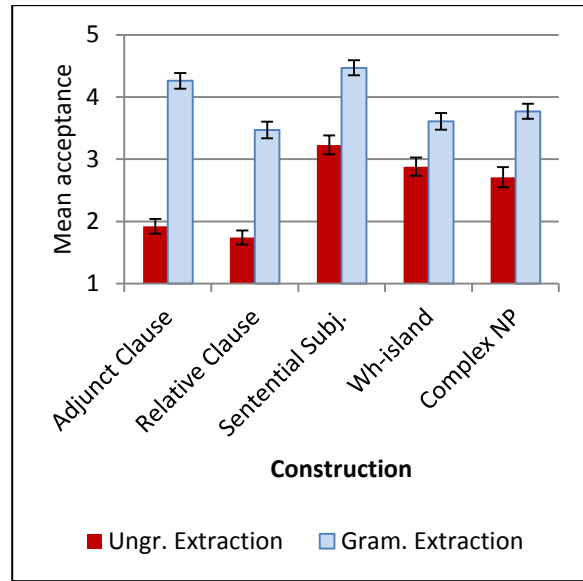


Figure 4: Learners 1 = Least accept. 5 = Most accept.

Interestingly, the general pattern of results was also supported by the results of individual learners who patterned similarly to English native speakers, except for ungrammatical *wh*-extractions in the sentential subject construction, which were rejected by only 10% of Najdi learners as compared to 85% of English native speakers<sup>8</sup>. Table 4 shows the individual results for both English native speakers and L2 learners.

<sup>8</sup> The individual results were analyzed by calculating the percentage of subjects who rejected ungrammatical *wh*-extractions and the percentage of subjects who accepted grammatical *wh*-extractions. For a subject to be counted in the percentage of subjects rejecting ungrammatical *wh*-extractions for a certain condition, the mean rating for all eight sentences in that condition had to be 2 or less. For a subject to be counted in the percentage of subjects accepting grammatical *wh*-extractions for a certain condition, the mean rating for all eight sentences in that condition had to be 4 or above.

Table 4: Percentage of subjects who rejected ungrammatical *wh*-extractions and percentage of subjects who accepted grammatical *wh*-extractions, for each of the ten conditions

	Strong Islands						Weak Islands			
	Adjunct Clause		Relative Clause		Sentential Subject		Wh-Island		Complex NP	
	<i>Ungr.</i>	<i>Gram.</i>	<i>Ungr.</i>	<i>Gram.</i>	<i>Ungr.</i>	<i>Gram.</i>	<i>Ungr.</i>	<i>Gram.</i>	<i>Ungr.</i>	<i>Gram.</i>
L1 subjects	88%	80%	77%	35%	85%	85%	54%	54%	35%	54%
L2 subjects	76%	76%	69%	28%	10%	79%	14%	34%	24%	48%

Based on Belikova and White’s (2009) proposal, L2 learners are expected to reject *wh*-movement out of strong islands more strongly than *wh*-movement out of weak islands, if they have access to UG. The findings obtained from Aldosari (2013) indicated that Belikova and White’s approach is on the right track. Except for the sentential subject construction, L2 learners in Aldosari rejected *wh*-movement out of strong islands more strongly than *wh*-movement out of weak islands. If we adopt Belikova and White’s proposal, many previous studies, especially those we reviewed above, show that L2 learners, like native speakers, are sensitive to syntactic island constraints on *wh*-movement.

In this section, we reviewed the previous studies that used acceptability judgment tasks (offline tasks) to examine whether L2 learners are sensitive to island constraints on *wh*-movement. In the following section, we present some of the previous studies that tested whether L2 learners are sensitive to syntactic island constraints on *wh*-movement during the online sentence processing of *wh*-dependencies.

## 2.2 L2 online processing of *wh*-dependencies and island constraints

Many studies have investigated the online processing of *wh*-dependencies in L2 learners (e.g., Marinis, Roberts, Felser & Clahsen, 2005; Felser & Roberts, 2007). In this section, we focus only on the previous studies that examined whether L2 learners are sensitive to syntactic

island constraints on *wh*-movement during online processing (e.g., Aldwayan, Fiorentino, & Gabriele, 2010; Omaki & Schulz, 2011; Felser, Cunnings, Batterham & Clahsen, 2012). For example, Aldwayan, Fiorentino, and Gabriele (2010), following the design of Stowe (1986), used a self-paced reading task to examine whether English native speakers and Najdi L2 learners use abstract syntactic island constraints in the online processing of *wh*-dependencies in English. The aim of the first experiment was to test whether English native speakers and Najdi learners process *wh*-dependencies incrementally. If parsing is incremental, the parser will posit a gap at each potential gap position in the *wh*-extraction condition (25b).

(25) DECLARATIVE

- a. My brother asked **if** Barbara will photograph **us** beside Mom at the graduation.

WH-EXTRACTION

- b. My brother asked **who** Barbara will photograph **us** beside \_\_\_ at the graduation.

Aldwayan et al. (2010) focused on the potential gap position following the verb ‘*photograph*’ in (25b)<sup>9</sup>. When the parser reaches the verb ‘*photograph*’, which is a potential gap licenser, the parser will predict that what follows the verb should be the gap position. When the parser finds this position, which was predicted to be empty, is actually filled with lexical material ‘*us*’, the parser will be surprised and show a filled-gap effect, a reading time slowdown, at this region in the *wh*-extraction condition (25b), as compared to the same region in the declarative condition (25a). The results showed that both English native speakers and Najdi learners had a reading time slowdown in the filled object position ‘*us*’ and a marginal reading time slowdown in the filled subject position ‘*Barbara*’ in the *wh*-extraction condition, as compared to the same

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<sup>9</sup> The first potential gap position is actually the embedded subject position ‘*Barbara*’ but studies have not consistently found evidence of subject filled gap effects (see Lee, 2004).



positions in the declarative condition. This suggests that natives and learners posit gaps incrementally in processing *wh*-dependencies.

The second experiment was designed to test whether the natives and learners avoid positing a gap in grammatically unlicensed positions such as complex NP islands from which a *wh*-extraction is not grammatically allowed. If the natives and learners use abstract syntactic island constraints on *wh*-movement during online processing, they will not show a reading time slowdown at the prepositional object position ‘*John’s*’ within the complex NP island (*e.g.*, *the boring comments about John’s used car*) in the *wh*-extraction condition (26b) as compared to the same position in the declarative condition (26a) although the preposition ‘*about*’ is a potential gap licensor.

(26) DECLARATIVE

- a. My sister wondered **if** the boring comments about **John’s** used car were intended to entertain the group.

WH-EXTRACTION

- b. My sister wondered **who** the boring comments about **John’s** used car were intended to entertain \_\_\_\_.

The results showed that both natives and learners had no reading time slowdown in the prepositional object position ‘*John’s*’ in the *wh*-extraction condition (26b) as compared to the same region in the declarative condition (26a). Based on these results obtained from the two experiments, the authors argued against the Shallow Structure Hypothesis (Clahsen & Felser, 2006), which claims that L2 learners do not use abstract syntactic knowledge in L2 processing. The results from the first experiment alone cannot be taken as strong evidence that L2 learners can use abstract syntactic knowledge because the filled-gap effect was observed in the position directly following the verb. It could be the case that the learners were just linking the verb with

its theme argument ‘*who*’. However, when the results of experiment one and experiment two are taken together, they provide more convincing evidence that L2 learners make use of abstract syntax. Like native speakers, L2 learners not only posited a gap in a grammatical position, as shown in the first experiment, but also avoided positing a gap in an ungrammatical position, as shown in the second experiment. This pattern of results exhibited by the same learners suggests that L2 learners did not simply posit a gap randomly whenever they encounter a licenser for a gap, but they were grammatically guided by syntactic rules and constraints that govern *wh*-movement in English.

Omaki and Schulz (2011) also provided another piece of evidence that L2 learners are sensitive to syntactic island constraints during online sentence processing, challenging the Shallow Structure Hypothesis. Omaki and Schulz tested whether Spanish learners, like English native speakers, can use abstract syntactic information and show sensitivity to the relative clause island constraint, using an offline judgment task and an online self-paced reading task. The goal of the judgment task was to ensure that learners know the relative clause island constraint tested in the online self-paced reading task. The results of the judgment task showed that both English native speakers and Spanish learners respected the relative clause island constraint.

The online self-paced reading task used a slightly modified version of the stimuli used in Traxler and Pickering (1996). The task used a plausibility mismatch paradigm to probe for gap filling and included four conditions, as shown in (27).

(27) NONISLAND / IMPLAUSIBLE

- a. **The city** that the author **wrote** regularly about \_\_\_ was named for an explorer.

NONISLAND / PLAUSIBLE

- b. **The book** that the author **wrote** regularly about \_\_\_ was named for an explorer.

ISLAND / IMPLAUSIBLE

- c. **The city** that the author who **wrote** regularly saw \_\_\_ was named for an explorer.

ISLAND / PLAUSIBLE

- d. **The book** that the author who **wrote** regularly saw \_\_\_ was named for an explorer.

The task manipulated the plausibility of the filler as an argument of the first verb (*e.g.*, ‘*the city*’ is not as a plausible argument of the verb ‘*wrote*’; ‘*the book*’ is as a plausible argument of the verb ‘*wrote*’). The structure type (non-island vs. island) was also manipulated. In non-island conditions (27a and 27b), there was only one relative clause (*e.g.*, *the city/ the book that the author wrote regularly about*). In these conditions, the critical verb ‘*wrote*’ is the first potential gap position. In island conditions (27c and 27d), however, the critical verb ‘*wrote*’ was inside an embedded clause (*e.g.*, *the author who wrote regularly*), which is an island. Thus, the critical verb ‘*wrote*’ is not a potential gap position in these conditions because it is inside an island from which *wh*-extraction is not grammatically permissible.

The results showed that both English native speakers and Spanish learners demonstrated a plausibility mismatch effect, a reading time slowdown, at the spillover region ‘*regularly*’ that immediately follows the critical verb ‘*wrote*’ in the implausible non-island condition (27a) as compared to the same region in the plausible non-island condition (27b). This suggests that they actively attempted to posit a gap at the verb ‘*wrote*’, a grammatically licensed position.

In contrast, both English native speakers and Spanish learners did not show a plausibility mismatch effect at the critical verb ‘*wrote*’ or the following spillover region, in the island implausible condition (27c), as compared to the same regions in the island plausible condition (27d). This suggests that they did not actively attempt to posit a gap inside the island, a grammatically unlicensed position. Omaki and Schulz argued that these findings indicate that L2 learners can use detailed syntactic information, such as syntactic island constraints, when

processing *wh*-dependencies and do not rely only on non-structural information as the Shallow Structure Hypothesis claims.

Felser, Cunnings, Batterham and Clahsen (2012) also examined the L2 sensitivity to syntactic island constraints, using an eye-tracking task, and argued that L2 learners may show sensitivity to syntactic island constraints in online processing but that their initial stages of processing rely more on semantic information than on syntactic information. In their first experiment, they tested German learners and English native speakers, using a plausibility mismatch design in four conditions, as shown in (28).

(28) NO CONSTRAINT / PLAUSIBLE

- a. Everyone liked **the magazine** that the hairdresser **read** extensively and with such enormous enthusiasm about \_\_\_\_ before going to the salon.

NO CONSTRAINT / IMPLAUSIBLE

- b. Everyone liked **the shampoo** that the hairdresser **read** extensively and with such enormous enthusiasm about \_\_\_\_ before going to the salon.

ISLAND CONSTRAINT / PLAUSIBLE

- c. Everyone liked **the magazine** that the hairdresser who **read** extensively and with such enormous enthusiasm bought \_\_\_\_ before going to the salon.

ISLAND CONSTRAINT / IMPLAUSIBLE

- d. Everyone liked **the shampoo** that the hairdresser who **read** extensively and with such enormous enthusiasm bought \_\_\_\_ before going to the salon.

Like Omaki and Schulz (2011), Felser et al. (2012) manipulated the plausibility of the filler as an argument of the first embedded verb (*e.g.*, ‘*the magazine*’ is a plausible argument of the first embedded verb ‘*read*’) and also manipulated the structure type (island vs. non-island constraint). The critical region was ‘*read extensively*’. In the non-island constraint conditions (28a, b), the first potential gap position was the critical verb ‘*read*’. In the island constraint

conditions, however, the critical verb ‘*read*’ was not a potential gap position as it was contained within an island.

It was predicted that if English native speakers and learners respect island constraints during online processing, they will show a plausibility effect at or around the critical region ‘*read extensively*’ in the implausible non-island condition (28b) as compared to the plausible non-island condition (28a). However, there should be no such plausibility effect at the critical region ‘*read extensively*’ within the relative clause island in the implausible island condition (28d) as compared to the plausible island condition (28c).

At the critical region ‘*read extensively*’, the English native speakers showed a plausibility effect, as reflected in rereading times (a measure of later processing), only in the non-island conditions, with longer reading times for the implausible than the plausible condition. The German learners also showed a plausibility effect at the critical region, but as reflected in first-pass reading times (a measure of early processing), only in the non-island conditions, with longer reading times for the implausible than the plausible condition.

At the spillover region ‘*and with*’, both the English native speakers and German learners showed a plausibility effect, as reflected in regression path times and rereading times (two measures of later processing), only in the non-island conditions, with longer reading times for the implausible than the plausible condition.

These results suggest that both English native speakers and German learners were sensitive to relative clause island constraints in online processing. However, Felser et al. (2012) argued that these results also suggest a difference between L1 and L2 processing of *wh*-dependencies. The learners, for example, showed sensitivity to plausibility effects at early stages of their processing as reflected in their first-pass reading times, while the native speakers showed

sensitivity to plausibility effects only at later stages of their processing of *wh*-dependencies, as reflected in their regression path times and rereading times. Felser et al. (2012) suggested that learners' initial stages of processing *wh*-dependencies rely more on semantic information because they showed early sensitivity to plausibility information, in contrast to the natives. Note, however, that the learners showed this sensitivity only in the non-island conditions, which suggests that the establishment of *wh*-dependencies by learners is indeed constrained by syntax.

Thus, Felser et al. (2012) conducted a second experiment to test whether German learners can make use of syntactic information rather than semantic information during processing of *wh*-dependencies. In this experiment, they used a filled-gap effect paradigm similar to a plausibility mismatch paradigm to test for gap filling. The design and materials were similar to those used in the first experiment. However, instead of manipulating the plausibility of the filler as an argument of the first embedded verb, they manipulated whether the potential gap following the first embedded verb 'read' was filled with an overt object NP 'articles' as in (29).

(29) NO CONSTRAINT / GAP

- a. Everyone liked **the magazine** that the hairdresser **read** \_\_\_\_ quickly and yet extremely thoroughly about before going to the beauty salon.

NO CONSTRAINT / FILLED GAP

- b. Everyone liked **the magazine** that the hairdresser **read** articles with such strong conclusions about before going to the beauty salon.

ISLAND CONSTRAINT / GAP

- c. Everyone liked **the magazine** that the hairdresser who **read** \_\_\_\_ quickly and yet extremely thoroughly bought before going to the beauty salon.

ISLAND CONSTRAINT / FILLED GAP

- d. Everyone liked **the magazine** that the hairdresser who **read** articles with such strong conclusions bought before going to the beauty salon.

The critical region was the word immediately following the embedded verb ‘*read*’ (e.g., ‘*articles*’ or ‘*quickly*’). If German learners are sensitive to island constraints, they will show a difference in reading times in the non-island constraint conditions, with reading times at the critical region being longer for (29b) than for (29a). However, no difference should be observed at the critical region between the island constraint conditions, (29c) and (29d).

At the critical region, the English native speakers showed a filled-gap effect, as reflected in rereading times, only in the non-island conditions, with longer reading times for the filled-gap than the unfilled-gap condition. The German learners, however, did not show any filled-gap effects at the critical region. At the spillover region, the three words following the critical region, the English native speakers showed a filled-gap effect, as reflected in regression path times, only in the non-island conditions, with longer reading times for the filled-gap than the unfilled-gap condition. The German learners also showed a filled-gap effect, as reflected in rereading times, only in the non-island conditions, with longer reading times for the filled-gap than the unfilled-gap condition.

Felser et al. (2012) argued that these results, combined with the results of the first experiment suggest that both English native speakers and German learners are sensitive to island constraints. However, Felser et al. (2012) claimed that there are some differences between natives and learners with respect to the nature of processing *wh*-dependencies. In the second experiment, for example, the natives showed sensitivity to filled-gap effects very early starting from the critical region, which suggests that they posited a gap and made use of syntactic information very early in their processing of *wh*-dependencies. The learners, however, did not show sensitivity to a filled-gap effect until they reached the spillover region, which suggests that

they did not posit a gap immediately and waited until they reached the spillover region to make use of the syntactic information.

To summarize the results of the L2 online studies reviewed above, both Aldwayan et al. (2010) and Omaki and Schulz (2011) showed that L2 learners, like native speakers, are sensitive to syntactic island constraints on *wh*-movement in online processing. Felser et al. (2012) also showed that L2 learners are sensitive to island constraints but claimed that L2 learners rely more on semantic information than on syntactic information at their initial stages of processing *wh*-dependencies, in contrast to native speakers.

In this section, we have shown that L2 learners, like native speakers, did not posit gaps inside islands in self-paced reading and eye tracking tasks (online tasks), which suggests that they are sensitive to the effects of islands during online sentence processing. We have also shown in Section 2.1 that L2 learners are sensitive to the effects of islands in acceptability judgment tasks (offline tasks) as reflected in their low acceptability judgments of ungrammatical island violation sentences. However, theories differ in their explanations for the source of this sensitivity to island effects. Under grammatical syntactic theories, sensitivity to island effects is driven by purely grammatical syntactic constraints that prohibit *wh*-extraction from islands. Under the resource-limitation theory (Kluender & Kutas, 1993; Hofmeister & Sag, 2010), however, sensitivity to island effects is driven by processing difficulty that arises when attempting to comprehend sentences with *wh*-extraction from islands. The resource-limitation theory is explained in more detail in the following section.



### 2.3 Resource-limitation theory

Each ungrammatical island violation sentence always contains two elements, a long-distance *wh*-dependency and a complex island structure. The ungrammatical island violation sentence in (30), for example, has a long-distance *wh*-dependency between the displaced element, ‘*what*,’ which is called the filler, and the gap in the embedded clause.

(30) \*What<sub>i</sub> does John wonder [whether Mary took *t*<sub>i</sub> ]? WH-ISLAND

The sentence also has a complex island structure, which is the embedded clause ‘*whether Mary took*’. Under the resource-limitation theory (Kluender & Kutas, 1993; Hofmeister & Sag, 2010), the unacceptability of ungrammatical island violation sentences as in (30) arises when the parser’s limited processing resources are exhausted as a result of simultaneously processing both the long-distance *wh*-dependency and the complex island structure. That is, once the parser recognizes the filler ‘*what*’ in sentence (30), for example, the parser will hold the filler in working memory and immediately start searching for a gap to close the dependency between the filler and the gap as soon as possible. When the parser crosses the embedded clause boundary ‘*whether*’ while holding the filler ‘*what*’ in working memory, the parser will also need to process the semantic content introduced by the embedded clause, *i.e.*, the island structure. At this point, the parser has two simultaneous processing costs, the cost of holding the filler ‘*what*’ in working memory and the cost of processing the semantic content introduced by the island structure. These two simultaneous processing costs overload the parser’s limited processing resources and cause processing difficulty, before the parser can posit a gap inside the island to complete the dependency between the filler and the gap. The following section reviews previous studies that

tested predictions of grammatical syntactic theories and the resource-limitation theory with respect to the source of island effects.

#### 2.4 Processing vs. grammatical accounts of islands

Kluender and Kutas (1993) argued that island effects that give rise to low acceptability judgments are due to processing difficulty and not due to innate syntactic constraints. More specifically, they claimed that ungrammatical *wh*-island violation sentences as in (31c) are unacceptable because the interrogative pronoun ‘*what*’ at the boundary of the embedded clause interferes with the processing of the dependency between the filler ‘*who*’ in the main clause and the gap in the embedded clause, *i.e.*, the island structure.

- (31)
- a. Who isn’t he sure [**that** the TA explained it to \_\_\_ in lab]?
  - b. ?Who isn’t he sure [**if** the TA explained it to \_\_\_ in lab]?
  - c. \*Who<sub>a</sub> isn’t he sure [**what**<sub>b</sub> the TA explained \_\_\_<sub>b</sub> to \_\_\_<sub>a</sub> in lab]?

The grammatical sentence in (31a) is typically more acceptable than the grammatical sentence in (31b), which in turn is more acceptable than the ungrammatical *wh*-island violation sentence in (31c). Kluender and Kutas claimed that the acceptability of these sentences varies based on the semantic nature of the element at the embedded clause boundary. In (31a), for example, the complementizer ‘*that*’ is semantically neutral and simply introduces a proposition. The complementizer ‘*if*’ in (31b) has more semantic content as compared with ‘*that*’ and denotes a possible state of affairs. In contrast to the two complementizers ‘*that*’ and ‘*if*’, the interrogative pronoun ‘*what*’ is an expression that has a referent in the discourse. Processing of the interrogative pronoun ‘*what*’ entails activation of its referent in mental representation, which represents a processing load. In (31c), while the parser holds the main clause filler ‘*who*’ in

working memory, the parser needs to simultaneously process the interrogative pronoun ‘*what*’ at the boundary of the embedded clause. The simultaneous performance of multiple processing tasks overloads the processing resources and causes processing difficulty, which results in low acceptability. Based on consistent data obtained from acceptability judgment and ERP experiments, Kluender and Kutas claimed that holding the main clause filler ‘*who*’ in working memory while crossing the embedded clause boundary is easier in (31a) and (31b), as compared to (31c).

Like Kluender and Kutas (1993), Hofmeister and Sag (2010) argued that sensitivity to island effects is due to processing difficulty. To support their argument, Hofmeister and Sag identified a range of linguistic factors that affect processing of ungrammatical island violation sentences. They focused on the linguistic properties of the *wh*-filler, the extracted element. The sentences in (32a) and (32b) are both ungrammatical *wh*-island violation sentences and differ only in the complexity of the *wh*-filler.

(32)

- a. \***What**<sub>i</sub> does John wonder whether Mary took *t*<sub>i</sub> to school?
- b. \***Which book**<sub>i</sub> does John wonder whether Mary took *t*<sub>i</sub> to school?

The sentence in (32a) has a bare *wh*-filler ‘*what*’, while the sentence in (32b) has a more complex *wh*-filler ‘*which book*’. Hofmeister and Sag argued that semantically and syntactically more complex *wh*-fillers like ‘*which book*’ in (32b) facilitate processing of ungrammatical island violation sentences at downstream regions. Their argument is based on the idea that the more complex the *wh*-filler, the stronger its mental representation will be in working memory. When a *wh*-filler has a stronger mental representation in working memory, its retrieval from working memory will be easier at the gap site, *i.e.*, the subcategorizing verb.

Hofmeister and Sag (2010) tested the role of complex *wh*-fillers in facilitating the processing of ungrammatical *wh*-island violation sentences. They tested English native speakers, using a self-paced reading task. The task had three conditions, as shown in (33).

(33) BACKGROUND SENTENCE

*Albert learned that the managers dismissed the employee with poor sales after the annual performance review.*

BARE CONDITION

- a. \***Who** did Albert learn whether they **dismissed** \_\_ after the annual performance review?

WHICH CONDITION

- b. \***Which employee** did Albert learn whether they **dismissed** \_\_ after the annual performance review?

BASELINE CONDITION

- c. Who did Albert learn that they dismissed after the annual performance review?

The first condition (33a) and the second condition (33b) both had ungrammatical *wh*-island violation sentences. In these two conditions, the complexity of the *wh*-filler was manipulated. The first condition (33a) had a bare *wh*-filler ‘*who*,’ while the second condition (33b) had a more complex *wh*-filler ‘*which employee*’. There was also a baseline condition (33c), which is grammatical and does not have an island violation. Each sentence in these three conditions was preceded by a declarative background sentence to set a context for the test sentence. Hofmeister and Sag predicted that the complex *wh*-filler ‘*which employee*’ in condition (33b), as compared to the bare *wh*-filler ‘*who*’ in condition (33a), would lead to faster reading times at or around the embedded verb ‘*dismissed*’ inside the island, where the retrieval of the *wh*-filler from working memory is expected to take place. As predicted, the results showed that the complex *wh*-filler condition (33b) revealed faster reading times at the three regions ‘*after the annual*’ that

immediately follow the embedded verb ‘*dismissed*,’ as compared to the bare *wh*-filler condition (33a). Interestingly, there was no difference between the complex *wh*-filler condition (33b) and the baseline condition (33c) at these three regions. Hofmeister and Sag argued that these results suggest that processing of ungrammatical island violation sentences can be facilitated when the complexity of *wh*-filler is increased.

To test whether complex *wh*-fillers that facilitated processing of ungrammatical island violation sentences can also improve their acceptability judgments, Hofmeister and Sag (2010) conducted a grammaticality judgment task. They used some of the stimuli used in the self-paced reading task, with slight modification. Instead of using direct questions, they used embedded questions as in (34) to avoid the pragmatic oddity of presenting questions without a context.

(34) BARE CONDITION

- a. \*Only a few individuals repeated **who** Albert learned whether we dismissed \_\_ after the annual performance evaluations.

WHICH CONDITION

- b. \*Only a few individuals repeated **which employee** Albert learned whether we dismissed \_\_ after the annual performance evaluations.

There were two conditions that had ungrammatical *wh*-island violation sentences, with the first condition having a bare *wh*-filler (34a) and the second condition having a more complex *wh*-filler (34b). Participants were asked to rate how natural each sentence sounded in English, using a seven-point rating scale, with seven being ‘*perfectly natural*’. The results showed that complex *wh*-fillers improved the acceptability judgments of ungrammatical *wh*-island violation sentences. That is, ungrammatical *wh*-island violation sentences with a complex *wh*-filler (34b) were rated higher than ungrammatical *wh*-island violation sentences with a bare *wh*-filler (34a).

The results of the self-paced reading task and the acceptability judgment task showed that more complex *wh*-fillers can facilitate processing of ungrammatical *wh*-island violation sentences and also can improve their acceptability judgments. Based on the parallel results of the acceptability judgments and the reading times, which measure processing difficulty, Hofmeister and Sag (2010) argued that these results support the view that the phenomenon of island effects is due to processing difficulty. Hofmeister and Sag claimed that these results do not support the grammatical view of islands because non-structural factors, such as the complexity of *wh*-filler phrase, can affect the processing and acceptability of ungrammatical island violation sentences.

However, Hofmeister and Sag (2010) did not examine the effect of complex *wh*-fillers on the acceptability of grammatical sentences without island violations. Goodall (2015) tested the effect of complex *wh*-fillers on the acceptability of grammatical sentences without island violations and argued that complex *wh*-fillers can improve the acceptability not only of ungrammatical island violation sentences but also of grammatical sentences without island violations. Goodall manipulated the type of the *wh*-filler (bare vs. complex) and the type of the structure in which the gap was located (complex NP vs. *wh*-clause vs. *that*-clause) in six conditions using a 2 × 3 design, as shown in (35).

- (35) UNGRAMMAICAL / COMPLEX NP ISLAND
- a. \*What / \***Which of the cars** do you believe the claim that he might buy \_\_\_?
- UNGRAMMAICAL / WH-ISLAND
- b. \*What / \***Which of the cars** do you wonder who might buy \_\_\_?
- GRAMMATICAL / NON-ISLAND
- c. What / **Which of the cars** do you believe that he might buy \_\_\_?

The first two conditions are ungrammatical due to a complex NP island violation, as shown in (35a). The third and fourth conditions are also ungrammatical due to a *wh*-island violation, as

shown in (35b). The last two conditions, however, are grammatical without island violations, as shown in (35c). Goodall tested English native speakers, using a grammaticality judgment task. Participants were asked to judge each sentence using a seven-point rating scale with seven being ‘*very good*’.

The results showed that ungrammatical sentences with a complex NP island violation (35a) and ungrammatical sentences with a *wh*-island violation (35b) were rejected, with the sentences with a complex *wh*-filler being rated higher than the sentences with a bare *wh*-filler. This suggests that complex *wh*-fillers increased the acceptability of ungrammatical sentences with island violations. The grammatical sentences without island violations (35c), on the other hand, were accepted, with the sentences with a complex *wh*-filler being rated higher than the sentences with a bare *wh*-filler. This suggests that complex *wh*-fillers also increased the acceptability of grammatical sentences without island violations. Goodall (2015) argued that these results support the view that complex *wh*-fillers facilitate processing at the gap site, regardless of whether the gap was located inside an island or non-island structure. Goodall also argued that although complex *wh*-fillers improve acceptability of ungrammatical island violation sentences, they are still judged significantly lower than grammatical sentences without island violations.

Furthermore, the results did not show an interaction between the type of *wh*-filler and the type of structure in which the gap was located. This suggests that complex *wh*-fillers did not have a larger effect on acceptability in ungrammatical island violation sentences than in grammatical sentences without island violations. Goodall (2015) argued that this result does not support the processing account of islands, which claims that island effects arise as a result of an interaction between the processing difficulty of the filler-gap dependency and the processing

difficulty of the island structure. If complex *wh*-fillers facilitate the processing of the filler-gap dependency, this facilitating effect should be magnified when the processing of the filler-gap dependency interacts with the processing of the island structure in ungrammatical island violation sentences. If this is the case, complex *wh*-fillers should lead to more improvement in acceptability of ungrammatical island violation sentences as in (35a) and (35b) than in grammatical sentences without island violations as in (35c). However, the results showed that complex *wh*-fillers led to a uniform improvement across the three structure types tested. Based on these results, Goodall argued that island effects are more likely not due to processing difficulty and could be due to grammatical syntactic constraints.

It should be noted that it is difficult to tease apart the processing and grammatical accounts of islands based on traditional acceptability judgments. Both accounts predict low acceptability judgments of ungrammatical island violation sentences. Under the processing account, the low acceptability judgments are attributable to processing difficulty that results from the simultaneous processing of the filler-gap dependency and the island structure, which overwhelms an individual's processing capacity. Under the grammatical account, however, the low acceptability judgments are attributable to violations of syntactic constraints.

It is also difficult to tease apart the processing and grammatical accounts of islands based on the results that show evidence for avoidance of positing a gap inside islands during L1 processing (*e.g.*, Stowe, 1986; Traxler & Pickering, 1996) or L2 processing (*e.g.*, Aldwayan, Fiorentino, & Gabriele, 2010; Omaki & Schulz, 2011). For example, Stowe (1986) used a self-paced reading task in her second experiment to examine whether English speakers can avoid positing a gap in grammatically unlicensed positions, such as within a complex NP island (*e.g.*, *the silly story about Greg's older brother*), as shown in (36b).



(36) DECLARATIVE

- a. The teacher asked **if** the silly story about **Greg's** older brother was supposed to mean anything.

WH-EXTRACTION

- b. The teacher asked **what** the silly story about **Greg's** older brother was supposed to mean \_\_\_\_.

If English speakers respect grammatical syntactic island constraints during online processing of *wh*-dependencies, they will not posit a gap at the prepositional object position ‘*Greg's*’ within the island in the *wh*-extraction condition (36b) although the preposition ‘*about*’ is a potential gap licenser.

Stowe's results showed that English speakers did not demonstrate a reading time slowdown in the prepositional object position ‘*Greg's*’ in the *wh*-extraction condition (36b), as compared to the same region in the declarative condition (36a). One possible interpretation of these results is that the parser avoided positing a gap inside the island because the parser respects grammatical syntactic island constraints, supporting the grammatical view of islands. However, these results are also consistent with the processing view of islands. Advocates of the processing account of islands may argue that the parser avoided positing a gap inside the island not because the parser respects grammatical island constraints but because the parser experiences processing difficulty when attempting to posit a gap inside the complex island structure.

However, Phillips (2006) showed that English speakers posit gaps inside islands when they are grammatically permissible, challenging the processing view of islands, which claims that speakers do not posit gaps inside islands due to processing difficulty. Phillips investigated processing of parasitic gaps inside subject islands, which are ungrammatical as in (37a) unless they are rescued by subsequent gaps as in (37b). However, for parasitic gaps to be rescued by other gaps, the verb inside the island must be non-finite.

(37)

- a. \*What did [the attempt to repair \_\_\_\_ ] ultimately damage the car?
- b. What did [the attempt to repair \_\_\_\_<sub>PG</sub>] ultimately damage \_\_\_\_?

Using a self-paced reading task, Philips (2006) tested whether the parser posits a gap inside a subject island where a sentence may or may not end up as a parasitic gap construction. The task used a plausibility mismatch paradigm to test for gap filling. The task had four conditions as in (38) and manipulated the finiteness of the verb in the island and the plausibility of the *wh*-phrase as an argument of the verb (e.g., ‘*which schools*’ as a plausible argument of ‘*expand*’; ‘*which high school students*’ as an implausible argument of ‘*expand*’).

(38) PLAUSIBLE / INFINITIVE

- a. The school superintendent learned **which schools** the proposal to **expand** drastically and innovatively upon the current curriculum would overburden \_\_\_\_ during the following semester.

IMPLAUSIBLE / INFINITIVE

- b. The school superintendent learned **which high school students** the proposal to **expand** drastically and innovatively upon the current curriculum would motivate \_\_\_\_ during the following semester.

PLAUSIBLE / FINITE

- c. The school superintendent learned **which schools** the proposal that **expanded** drastically and innovatively upon the current curriculum would overburden \_\_\_\_ during the following semester.

IMPLAUSIBLE / FINITE

- d. The school superintendent learned **which high school students** the proposal that **expanded** drastically and innovatively upon the current curriculum would motivate \_\_\_\_ during the following semester.

Under the grammatical account of islands, the parser will only posit a gap inside the subject island with a non-finite verb, an environment that could end up as a grammatical parasitic gap construction, and will avoid positing a gap inside the subject island with a finite verb, an

environment which cannot end up as a grammatical parasitic gap construction. If this is the case, the parser should show a plausibility mismatch effect, a reading time slowdown, at the verb ‘*expand*’ in the implausible infinitival condition (38b) but not in the implausible finite condition (38d).

Under the resource-limitation account of islands, however, the parser will not posit a gap inside the subject island because processing the complex island structure while holding in working memory the *wh*-filler phrase, e.g., ‘*which school*’ overloads the parser’s limited processing resources before the parser can posit a gap inside the island. If this claim is correct, the parser should not posit a gap inside the subject island, regardless of whether the subject island has a finite or non-finite verb. In other words, the parser should not show a plausibility mismatch effect, a reading time slowdown, at the verb ‘*expand*’ in the implausible infinitival condition (38b) or the implausible finite condition (38d).

The results showed a plausibility mismatch effect, a reading time slowdown, at the verb ‘*expand*’ in the implausible infinitival condition (38b), where the potential parasitic gap inside the island is rescuable. However, there was no plausibility mismatch effect at the verb ‘*expanded*’ in the implausible finite condition (38d), where the gap inside the island is not rescuable. These results, which show that the parser posits a gap inside islands under some circumstances based on grammar information, support the grammatical view of islands and represent a challenge for the resource-limitation account of islands, which claims that the parser does not posit a gap inside islands because islands are simply processing bottlenecks.

Contrary to the prediction of the processing view of islands, Wagers and Phillips (2009) also showed that the parser posits gaps inside islands when they are needed to satisfy a grammatical constraint. The study examined whether the parser respects the coordinate structure

constraint (CSC) when processing multiple dependencies in coordinate VP structures. In (39), the island is the coordinate VP structure, which consists of the two conjuncts, [designed \_\_\_ for his boss] and [methodically sprayed the special test surfaces with \_\_\_].

(39) COORDINATE VP, PLAUSIBLE

- a. The adhesive coating that the talented engineer designed \_\_\_ for his boss and methodically **sprayed** the special test surfaces with \_\_\_ in his new laboratory could make the company lots of money.

COORDINATE VP, IMPLAUSIBLE

- b. The computer program that the talented engineer designed \_\_\_ for his boss and methodically **sprayed** the special test surfaces with \_\_\_ in his new laboratory could make the company lots of money.

According to the CSC, extraction from coordinate structure islands is possible only if it is across the board. In (39), for example, the gap after the verb ‘*designed*’ and the gap after the preposition ‘*with*’ of the locative verb ‘*sprayed*’ are both grammatically obligatory.

Wagers and Phillips used a self-paced reading task. They used a plausibility mismatch paradigm, manipulating plausibility between the filler and the second verb (e.g., ‘*the adhesive coating*’ as a plausible argument of ‘*sprayed*’; ‘*the computer program*’ as an implausible argument of ‘*sprayed*’). The critical region was the second coordinated verb ‘*sprayed*’. Under the grammatical account of islands, when the parser posits a gap after the first verb ‘*designed*’, the parser will actively continue to search for a second gap to posit after the second verb ‘*sprayed*’ to satisfy the CSC. If this is the case, there should be a reading time slowdown at the critical verb ‘*sprayed*’ in the implausible condition (39b) as the filler ‘*the computer program*’ is an implausible argument of ‘*spray*’. Under the processing account of islands, however, the parser will not posit a gap after the second verb ‘*spray*’ as the parser gets stuck when trying to posit a

gap inside islands because islands are complex places in a sentence that require more processing demands.

The results showed an implausibility effect, a reading time slowdown, at the spillover region ‘*the*’ after the critical verb ‘*sprayed*’. These results suggest that the parser continued to look for a second gap to posit in the coordinate structure island to satisfy the grammatical constraint. Because the gap was separated from the critical verb ‘*sprayed*’ as shown in (39), the implausibility effect at the spillover region ‘*the*’, which was observed before the parser encountered the gap, suggests that the dependency formation was not driven by bottom-up information that indicates the presence of a gap. These results, which show that the parser continued to actively predict a second gap in the coordinate structure island, do not support the processing account of islands and are more compatible with the grammatical account of islands.

To further investigate the source of island effects, Sprouse, Wagers, and Phillips (2012) took a different approach that focused on individual differences in processing resources. More specifically, they examined the relationship between individual differences in processing resources and sensitivity to island effects in two acceptability judgment experiments. In the first experiment, they tested 142 English native speakers, using a seven-point rating scale, with seven being ‘*most acceptable*’. They tested four island types: adjunct islands, subject islands, complex NP islands, and *whether* islands. They manipulated two linguistic factors, the *wh*-dependency length and the presence of an island structure, in four conditions using a  $2 \times 2$  factorial design, as shown in (40).

(40) ADJUNCT ISLAND

- |   |                     |
|---|---------------------|
| a. Who __suspects that the boss left her keys in the car.       | NONISLAND/ MATRIX   |
| b. What do you suspect that the boss left __in the car?         | NONISLAND/ EMBEDDED |
| c. Who __worries <b>if the boss leaves her keys</b> in the car? | ISLAND/ MATRIX      |
| d. *What do you worry <b>if the boss leaves</b> __in the car?   | ISLAND/ EMBEDDED    |

The *wh*-dependency was either short, as in (40a) and (40c), with a *wh*-extraction from a matrix clause, or long, as in (40b) and (40d), with a *wh*-extraction from an embedded clause. The island structure was either absent, as in (40a) and (40b), or present, as in (40c) and (40d). The first three conditions are grammatical, while the last condition is ungrammatical due to an island violation.

Under the processing account of islands, manipulation of *wh*-dependency length and presence of an island structure should affect acceptability judgments of sentences. For example, the grammatical sentence in the baseline condition in (40a) and repeated in (41) is expected to receive a high acceptability judgment rating because it only has a short *wh*-dependency and does not contain an island structure.

(41) Who \_\_suspects that the boss left her keys in the car. NONISLAND/ MATRIX

The grammatical sentence in (40b) and repeated in (42), which has a long *wh*-dependency, is expected to receive a lower acceptability judgment rating than the grammatical sentence in the baseline condition (41), which has a short *wh*-dependency.

(42) What do you suspect that the boss left \_\_in the car? NONISLAND/ EMBEDDED

The grammatical sentence in (40c) and repeated in (43), which contains an island structure, is expected to receive a lower acceptability judgment rating than the grammatical sentence in the baseline condition (41), which does not have an island structure.

(43) Who \_\_worries **if the boss leaves her keys** in the car? ISLAND/ MATRIX

The ungrammatical island violation sentence in (40d) and repeated in (44) is the only sentence among the four sentences, which has both a long *wh*-dependency and a complex island structure at the same time.

(44) \*What do you worry **if the boss leaves** \_\_in the car? ISLAND/ EMBEDDED

Under the processing account of islands, this ungrammatical island violation sentence is expected to receive a very low acceptability rating because the simultaneous processing of both the long *wh*-dependency and the island structure overloads the parser's limited processing resources and causes processing difficulty. That is, it is the exhaustion of the parser's limited processing resources that causes processing difficulty and leads to a sharp, rather than linear or smooth, decline in acceptability of ungrammatical island violation sentences. The sharp decline in acceptability of the ungrammatical island violation sentence in (44) is expected to cause a statistical interaction when using the  $2 \times 2$  factorial design in (40) and repeated in (45).

(45) ADJUNCT ISLAND

- a. Who \_\_suspects that the boss left her keys in the car. NONISLAND/ MATRIX
- b. What do you suspect that the boss left \_\_in the car? NONISLAND/ EMBEDDED
- c. Who \_\_worries **if the boss leaves her keys** in the car? ISLAND/ MATRIX
- d. \*What do you worry **if the boss leaves** \_\_in the car? ISLAND/ EMBEDDED

However, under the grammatical account of islands, the factorial design in (45) is also expected to elicit an interaction. This interaction would be due to extremely low acceptability judgments of the ungrammatical island violation condition (45d), as compared to higher acceptability judgments of the other three grammatical conditions (45a, b, and c). Under the grammatical account of islands, the extremely low acceptability judgment of the ungrammatical island violation condition (45d) is due to a violation of a syntactic constraint that prohibits *wh*-extraction from an island. Because both the processing and grammatical accounts of islands predict an interaction when using the factorial design shown in (45), it would be difficult to tease apart the two different accounts of islands based only on the pattern of average acceptability ratings. Thus, an additional measure is needed, as is explained below.

As predicted under both processing and grammatical accounts of islands, the results of acceptability ratings showed an interaction between *wh*-dependency length and island structure for each of the four island types tested. This interaction was due to low acceptability judgment ratings of the ungrammatical island violation condition (45d), as compared to higher acceptability ratings of the other three grammatical conditions (45a, b, c). The interaction indicated that the effect of an island structure was greater in sentences with a long *wh*-dependency (45b and 45d) than in sentences with a short *wh*-dependency (45a and 45c), suggesting that participants were sensitive to effects of islands.

To tease apart the processing and grammatical accounts of island effects, Sprouse et al. (2012) focused on individual differences in processing resources, a factor that plays a crucial role in the sensitivity to island effects under the processing account but not under the grammatical account of islands. Under the processing account of islands, there should be a correlation between an individual's processing resources and sensitivity to island effects. That is, individuals with greater processing resources would be more likely to posit gaps inside islands and accept ungrammatical island violation sentences, showing a weak sensitivity to island effects. However, individuals with lower processing resources should have greater difficulty positing gaps inside islands (as islands present processing bottlenecks) and, therefore, will reject ungrammatical island violation sentences, showing a strong sensitivity to island effects. Under the grammatical account of islands, there should be no correlation between the size of processing resources and sensitivity to island effects.

To test these predictions, Sprouse et al. (2012) used two measures for each individual, a measure of working-memory capacity and a measure of sensitivity to island effects. To measure working-memory capacity, they used a serial-recall task. In this task, participants were asked to



recall a list of eight disyllabic words in the order they were presented. These words were *bagel*, *humor*, *level*, *magic*, *novel*, *topic*, *tulip*, and *woman*. Ten lists were created, with each list having these same eight words in a different order. Each participant was auditorily presented with all ten lists in the same order. After the auditory presentation of each list, participants had 30 seconds to recall from memory the words of that list using a pencil and scoring sheet.

To measure sensitivity to island effects, they used a measure called a differences-in-differences (DD) score, which was calculated for each individual. To calculate the DD score, as shown in (46), for example, they first calculated the difference (D1) between the mean acceptability ratings of the NONISLAND/EMBEDDED condition (46b) and the ISLAND/EMBEDDED condition (46d), to measure the effect of an island structure in sentences with a long *wh*-dependency, *i.e.*, a *wh*-extraction from an embedded clause.

(46)		Rating (z-score units)
	$D1 = (\text{NONISLAND/EMBEDDED}) - (\text{ISLAND/EMBEDDED})$	
	b. What do you suspect that the boss left __ in the car?	0.5
	d. *What do you worry <b>if the boss leaves</b> __ in the car?	- 1.5
		2.0
	$D2 = (\text{NONISLAND/MATRIX}) - (\text{ISLAND/MATRIX})$	
	a. Who __ suspects that the boss left her keys in the car?	1.5
	c. Who __ worries <b>if the boss leaves her keys</b> in the car?	- 0.7
		0.8
	$DD = D1 - D2 = 2.0 - 0.8 = 1.2$	

Then they calculated the difference (D2) between the mean acceptability ratings of the NONISLAND/MATRIX condition (46a) and the ISLAND/MATRIX condition (46c) to measure the effect of an island structure in sentences with a short *wh*-dependency, *i.e.* a *wh*-extraction from a matrix clause. Finally, they calculated the difference between D1 and D2 to get the DD score, which measures the difference between the effect of an island structure in a sentence with a long *wh*-dependency and the effect of an island structure in a sentence with a short *wh*-dependency.

A high positive DD score means a strong sensitivity to island effects, while a low positive DD score means a weak sensitivity to island effects. A positive DD score occurs when the difference (D1) between the mean acceptability ratings of the NONISLAND/EMBEDDED condition (46b) and the ISLAND/EMBEDDED condition (46d) is greater than the difference (D2) between the mean acceptability ratings of the NONISLAND/MATRIX condition (46a) and the ISLAND/MATRIX condition (46c). This indicates that the effect of an island structure is greater in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency, suggesting sensitivity to classic superadditive island effects<sup>10</sup>.

A negative DD score, which is not predicted under either the processing or grammatical accounts of islands, occurs when the difference (D1) between the mean acceptability ratings of the NONISLAND/EMBEDDED condition (46b) and the ISLAND/EMBEDDED condition (46d) is less than the difference (D2) between the mean acceptability ratings of the NONISLAND/MATRIX condition (46a) and the ISLAND/MATRIX condition (46c). This indicates that the effect of an island structure is less in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency, suggesting sensitivity to subadditive island effects<sup>11</sup>.

The processing account of islands predicts a negative relationship between serial-recall scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects. That is, as serial-recall scores increase, DD scores will decrease. The grammatical account of islands, on the other hand, does not predict a relationship between serial-recall scores and DD scores, which measure sensitivity to island effects.

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<sup>10</sup> A superadditive island effect means that the combined effects of simultaneously processing both the long *wh*-dependency and the island structure are greater than the sum of the individual effect of processing the long *wh*-dependency and the individual effect of processing the island structure.

<sup>11</sup> A subadditive island effect means that the combined effects of simultaneously processing both the long *wh*-dependency and the island structure are less than the sum of the individual effect of processing the long *wh*-dependency and the individual effect of processing the island structure.

Two sets of simple linear regressions were conducted, with recall scores as the independent variable and DD scores as the dependent variable. The results of the first set of regressions, which included all DD scores, showed a negative relationship between recall scores and DD scores for subject islands ( $p < 0.05$ ), and no relationship for adjunct islands, complex NP islands, and *whether* islands ( $p > 0.05$ ). The second set of regressions, which included only DD scores greater than or equal to zero, showed a negative relationship between recall scores and DD scores for adjunct islands, subject islands, and *whether* islands ( $p < 0.05$ ), and no relationship for complex NP islands ( $p > 0.05$ ).

Although the relationship between recall scores and DD scores was significant for some island types, Sprouse et al. (2012) argued that this relationship was very weak, as indicated by the small  $R^2$  value (between 0.00 and 0.06), which measures the proportion of the variance in DD scores that can be accounted for by recall scores. For each of the four island types, the recall scores, which measure working-memory capacity, accounted for only 1% to 6% of the variance in DD scores, which measure the sensitivity to island effects. Based on the small  $R^2$  value for each island type, Sprouse et al. (2012) argued that these results suggest no relationship between recall scores and DD scores.

In their second experiment, Sprouse et al. (2012) used magnitude estimation instead of a seven-point rating scale. In this experiment, participants were provided with a sentence, called the standard. This sentence was assigned a numeric value that represented its acceptability, called the modulus. Participants were then asked to rate each test sentence as a proportion of value of the standard. An example is shown in (47).

(47) MAGNITUDE ESTIMATION

**Standard:** Who thinks that my brother was kept tabs on by the FBI?

Acceptability: 100

**Item:** What did Lisa meet the man that bought?

Acceptability: \_\_\_\_\_

The experiment tested the same four island types as the first experiment and used two working memory measures, a serial-recall task and an  $n$ -back task. In the  $n$ -back task, participants were presented with a sequence of letters, one at a time, on a computer screen. The participant's task was to press a button if the letter currently presented on the screen was presented  $n$  letters ago.

The results showed no relationship between recall scores and DD scores ( $p > 0.05$ ), except for adjunct islands, which showed a positive relationship ( $p < 0.05$ ) when DD scores below zero were either included or excluded from the analysis. The results also showed no relationship between  $n$ -back scores and DD scores ( $p > 0.05$ ), except for adjunct islands, which showed a negative relationship ( $p < 0.05$ ) when DD scores below zero were included in the analysis. Relying on the extremely low  $R^2$  value for each island type (between 0.00 and 0.04), Sprouse et al. (2012) argued that there is no relationship between DD scores and the two working memory measures, recall scores and  $n$ -back scores. Sprouse et al. argued that these results combined with the results of the first experiment suggest that sensitivity to island effects is not driven by processing resources and claimed that these results are more in line with grammatical account of islands.

However, in a response paper, Hofmeister, Casasanto, and Sag (2012) made three main criticisms of the results of Sprouse et al. (2012). The first criticism is that Sprouse and colleagues misinterpreted their results when they relied on  $R^2$  values as a means of hypothesis testing, instead of  $p$ -values. Specifically, Hofmeister et al. (2012) argued that Sprouse and colleagues

found in their first experiment, for three out of four island types, a significant negative relationship ( $p < 0.05$ ) between recall scores and DD scores greater than or equal to zero, as predicted by the resource-limitation theory. Hofmeister et al. (2012) claimed that Sprouse and colleagues, who argued that there was no relationship between recall scores and DD scores, underestimated these statistically significant results.

The second criticism is that Sprouse and colleagues used complex stimuli that made it difficult to observe a relationship between recall scores and DD scores. More specifically, Hofmeister et al. (2012) claimed that the critical ungrammatical island violation sentences in the ISLAND/EMBEDDED condition (48) received low acceptability judgment ratings because they were too hard to process, even for individuals with high working-memory capacity.

(48) \*What do you worry **if the boss leaves** \_\_in the car? ISLAND/ EMBEDDED

Hofmeister et al. (2012) argued that these ungrammatical island violation sentences, which are direct questions, were presented to participants without a context and that they contained referential NPs (*e.g.*, the boss) with no discourse antecedents, making them sound pragmatically odd and difficult to process. They also argued that these sentences had vague *wh*-fillers (*e.g.*, what) rather than specific *wh*-fillers (*e.g.*, *which*-NP), making their processing even more difficult. Hofmeister et al. (2012) claimed that the extreme processing difficulty did not allow individual differences in working-memory capacity to emerge in acceptability ratings of ungrammatical island violation sentences. They argued that more variability will emerge in acceptability judgments if ungrammatical island violation sentences are less complex.

The third criticism is that the serial-recall task and the *n*-back task chosen by Sprouse and colleagues may not be appropriate measures of working-memory capacity. Hofmeister et al. (2012) argued that these two tasks are only simple span tasks and may not be considered

measures of working memory. They claimed that Sprouse and colleagues failed to find a relationship between working-memory capacity and sensitivity to island effects because they used inappropriate measures of working memory.

The question of whether island effects are due to violations of syntactic constraints or to processing difficulty is still a controversial issue. The present study further investigates this issue, while addressing Hofmeister et al.'s (2012) criticisms of the results of Sprouse et al. (2012), which showed no relationship between working-memory capacity and sensitivity to island effects.

### **3. The present study**

#### *3.1 The focus of the present study*

The present study has two objectives. The first objective is to test two competing hypotheses in SLA by examining the L2 acquisition of syntactic island constraints on *wh*-movement. The first hypothesis is the Interpretability Hypothesis (Tsimplici & Dimitrakopoulou, 2007), which is the most recent version of the Failed Functional Features Hypothesis (Hawkins & Chan, 1997). According to the Interpretability Hypothesis, which makes a distinction between interpretable and uninterpretable features, adult L2 learners can acquire only interpretable features that have an effect on the semantic interpretation of lexical items, like the plural feature on the noun in English (*e.g.*, books). However, uninterpretable features that have an effect on the realization of syntactic structures, like the uninterpretable *wh*-feature on the complementizer in English, cannot be acquired if they were not selected from the UG inventory of features during the critical period. Under the Interpretability Hypothesis, adult L2 learners will not be able to

show sensitivity to syntactic island constraints on *wh*-movement if their native language does not instantiate *wh*-movement.

The second hypothesis is the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), which claims that L2 learners start their L2 acquisition using the grammar of their L1, but it is possible for advanced adult learners to reset parameters in the L2 when the appropriate input is available. Under the Full Transfer/Full Access Hypothesis, adult L2 learners at advanced levels of proficiency can potentially show sensitivity to syntactic island constraints on *wh*-movement, even if *wh*-movement is not instantiated in their native language.

The second objective of the present study is to tease apart the resource-limitation theory (Kluender & Kutas, 1993; Hofmeister & Sag, 2010) and grammatical syntactic theories (*e.g.*, Ross, 1967; Chomsky, 1973, 1986; Huang, 1982) with respect to the source of island effects. It is still debatable whether island effects are due to syntactic constraints or to processing difficulty. Hofmeister and Sag (2010) argued that island effects arise as a result of processing difficulty, supporting the resource-limitation account of island effects. Hofmeister and Sag based their argument on consistent results from their self-paced reading and acceptability judgment tasks, which showed that complex *wh*-fillers, as compared to bare *wh*-fillers, can facilitate processing of ungrammatical island violation sentences and also can improve their acceptability judgments. However, Hofmeister and Sag did not test the effect of complex *wh*-fillers on the acceptability of grammatical sentences without island violations (see Goodall, 2015).

Using a different approach, Sprouse et al. (2012) further investigated the source of island effects by focusing on individual differences in working memory resources. Results showed no relationship between the measures of working-memory capacity and the measure of sensitivity to

island effects. Sprouse and colleagues concluded that these results are more in line with the grammatical account of islands.

However, as discussed earlier, Hofmeister et al. (2012) criticized the results of Sprouse et al. (2012) and argued that the lack of a relationship between working-memory capacity and sensitivity to island effects in the results of Sprouse et al. is likely due to the use of complex stimuli. Specifically, they argued that the stimuli of Sprouse et al. were extremely hard to process, even for individuals with high working-memory capacity, and did not allow cognitive individual differences to emerge in acceptability ratings. Hofmeister et al. also argued that the serial-recall task and the *n*-back task that Sprouse and colleagues chose may not be appropriate tasks to measure working-memory capacity.

Building on Sprouse et al. (2012), the present study further investigates the source of island effects, while considering Hofmeister et al.'s (2012) possible explanations for the absence of a relationship between working-memory capacity and sensitivity to island effects seen in the results of Sprouse et al. The present study uses the approach of Sprouse et al., which focused on testing the relationship between working-memory capacity and sensitivity to island effects. The study seeks to provide evidence not only from native speakers but also from L2 learners by testing English native speakers and Najdi Arabic learners of English.

The present study uses a revised version of the stimuli of Sprouse et al. (2012). We made the revised stimuli of Sprouse et al. less complex to allow individual differences in working-memory capacity to emerge in acceptability ratings. Specifically, we made two modifications to the stimuli of Sprouse et al. First, we preceded each test sentence (49b) with a declarative background sentence (49a) to make the processing of the test sentence easier, avoiding the pragmatic oddity of presenting questions without a context.







min-**ih**      sa9ad      a-dhahaya  
 from-**it**      help.PERF      the- victims

‘Which bank does the president think the loan from it helped the victims?’  
 (cf. \*Which bank does the president think the loan from \_\_ helped the victims?)

COMPLEX NP ISLAND

c. ayy      sayyarah      sama9      Ali    khabar    in    Fahd  
 which    car            hear.PERF.3SG.MASC    Ali    news    c    Fahd

sarag-**ha**  
 steal.PERF.3SG.MASC-**it**

‘Which car did Ali hear the news that Fahd stole it?’  
 (cf. \*Which car did Ali hear the news that Fahd stole \_\_?)

WH-ISLAND

d. ayy      rjal      9alima-ni      Ali    mita    zar-**ah**  
 which    man      tell.PERF.3SG.MASC-me    Ali    when    visit.PERF.3SG.MASC-**him**

‘Which man did Ali tell me when he visited him?’  
 (cf. \*Which man did Ali tell me when he visited \_\_?)

3.3 *Research questions*

The present study investigates two research questions. The first research question is whether adult Najdi learners of English can acquire *wh*-movement in English and show sensitivity to its syntactic island constraints. The answer to this question will help us to know whether adult Najdi learners can acquire the underlying structure of syntactic *wh*-movement in English, an operation that is not instantiated in Najdi Arabic. If adult Najdi learners show sensitivity to syntactic island constraints on *wh*-movement, as English native speakers do, this prompts the second research question: is this sensitivity to island constraints exhibited by learners and English native speakers due to innate grammatical syntactic constraints or due to

processing difficulty? The answer to this question will help us to tease apart the resource-limitation theory and grammatical theories with respect to the cause of island effects.

### *3.4 Methodology*

#### *3.4.1 Participants*

The study tested 84 Arabic learners of English who started learning English as adults in public schools in Saudi Arabia. All learners were speakers of one Arabic dialect, called Najdi Arabic. Twenty-nine of these learners studied in an English-speaking country and had exposure to English for one to seven years. All Arabic learners were asked to take the Michigan Listening Comprehension Test to assess their English proficiency. The test consisted of 45 listening comprehension questions that targeted various grammatical constructions. The scores of 72 participants ranged from 35 to 44 out of 45 possible correct answers. The scores of 12 participants ranged from 27 to 34. Because the study investigates the acquisition of the sensitivity to a complex linguistic phenomenon, the study focuses on only the 72 advanced learners of English who scored 35 or above in the proficiency test<sup>12</sup>.

The study also tested 85 monolingual native speakers of English. They were undergraduate students at the University of Kansas and received extra credit in LING 106 for participating in the study. The final data analysis included data from 82 English native speakers with a mean age of 19.90, as shown in Table 5<sup>13</sup>.

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<sup>12</sup> The results of the remaining 12 learners whose scores were below 35 on Michigan Test will be analyzed in a future study that tests learners with multiple English proficiency levels.

<sup>13</sup> For English native speakers, we excluded two participants from the data analysis because they rejected almost all sentences in the grammaticality judgment task, rating them 3 or 2. We also excluded one participant whose accuracy in solving math problems was 72 % in the working memory task. Subjects were required to maintain their math accuracy at or above 85% throughout the task.

Table 5: Number of participants, proficiency test score, age, and length of exposure to English

Group	No. of subjects	Michigan Test		Age		Exposure to English in an English-speaking country
		Range	Mean	range	Mean	
High proficiency learners	72	35-44	40.05	22-45	27.48	1-7 years
English native speakers	82	-	-	17-43	19.90	-

### 3.4.2 Materials

The present study uses a revised version of the stimuli of Sprouse et al. (2012), making the stimuli less complex to allow cognitive individual differences to emerge in acceptability ratings. Following the suggestions of Hofmeister et al. (2012), we made two modifications to the stimuli to reduce the processing difficulty of ungrammatical island violation sentences and to potentially increase the possibility of observing a relationship between working-memory capacity and sensitivity to island effects. In the first modification, participants initially are presented with a declarative background sentence as shown in (52a) before they are asked to judge the test sentence as shown in (52b).

(52) BACKGROUND SENTENCE

- a. *The worker worries if the boss leaves her office keys in the car.*

TEST SENTENCE

- b. \***Which keys** does the worker worry if the boss leaves in the car?

The aim of the initial declarative background sentence is to set up a context for the test sentence and to remove the pragmatic oddity of presenting questions without a context. The second modification made to the stimuli of Sprouse et al. is the use of a complex *wh*-filler phrase (e.g., *which keys*) in the test sentences as in (52b) instead of a bare *wh*-filler phrase (e.g., *what*). As discussed earlier in the literature review, Hofmeister and Sag (2010) argued that complex *wh*-

filler phrases can facilitate processing of ungrammatical island violation sentences and improve their acceptability judgments.

We used these revised stimuli to find out whether the lack of a relationship between working-memory capacity and sensitivity to island effects in Sprouse et al. is attributable to the complex stimuli they used. If the results of the present study still show no relationship between working-memory capacity and sensitivity to island effects, island effects are more likely due to grammatical syntactic constraints and not to processing difficulty, as proposed by Hofmeister et al. (2012).

The stimuli in the present study are designed to test the effects of four island types: adjunct islands, subject islands, complex NP islands, and *whether* islands. To test each of the four island types, *wh*-dependency length and presence of an island structure are manipulated in four conditions using a  $2 \times 2$  factorial design, as shown in (53).

#### ADJUNCT ISLAND

(53) NONISLAND/ MATRIX

*The helpful worker thinks that the boss left her keys in the car.*

- a. **Which worker** \_\_\_ thinks that the boss left her keys in the car?

NONISLAND/ EMBEDDED

*The worker thinks that the boss left her office keys in the car.*

- b. **Which keys** does the worker think that the boss left \_\_\_ in the car?

ISLAND/ MATRIX

*The helpful worker worries if the boss leaves her keys in the car.*

- c. **Which worker** \_\_\_ worries **if the boss leaves her keys** in the car?

ISLAND/ EMBEDDED

*The worker worries if the boss leaves her office keys in the car.*

- d. **\*Which keys** does the worker worry **if the boss leaves** \_\_\_ in the car?

The *wh*-dependency is either short, as in (53a) and (53c), with a *wh*-extraction from a matrix clause, or long, as in (53b) and (53d), with a *wh*-extraction from an embedded clause. The island structure is either absent, as in (53a) and (53b), or present, as in (53c) and (53d). The first three conditions are grammatical, while the last condition is ungrammatical due to an island violation.

The context sentence in each condition was designed to match the test sentence in structure and lexical material. In terms of structure, the context sentence in each of the two non-island conditions (53a and b) does not contain an island structure, as the test sentence does. However, the context sentence in each of the other two island conditions (53c and d) contains an island structure, as the test sentence does. In terms of lexical material, all lexical items used in each test sentence were also used in the context sentence. The extracted NP in each test sentence is modified in the context sentence.

To test each of the four island types, we use 16 sets of sentences. Each set consists of four sentences that represent four conditions, as shown in (53). The sentences from the 64 sets are distributed among four lists using a Latin square design, such that every participant is presented with only one sentence from every set. Each list has 64 sentences that include four sentences for each of the four conditions in adjunct islands, subject islands, complex NP islands, and *whether* islands.

Because all experimental sentences are *wh*-questions and most of them are grammatical, 32 ungrammatical declarative filler sentences are added to each of the four lists. These filler sentences include ungrammatical relative clauses with a resumptive pronoun in subject (54a), object, indirect object, oblique object and object comparative positions. The filler sentences also

include ungrammatical relative clauses with double complementizers (54b), ungrammatical sentences with null subjects in embedded clauses, and sentences with ungrammatical passive<sup>14</sup>.

(54) RESUMPTIVE PRONOUN

*The thieves stole my purse, and they disappeared quickly.*

- a. \*The thieves who **they** stole my purse disappeared quickly.

DOUBLE COMPLEMENTIZERS

*The cat which I gave the milk to was very skinny.*

- b. \*The cat **which that** I gave the milk to was very skinny.

Thus, the total number of sentences in each list is 96, including 64 experimental sentences (48 grammatical and 16 ungrammatical) and 32 ungrammatical filler sentences. The number of grammatical and ungrammatical sentences is balanced in each list. The sentences in each list are presented in four blocks. Each block consists of 24 sentences that include 16 experimental sentences (12 grammatical and 4 ungrammatical) and 8 ungrammatical filler sentences. The 16 experimental sentences in each block include one sentence for each of the four conditions in adjunct islands, subject islands, complex NP islands, and *whether* islands. The experimental and filler sentences are randomized in each block. The order of blocks is also randomized across participants. All experimental and filler sentences are given in Appendix.

### 3.4.3 Task

We conduct a grammaticality judgment task, using the experimental control software Paradigm (Tagliaferri, 2005). In each experimental trial, a declarative background sentence as in (55a) appears on the computer screen.

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<sup>14</sup> The filler sentences are taken from Hawkins and Chan (1997) with some modifications.



(55) BACKGROUND SENTENCE

- a. *The worker worries if the boss leaves her office keys in the car.*

TEST SENTENCE

- b. **Which keys does the worker worry if the boss leaves in the car?**

After reading the declarative background sentence, the participant presses the space bar on the computer keyboard to advance to the next screen and is presented with only the test sentence as in (55b). The participant then judges, with no time limits, whether the test sentence sounds natural or unnatural in English, using a seven-point rating scale displayed underneath the test sentence. The rating scale ranges from ‘*totally unnatural*’ to ‘*perfectly natural*’. The participants may choose ‘*I do not know*’ if they cannot make a judgment. The test begins with 6 practice trials to familiarize participants with the task.

### 3.5 *Predictions of L2 theories with respect to sensitivity to island violations*

One objective of the present study is to investigate the L2 acquisition of *wh*-movement in English by Najdi Arabic learners to test predictions of two theories in SLA, the Interpretability Hypothesis (Tsimpili & Dimitrakopoulou, 2007) and the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996). According to the Interpretability Hypothesis, Najdi learners of English will not acquire the uninterpretable *wh*-feature on the complementizer in English because it was not selected in their native language during the critical period. If the claim of the Interpretability Hypothesis is right, Najdi learners will not acquire *wh*-movement in English and, therefore, they will not be able to show sensitivity to its syntactic island constraints. If this is the case, Najdi learners are predicted to incorrectly accept the ungrammatical island violation condition (56d) and correctly accept the other three grammatical conditions (56a, b, and c).

ADJUNCT ISLAND

(56) NONISLAND/ MATRIX

*The helpful worker thinks that the boss left her keys in the car.*

- a. **Which worker** \_\_\_ thinks that the boss left her keys in the car?

NONISLAND/ EMBEDDED

*The worker thinks that the boss left her office keys in the car.*

- b. **Which keys** does the worker think that the boss left \_\_\_ in the car?

ISLAND/ MATRIX

*The helpful worker worries if the boss leaves her keys in the car.*

- c. **Which worker** \_\_\_ worries **if the boss leaves her keys** in the car?

ISLAND/ EMBEDDED

*The worker worries if the boss leaves her office keys in the car.*

- d. **\*Which keys** does the worker worry **if the boss leaves** \_\_\_ in the car?

This pattern of acceptability judgments will not lead to an interaction between *wh*-dependency length and island structure, as is expected for English native speakers, suggesting that learners are not sensitive to the syntactic island constraints on *wh*-movement.

According to the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), however, Najdi learners of English can potentially acquire L2 properties regardless of L1. If this claim is right, Najdi learners will acquire *wh*-movement in English and, therefore, they will be able to show sensitivity to its syntactic island constraints. If this is the case, Najdi learners are predicted to correctly reject the ungrammatical island violation condition (56d) and correctly accept the other three grammatical conditions (56a, b, and c). This pattern of acceptability judgments will lead to an interaction between *wh*-dependency length and island structure, suggesting that learners are sensitive to the syntactic island constraints on *wh*-movement.

It is worth mentioning that this part of the study follows up on the earlier work by Aldosari (2013), which investigated the L2 acquisition of syntactic island constraints (*i.e.*,

adjunct islands, subject islands, complex NP islands and *wh*-islands) and showed that L2 learners had sensitivity to these islands. However, my previous work did not examine the source of the sensitivity to these island types, which is investigated in this study and is discussed in the following section.

### 3.6 *Source of island effects*

The second objective of the present study is to tease apart the predictions of the resource-limitation theory (Kluender & Kutas, 1993; Hofmeister & Sag, 2010) and grammatical syntactic theories (*e.g.*, Ross, 1967; Chomsky, 1973, 1986; Huang, 1982) with respect to the source of island effects. To examine whether island effects are due to syntactic constraints or processing difficulty, the present study tests the relationship between working-memory capacity and sensitivity to island effects. To test the relationship between these two variables, the study needs for each individual a measure of working-memory capacity and a measure of sensitivity to island effects. In the following sections, I discuss the measure of working-memory capacity and the measure of sensitivity to island effects that are used in this study and present the predictions of the resource-limitation theory and grammatical syntactic theories with respect to the source of sensitivity to island effects.

#### 3.6.1 *Measure of working-memory capacity*

Sprouse et al. (2012) used two measures of working memory capacity, a serial-recall task and an *n*-back task, and did not find a relationship between these two measures and DD scores that measure sensitivity to island effects. However, Hofmeister et al. (2012) argued that the serial-recall task and the *n*-back task may not be considered measures of working memory

because they do not involve a secondary processing task, as is the case in complex span tasks. In complex span tasks, participants are asked to do an additional secondary processing task, like reading a sentence or solving a math problem, between each of the items that need to be recalled. To support their argument, Hofmeister and colleagues cited Kane et al. (2004), which regarded the serial-recall task and the  $n$ -back task as measures of short-term memory rather than measures of working memory because they measure only storage capacity. Conway et al. (2005) defined working memory as a multicomponent system that involves the storage and processing of information. Conway and colleagues argued that complex span tasks are designed to measure working memory because they require not only storing information but also simultaneous processing of additional information.

The present study, then, uses a complex span task, which is the automated operation span task (Unsworth, Heitz, Schrock, & Engle, 2005). In this task, participants first see a math operation (*e.g.*,  $(1*2) + 1 = ?$ ). After they solve the math operation, they click the mouse to move to the next screen. On the next screen, a digit will appear (*e.g.*, 3) and participants then choose either ‘true’ if the digit corresponds to the correct answer or ‘false’ if the digit is not the correct answer. After they click on their answer with the mouse, they advance to the next screen and see a letter. After three to seven such operation-letter strings, participants are presented with a recall grid and are asked to click on the letters they saw in the correct order in which they saw them. Each participant is presented with three sets of each set size; the set sizes range from three to seven operation-letter strings. Each participant is presented with a total of 75 letters and 75 math operations.

Before participants start the real task, they go through three practice sessions. In the first session, participants practice recalling letters in the order they were presented (simple span task).

In the second session, participants practice solving math operations (processing task). In the third session, participants practice performing both letter recall and math operations, similar to what they will do in the real task. It should be noted that in the real task participants cannot take unlimited time to solve the math operations. A time limit for solving each math operation is individually calculated. The calculation is based on each participant's mean time needed to solve the math operations in the math practice session, plus 2.5 SD. Moreover, participants are required to maintain their math accuracy at or above 85% throughout the task; otherwise, their data will not be included in the analysis. At the end of the task, the program shows three types of scores. The first type of score shows the total of all correctly recalled sets. For example, if a participant correctly recalled 4 letters in a set size of 4, 5 letters in a set size of 5 but 4 letters in a set size of 6, the operation span score will be 9 (4+5+0). The second type of score indicates the total number of letters recalled in the correct position regardless of whether all the letters in each set were recalled. The third type of score shows the total number of math errors, which are divided into two types: speed errors and accuracy errors.

There is evidence that supports using the automated operation span task to assess the relationship between working memory and comprehension of syntactically complex sentences. O'Rourke (2013) investigated the relationship between working memory and the comprehension of syntactically difficult structures, using garden-path sentences (57a) and object relative sentences (57b). The test sentences were presented word by word, followed by comprehension questions.

(57) GARDEN-PATH

- a. The patient met the doctor and the nurse with the white dress showed the chart during the meeting.

#### OBJECT RELATIVE

- b. The patient met the doctor to whom the nurse with the white dress showed the chart during the meeting.

#### CONTROL

- c. The patient met the doctor while the nurse with the white dress showed the chart during the meeting.

Working memory was measured using four tasks: the automated operation span task and the *n*-back task, as discussed earlier, as well as the automated reading span task and the anti-saccade task. In the automated reading span task, the participant reads a sentence and is asked to indicate whether the sentence makes sense. After the participant chooses an answer, she or he is presented with a letter. After two to five such sentence-letter strings, the participant is asked to recall the letters in the order they were presented. In the anti-saccade task, the participant sees a flashing signal on the left or right side of the computer screen. Then, a letter appears, either on the same side of the screen as the signal or on the opposite side. The participant's task is to control the tendency to direct his or her gaze towards the signal.

The results showed that all four working memory tasks correlated with the comprehension accuracy for simple control sentences (57c). However, only the operation span task correlated with the comprehension accuracy for syntactically complex sentences, garden-path sentences (57a) and object relative sentences (57b).

#### *3.6.2 Measure of sensitivity to island effects*

To test the relationship between sensitivity to island effects and working-memory capacity, we need a measure of sensitivity to island effects for each individual, so we can compare it with operation span scores, which measure working-memory capacity for each

individual. To measure sensitivity to island effects, the study uses a differences-in-differences (DD) score, which was used in Sprouse et al. (2012), as shown in (58).

(58)	Rating (z-score units)
$D1 = (\text{NONISLAND/EMBEDDED}) - (\text{ISLAND/EMBEDDED})$	
b. Which keys does the worker think that the boss left __in the car?	0.7
d. *Which keys does the worker worry <b>if the boss leaves</b> __in the car?	- <u>-1.4</u>
	2.1
$D2 = (\text{NONISLAND/MATRIX}) - (\text{ISLAND/MATRIX})$	
a. Which worker __thinks that the boss left her keys in the car?	1.6
c. Which worker __worries <b>if the boss leaves her keys</b> in the car?	- <u>0.4</u>
	1.2
$DD = D1 - D2 = 2.1 - 1.2 = 0.9$	

The DD scores basically measure how much greater the effect of an island structure is in a sentence with a long *wh*-dependency than in a sentence with a short *wh*-dependency.

### 3.7 Predictions: processing vs. grammatical accounts of island effects

The present study tests the predictions of the resource-limitation theory and grammatical syntactic theories with respect to the source of island effects. The resource-limitation theory argues that sensitivity to island effects is due to processing difficulty and makes a specific claim that it is the exhaustion of a speaker’s limited processing resources that causes sensitivity to island effects. If this claim is correct, English native speakers and Najdi Arabic learners who show sensitivity to island effects are predicted to show a negative relationship between operation span scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects. That is, individuals with higher operation span scores will posit a gap inside islands and accept ungrammatical island violation sentences as in (59), showing a weaker sensitivity to island effects (lower DD scores).

(59) \*Which keys<sub>i</sub> does the worker worry [**if the boss leaves**  $t_i$ ] in the car?

However, individuals with lower operation span scores are expected to fail to posit a gap inside islands due to processing difficulty and, as a result, they will reject ungrammatical island violation sentences as in (59), showing a stronger sensitivity to island effects (higher DD scores).

Grammatical syntactic theories, on the other hand, argue that sensitivity to island effects is due to innate syntactic constraints. If this claim is correct, English native speakers and Najdi Arabic learners who show sensitivity to island effects are predicted to show either a positive relationship or no relationship between operation span scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects. A positive relationship means that individuals with higher operation span scores will show more sensitivity to syntactic island constraints (*i.e.*, more avoidance of positing a gap inside islands) and will reject ungrammatical island violation sentences as in (59), showing a stronger sensitivity to island effects (higher DD scores). Individuals with lower operation span scores will show less sensitivity to syntactic island constraints (*i.e.*, less avoidance of positing a gap inside islands) and will accept ungrammatical island violation sentences as in (59), showing a weaker sensitivity to island effects (lower DD scores). These predictions are compatible with the grammatical account of islands because they suggest that individuals with greater processing resources may be more likely to retrieve their knowledge of syntactic constraints online and, therefore, they would be more sensitive to syntactic island constraints.

### 3.8 Procedure

English native speakers and Najdi Arabic learners were tested individually, using a computer. They signed a consent form and filled out a background information questionnaire.



Najdi learners were provided with a translated list of difficult words to ensure that they understood all items in the stimuli. Both English native speakers and Najdi Arabic learners first took the grammaticality judgment task and then completed the working memory task. Najdi learners were also asked to take a proficiency test after they completed the grammaticality judgment task and working memory task.

### *3.9 Results*

In this section, we first present the results of English native speakers and L2 learners in the acceptability judgment task to see whether they are sensitive to island effects. Then, we present the results of English native speakers and L2 learners with respect to the relationship between working-memory capacity and sensitivity to island effects to find out whether sensitivity to island effects is due to syntactic constraints or processing difficulty. Prior to analysis, each participant's acceptability judgment ratings were converted into z-scores. The purpose of this z-score transformation is to eliminate the possibility that participants may vary in their use of the range of the seven-point rating scale used in the acceptability judgment task.

#### *3.9.1 Results of the acceptability judgment task*

In this section, we present the results of the acceptability judgment task. We first present the results of English native speakers in Section 3.9.1.1, and then we present the results of L2 learners in Section 3.9.1.2.

### 3.9.1.1 English native speakers

The English native speakers' mean acceptability ratings and standard deviations for each condition in the four island types tested are reported in Table 6. These island types are adjunct islands, subject islands, complex NP islands and *whether* islands. The results are summarized in Figure 5.

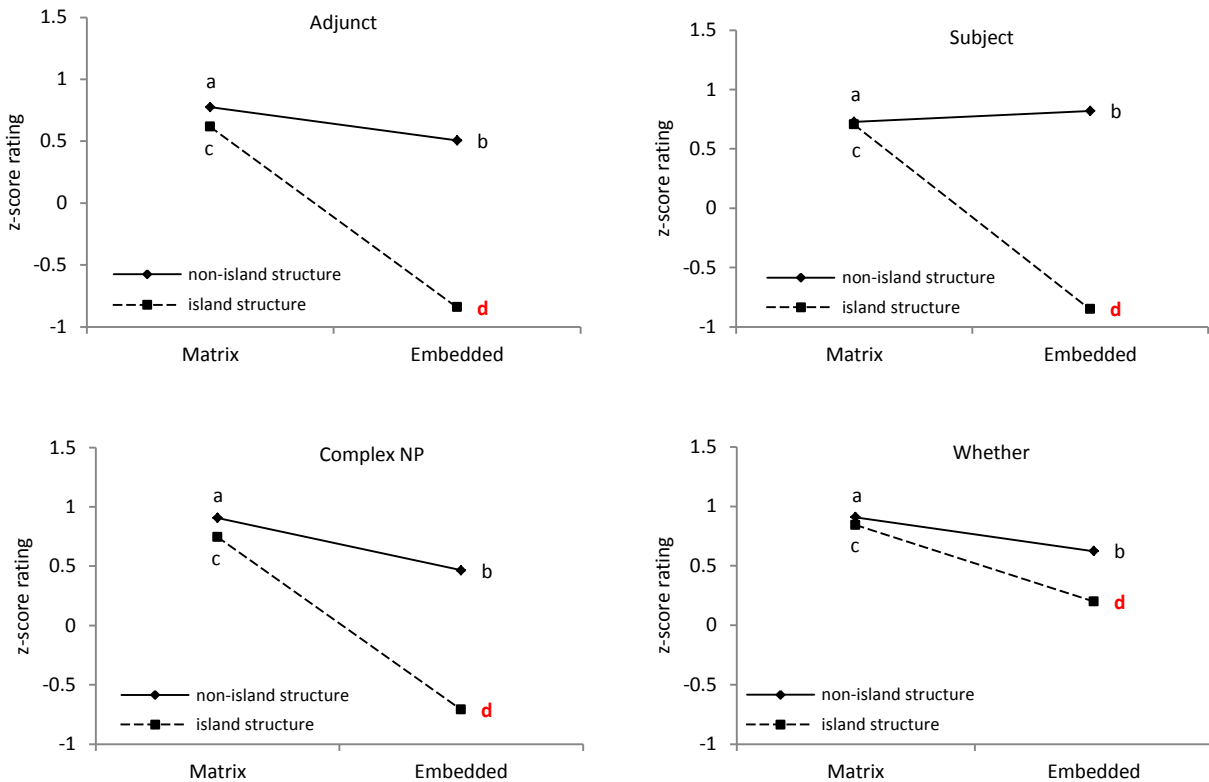


Figure 5: English native speakers' interaction plots for each island type (N = 82)

Table 6: English native speakers' means and standard deviations for each condition (N = 82)

CONDITION	ADJUNCT		SUBJECT		COMPLEX NP		<i>Whether</i>	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
NONISLAND / MATRIX	0.77	0.25	0.73	0.32	0.91	0.20	0.91	0.30
NONISLAND / EMBEDDED	0.51	0.35	0.82	0.25	0.47	0.36	0.62	0.36
ISLAND / MATRIX	0.62	0.39	0.70	0.34	0.74	0.25	0.84	0.24
ISLAND / EMBEDDED	-0.84	0.52	-0.85	0.44	-0.71	0.48	0.20	0.43

To examine whether English native speakers were sensitive to island effects in the acceptability judgment task, we conducted a two-way repeated measures ANOVA for acceptability ratings with *Wh*-dependency Length (short vs. long) and Island Structure (island vs. non-island) as two independent variables for each island type. The results of ANOVAs revealed a main effect of *Wh*-dependency Length for each island type (adjunct islands:  $F(1,81) = 554.184$ ,  $p = .000$ ; subject islands:  $F(1,81) = 378.610$ ,  $p = .000$ ; complex NP islands:  $F(1,81) = 404.358$ ,  $p = .000$ ; *whether* islands:  $F(1,81) = 112.625$ ,  $p = .000$ ). The analyses also showed a main effect of Island Structure for each island type (adjunct islands:  $F(1,81) = 242.678$ ,  $p = .000$ ; subject islands:  $F(1,81) = 469.434$ ,  $p = .000$ ; complex NP islands:  $F(1,81) = 400.270$ ,  $p = .000$ ; *whether* islands:  $F(1,81) = 45.142$ ,  $p = .000$ ).

Crucially, there was a significant interaction between *Wh*-dependency Length and Island Structure for every island type (adjunct islands:  $F(1,81) = 219.147$ ,  $p = .000$ ; subject islands:  $F(1,81) = 547.608$ ,  $p = .000$ ; complex NP islands:  $F(1,81) = 225.895$ ,  $p = .000$ ; *whether* islands:  $F(1,81) = 38.734$ ,  $p = .000$ ). The interaction was caused by low acceptability ratings of the ungrammatical island violation condition as compared to higher acceptability ratings of the other three grammatical conditions for each island type. This interaction indicates that the effect of an island structure was greater in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency, suggesting that English native speakers were sensitive to the effects of adjunct islands, subject islands, complex NP islands and *whether* islands. Although English native speakers showed sensitivity to the effects of *whether* islands, their sensitivity to this type of island was not as strong as their sensitivity to the other types of islands as shown in Figure 5.

To explore the interaction between *Wh*-dependency Length and Island Structure for each island type, we conducted pairwise comparisons between the grammatical non-island/embedded

condition (b) and the ungrammatical island/embedded condition (d) to examine the effect of Island Structure on sentences with a long *wh*-dependency. Results showed an effect of Island Structure on sentences with a long *wh*-dependency for every island type (adjunct islands:  $t(81) = 17.716, p = .000$ ; subject islands:  $t(81) = 29.617, p = .000$ ; complex NP islands:  $t(81) = 19.138, p = .000$ ; *whether* islands:  $t(81) = 8.350, p = .000$ ). This indicates that the ungrammatical island/embedded condition (d) was rated significantly lower than the grammatical non-island/embedded condition (b) across the four island types, suggesting that English native speakers were sensitive to island effects.

We also conducted pairwise comparisons between the grammatical non-island/matrix condition (a) and the grammatical island/matrix condition (c) to examine the effect of Island Structure on sentences with a short *wh*-dependency. Results showed an effect of Island Structure on sentences with a short *wh*-dependency for adjunct islands ( $t(81) = 3.464, p = .001$ ) and complex NP islands ( $t(81) = 5.978, p = .000$ ), but not for subject islands ( $t(81) = .456, p = .650$ ) and *whether* islands ( $t(81) = 1.588, p = .116$ ). This indicates that the grammatical island/matrix condition (c) was rated significantly lower than the grammatical non-island/matrix condition (a) for adjunct islands and complex NP islands. However, although Island Structure had an effect on sentences with a short *wh*-dependency in some island types, the effect of Island Structure was obviously greater in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency for each island type as shown in Figure 5, suggesting sensitivity to island effects.

Following Sprouse et al. (2012), we also conducted additional analyses to determine if there was an independent effect of *Wh*-dependency Length and an independent effect of Island Structure as the resource-limitation theory claims. To isolate the effect of *Wh*-dependency Length, we contrasted the baseline non-island/matrix condition (a), which does not contain an

island and has a short *wh*-dependency, with the non-island/embedded condition (b), which does not contain an island and has a long *wh*-dependency. Pairwise comparisons showed an independent effect of *Wh*-dependency Length for every island type (adjunct islands:  $t(81) = 7.116, p = .000$ ; subject islands:  $t(81) = -2.314, p = .023$ ; complex NP islands:  $t(81) = 8.601, p = .000$ ; *whether* islands:  $t(81) = 5.522, p = .000$ ). To isolate the effect of Island Structure, we contrasted the baseline non-island/matrix condition (a), which does not contain an island and has a short *wh*-dependency, with the island/matrix condition (c), which contains an island and has a short *wh*-dependency. The pairwise comparisons that we already conducted for these two conditions, as indicated above, showed an independent effect of Island Structure for adjunct islands and complex NP islands, but not for subject islands and *whether* islands.

These results indicate that although English native speakers consistently showed an independent effect of *Wh*-dependency Length, they did not consistently show an independent effect of Island Structure across the four island types. These results don't support the resource-limitation theory, which claims that island effects occur because of a combination of two independent processing costs: the processing cost of a long *wh*-dependency and the processing cost of a complex island structure. In the following section, we show the results of L2 learners in the acceptability judgment task.

### 3.9.1.2 L2 learners

L2 learners patterned similarly to English native speakers in the acceptability judgment task. The L2 learners' mean acceptability ratings and standard deviations for each condition in the four island types tested are reported in Table 7. These island types are adjunct islands, subject islands, complex NP islands and *whether* islands. The results are summarized in Figure 6.

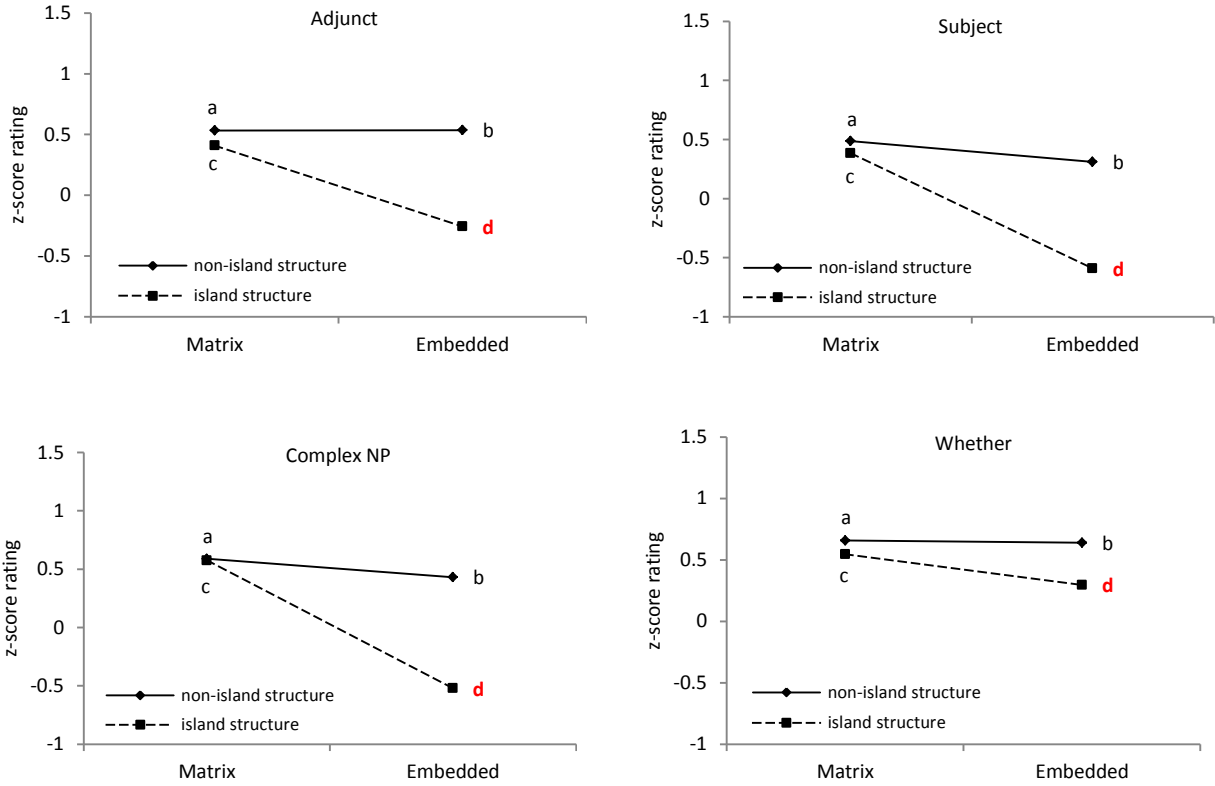


Figure 6: L2 learners' interaction plots for each island type (N = 72)

Table 7: L2 learners' means and standard deviations for each condition (N = 72)

CONDITION	ADJUNCT		SUBJECT		COMPLEX NP		<i>Whether</i>	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
NONISLAND / MATRIX	0.53	0.44	0.49	0.48	0.59	0.48	0.66	0.37
NONISLAND / EMBEDDED	0.54	0.45	0.31	0.54	0.43	0.44	0.64	0.40
ISLAND / MATRIX	0.41	0.48	0.38	0.45	0.58	0.39	0.55	0.43
ISLAND / EMBEDDED	-0.26	0.60	-0.59	0.64	-0.52	0.65	0.30	0.55

To examine whether L2 learners were sensitive to island effects in the acceptability judgment task, we conducted a two-way repeated measures ANOVA for acceptability ratings with *Wh*-dependency Length (short vs. long) and Island Structure (island vs. non-island) as two independent variables for each island type. The results of ANOVAs revealed a main effect of *Wh*-dependency Length for each island type (adjunct islands:  $F(1,71) = 23.382, p = .000$ ; subject

islands:  $F(1,71) = 23.876, p = .000$ ; complex NP islands:  $F(1,71) = 82.059, p = .000$ ; *whether* islands:  $F(1,71) = 4.944, p = .029$ ). The analyses also showed a main effect of Island Structure for each island type (adjunct islands:  $F(1,71) = 67.778, p = .000$ ; subject islands:  $F(1,71) = 102.184, p = .000$ ; complex NP islands:  $F(1,71) = 93.473, p = .000$ ; *whether* islands:  $F(1,71) = 21.677, p = .000$ ).

Importantly, there was a significant interaction between *Wh*-dependency Length and Island structure for every island type (adjunct islands:  $F(1,71) = 46.457, p = .000$ ; subject islands:  $F(1,71) = 55.273, p = .000$ ; complex NP islands:  $F(1,71) = 102.330, p = .000$ ; *whether* islands:  $F(1,71) = 6.737, p = .011$ ). The interaction was caused by low acceptability ratings of the ungrammatical island violation condition as compared to higher acceptability ratings of the other three grammatical conditions for each island type. This interaction indicates that the effect of an island structure was greater in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency, suggesting that L2 learners, like English native speakers, were sensitive to the effects of adjunct islands, subject islands, complex NP islands and *whether* islands. Interestingly, L2 learners, like English native speakers, did not show a strong sensitivity to the effects of *whether* islands as compared to their sensitivity to the effects of the other types of islands as shown in Figure 6. This pattern of results will be discussed in Section 3.10.

To explore the interaction between *Wh*-dependency Length and Island Structure for each island type, we conducted pairwise comparisons between the grammatical non-island/embedded condition (b) and the ungrammatical island/embedded condition (d) to examine the effect of Island Structure on sentences with a long *wh*-dependency. Results showed an effect of Island Structure on sentences with a long *wh*-dependency for every island type (adjunct islands:  $t(71) = 9.246, p = .000$ ; subject islands:  $t(71) = 10.088, p = .000$ ; complex NP islands:  $t(71) = 11.518, p$

= .000; *whether* islands:  $t(71) = 4.400, p = .000$ ). This indicates that the ungrammatical island/embedded condition (d) was rated significantly lower than the grammatical non-island/embedded condition (b) across the four island types, suggesting that L2 learners were sensitive to island effects.

We also conducted pairwise comparisons between the grammatical non-island/matrix condition (a) and the grammatical island/matrix condition (c) to examine the effect of Island Structure on sentences with a short *wh*-dependency. Results showed an effect of Island Structure on sentences with a short *wh*-dependency for adjunct islands ( $t(71) = 2.042, p = .045$ ) and *whether* islands ( $t(71) = 2.165, p = .034$ ) and a marginal effect for subject islands ( $t(71) = 1.953, p = .055$ ), but no effect for complex NP islands ( $t(71) = .269, p = .789$ ). This indicates that the grammatical island/matrix condition (c) was rated significantly lower than the grammatical non-island/matrix condition (a) for adjunct islands, subject islands, and *whether* islands. However, although Island Structure had an effect on sentences with a short *wh*-dependency in some island types, the effect of Island Structure was obviously greater in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency for each island type as shown in Figure 6, suggesting sensitivity to island effects.

Following Sprouse et al. (2012), we also conducted additional analyses to determine if there was an independent effect of *Wh*-dependency Length and an independent effect of Island Structure as the resource-limitation theory claims. To isolate the effect of *Wh*-dependency Length, we contrasted the baseline non-island/matrix condition (a), which does not contain an island and has a short *wh*-dependency, with the non-island/embedded condition (b), which does not contain an island and has a long *wh*-dependency. Pairwise comparisons showed an independent effect of *Wh*-dependency Length for subject islands ( $t(71) = 2.368, p = .021$ ) and



complex NP islands ( $t(71) = 2.222, p = .029$ ), but not for adjunct islands ( $t(71) = -.025, p = .980$ ) and *whether* islands ( $t(71) = .269, p = .789$ ). To isolate the effect of Island Structure, we contrasted the baseline non-island/matrix condition (a), which does not contain an island and has a short *wh*-dependency, with the island/matrix condition (c), which contains an island and has a short *wh*-dependency. The pairwise comparisons that we already conducted for these two conditions, as indicated above, showed an independent effect of Island Structure for adjunct islands, subject islands and *whether* islands, but not for complex NP islands.

These results indicate that learners did not consistently show an independent effect of *Wh*-dependency Length and an independent effect of Island Structure across the four island types. These results are not consistent with the resource-limitation theory, which argues that island effects arise as a result of an independent cost of *wh*-dependency and an independent cost of island structure that combine together and cause processing difficulty.

### 3.9.2 *Results of relationship between working-memory capacity & sensitivity to island effects*

In the previous section, the results of the acceptability judgment task showed that both English native speakers and L2 learners were sensitive to island effects. We can now raise the question of whether the sensitivity to island effects, exhibited by both English native speakers and L2 learners, is due to grammatical syntactic constraints or processing difficulty. To answer this question, we examined the relationship between operation span scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects. In the following section, we present the results of the relationship between operation span scores and DD scores for English native speakers, followed by the results of L2 learners in Section 3.9.2.2.

### 3.9.2.1 English native speakers

English native speakers' scores on the operation span task, which measures working-memory capacity, ranged from 8 to 75 (mean = 42.57 and standard deviation = 16.40). The DD score, which measures sensitivity to island effects, was calculated for each participant in each island type following the formula given in Section 3.6.2 and after each participant's acceptability ratings were converted into z-scores.

The English native speakers' DD scores are plotted as a function of their operation span scores in Figure 7. We ran two sets of simple linear regressions, with the operation span scores as the independent variable and DD scores as the dependent variable. We ran the first set of regressions on the complete set of DD scores for each island type. We then ran the second set of linear regressions on only the DD scores greater than or equal to zero for each island type. The second regression analysis excluded five participants for adjunct islands (6.1%), one participant for subject islands (1.2%), two participants for complex NP islands (2.4%) and 17 participants for *whether* islands (20.1%).

We performed the second analysis because, as noted by Sprouse et al. (2012), DD scores below zero suggest a subadditive island effect, which is not predicted by the resource-limitation theory or grammatical theories. A subadditive island effect means that the effect of an island structure is less in sentences with a long *wh*-dependency than in sentences with a short *wh*-dependency. That is, the difference (D1) between the mean acceptability ratings of the NONISLAND/EMBEDDED condition (60b) and the ISLAND/EMBEDDED condition (60d) is less than the difference (D2) between the mean acceptability ratings of the NONISLAND/MATRIX condition (60a) and the ISLAND/MATRIX condition (60c).

(60)		Rating
	$D1 = (NONISLAND/EMBEDDED) - (ISLAND/EMBEDDED)$	(z-score units)
	b. Which keys does the worker think that the boss left __in the car?	1.5
	d. *Which keys does the worker worry <b>if the boss leaves</b> __in the car?	- 0.7
		0.8
	$D2 = (NONISLAND/MATRIX) - (ISLAND/MATRIX)$	
	a. Which worker __thinks that the boss left her keys in the car?	0.5
	c. Which worker __worries <b>if the boss leaves her keys</b> in the car?	- -1.5
		2.0
	$DD = D1 - D2 = 0.8 - 2.0 = -1.2$	

Because neither the resource-limitation theory nor grammatical theories predict DD scores below zero, the inclusion of those scores in the linear regression analysis may, as noted by Sprouse et al. (2012), cause noise in the data and decrease the ability to observe a relationship between operation span scores and DD scores. For this reason, DD scores below zero were excluded from the second set of regressions. However, it could be the case, as Sprouse et al. (2012) noted, that these DD scores below zero represent people who actually do not have sensitivity to superadditive island effects. If this is true, then including DD scores below zero may increase the possibility of finding a relationship between operation span scores and DD scores. Because both analyses are plausible, we reported here the two analyses, following Sprouse et al. (2012).

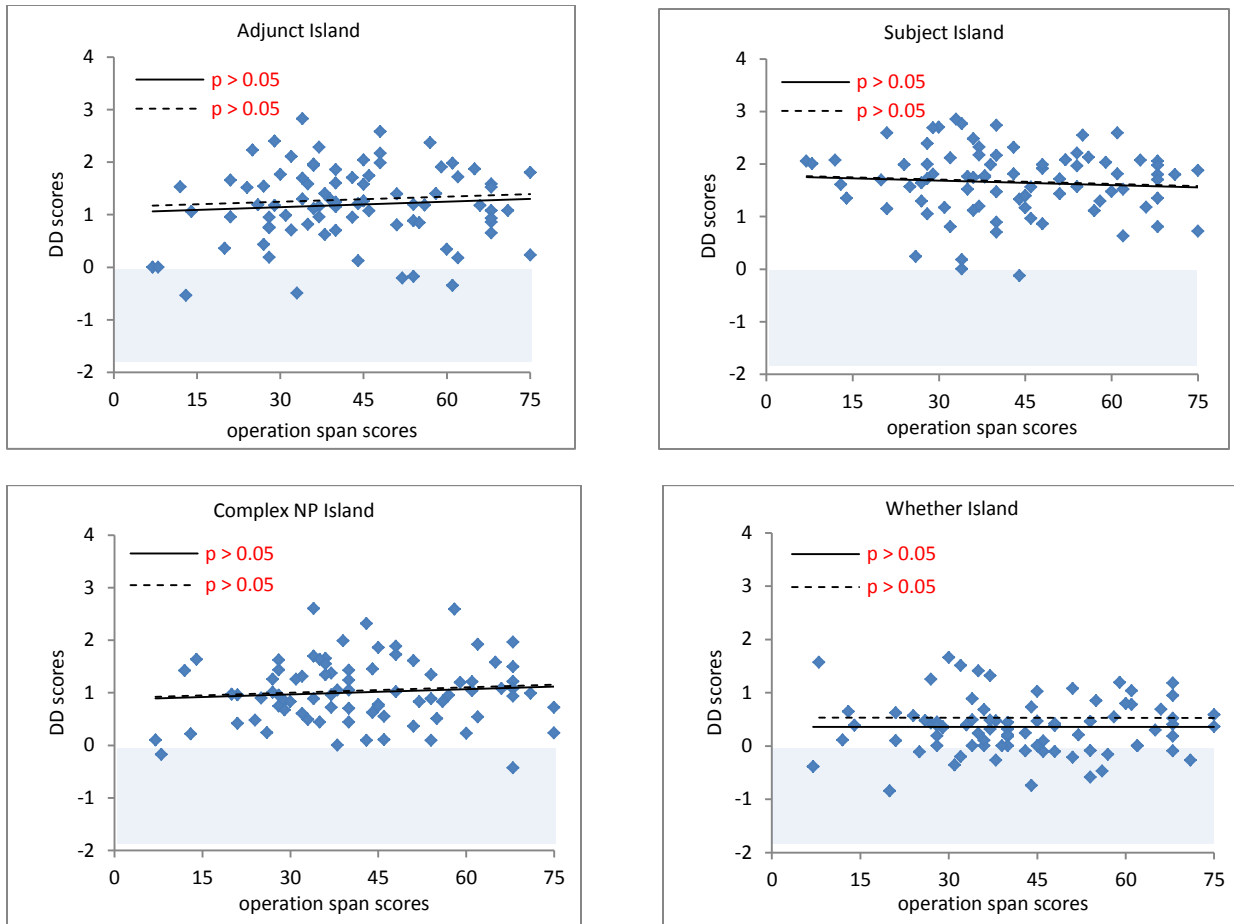


Figure 7: DD scores plotted as a function of operation span scores ( $N = 82$ ). The solid line represents the line of best fit for all of the DD scores. The dashed line represents the line of best fit when DD scores below zero are removed from the analysis (shaded blue).  $P$ -value for each trend line is reported in the legend.

Table 8 shows the results of the linear regressions for English native speakers. It shows the values of the line of best fit (intercept and slope), goodness of fit ( $R^2$ ) and significance of slope ( $t$ -statistic and  $p$ -value) for each regression analysis performed for every island type.

Table 8: Linear regression modeling DD scores as a function of operation span scores (N = 82)

	Island	Line of Best Fit		Goodness of Fit	Significance Test	
		intercept	slope	R <sup>2</sup>	t-statistic	p-value
All DDs	adjunct	1.04	0.00	.01	4.62	0.48
	subject	1.77	-0.00	.01	8.96	0.50
	complex NP	0.86	0.00	.01	4.60	0.42
	<i>whether</i>	0.35	-0.00	.00	2.21	0.99
DDs ≥ 0	adjunct	1.15	0.00	.01	5.70	0.46
	subject	1.78	-0.00	.01	9.45	0.50
	complex NP	0.89	0.00	.01	4.80	0.40
	<i>whether</i>	0.53	-0.00	.00	3.57	0.98

For the first set of regressions, which included all DD scores, the null hypothesis significance test, which indicates the probability of observing the best-fit slope if we assume that the linear relationship between DD scores and operation span scores has a slope of zero (i.e., a horizontal line) showed that the best-fit slope was not statistically different from zero for each island type ( $p > 0.05$ ), as shown in Table 8. Therefore, we cannot reject the null hypothesis that assumes a slope of zero for the linear relationship between DD scores and operation span scores, suggesting a lack of relationship between these two variables for each island type.

Moreover, the goodness of fit of the line ( $R^2$ ), a measure of the proportion of the variance in DD scores that can be explained by operation span scores (between zero and one), was only .01 or .00 for each island type. This means that operation span scores cannot substantially account for the variance in DD scores, again suggesting no relationship between DD scores and operation span scores for each island type.

The second set of regressions, which included only DD scores greater than or equal to zero, showed a very similar pattern of results, as shown in Figure 7 and Table 8, indicating an

absence of a relationship between DD scores and operation span scores for each island type<sup>15, 16</sup>. In the following section, we present the results of L2 learners.

### 3.9.2.2 L2 learners

L2 learners' scores on the operation span task ranged from 0 to 75 (mean = 42.19 and standard deviation = 18.76). The L2 learners' DD scores are plotted as a function of their operation span scores in Figure 8. We performed two sets of simple linear regressions, using the operation span scores as the independent variable and DD scores as the dependent variable. We performed the first set of regressions on the complete set of DD scores for each island type. We then performed the second set of linear regressions on only the DD scores greater than or equal to zero for each island type. The second regression analysis excluded 14 participants for adjunct islands (19.4%), 10 participants for subject islands (13.9%), four participants for complex NP islands (5.6%) and 21 participants for *whether* islands (29.2%).

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<sup>15</sup> All regression analyses for English natives were also run with age as an independent variable in addition to working memory. The results did not differ from the results reported here, suggesting age is not an important factor. This is not surprising given the limited age range of English native speakers. Their ages ranged from 17 to 43, but 91% of the ages ranged from 18 to 22.

<sup>16</sup> We also ran all of these regression analyses using the raw ratings rather than the z-score transformed ratings, and the results did not differ from the results reported here.

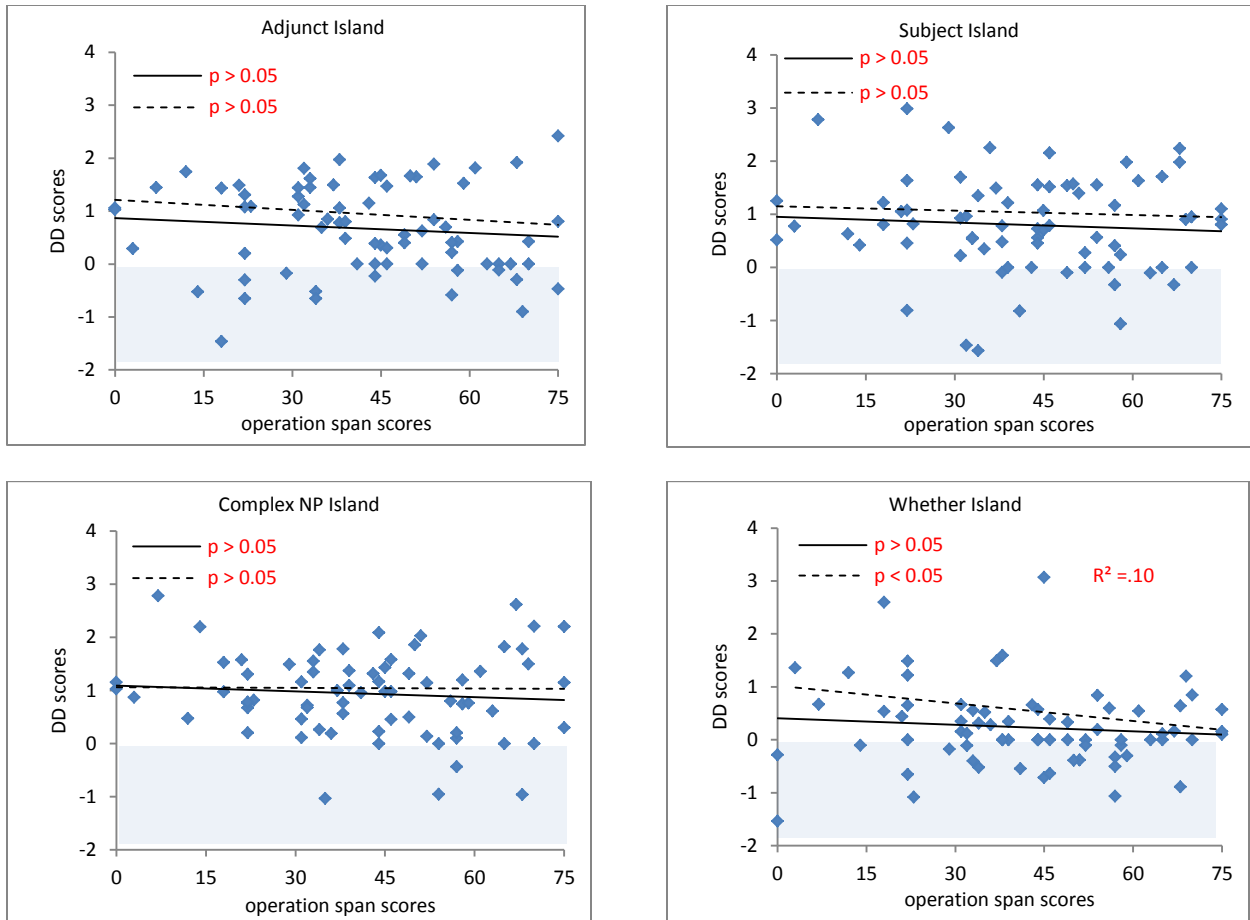


Figure 8: DD scores plotted as a function of operation span scores ( $N = 72$ ). The solid line represents the line of best fit for all of the DD scores. The dashed line represents the line of best fit when DD scores below zero are removed from the analysis (shaded blue).  $P$ -value for each trend line is reported in the legend.

Table 9 shows the results of the linear regressions for L2 learners. It shows the values of the line of best fit (intercept and slope), goodness of fit ( $R^2$ ) and significance of slope ( $t$ -statistic and  $p$ -value) for each regression analysis performed for every island type.

Table 9: Linear regression modeling DD scores as a function of operation span scores (N = 72)

	Island	Line of Best Fit		Goodness of Fit	Significance Test	
		intercept	slope	R <sup>2</sup>	t-statistic	p-value
All DDs	Adjunct	0.86	-0.00	.01	3.56	0.37
	subject	0.95	-0.00	.01	3.56	0.53
	complex NP	1.09	-0.00	.01	4.73	0.46
	<i>whether</i>	0.40	-0.00	.01	1.83	0.93
DDs ≥ 0	Adjunct	1.21	-0.00	.03	5.73	0.17
	Subject	1.15	-0.00	.01	5.27	0.56
	complex NP	1.05	0.00	.00	5.30	0.93
	<i>whether</i>	1.02	-0.01	.10	4.55	0.02

For the first set of regressions, which included all DD scores, the null hypothesis significance test showed that the best-fit slope was not statistically different from zero for each island type ( $p > 0.05$ ), as shown in Table 9. This suggests no linear relationship between DD scores and operation span scores for each island type. Moreover, the goodness of fit of the line ( $R^2$ ), which measures the proportion of the variance in DD scores that can be accounted for by operation span scores (between zero and one), was only .01 for every island type. This means that operation span scores cannot substantially account for the variance in DD scores, again suggesting no linear relationship between DD scores and operation span scores for each island type.

The second set of regressions, which included only DD scores greater than or equal to zero, showed a similar pattern of results, as shown in Figure 8 and Table 9. The only difference in the results of the second set of regressions is that the null hypothesis significance test showed that the best-fit slope in the case of *whether* islands was statistically different from zero, indicating a linear relationship between DD scores and operation span scores. However, this



relationship is very weak as indicated by the  $R^2$  value of .10, meaning that operation span scores could account for only 10% of the variance in DD scores<sup>17, 18, 19</sup>.

### *3.10 Discussion*

The present study investigated two research questions. The first question is whether Najdi learners of English can show sensitivity to syntactic island constraints on *wh*-movement, a syntactic property that does not exist in their L1. The second question is whether the sensitivity to island effects is due to syntactic constraints or to processing difficulty.

The first question was investigated in the present study to test the predictions of two contrasting theories in SLA, the Interpretability Hypothesis and the Full Transfer/ Full Access Hypothesis. The Interpretability Hypothesis argues that L2 learners cannot acquire uninterpretable features if those features are not selected in their L1 during the critical period. If this claim is correct, Najdi learners will not acquire *wh*-movement in English because the uninterpretable *wh*-feature was not activated in their L1 during the critical period. If this is the case, Najdi learners will not show sensitivity to syntactic island constraints on *wh*-movement. More specifically, they will incorrectly accept the ungrammatical island violation condition and correctly accept the other three grammatical conditions for each of the four island types tested.

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<sup>17</sup> All regression analyses for L2 learners were also run with age as an independent variable in addition to working memory. The results did not differ from the results reported here, suggesting age is not an important factor. The ages of learners ranged from 22 to 45, but 92% of the ages ranged from 22 to 33.

<sup>18</sup> All regression analyses for L2 learners were also run with proficiency as an independent variable in addition to working memory. The results did not differ from the results reported here, suggesting proficiency is not an important factor.

<sup>19</sup> We also ran all of these regression analyses for L2 learners using the raw ratings rather than the z-score transformed ratings, and the results did not differ from the results reported here.

The Full Transfer/Full Access Hypothesis, on the other hand, argues that L2 learners can possibly acquire L2 properties, regardless of L1, when they are at advanced levels of proficiency and have sufficient L2 input. If this claim is correct, Najdi learners can acquire *wh*-movement in English and show sensitivity to its syntactic island constraints. More specifically, they will correctly reject the ungrammatical island violation condition and correctly accept the other three grammatical conditions for each of the four island types tested.

The results of the acceptability judgment task showed that Najdi learners, like English native speakers, rejected the ungrammatical island violation condition and accepted the other three grammatical conditions for each of the four island types tested. This result was reflected in their lower acceptability ratings of the ungrammatical island violation condition as compared to higher acceptability ratings of the other three grammatical conditions. This pattern of acceptability judgments exhibited by both English native speakers and Najdi learners led to an interaction between *wh*-dependency length and island structure, suggesting that Najdi learners, like English native speakers, were sensitive to syntactic island constraints on *wh*-movement.

These results support the Full Transfer/Full Access Hypothesis because they suggest that Najdi learners acquired *wh*-movement in English and were sensitive to its syntactic island constraints. Contrary to the prediction of the Interpretability Hypothesis, these findings indicate that Najdi learners did not have a problem acquiring the uninterpretable *wh*-feature in English that was not selected in their L1 during the critical period.

The results of the acceptability judgment task also showed that Najdi learners patterned similarly to English native speakers in terms of the strength of their sensitivity to the four island types tested. Both English native speakers and Najdi learners showed a weaker sensitivity to *whether* islands as compared to their sensitivity to adjunct islands, subject islands, and complex

NP islands. In *whether* islands, both English native speakers and Najdi learners did not strongly reject the ungrammatical island violation condition as compared to the other three grammatical conditions, showing weak sensitivity to *whether* islands.

This pattern of sensitivity exhibited by English native speakers and Najdi learners can be attributable to the types of islands tested in the present study. In the case of adjunct islands and subject islands, for example, syntacticians have argued that these two types of islands are strong islands from which extraction is not possible crosslinguistically (*e.g.*, Huang, 1982, Chomsky, 1986). Therefore, native speakers and L2 learners as well are predicted to reject extractions from such islands because they are universal constraints on extraction. The results of the present study are consistent with this prediction. Both English native speakers and Najdi learners rejected these two types of islands, showing strong sensitivity to their effects as reflected in the size of the statistical interaction observed for each of these two island types.

In contrast, *whether* islands are one type of *wh*-island and they are considered weak islands (Chomsky, 1986). Unlike strong islands, extraction from *whether* islands is not prohibited crosslinguistically. For example, in Greek, as shown in (61), extraction from *whether* islands is grammatical (Alexopoulou & Keller, 2003).

#### WHETHER ISLAND IN GREEK

- (61) Pion            anarotihikes    an            tha    apolisoune?  
Who.ACC    wondering.2SG    whether/if    will    fire.3PL  
'Who did you wonder whether they will fire?'

Although extraction from *whether* islands (weak islands) is ungrammatical in English, it is not as fully ungrammatical as extraction from adjuncts or subjects (strong islands). As noted by Szabolcsi (2006), there is also some variation within English native speakers with respect to the acceptability of extractions from *wh*-islands. While some English native speakers reject such

extractions, others tend to accept them, as shown in Johnson and Newport (1991) and Martohardjono (1993).

However, it has been observed that island effects can be avoided or weakened when the extracted *wh*-filler phrase is a complex or discourse-linked *wh*-phrase, as shown in (62b), rather than a bare *wh*-phrase, as shown in (62a) (Pesetsky, 1987; Rizzi, 1990).

- (62)        WHETHER ISLAND
- a. \***What** do you know whether John read \_\_\_?
  - b. **Which of those books** do you know whether John read \_\_\_?

However, as noted by Phillips (2013), complex *wh*-filler phrases cannot eliminate the effects of all island types. That is, they can only improve the acceptability of ungrammatical sentences that violate weaker island constraints like *whether* islands, as shown in (62), but they cannot greatly improve the acceptability of ungrammatical sentences that violate stronger island constraints like relative clause islands (strong islands), as in shown in (63)<sup>20</sup>.

- (63)        RELATIVE CLAUSE ISLAND
- a. \***What** do you know the man who wrote \_\_\_?
  - b. **Which of those books** do you know the man who wrote \_\_\_?

In the present study, both English native speakers and Najdi learners are predicted to tend to accept the ungrammatical sentences that violate *whether* islands for two reasons. The first reason is that *whether* islands are weak islands. The second reason is that the *wh*-filler phrase extracted from these islands is a complex *wh*-filler phrase, which arguably dilutes the effects of weak islands, thereby increasing the acceptability of ungrammatical weak island violation sentences. The results of the present study are consistent with this prediction. Both English

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<sup>20</sup> The examples in (62) and (63) are from Phillips (2013), p. 8.

native speakers and Najdi learners tended to accept ungrammatical sentences with *whether* island violations, showing weak sensitivity to their effects as reflected in the size of the statistical interaction observed for this island type.

Like *whether* islands, complex NP islands tested in the present study are also considered weak islands (Chomsky, 1986). Although complex NP islands are weak islands, the ungrammatical sentences that violate this type of island were strongly rejected by both English native speakers and Najdi learners. This clear rejection can be attributed to a combination of factors in the sentences used to test this type of island, as in (64).

COMPLEX NP ISLAND

- (64) \*Which pie did the chef hear the message that Jeff baked?

In the test sentences, as exemplified in (64), the complex NPs (*e.g.*, *the message that Jeff baked*) are tensed. Moreover, the head of the complex NPs in these sentences (*e.g.*, *the message*) is a definite noun. Tensed and definite complex NPs have been observed to cause stronger rejection of ungrammatical sentences with complex NP island violations (*e.g.*, Chomsky, 1986; Szabolcsi & den Dikken, 2003).

Regarding tensed complex NP islands, Chomsky (1986) noted that extraction from these islands (65a) was less acceptable than extraction from their non-tensed counterparts (65b).

(65) TENSED COMPLEX NP

- a. ?\*Which book<sub>i</sub> did John hear [a rumor that you had read  $t_i$  ]?

NON TENSED COMPLEX NP

- b. ?Which book<sub>i</sub> did John announce [a plan to read  $t_i$  ]?

Regarding definite complex NP islands, Szabolcsi and den Dikken (2003) pointed out that extraction from these islands (66a) was less acceptable than extraction from their indefinite counterparts (66b).

(66) DEFINITE COMPLEX NP

- a. ?\*Which man<sub>i</sub> did they consider [the rumors that Bob would betray *t<sub>i</sub>* ]?

INDEFINITE COMPLEX NP

- b. ?Which man<sub>i</sub> did they consider [ rumors that Bob would betray *t<sub>i</sub>* ]?

Another factor that may have led to the strong rejection of the sentences with complex NP island violations can be related to the structure of those islands. Although both complex NP islands and *whether* islands are weak islands, they differ in their structures. The structure of *whether* islands is a CP complement of a verb, as shown in (67).

(67) \*Which cupcakes does the baker wonder [<sub>CP</sub> **whether Tom loves** ]?

However, as discussed in section 2.1, it is still unclear whether complement clauses of nouns in complex NP islands (e.g., *that Jeff baked*), as shown in (68), are indeed complements or instead are adjuncts (Belikova & White, 2009).

(68) \*Which pie did the Chef hear the message [<sub>CP</sub> **that Jeff baked** ]?

Relatedly, Chomsky argued that complement clauses of nouns are more like adjuncts because nouns cannot properly govern their complements as verbs do. In (69a), for example, the sentence is grammatical when the complementizer ‘*that*’ is deleted, which suggests that the verb ‘*claimed*’ can properly govern a null complementizer.

- (69)      VERB COMPLEMENT  
a. He claimed [(that) Bill had left the party].

- NOUN COMPLEMENT  
b. \*I distrust the claim [Bill had left the party].

In (69b)<sup>21</sup>, however, the sentence is ungrammatical when the complementizer ‘*that*’ is deleted, which suggests that the noun ‘*claim*’ cannot properly govern a null complementizer (as cited in Belikova and White, 2009, p. 214). Stowell also argued that tensed complements of nouns, as shown in (70a), are not true complements because extraction from them is less acceptable than extraction from non-tensed complements of nouns, as shown in (70b)<sup>22</sup>, (as cited in Belikova and White, 2009, p. 215).

- (70)      TENSED COMPLEX NP  
a. ?\*Which book<sub>i</sub> did John hear [a rumor that you had read *t<sub>i</sub>* ]?

- NON TENSED COMPLEX NP  
b. ?Which book<sub>i</sub> did John announce [a plan to read *t<sub>i</sub>* ]?

If tensed complement clauses of nouns in complex NP islands behave more like adjuncts than complements as Chomsky and Stowell claimed, then extraction from them is predicted to be more strongly rejected than extraction from *whether* islands. This prediction is borne out in the present study, as both English native speakers and Najdi learners rejected ungrammatical sentences with complex NP island violations more strongly than ungrammatical sentences with *whether* island violations.

The results of Najdi learners in the present study are largely consistent with Belikova and White’s (2009) proposal, which argues that L2 learners are expected to perform more accurately

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<sup>21</sup> The examples in (69) are from Stowell (1986, cited in Belikova and White, 2009, p. 215).

<sup>22</sup> The examples in (70) are from Chomsky (1986, cited in Belikova and White, 2009, p. 214).

on *wh*-extraction from strong islands (universal constraints on extraction) than on *wh*-extraction from weak islands if they have access to UG. Najdi learners rejected *wh*-extraction from adjunct islands and subject islands (strong islands) more strongly than *wh*-extraction from *whether* islands (weak islands). Najdi learners' stronger rejection of *wh*-extraction from complex NP islands (weak islands) can be explained if we take into account the factors discussed above.

To conclude, then, and in answer to the first research question of the present study, Najdi learners did in fact show sensitivity to syntactic island constraints on *wh*-movement across the four tested island types, just as English native speakers did.

The second research question investigated in the present study is whether this sensitivity to island effects, exhibited by both English native speakers and Najdi learners, is driven by grammatical syntactic constraints or processing difficulty. The present study investigates this question, teasing apart the resource-limitation theory and grammatical syntactic theories with respect to the underlying source of island effects.

The pattern of average acceptability ratings exhibited by English native speakers and Najdi learners in the acceptability judgment task cannot tease apart the resource-limitation theory and grammatical theories of island effects. Although both English native speakers and Najdi learners gave low acceptability ratings to the ungrammatical island violation condition that led to an interaction between *wh*-dependency length and island structure for each island type, this interaction is predicted under both accounts of island effects. That is, both the resource-limitation and grammatical accounts predict low acceptability judgments of the ungrammatical island violation condition, but they differ in their explanations for the source of island effects that give rise to low acceptability judgments of ungrammatical island violation condition, as in (71).

(71) \*Which keys<sub>i</sub> does the worker worry [**if the boss leaves** *t<sub>i</sub>* ] in the car?



Under the grammatical account, island effects that give rise to low acceptability judgments are caused by violations of grammatical syntactic constraints that prohibit *wh*-extraction from islands. That is, speakers give low acceptability judgments to ungrammatical island violation sentences, as shown in (71) because they have grammatical knowledge that guides them to avoid associating the *wh*-filler ‘*which keys*’ with any potential gap site inside an island, grammatically unlicensed position for hosting a gap.

Under the resource-limitation account, however, island effects that give rise to low acceptability judgments occur as a result of processing difficulty. That is, speakers give low acceptability judgments to ungrammatical island violation sentences, as shown in (71), because they undergo processing difficulty when attempting to posit a gap inside an island. This processing difficulty arises from processing the island structure, which is the complex embedded clause (*e.g.*, *if the boss leaves t<sub>i</sub>*), while simultaneously maintaining the *wh*-filler ‘*which keys*’ in working memory. These two simultaneous processing costs overwhelm an individual’s limited processing resources before the *wh*-filler can be retrieved from working memory and reintegrated into the gap site in the island. So it is the exhaustion of a speaker’s limited processing resources that causes processing difficulty and leads to sensitivity to island effects.

To tease apart the resource-limitation theory and grammatical theories of island effects, the present study, like Sprouse et al. (2012), focused on individual differences in processing resources, which play a crucial role in sensitivity to island effects under the resource-limitation theory but not under grammatical theories of island effects. Under the resource-limitation theory, there should be a relationship between an individual’s processing resources and the strength of sensitivity to island effects. That is, individuals with greater processing resources are expected to posit a gap inside islands and accept ungrammatical island violation sentences, showing weaker

sensitivity to island effects. To test this claim, we examined the relationship between working-memory resources and the strength of sensitivity to island effects. To assess the relationship between these two variables, we used two measures for each individual, a measure of working-memory capacity (*i.e.*, the operation span score) and a measure of sensitivity to island effects (*i.e.*, the DD score).

Under the resource-limitation theory, English native speakers and Najdi learners who showed sensitivity to island effects are predicted to show a negative relationship between operation span scores, which measure working-memory capacity, and DD scores, which measure sensitivity to island effects. That is, individuals with higher operation span scores will posit a gap inside islands and accept ungrammatical island violation sentences as in (72), showing a weaker sensitivity to island effects (lower DD scores).

(72) \*Which keys<sub>i</sub> does the worker worry [if the boss leaves  $t_i$  ] in the car?

Under grammatical theories that argue that island effects are due to syntactic constraints, English native speakers and Najdi learners who showed sensitivity to island effects are predicted to show either a positive relationship or no relationship between operation span scores and DD scores, which measure sensitivity to island effects.

The results for English native speakers in the present study showed no relationship between operation span scores (a measure working-memory capacity) and DD scores (a measure of sensitivity to island effects) for each of the four island types tested ( $p > 0.05$ ), when DD scores below zero were included or excluded from the regression analysis. Najdi learners showed a very similar pattern of results and differed from English native speakers only in *whether* island type, where they showed a negative relationship between operation span scores and DD scores greater than or equal to zero ( $p < 0.05$ ). Although this negative relationship is predicted by the resource-

limitation theory, this relationship is very weak, as demonstrated by the small  $R^2$  value of 0.10, which suggests that operation span scores could account for only 10% of the variance in DD scores. Crucially, this observed weak relationship is not a practically meaningful relationship given that, under the resource-limitation theory, the only predictor of the strength of sensitivity to island effects is working memory resources.

Contrary to the prediction of the resource-limitation theory, the results obtained from both English native speakers and Najdi learners suggest no relationship between an individual's processing resources and sensitivity to island effects. The sensitivity to island effects did not vary across English native speakers and Najdi learners as a function of individual differences in processing resources. These results do not support the resource-limitation theory, which claims that individual differences in processing resources play a crucial role in sensitivity to island effects. These results suggest that sensitivity to island effects is not driven by limited processing resources and is more likely to be driven by grammatical syntactic constraints.

Compared to the results of Sprouse et al. (2012), the results of the present study provide stronger evidence in support of the grammatical account of island effects. In their first experiment, which used a seven-point rating scale, Sprouse et al. (2012) found in the first set of regressions, which included all DD scores, a significant negative relationship between recall scores and DD scores for subject islands ( $p < 0.05$ ) and no relationship for adjunct islands, complex NP islands, and *whether* islands ( $p > 0.05$ ). In the second set of regressions, which included only DD scores greater than or equal to zero, Sprouse and colleagues found a significant negative relationship between recall scores and DD scores for adjunct islands, subject islands, and *whether* islands ( $p < 0.05$ ) and no relationship for complex NP islands ( $p > 0.05$ ).

Relying on the small  $R^2$  value for each island type (between 0.00 and 0.06), which measures the proportion of the variance in DD scores that can be explained by recall scores, Sprouse et al. (2012) argued that their results suggest no relationship between recall scores and DD scores. They argued that, although a significant negative relationship was found between the two tested variables for some island types, as predicted by the processing account of islands, the small  $R^2$  value for each island type suggests that working memory capacity cannot account for a substantial proportion of the variance in sensitivity to island effects. They argued that these results do not support the processing account of island effects, which largely relies on working memory as a single factor to account for sensitivity to island effects.

However, Hofmeister et al. (2012) leveled three primary criticisms at the results of Sprouse et al. (2012). The first criticism is that Sprouse and colleagues relied on  $R^2$  values instead of  $p$ -values when they interpreted their results. The second criticism is that Sprouse and colleagues used complex stimuli that were hard to process even for individuals with high working-memory capacity. The third criticism is that Sprouse and colleagues used ineffective or inappropriate working memory tasks to measure working-memory capacity. We will address these three criticisms, contrasting the methods of Sprouse et al. (2012) with our methods and, in turn, highlighting the strengths of the present study.

## **I. Interpretation of results**

In a response paper, Hofmeister et al. (2012) argued that the Sprouse et al. results are statistically consistent with the processing account of islands, which predicts that sensitivity to island effects varies as a function of working memory capacity. More specifically, Hofmeister and colleagues argued that Sprouse et al. (2012) found in their first experiment, for three out of four island types, a significant negative relationship ( $p < 0.05$ ) between recall scores and DD

scores greater than or equal to zero. Hofmeister and colleagues claimed that Sprouse et al. (2012), who based their interpretation on  $R^2$  values instead of  $p$ -values, underestimated the statistical importance of  $p$ -values when they argued that there is no relationship between recall scores and DD scores.

Hofmeister et al. (2012) claimed that any significant negative relationship supports the processing account. They argued that, regardless of how small the  $R^2$  value is, statistically significant  $p$ -values are meaningful. Hofmeister and colleagues claimed that we should not expect a larger  $R^2$  value in the results of Sprouse et al. because no working memory measure has been found to ideally account for all differences in working memory. They also claimed that the small  $R^2$  values in the results of Sprouse et al. could be because a larger portion of the variance in acceptability studies is usually attributable to differences in participants and items, rather than the manipulation of the factor of interest.

Unlike Sprouse et al. (2012) who made their argument based on  $R^2$  values, the present study makes its argument of the non-relationship between working-memory capacity and sensitivity to island effects based on  $p$ -values. For example, English native speakers in the present study did not show, for any of the four island types tested, a statistically significant relationship ( $p > 0.05$ ) between operation span scores and DD scores in both sets of regression analyses we conducted. Similarly, learners also did not show a statistically significant relationship ( $p > 0.05$ ) between operation span scores and DD scores, except for *whether* island type ( $p < 0.05$ ), and crucially, only when DD scores below zero were excluded from the statistical analysis. Relying on  $p$ -values, our results from both natives and learners suggest no relationship between working-memory capacity and sensitivity to island effects, supporting the grammatical account of islands. Unlike Sprouse et al. (2012), who were criticized by Hofmeister

and colleagues for relying on  $R^2$  values in interpreting their results, such criticism cannot be raised against the present study.

## II. Revised stimuli

Hofmeister et al. (2012) also argued that the use of complex stimuli by Sprouse and colleagues likely obscured the relationship between working-memory capacity and sensitivity to island effects. Hofmeister et al. (2012) particularly argued that the critical ungrammatical island violation sentences, as shown in (73), were extremely hard to process, even for individuals with high working-memory capacity, and did not leave room for individual differences in working-memory capacity to emerge in acceptability ratings.

(73) \*What do you worry if the boss leaves in the car?

Hofmeister et al. (2012) claimed that these critical sentences involved many sources of processing difficulty in addition to the island structure itself. For example, they argued that these sentences, which were direct questions, were presented to participants without a context, had referential NPs with no discourse antecedents (*e.g.*, the boss), and had vague *wh*-fillers (*e.g.*, what) instead of specific *wh*-fillers (*e.g.*, *which*-NP). Hofmeister et al. (2012) argued that these factors, which made the critical sentences sound pragmatically odd and difficult to process, hindered the emergence of cognitive individual differences in acceptability ratings. Hofmeister et al. (2012) argued that more variability will emerge in acceptability judgments if ungrammatical island violation sentences are less complex.

In the present study, to reduce the difficulty in processing the critical ungrammatical island violation sentences, we made the revised stimuli of Sprouse et al. less complex, allowing cognitive individual differences to emerge in acceptability ratings. Specifically, we made two

modifications to the stimuli of Sprouse et al. First, we preceded each test sentence with a declarative background sentence to make the processing of the test sentence easier, avoiding the pragmatic oddity of presenting questions without a context. Second, we used a complex *wh*-filler in the test sentences, which has been argued to facilitate processing of *wh*-dependency sentences at the gap site (e.g., Hofmeister & Sag, 2010; Goodall, 2015).

Although the present study used less complex stimuli involving less processing difficulty compared to Sprouse et al. (2012), the results from both English native speakers and learners showed no relationship between operation span scores and DD scores. Because we used less complex stimuli, if there were indeed a relationship between these two tested variables, stimuli complexity would not affect the ability to observe that relationship. We removed most unnecessary sources of processing difficulty from the stimuli of Sprouse et al., in an attempt to preserve only those sources associated with island effects. In contrast to the stimuli of Sprouse et al., our stimuli, as shown in (74), do not involve decontextualized direct questions, vague *wh*-fillers, or referential NPs with no referents in the discourse.

(74)      BACKGROUND SENTENCE

a. *The worker worries if the boss leaves her office keys in the car.*

TEST SENTENCE

b. \***Which keys** does the worker worry if the boss leaves in the car?

Our modifications to the stimuli used by Sprouse and colleagues were implemented simultaneously, greatly reducing unnecessary processing difficulty according to Hofmeister et al.'s proposal. The criticisms of Hofmeister et al. (2012) against Sprouse et al. (2012) cannot be raised against the present study.

### III. Working memory task

Hofmeister et al. (2012) also claimed that the failure of Sprouse and colleagues to find a relationship between working memory and sensitivity to island effects is because they used inappropriate measures of working memory. Particularly, Hofmeister et al. (2012) argued that the serial-recall task and the *n*-back task that Sprouse and colleagues used are only simple span tasks and may not be considered measures of working memory. Hofmeister et al. (2012) also claimed that these two simple span tasks are measures of short-term memory because they can measure only storage capacity.

In the present study, we used a complex span task, which is the automated operation span task. Unlike the serial-recall and *n*-back tasks that Hofmeister et al. (2012) claimed may not be measures of working memory, the automated operation span task is considered a true measure of working memory because it is a complex span task (Conway et al., 2005). The automated operation span task used in the present study is an appropriate measure of working memory because it engages the relevant cognitive processes used in processing island violation sentences. The automated operation span task we used requires not only storing information but also simultaneous processing of additional information. These cognitive abilities are used in processing island violation sentences. For a speaker to process an island violation sentence, for example, she or he needs to store the *wh*-filler in working memory, while simultaneously processing the elements that intervene between the *wh*-filler and the gap site in the island structure.

In a response paper to Sprouse and colleagues, Hofmeister et al. (2012) specifically claimed that a relationship between working memory and sensitivity to island effects can be observed in acceptability judgments if two conditions are met. The first condition is to use a



working memory task that engages the cognitive processes used in processing island violation sentences. The second condition is to use test sentences that allow for individual differences in working memory to emerge in acceptability judgments. Although these two conditions were largely met in the present study, the results of both natives and learners did not show a relationship between working memory and sensitivity to island effects, contrary to the prediction of the resource-limitation theory.

Regarding the first condition, we used a complex span task that engages cognitive processes associated with information storage and simultaneous processing of additional information and these cognitive capabilities are involved in processing island violation sentences. Regarding the second condition, we sought to remove most unnecessary sources of processing difficulty from the stimuli of Sprouse et al. (2012) and keep those sources associated with processing island violation sentences. Thus, our sentences should allow any individual differences in working memory to emerge in acceptability judgments. However, our results did not show that individual differences in working memory have an effect on acceptability judgments of island violations sentences contrary to the prediction of the resource-limitation theory.

It is possible that we failed to find a relationship between working memory and sensitivity to island effects because we did not use an appropriate measure of working memory that perfectly captures the relevant processes used in processing island violation sentences. However, as Sprouse and colleagues pointed out, this is improbable because it is unlikely to find a new working memory measure that does not correlate with the serial-recall task or the *n*-back task used in Sprouse et al. (2012) or with the operation span task used in the present study. This is particularly true if we take into account that many working-memory measures engage some

common cognitive processes (Conway et al., 2005). For example, the operation span task we used in the present study has been shown to significantly correlate with two other complex span tasks, reading span and counting span tasks, suggesting that these three measures engage some common processes of working memory (Conway et al., 2005). As Sprouse and colleagues pointed out in their response to Hofmeister et al. (2012), although there are many working memory tasks, the types of cognitive processes which these tasks can engage are very limited. Thus, using a different working memory measure is more likely to yield results similar to those found in the present study and Sprouse et al. (2012).

It should be noted that the absence of a relationship between operation span scores and DD scores in the present study cannot be attributable to a lack of variation in any of these two tested variables. Both English native speakers and learners showed a wide range of variation in operation span scores and DD scores across the four island types tested, as shown in Figures 7 and 8 in the results section. The working memory scores, for example, ranged from 8 to 75 for English native speakers and from 0 to 75 for learners. With respect to DD scores, some English native speakers and learners had high positive DD scores (strong sensitivity to islands), some had low positive DD scores (weak sensitivity to islands), some had DD scores of zero (no sensitivity to islands), and others in some island types had negative DD scores (subadditive sensitivity to islands).

In the present study, we argue that our results support grammatical theories of island effects because neither natives nor learners provided evidence of a relationship between operation span scores and DD scores, contrary to the prediction of the resource-limitation theory of island effects. To conclude, then, and in answer to the second question of the present study,

sensitivity to island effects exhibited by natives and learners is more likely to be due to syntactic constraints than processing difficulty.

#### **4. Conclusion**

This study shows that it is possible for adult L2 learners to acquire syntactic properties that do not exist in their L1. Najdi learners showed sensitivity to syntactic constraints on *wh*-movement in English although Najdi Arabic is a *wh*-in-situ language. Our results provide support for theories which argue that L2 learners are not ultimately constrained by the properties of their L1. With regard to the source of island effects, the present study, like Sprouse et al. (2012), found no relationship between processing resources and sensitivity to island effects in acceptability judgments. Our results combined with the results of Sprouse et al. (2012) suggest that island effects most likely occur due to grammatical syntactic constraints in both learners and native speakers. An interesting next step would be to investigate the relationship between processing resources and sensitivity to islands using an online task that can more directly measure whether islands present a processing bottleneck and whether sensitivity is impacted by individual differences (see Johnson et al., 2013).

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## APPENDIX

### Sentences included in the Grammaticality Judgment Task (GJT)

#### 1. WHETHER ISLAND

1. The second detective thinks that Paul took the necklace.
  - a. Which detective\_\_ thinks that Paul took the necklace? (NONISLAND/MATRIX)
  - b. The detective thinks that Paul took the gold necklace.  
Which necklace does the detective think that Paul took\_\_? (NONISLAND/EMBEDDED)
  - c. The second detective wonders whether Paul took the necklace.  
Which detective\_\_ wonders whether Paul took the necklace? (ISLAND/MATRIX)
  - d. The detective wonders whether Paul took the gold necklace.  
\*Which necklace does the detective wonder whether Paul took\_\_? (ISLAND/EMBEDDED)
2. The tall police officer thinks that Matt chased the bus.
  - a. Which police officer\_\_ thinks that Matt chased the bus? (NONISLAND/MATRIX)
  - b. The police officer thinks that Matt chased the yellow bus.  
Which bus does the police officer think that Matt chased\_\_? (NONISLAND/EMBEDDED)
  - c. The tall police officer wonders whether Matt chased the bus.  
Which police officer\_\_ wonders whether Matt chased the bus? (ISLAND/MATRIX)
  - d. The police officer wonders whether Matt chased the yellow bus.  
\*Which bus does the police officer wonder whether Matt chased\_\_? (ISLAND/EMBEDDED)
3. The cupcake baker thinks that Caroline loves cupcakes.
  - a. Which baker\_\_ thinks that Caroline loves cupcakes? (NONISLAND/MATRIX)
  - b. The baker thinks that Caroline loves chocolate cupcakes.  
Which cupcakes does the baker think that Caroline loves\_\_? (NONISLAND/EMBEDDED)
  - c. The cupcake baker wonders whether Caroline loves cupcakes.  
Which baker\_\_ wonders whether Caroline loves cupcakes? (ISLAND/MATRIX)
  - d. The baker wonders whether Caroline loves chocolate cupcakes.  
\*Which cupcakes does the baker wonder whether Caroline loves\_\_? (ISLAND/EMBEDDED)
4. The sales manager thinks that Tom sold the television.
  - a. Which manager\_\_ thinks that Tom sold the television? (NONISLAND/MATRIX)
  - b. The manager thinks that Tom sold the small television.  
Which television does the manager think that Tom sold\_\_? (NONISLAND/EMBEDDED)
  - c. The sales manager wonders whether Tom sold the television.  
Which manager\_\_ wonders whether Tom sold the television? (ISLAND/MATRIX)
  - d. The manager wonders whether Tom sold the small television.  
\*Which television does the manager wonder whether Tom sold\_\_? (ISLAND/EMBEDDED)
5. The café waiter thinks that Christine likes soup.
  - a. Which waiter\_\_ thinks that Christine likes soup? (NONISLAND/MATRIX)
  - b. The waiter thinks that Christine likes vegetable soup.  
Which soup does the waiter think that Christine likes\_\_? (NONISLAND/EMBEDDED)
  - c. The café waiter wonders whether Christine likes soup.  
Which waiter\_\_ wonders whether Christine likes soup? (ISLAND/MATRIX)



- d. The waiter wonders whether Christine likes vegetable soup.  
\*Which soup does the waiter wonder whether Christine likes\_\_? (ISLAND/EMBEDDED)
6. The motorcycle mechanic thinks that Alan drives a motorcycle.  
a. Which mechanic\_\_ thinks that Alan drives a motorcycle? (NONISLAND/MATRIX)  
The mechanic thinks that Alan drives the blue motorcycle.  
b. Which motorcycle does the mechanic think that Alan drives\_\_? (NONISLAND/EMBEDDED)  
The motorcycle mechanic wonders whether Alan drives a motorcycle.  
c. Which mechanic\_\_ wonders whether Alan drives a motorcycle? (ISLAND/MATRIX)  
The mechanic wonders whether Alan drives the blue motorcycle.  
d. \*Which motorcycle does the mechanic wonder whether Alan drives\_\_? (ISLAND/EMBEDDED)
7. The French chef thinks that Jessica hates cheese.  
a. Which chef\_\_ thinks that Jessica hates cheese? (NONISLAND/MATRIX)  
The chef thinks that Jessica hates French cheese.  
b. Which cheese does the chef think that Jessica hates\_\_? (NONISLAND/EMBEDDED)  
The French chef wonders whether Jessica hates cheese.  
c. Which chef\_\_ wonders whether Jessica hates cheese? (ISLAND/MATRIX)  
The chef wonders whether Jessica hates French cheese.  
d. \*Which cheese does the chef wonder whether Jessica hates\_\_? (ISLAND/EMBEDDED)
8. The math tutor thinks that Rachel likes the library.  
a. Which tutor\_\_ thinks that Rachel likes the library? (NONISLAND/MATRIX)  
The tutor thinks that Rachel likes the university library.  
b. Which library does the tutor think that Rachel likes\_\_? (NONISLAND/EMBEDDED)  
The math tutor wonders whether Rachel likes the library.  
c. Which tutor\_\_ wonders whether Rachel likes the library? (ISLAND/MATRIX)  
The tutor wonders whether Rachel likes the university library.  
d. \*Which library does the tutor wonder whether Rachel likes\_\_? (ISLAND/EMBEDDED)
9. The university professor thinks that Walter likes sports.  
a. Which professor\_\_ thinks that Walter likes sports? (NONISLAND/MATRIX)  
The professor thinks that Walter likes dangerous sports.  
b. Which sports does the professor think that Walter likes\_\_? (NONISLAND/EMBEDDED)  
The university professor wonders whether Walter likes sports.  
c. Which professor\_\_ wonders whether Walter likes sports? (ISLAND/MATRIX)  
The professor wonders whether Walter likes dangerous sports.  
d. \*Which sports does the professor wonder whether Walter likes\_\_? (ISLAND/EMBEDDED)
10. The young soldier thinks that Stacey wrote the letter.  
a. Which soldier\_\_ thinks that Stacey wrote the letter? (NONISLAND/MATRIX)  
The soldier thinks that Stacey wrote the love letter.  
b. Which letter does the soldier think that Stacey wrote\_\_? (NONISLAND/EMBEDDED)  
The young soldier wonders whether Stacey wrote the letter.  
c. Which soldier\_\_ wonders whether Stacey wrote the letter? (ISLAND/MATRIX)  
The soldier wonders whether Stacey wrote the love letter.  
d. \*Which letter does the soldier wonder whether Stacey wrote\_\_? (ISLAND/EMBEDDED)
11. The local agent thinks that Aaron bought the house.  
a. Which agent\_\_ thinks that Aaron bought the house? (NONISLAND/MATRIX)  
The agent thinks that Aaron bought the new house.  
b. Which house does the agent think that Aaron bought\_\_? (NONISLAND/EMBEDDED)

- The local agent wonders whether Aaron bought the house.  
c. Which agent\_\_ wonders whether Aaron bought the house? (ISLAND/MATRIX)
- The agent wonders whether Aaron bought the new house.  
d. \*Which house does the agent wonder whether Aaron bought\_\_? (ISLAND/EMBEDDED)
12. The restaurant waitress thinks that Katie ate a sandwich.  
a. Which waitress\_\_ thinks that Katie ate a sandwich? (NONISLAND/MATRIX)
- The waitress thinks that Katie ate a chicken sandwich.  
b. Which sandwich does the waitress think that Katie ate\_\_? (NONISLAND/EMBEDDED)
- The restaurant waitress wonders whether Katie ate a sandwich.  
c. Which waitress\_\_ wonders whether Katie ate a sandwich? (ISLAND/MATRIX)
- The waitress wonders whether Katie ate a chicken sandwich.  
d. \*Which sandwich does the waitress wonder whether Katie ate\_\_? (ISLAND/EMBEDDED)
13. The science teacher thinks that George read the book.  
a. Which teacher\_\_ thinks that George read the book? (NONISLAND/MATRIX)
- The teacher thinks that George read the chemistry book.  
b. Which book does the teacher think that George read\_\_? (NONISLAND/EMBEDDED)
- The science teacher wonders whether George read the book.  
c. Which teacher\_\_ wonders whether George read the book? (ISLAND/MATRIX)
- The teacher wonders whether George read the chemistry book.  
d. \*Which book does the teacher wonder whether George read\_\_? (ISLAND/EMBEDDED)
14. The beautiful girl thinks that Heather saw the movie.  
a. Which girl\_\_ thinks that Heather saw the movie? (NONISLAND/MATRIX)
- The girl thinks that Heather saw the new movie.  
b. Which movie does the girl think that Heather saw\_\_? (NONISLAND/EMBEDDED)
- The beautiful girl wonders whether Heather saw the movie.  
c. Which girl\_\_ wonders whether Heather saw the movie? (ISLAND/MATRIX)
- The girl wonders whether Heather saw the new movie.  
d. \*Which movie does the girl wonder whether Heather saw\_\_? (ISLAND/EMBEDDED)
15. The college student thinks that David passed the exam.  
a. Which student\_\_ thinks that David passed the exam? (NONISLAND/MATRIX)
- The student thinks that David passed the final exam.  
b. Which exam does the student think that David passed\_\_? (NONISLAND/EMBEDDED)
- The college student wonders whether David passed the exam.  
c. Which student\_\_ wonders whether David passed the exam? (ISLAND/MATRIX)
- The student wonders whether David passed the final exam.  
d. \*Which exam does the student wonder whether David passed\_\_? (ISLAND/EMBEDDED)
16. The Italian guest thinks that Casey baked the cake.  
a. Which guest\_\_ thinks that Casey baked the cake? (NONISLAND/MATRIX)
- The guest thinks that Casey baked the birthday cake.  
b. Which cake does the guest think that Casey baked\_\_? (NONISLAND/EMBEDDED)
- The Italian guest wonders whether Casey baked the cake.  
c. Which guest\_\_ wonders whether Casey baked the cake? (ISLAND/MATRIX)
- The guest wonders whether Casey baked the birthday cake.  
d. \*Which cake does the guest wonder whether Casey baked\_\_? (ISLAND/EMBEDDED)

## II. COMPLEX NP ISLANDS

1. The Indian chef heard that Jeff baked a pie.
  - a. Which chef\_\_ heard that Jeff baked a pie? (NONISLAND/MATRIX)
  - The chef heard that Jeff baked the apple pie.
    - b. Which pie did the chef hear that Jeff baked\_\_? (NONISLAND/EMBEDDED)
    - The Indian chef heard the message that Jeff baked a pie.
      - c. Which chef\_\_ heard the message that Jeff baked a pie? (ISLAND/MATRIX)
      - The chef heard the message that Jeff baked the apple pie.
        - d. \*Which pie did the chef hear the message that Jeff baked\_\_? (ISLAND/EMBEDDED)
2. The lazy fisherman denied that Laura caught the fish.
  - a. Which fisherman\_\_ denied that Laura caught the fish? (NONISLAND/MATRIX)
  - The fisherman denied that Laura caught the big fish.
    - b. Which fish did the fisherman deny that Laura caught\_\_? (NONISLAND/EMBEDDED)
    - The lazy fisherman denied the fact that Laura caught the fish.
      - c. Which fisherman\_\_ denied the fact that Laura caught the fish? (ISLAND/MATRIX)
      - The fisherman denied the fact that Laura caught the big fish.
        - d. \*Which fish did the fisherman deny the fact that Laura caught\_\_? (ISLAND/EMBEDDED)
3. The new student heard that Billy missed the bus.
  - a. Which student\_\_ heard that Billy missed the bus? (NONISLAND/MATRIX)
  - The student heard that Billy missed the last bus.
    - b. Which bus did the student hear that Billy missed\_\_? (NONISLAND/EMBEDDED)
    - The new student heard the story that Billy missed the bus.
      - c. Which student\_\_ heard the story that Billy missed the bus? (ISLAND/MATRIX)
      - The student heard the story that Billy missed the last bus.
        - d. \*Which bus did the student hear the story that Billy missed\_\_? (ISLAND/EMBEDDED)
4. The American judge announced that Andrew won the medal.
  - a. Which judge\_\_ announced that Andrew won the medal? (NONISLAND/MATRIX)
  - The judge announced that Andrew won the gold medal.
    - b. Which medal did the judge announce that Andrew won\_\_? (NONISLAND/EMBEDDED)
    - The American judge announced the news that Andrew won the medal.
      - c. Which judge\_\_ announced the news that Andrew won the medal? (ISLAND/MATRIX)
      - The judge announced the news that Andrew won the gold medal.
        - d. \*Which medal did the judge announce the news that Andrew won\_\_? (ISLAND/EMBEDDED)
5. The old doctor suggested that Josh take the medicine.
  - a. Which doctor\_\_ suggested that Josh take the medicine? (NONISLAND/MATRIX)
  - The doctor suggested that Josh take the liquid medicine.
    - b. Which medicine did the doctor suggest that Josh take\_\_? (NONISLAND/EMBEDDED)
    - The old doctor suggested the plan that Josh take the medicine.
      - c. Which doctor\_\_ suggested the plan that Josh take the medicine? (ISLAND/MATRIX)
      - The doctor suggested the plan that Josh take the liquid medicine.
        - d. \*Which medicine did the doctor suggest the plan that Josh take\_\_? (ISLAND/EMBEDDED)
6. The nice man mentioned that Bob rented the room.
  - a. Which man\_\_ mentioned that Bob rented the room? (NONISLAND/MATRIX)
  - The man mentioned that Bob rented the small room.
    - b. Which room did the man mention that Bob rented\_\_? (NONISLAND/EMBEDDED)

- c. The nice man mentioned the fact that Bob rented the room.  
Which man\_\_ mentioned the fact that Bob rented the room? (ISLAND/MATRIX)
- d. The man mentioned the fact that Bob rented the small room.  
\*Which room did the man mention the fact that Bob rented\_\_? (ISLAND/EMBEDDED)
7. The little child believed that Jane bought the toy.  
a. Which child\_\_ believed that Jane bought the toy? (NONISLAND/MATRIX)
- b. The child believed that Jane bought the popular toy.  
Which toy did the child believe that Jane bought\_\_? (NONISLAND/EMBEDDED)
- c. The little child believed the story that Jane bought the toy.  
Which child\_\_ believed the story that Jane bought the toy? (ISLAND/MATRIX)
- d. The child believed the story that Jane bought the popular toy.  
\*Which toy did the child believe the story that Jane bought\_\_? (ISLAND/EMBEDDED)
8. The foreign customer discovered that Amy stole the pizza.  
a. Which customer\_\_ discovered that Amy stole the pizza? (NONISLAND/MATRIX)
- b. The customer discovered that Amy stole the large pizza.  
Which pizza did the customer discover that Amy stole\_\_? (NONISLAND/EMBEDDED)
- c. The foreign customer discovered the secret that Amy stole the pizza.  
Which customer\_\_ discovered the secret that Amy stole the pizza? (ISLAND/MATRIX)
- d. The customer discovered the secret that Amy stole the large pizza.  
\*Which pizza did the customer discover the secret that Amy stole\_\_? (ISLAND/EMBEDDED)
9. The Canadian coach suggested that Susie play golf.  
a. Which coach\_\_ suggested that Susie play golf? (NONISLAND/MATRIX)
- b. The coach suggested that Susie play golf.  
Which sport did the coach suggest that Susie play\_\_? (NONISLAND/EMBEDDED)
- c. The Canadian coach made the suggestion that Susie play golf.  
Which coach\_\_ made the suggestion that Susie play golf? (ISLAND/MATRIX)
- d. The coach made the suggestion that Susie play golf.  
\*Which sport did the coach make the suggestion that Susie play\_\_? (ISLAND/EMBEDDED)
10. The silly boy believed that Vivian took the orange.  
a. Which boy\_\_ believed that Vivian took the orange? (NONISLAND/MATRIX)
- b. The boy believed that Vivian took the last orange.  
Which orange did the boy believe that Vivian took\_\_? (NONISLAND/EMBEDDED)
- c. The silly boy believed the lie that Vivian took the orange.  
Which boy\_\_ believed the lie that Vivian took the orange? (ISLAND/MATRIX)
- d. The boy believed the lie that Vivian took the last orange.  
\*Which orange did the boy believe the lie that Vivian took\_\_? (ISLAND/EMBEDDED)
11. The history teacher reported that Ralph received the award.  
a. Which teacher\_\_ reported that Ralph received the award? (NONISLAND/MATRIX)
- b. The teacher reported that Ralph received the highest award.  
Which award did the teacher report that Ralph received\_\_? (NONISLAND/EMBEDDED)
- c. The history teacher reported the news that Ralph received the award.  
Which teacher\_\_ reported the news that Ralph received the award? (ISLAND/MATRIX)
- d. The teacher reported the news that Ralph received the highest award.  
\*Which award did the teacher report the news that Ralph received\_\_? (ISLAND/EMBEDDED)
12. The busy woman repeated that Jared should write the letter.  
a. Which woman\_\_ repeated that Jared should write the letter? (NONISLAND/MATRIX)

- The woman repeated that Jared should write the important letter.  
b. Which letter did the woman repeat that Jared should write \_\_\_? (NONISLAND/EMBEDDED)
- The busy woman repeated the idea that Jared should write the letter.  
c. Which woman\_\_ repeated the idea that Jared should write the letter? (ISLAND/MATRIX)
- The woman repeated the idea that Jared should write the important letter.  
d. \*Which letter did the woman repeat the idea that Jared should write \_\_\_? (ISLAND/EMBEDDED)
13. The close neighbor suggested that Susan take the bus.  
a. Which neighbor\_\_ suggested that Susan take the bus? (NONISLAND/MATRIX)
- The neighbor suggested that Susan take the early bus.  
b. Which bus did the neighbor suggest that Susan take\_\_\_? (NONISLAND/EMBEDDED)
- The close neighbor made the suggestion that Susan take the bus.  
c. Which neighbor \_\_ made the suggestion that Susan take the bus? (ISLAND/MATRIX)
- The neighbor made the suggestion that Susan take the early bus.  
d. \*Which bus did the neighbor make the suggestion that Susan take \_\_\_? (ISLAND/EMBEDDED)
14. The young hunter believed that Elizabeth saw the bear.  
a. Which hunter\_\_ believed that Elizabeth saw the bear? (NONISLAND/MATRIX)
- The hunter believed that Elizabeth saw the brown bear.  
b. Which bear did the hunter believe that Elizabeth saw\_\_\_? (NONISLAND/EMBEDDED)
- The young hunter believed the lie that Elizabeth saw the bear.  
c. Which hunter\_\_ believed the lie that Elizabeth saw the bear? (ISLAND/MATRIX)
- The hunter believed the lie that Elizabeth saw the brown bear.  
d. \*Which bear did the hunter believe the lie that Elizabeth saw\_\_\_? (ISLAND/EMBEDDED)
15. The blonde girl heard that Michael sold the car.  
a. Which girl\_\_ heard that Michael sold the car? (NONISLAND/MATRIX)
- The girl heard that Michael sold the sports car.  
b. Which car did the girl hear that Michael sold\_\_\_? (NONISLAND/EMBEDDED)
- The blonde girl heard the report that Michael sold the car.  
c. Which girl\_\_ heard the report that Michael sold the car? (ISLAND/MATRIX)
- The girl heard the report that Michael sold the sports car.  
d. \*Which car did the girl hear the report that Michael sold \_\_\_? (ISLAND/EMBEDDED)
16. The tall player learned that the team broke the window.  
a. Which player\_\_ learned that the team broke the window? (NONISLAND/MATRIX)
- The player learned that the team broke the outside window.  
b. Which window did the player learn that the team broke\_\_\_? (NONISLAND/EMBEDDED)
- The tall player learned the secret that the team broke the window.  
c. Which player\_\_ learned the secret that the team broke the window? (ISLAND/MATRIX)
- The player learned the secret that the team broke the outside window.  
d. \*Which window did the player learn the secret that the team broke \_\_\_? (ISLAND/EMBEDDED)

### III. SUBJECT ISLANDS

1. The beautiful woman thinks the gift caused a difficult problem.  
a. Which woman\_\_ thinks the gift caused a difficult problem? (NONISLAND/MATRIX)
- The woman thinks the gift from the actor caused a difficult problem.  
b. Which gift does the woman think\_\_ caused a difficult problem? (NONISLAND/EMBEDDED)

- The beautiful woman thinks the gift from the actor caused a difficult problem.  
c. Which woman\_\_ thinks the gift from the actor caused a difficult problem? (ISLAND/MATRIX)
- The woman thinks the gift from the famous actor caused a difficult problem.  
d. \*Which actor does the woman think the gift from\_\_ caused a difficult problem? (ISLAND/EMBEDDED)
2. The old man thinks the speech interrupted the TV show.  
a. Which man\_\_ thinks the speech interrupted the TV show? (NONISLAND/MATRIX)
- The man thinks the speech by the president interrupted the TV show.  
b. Which speech does the man think\_\_ interrupted the TV show? (NONISLAND/EMBEDDED)
- The old man thinks the speech by the president interrupted the TV show.  
c. Which man\_\_ thinks the speech by the president interrupted the TV show? (ISLAND/MATRIX)
- The man thinks the speech by the Italian president interrupted the TV show.  
d. \*Which president does the man think the speech by\_\_ interrupted the TV show? (ISLAND/EMBEDDED)
3. The math teacher thinks the meeting helped the new school.  
a. Which teacher\_\_ thinks the meeting helped the new school? (NONISLAND/MATRIX)
- The teacher thinks the meeting with the millionaire helped the new school.  
b. Which meeting does the teacher think\_\_ helped the new school? (NONISLAND/EMBEDDED)
- The math teacher thinks the meeting with the millionaire helped the new school.  
c. Which teacher\_\_ thinks the meeting with the millionaire helped the new school? (ISLAND/MATRIX)
- The teacher thinks the meeting with the kind millionaire helped the new school.  
d. \*Which millionaire does the teacher think the meeting with \_\_helped the new school? (ISLAND/EMBEDDED)
4. The history student thinks the book won the top prize.  
a. Which student\_\_ thinks the book won the top prize? (NONISLAND/MATRIX)
- The student thinks the book on the table won the top prize.  
b. Which book does the student think\_\_ won the top prize? (NONISLAND/EMBEDDED)
- The history student thinks the book on the table won the top prize.  
c. Which student\_\_ thinks the book on the table won the top prize? (ISLAND/MATRIX)
- The student thinks the book on the round table won the top prize.  
d. \*Which table does the student think the book on\_\_ won the top prize? (ISLAND/EMBEDDED)
5. The company secretary thinks the e-mail confused the workers.  
a. Which secretary\_\_ thinks the e-mail confused the workers? (NONISLAND/MATRIX)
- The secretary thinks the e-mail from the boss confused the workers.  
b. Which e-mail does the secretary think\_\_ confused the workers? (NONISLAND/EMBEDDED)
- The company secretary thinks the e-mail from the boss confused the workers.  
c. Which secretary\_\_ thinks the e-mail from the boss confused the workers? (ISLAND/MATRIX)
- The secretary thinks the e-mail from the tired boss confused the workers.  
d. \*Which boss does the secretary think the e-mail from\_\_ confused the workers? (ISLAND/EMBEDDED)
6. The worried mother thinks the picture frightened the little boy.  
a. Which mother\_\_ thinks the picture frightened the little boy? (NONISLAND/MATRIX)
- The mother thinks the picture of the lion frightened the little boy.  
b. Which picture does the mother think\_\_ frightened the little boy? (NONISLAND/EMBEDDED)
- The worried mother thinks the picture of the lion frightened the little boy.  
c. Which mother\_\_ thinks the picture of the lion frightened the little boy? (ISLAND/MATRIX)
- The mother thinks the picture of the huge lion frightened the little boy.  
d. \*Which lion does the mother think the picture of \_\_ frightened the little boy? (ISLAND/EMBEDDED)
7. The teenage girl thinks the store sold the fancy dress.  
a. Which girl\_\_ thinks the store sold the fancy dress? (NONISLAND/MATRIX)

- The girl thinks the store on the corner sold the fancy dress.  
b. Which store does the girl think\_\_ sold the fancy dress? (NONISLAND/EMBEDDED)
- The teenage girl thinks the store on the corner sold the fancy dress.  
c. Which girl\_\_ thinks the store on the corner sold the fancy dress? (ISLAND/MATRIX)
- The girl thinks the store on the busy corner sold the fancy dress.  
d. \*Which corner does the girl think the store on\_\_ sold the fancy dress? (ISLAND/EMBEDDED)
8. The smart lawyer thinks the decision ended the long conflict.  
a. Which lawyer\_\_ thinks the decision ended the long conflict? (NONISLAND/MATRIX)
- The lawyer thinks the decision by the judge ended the long conflict.  
b. Which decision does the lawyer think\_\_ ended the long conflict? (NONISLAND/EMBEDDED)
- The smart lawyer thinks the decision by the judge ended the long conflict.  
c. Which lawyer\_\_ thinks the decision by the judge ended the long conflict? (ISLAND/MATRIX)
- The lawyer thinks the decision by the powerful judge ended the long conflict.  
d. \*Which judge does the lawyer think the decision by\_\_ ended the long conflict? (ISLAND/EMBEDDED)
9. The TV reporter thinks the discovery surprised the entire world.  
a. Which reporter\_\_ thinks the discovery surprised the entire world? (NONISLAND/MATRIX)
- The reporter thinks the discovery by the chemist surprised the entire world.  
b. Which discovery does the reporter think\_\_ surprised the entire world? (NONISLAND/EMBEDDED)
- The TV reporter thinks the discovery by the chemist surprised the entire world.  
c. Which reporter\_\_ thinks the discovery by the chemist surprised the entire world? (ISLAND/MATRIX)
- The reporter thinks the discovery by the Iraqi chemist surprised the entire world.  
d. \*Which chemist does the reporter think the discovery by\_\_ surprised the entire world? (ISLAND/EMBEDDED)
10. The journal editor thinks the translation pleased the Spanish author.  
a. Which editor\_\_ thinks the translation pleased the Spanish author? (NONISLAND/MATRIX)
- The editor thinks the translation by the poet pleased the Spanish author.  
b. Which translation does the editor think \_\_ pleased the Spanish author? (NONISLAND/EMBEDDED)
- The journal editor thinks the translation by the poet pleased the Spanish author.  
c. Which editor\_\_ thinks the translation by the poet pleased the Spanish author? (ISLAND/MATRIX)
- The editor thinks the translation by the French poet pleased the Spanish author.  
d. \*Which poet does the editor think the translation by\_\_ pleased the Spanish author? (ISLAND/EMBEDDED)
11. The family doctor thinks the medicine cured the sick woman.  
a. Which doctor\_\_ thinks the medicine cured the sick woman? (NONISLAND/MATRIX)
- The doctor thinks the medicine for cancer cured the sick woman.  
b. Which medicine does the doctor think\_\_ cured the sick woman? (NONISLAND/EMBEDDED)
- The family doctor thinks the medicine for cancer cured the sick woman.  
c. Which doctor\_\_ thinks the medicine for cancer cured the sick woman? (ISLAND/MATRIX)
- The doctor thinks the medicine for lung cancer cured the sick woman.  
d. \*Which cancer does the doctor think the medicine for\_\_ cured the sick woman? (ISLAND/EMBEDDED)
12. The college student thinks the lecture improved the test scores.  
a. Which student\_\_ thinks the lecture improved the test scores? (NONISLAND/MATRIX)
- The student thinks the lecture by the professor improved the test scores.  
b. Which lecture does the student think \_\_ improved the test scores? (NONISLAND/EMBEDDED)
- The college student thinks the lecture by the professor improved the test scores.  
c. Which student\_\_ thinks the lecture by the professor improved the test scores? (ISLAND/MATRIX)
- The student thinks the lecture by the physics professor improved the test scores.  
d. \*Which professor does the student think the lecture by\_\_ improved the test scores? (ISLAND/EMBEDDED)

13. The happy mother thinks the visit excited the little girls.  
 a. Which mother\_\_ thinks the visit excited the little girls? (NONISLAND/MATRIX)
- The mother thinks the visit of the princess excited the little girls.  
 b. Which visit does the mother think \_\_ excited the little girls? (NONISLAND/EMBEDDED)
- The happy mother thinks the visit of the princess excited the little girls.  
 c. Which mother\_\_ thinks the visit of the princess excited the little girls? (ISLAND/MATRIX)
- The mother thinks the visit of the beautiful princess excited the little girls.  
 d. \*Which princess does the mother think the visit of \_\_ excited the little girls? (ISLAND/EMBEDDED)
14. The kind doctor thinks the milk harmed the younger children.  
 a. Which doctor\_\_ thinks the milk harmed the younger children? (NONISLAND/MATRIX)
- The doctor thinks the milk from the market harmed the younger children.  
 b. Which milk does the doctor think \_\_ harmed the younger children? (NONISLAND/EMBEDDED)
- The kind doctor thinks the milk from the market harmed the younger children.  
 c. Which doctor\_\_ thinks the milk from the market harmed the younger children? (ISLAND/MATRIX)
- The doctor thinks the milk from the old market harmed the younger children.  
 d. \*Which market does the doctor think the milk from\_\_ harmed the younger children? (ISLAND/EMBEDDED)
15. The close neighbor thinks the letter encouraged the whole family.  
 a. Which neighbor\_\_ thinks the letter encouraged the whole family? (NONISLAND/MATRIX)
- The neighbor thinks the letter from the soldier encouraged the whole family.  
 b. Which letter does the neighbor think \_\_ encouraged the whole family? (NONISLAND/EMBEDDED)
- The close neighbor thinks the letter from the soldier encouraged the whole family.  
 c. Which neighbor\_\_ thinks the letter from the soldier encouraged the whole family? (ISLAND/MATRIX)
- The neighbor thinks the letter from the brave soldier encouraged the whole family.  
 d. \*Which soldier does the neighbor think the letter from\_\_ encouraged the whole family? (ISLAND/EMBEDDED)
16. The French president thinks the loan helped the flood victims.  
 a. Which president\_\_ thinks the loan helped the flood victims? (NONISLAND/MATRIX)
- The president thinks the loan from the agency helped the flood victims.  
 b. Which loan does the president think\_\_ helped the flood victims? (NONISLAND/EMBEDDED)
- The French president thinks the loan from the agency helped the flood victims.  
 c. Which president\_\_ thinks the loan from the agency helped the flood victims? (ISLAND/MATRIX)
- The president thinks the loan from the local agency helped the flood victims.  
 d. \*Which agency does the president think the loan from\_\_ helped the flood victims? (ISLAND/EMBEDDED)

#### IV ADJUNCT ISLANDS

1. The new secretary thinks that the lawyer forgot the folder at the office.  
 a. Which secretary\_\_ thinks that the lawyer forgot the folder at the office? (NONISLAND/MATRIX)
- The secretary thinks that the lawyer forgot the yellow folder at the office.  
 b. Which folder does the secretary think that the lawyer forgot\_\_ at the office? (NONISLAND/EMBEDDED)
- The new secretary worries if the lawyer forgets the folder at the office.  
 c. Which secretary\_\_ worries if the lawyer forgets his folder at the office? (ISLAND/MATRIX)
- The secretary worries if the lawyer forgets the yellow folder at the office.  
 d. \*Which folder does the secretary worry if the lawyer forgets\_\_ at the office? (ISLAND/EMBEDDED)
2. The history teacher wishes that the boy bought a book at the store.  
 a. Which teacher\_\_ wishes that the boy bought a book at the store? (NONISLAND/MATRIX)



- The teacher wishes that the boy bought a history book at the store.  
b. Which book does the teacher wish that the boy bought \_\_ at the store? (NONISLAND/EMBEDDED)
- The history teacher laughs if the boy buys a book at the store.  
c. Which teacher\_\_ laughs if the boy buys a book at the store? (ISLAND/MATRIX)
- The teacher laughs if the boy buys a history book at the store.  
d. \*Which book does the teacher laugh if the boy buys\_\_ at the store? (ISLAND/EMBEDDED)
3. The helpful worker thinks that the boss left her keys in the car.  
a. Which worker\_\_ thinks that the boss left her keys in the car? (NONISLAND/MATRIX)
- The worker thinks that the boss left her office keys in the car.  
b. Which keys does the worker think that the boss left\_\_ in the car? (NONISLAND/EMBEDDED)
- The helpful worker worries if the boss leaves her keys in the car.  
c. Which worker\_\_ worries if the boss leaves her keys in the car? (ISLAND/MATRIX)
- The worker worries if the boss leaves her office keys in the car.  
d. \*Which keys does the worker worry if the boss leaves\_\_ in the car? (ISLAND/EMBEDDED)
4. The new director hopes that the artist will give a painting to the museum.  
a. Which director\_\_ hopes that the artist will give a painting to the museum? (NONISLAND/MATRIX)
- The director hopes that the artist will give a rare painting to the museum.  
b. Which painting does the director hope that the artist will give\_\_ to the museum? (NONISLAND/EMBEDDED)
- The new director smiles if the artist gives a painting to the museum  
c. Which director\_\_ smiles if the artist gives a painting to the museum? (ISLAND/MATRIX)
- The director smiles if the artist gives a rare painting to the museum.  
d. \*Which painting does the director smile if the artist gives\_\_ to the museum? (ISLAND/EMBEDDED)
5. The older neighbor hopes that the dog owner will open the window at night.  
a. Which neighbor\_\_ hopes that the dog owner will open the window at night? (NONISLAND/MATRIX)
- The neighbor hopes that the dog owner will open the kitchen window at night  
b. Which window does the neighbor hope that the dog owner will open\_\_ at night? (NONISLAND/EMBEDDED)
- The older neighbor sneezes if the dog owner opens the window at night  
c. Which neighbor\_\_ sneezes if the dog owner opens the window at night? (ISLAND/MATRIX)
- The neighbor sneezes if the dog owner opens the kitchen window at night  
d. \*Which window does the neighbor sneeze if the dog owner opens\_\_ at night? (ISLAND/EMBEDDED)
6. The nervous woman fears that her daughter drove the car to a party.  
a. Which woman\_\_ fears that her daughter drove the car to a party? (NONISLAND/MATRIX)
- The woman fears that her daughter drove the new car to a party.  
b. Which car does the woman fear that her daughter drove\_\_ to a party? (NONISLAND/EMBEDDED)
- The nervous woman cries if her daughter drives the car to a party.  
c. Which woman\_\_ cries if her daughter drives the car to a party? (ISLAND/MATRIX)
- The woman cries if her daughter drives the new car to a party.  
d. \*Which car does the woman cry if her daughter drives \_\_ to a party? (ISLAND/EMBEDDED)
7. The English teacher thinks that the student erased the notes from the blackboard.  
a. Which teacher\_\_ thinks that the student erased the notes from the blackboard? (NONISLAND/MATRIX)
- The teacher thinks that the student erased the math notes from the blackboard.  
b. Which notes does the teacher think that the student erased\_\_ from the blackboard? (NONISLAND/EMBEDDED)
- The English teacher shouts if the student erases the notes from the blackboard  
c. Which teacher\_\_ shouts if the student erases the notes from the blackboard? (ISLAND/MATRIX)
- The teacher shouts if the student erases the math notes from the blackboard  
d. \*Which notes does the teacher shout if the student erases\_\_ from the blackboard? (ISLAND/EMBEDDED)

8. The kind boss expects that her assistant will organize the files in the morning.  
 a. Which boss\_\_ expects that her assistant will organize the files in the morning? (NONISLAND/MATRIX)
- The boss expects that her assistant will organize the important files in the morning.  
 b. Which files does the boss expect that her assistant will organize\_\_ in the morning? (NONISLAND/EMBEDDED)
- The kind boss smiles if her assistant organizes the files in the morning.  
 c. Which boss\_\_ smiles if her assistant organizes the files in the morning? (ISLAND/MATRIX)
- The boss smiles if her assistant organizes the important files in the morning.  
 d. \*Which files does the boss smile if her assistant organizes\_\_ in the morning? (ISLAND/EMBEDDED)
9. The nervous patient expects that the doctor will send the e-mail in the afternoon.  
 a. Which patient\_\_ expects that the doctor will send the e-mail in the afternoon? (NONISLAND/MATRIX)
- The patient expects that the doctor will send the last e-mail in the afternoon.  
 b. Which e-mail does the patient expect that the doctor will send\_\_ in the afternoon? (NONISLAND/EMBEDDED)
- The nervous patient relaxes if the doctor sends the e-mail in the afternoon.  
 c. Which patient\_\_ relaxes if the doctor sends the e-mail in the afternoon? (ISLAND/MATRIX)
- The patient relaxes if the doctor sends the last e-mail in the afternoon.  
 d. \*Which e-mail does the patient relax if the doctor sends\_\_ in the afternoon? (ISLAND/EMBEDDED)
10. The allergic man thinks that the neighbor will plant flowers under the window.  
 a. Which man\_\_ thinks that the neighbor will plant flowers under the window? (NONISLAND/MATRIX)
- The man thinks that the neighbor will plant yellow flowers under the window  
 b. Which flowers does the man think the neighbor will plant\_\_ under the window? (NONISLAND/EMBEDDED)
- The allergic man sneezes if the neighbor plants flowers under the window.  
 c. Which man\_\_ sneezes if the neighbor plants flowers under the window? (ISLAND/MATRIX)
- The man sneezes if the neighbor plants yellow flowers under the window  
 d. \*Which flowers does the man sneeze if the neighbor plants\_\_ under the window? (ISLAND/EMBEDDED)
11. The young child thinks that his mother will sing a song before bedtime.  
 a. Which child\_\_ thinks that his mother will sing a song before bedtime? (NONISLAND/MATRIX)
- The child thinks that his mother will sing a sweet song before bedtime.  
 b. Which song does the child think that his mother will sing\_\_ before bedtime? (NONISLAND/EMBEDDED)
- The young child sleeps if his mother sings a song before bedtime.  
 c. Which child\_\_ sleeps if his mother sings a song before bedtime? (ISLAND/MATRIX)
- The child sleeps if his mother sings a sweet song before bedtime.  
 d. \*Which song does the child sleep if his mother sings\_\_ before bedtime? (ISLAND/EMBEDDED)
12. The late passenger hopes that the mechanic will change the tire before noon.  
 a. Which passenger\_\_ hopes that the mechanic will change the tire before noon? (NONISLAND/MATRIX)
- The passenger hopes that the mechanic will change the flat tire before noon.  
 b. Which tire does the passenger hope that the mechanic will change\_\_ before noon? (NONISLAND/EMBEDDED)
- The late passenger arrives if the mechanic changes the tire before noon.  
 c. Which passenger\_\_ arrives if the mechanic changes the tire before noon? (ISLAND/MATRIX)
- The passenger arrives if the mechanic changes the flat tire before noon.  
 d. \*Which tire does the passenger arrive if the mechanic changes\_\_ before noon? (ISLAND/EMBEDDED)
13. The old man believes that his wife will burn the steak on the stove.  
 a. Which man\_\_ believes that his wife will burn the steak on the stove? (NONISLAND/MATRIX)
- The old man believes that his wife will burn the expensive steak on the stove.  
 b. Which steak does the man believe that his wife will burn\_\_ on the stove? (NONISLAND/EMBEDDED)
- The old man coughs if his wife burns the steak on the stove.  
 c. Which man\_\_ coughs if his wife burns the steak on the stove? (ISLAND/MATRIX)

- d. The man coughs if his wife burns the expensive steak on the stove.  
\*Which steak does the man cough if his wife burns\_\_ on the stove? (ISLAND/EMBEDDED)
14. The unhappy coach fears that the boys will lose the ball on the field.  
a. Which coach\_\_ fears that the boys will lose the ball on the field? (NONISLAND/MATRIX)  
The coach fears that the boys will lose the red ball on the field.  
b. Which ball does the coach fear that the boys will lose\_\_ on the field? (NONISLAND/EMBEDDED)  
The unhappy coach shouts if the boys lose the ball on the field.  
c. Which coach\_\_ shouts if the boys lose the ball on the field? (ISLAND/MATRIX)  
The coach shouts if the boys lose the red ball on the field.  
d. \*Which ball does the coach shout if the boys lose\_\_ on the field? (ISLAND/EMBEDDED)
15. The young woman thinks that her boyfriend will bring roses tonight.  
a. Which woman\_\_ thinks that her boyfriend will bring roses tonight? (NONISLAND/MATRIX)  
The woman thinks that her boyfriend will bring red roses tonight.  
b. Which roses does the woman think that her boyfriend will bring\_\_ tonight? (NONISLAND/EMBEDDED)  
The young woman laughs if her boyfriend brings roses tonight.  
c. Which woman\_\_ laughs if her boyfriend brings roses tonight? (ISLAND/MATRIX)  
The woman laughs if her boyfriend brings red roses tonight.  
d. \*Which roses does the woman laugh if her boyfriend brings\_\_ tonight? (ISLAND/EMBEDDED)
16. The nervous director hopes that the actor will remember the words on stage.  
a. Which director\_\_ hopes that the actor will remember the words on stage? (NONISLAND/MATRIX)  
The director hopes that the actor will remember the difficult words on stage.  
b. Which words does the director hope that the actor will remember\_\_ on stage? (NONISLAND/EMBEDDED)  
The nervous director relaxes if the actor remembers the words on stage.  
c. Which director\_\_ relaxes if the actor remembers the words on stage? (ISLAND/MATRIX)  
The director relaxes if the actor remembers the difficult words on stage.  
d. \*Which words does the director relax if the actor remembers\_\_ on stage? (ISLAND/EMBEDDED)

### Fillers

1. The young man was driving his car fast, and he had an accident.  
\*The young man who **he** was driving fast had an accident. (RP in subj. position)
2. The nice waiter always serves us, and his name is George.  
\*The nice waiter who **he** always serves us is named George. (RP in subj. position)
3. The thieves stole my purse, and they disappeared quickly.  
\*The thieves who **they** stole my purse disappeared quickly. (RP in subj. position)
4. This woman studies economics, and she works in a bank.  
\*The woman who **she** studies economics works in a bank. (RP in subj. position)
5. The patient was very sick, and I visited him yesterday.  
\*The patient who I visited **him** yesterday was very sick. (RP in obj. position)
6. She saw a film last night, and it was very interesting.  
\*The film that she saw **it** was very interesting. (RP in obj. position)
7. The girl is studying at the university, and John likes her.  
\*The girl who John likes **her** is studying at the university. (RP in obj. position)
8. Mary visited a doctor last Friday, and he was really kind.  
\*The doctor who Mary visited **him** last Friday was really kind. (RP in obj. position)

9. I lent the friend the book last week, and he studied very hard.  
\*The friend whom I lent the book to **him** studied very hard. (RP in IO position)
10. He gave a gift to a girl yesterday, and she was delighted.  
\*The girl whom he gave a gift to **her** yesterday was delighted. (RP in IO position)
11. She brought milk to the cats, and they were happy.  
\*The cats that she brought milk to **them** were happy. (RP in IO position)
12. The man is very rich, and I borrowed money from him.  
\*The man whom I borrowed money from **him** is very rich. (RP in IO position)
13. The girl is my cousin, and I always play with her.  
\*The girl who I always play with **her** is my cousin. (RP in obl. Obj. position)
14. The room is very big, and they usually work in it.  
\*The room they usually work in **it** is very big. (RP in obl. Obj. position)
15. The boy is my friend, and I always study with him.  
\*The boy who I always study with **him** is my friend. (RP in obl. Obj. position)
16. The chairs were very comfortable, and we sat in them.  
\*The chairs we sat in **them** were very comfortable. (RP in obl. Obj. position)
17. The man whom Peter runs faster than is an athlete.  
\*The man whom Peter runs faster than **him** is an athlete. (Obj. Comp.)
18. The girl whom we sing better than is in the choir.  
\*The girl whom we sing better than **her** is in the choir. (Obj. Comp.)
19. The classmates whom Sally is smarter than read very slowly.  
\*The classmates whom Sally is smarter than **them** read very slowly. (Obj. Comp.)
20. The tree that I am shorter than is falling down.  
\*The tree that I am shorter than **it** is falling down. (Obj. Comp.)
21. The little girl cried when she lost her way yesterday.  
\*The little girl cried when lost her way yesterday. (Null subject)
22. The children played games when they attended lessons.  
\*The children played games when attended lessons. (Null subject)
23. The boy felt sick when he took the examination.  
\*The boy felt sick when took the examination. (Null subject)
24. My sister burnt her fingers when she cooked the chicken.  
\*My sister burnt her fingers when cooked the chicken. (Null subject)
25. The cat which I gave the milk to was very skinny.  
\*The cat **which that** I gave the milk to was very skinny. (Double complementizer)
26. The school which they are studying English at is very famous.  
\*The school **which that** they are studying English at is very famous. (Double complementizer)
27. The beautiful vase that I broke was very expensive.  
\*The beautiful vase **which that** I broke was very expensive. (Double complementizer)
28. The noisy classmate whom I hate is very selfish.  
\*The noisy classmate **whom that** I hate is very selfish. (Double complementizer)
29. John stayed in bed until 11:00 because he was very sick.  
\*John was stayed in bed until 11:00 because he was very sick. (Ungr. Passive)
30. The plane arrived at the international airport on time yesterday.  
\*The plane was arrived at the international airport on time yesterday. (Ungr. Passive)
31. The sick student coughed a lot in the classroom yesterday.  
\*The sick student was coughed a lot in the classroom yesterday. (Ungr. Passive)

32. The little child cried a lot last night because he was so hungry.  
\*The little child was cried a lot last night because he was so hungry.

(Ungr. Passive)