Chapter 16

Island phenomena and related matters

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Extraction constraints on long-distance dependencies – so-called *islands* – have been the subject of intense linguistic and psycholinguistic research for the last half century. Despite of their importance in syntactic theory, the heterogeneity of island constraints has posed many difficult challenges to linguistic theory, across all frameworks. The HPSG perspective of island phenomena is that they are unlikely to be due to a unitary syntactic constraint given the fact that virtually all such island constraints have known exceptions. Rather, it is more plausible that island constraints result from a combination of independently motivated syntactic, semantic, pragmatic and processing phenomena. The present chapter is somewhat different from others in this volume in that its focus in not on HPSG analyses of some phenomena, but rather on the nature of the phenomena itself. This is because there is evidence that most of the phenomena are not purely grammatical, and to that extent independent from HPSG or indeed any theory of grammar. One may call this view of island phenomena 'minimalist' in the sense that much of it does not involve formal grammar.

1 Introduction

This chapter provides an overview of various island effects that have received attention from members of the HPSG community. I begin with the extraction constraints peculiar to coordinate structures, because they not only have a special status in the history of HPSG, but also because they illustrate well the non-unitary nature of island constraints. I then argue that, at a deeper level, some of these constraints are in fact present in many other island types, though not necessarily all. For example, I take it as relatively clear that *factive islands* are purely pragmatic in nature (Oshima 2007), as are *negative islands* (Kroch 1989;

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Szabolcsi & Zwarts 1993; Abrusán 2011; Fox & Hackl 2006; Abrusán & Spector 2011), although one can quibble about the particular technical details of how such accounts are best articulated. Similarly, the *NP Constraint* in the sense of Horn (1972) is likely to be semantic-pragmatic in nature (Kuno 1987; Godard 1988; Davies & Dubinsky 2009). Conversely, I take it as relatively uncontroversial that the *Clause Non-Final Incomplete Constituent Constraint* is due to processing difficulty (Hukari & Levine 1991; Fodor 1992). See also Kothari (2008) for evidence that 'bridge' verb effects in filler-gap dependencies are partly due to lack of contextualization.

In the present chapter I focus on islands that have garnered more attention from members of the HPSG community, and that have caused more controversy cross-theoretically. My goal is to provide an overview of the range of explanations that have been proposed to account for the complex array of facts surrounding islands, and to show that no single unified account is likely.

2 Background

As already detailed in Borsley & Crysmann (2020), Chapter 14 of this volume, HPSG encodes filler-gap dependencies in terms of a set-valued feature SLASH. Because the theory consists of a feature-based declarative system of constraints, virtually all that goes on in the grammar involves constraints stating which value a given feature takes. By allowing SLASH sets to be unified (or unioned), it follows that constructions in which multiple gaps are linked to the same filler are trivially obtained, as in (1).

(1) a. Which celebrity did [the article insult _ more than it praised _]?
b. Which celebrity did you expect [[the pictures of _] to bother _ the most]?
c. Which celebrity did you [inform _ [that the police was coming to arrest _]]?
d. Which celebrity did you [compare [the memoir of _] [with a movie about _]?
e. Which celebrity did you [hire _ [without auditioning _ first]]?
f. Which celebrity did you [[meet _ at a party] and [date _ for a few months]]?

But another advantage of encoding the presence of filler-gap dependencies as a feature is that certain lexical items and constructions can easily impose idiosyn-

cratic constraints on SLASH values. For example, to account for languages that do not allow preposition stranding, it suffices to state that prepositions are necessarily specified as [SLASH {}]. Thus, their complements cannot appear in SLASH instead of COMPS. The converse also occurs. Certain uses of the verb *assure*, for example, are lexically required to have one complement in SLASH rather than in COMPS. Thus, extraction is obligatory as (2) shows.

(2) a. * I can assure you him to be the most competent.
b. Who$_i$ can you assure me _ $_i$ to be the most competent? (Kayne 1980).

As we shall see, it would be rather trivial to impose the classic island constraints in the standard syntactic environments in which they arise.[1] The problem is that island effects are riddled with exceptions which defy purely syntactic accounts of the phenomena. Hence, HPSG has generally refrained from assuming that islands are syntactic, in contrast to mainstream linguistic theory.

3 The Coordinate Structure Constraint

Ross (1967) first observed that coordinate structures impose various constraints on long-distance dependencies, shown in (3), collectively dubbed the *Coordinate Structure Constraint*. For perspicuity, I follow Grosu (1973a) in referring to (i) as the *Conjunct Constraint* and to (ii) as the *Element Constraint*.

(3) COORDINATE STRUCTURE CONSTRAINT (CSC):
In a coordinate structure, (i) no conjunct may be moved, (ii) nor may any element contained in a conjunct be moved out of that conjunct … unless each conjunct properly contains a gap paired with the same filler.

The *Conjunct Constraint* (CC) is illustrated by the unacceptability of the extractions in (3.1). No such constraint is active in other constructions like those in (5) and (6), for example.

(4) a. * Which celebrity did you see [Priscilla and _]? (cf. with 'Did you see Priscilla and Elvis?')
b. * Which celebrity did you see [_ and Priscilla]? (cf. with 'Did you see Elvis and Priscilla?')

[1] In such a view, island effects could perhaps result from grammaticized constraints, induced by parsing and performance considerations (Pritchett 1991; Fodor 1978; 1983a).

c. * Which celebrity did you see [_ or/and a picture of _]?
(cf. with 'Did you see Elvis or/and a picture of Elvis?')

(5) a. Which celebrity did you see Priscilla with _ ?
(cf. with 'Did you see Priscilla with Elvis?')

b. Which celebrity did you see _ with Elvis?
(cf. with 'Did you see Priscilla with Elvis?')

(6) a. Which celebrity is Kim as tall as _ ?

b. Which celebrity did you say Robin arrived earlier than _ ?

In HPSG accounts of extraction that assume the existence of traces (Pollard & Sag 1994; Levine & Hukari 2006) the CC must be stipulated at the level of the coordination construction, by stating that conjuncts cannot be empty elements.[2] On the other hand, the CC follows immediately in a traceless account of filler-gap dependencies (Sag & Fodor 1994; Bouma et al. 2001; Ginzburg & Sag 2000; Sag 2010) since there is simply nothing to conjoin in (3.1), and thus nothing else needs to be said about conjunct extraction; see Sag (2000) for more criticism of traces.

HPSG's traceless account of the CC is semantic in nature, in a sense. Coordinators like *and*, *or*, *but* and so on are not regarded as heads that select arguments, and therefore have empty ARG-ST and valence specifications. And given that HPSG assumes that the signs that can appear in a given lexical head SLASH values are valents, then it follows that the signs that coordinators combine with cannot instead be registered in the coordinator's SLASH feature. Hence, words like *and* have no valents, no arguments and therefore no conjunct extraction. Incidentally, adnominal adjectives cannot be extracted either, for exactly the same reason, as they are not selected by any head, and therefore are not listed in any ARG-ST list.

In order to allow certain adverbials to be extractable, Ginzburg & Sag (2000) assume that those adverbials are members of ARG-ST. See Levine & Hukari (2006) for more on adverbial extraction, and see Borsley & Crysmann (2020), Chapter 14 of this volume for further discussion.[3]

[2] See however Levine (n.d.: 317–318) for the claim that each conjunct must contain at least one stressed syllable. Given that traces are phonologically silent, nothing is there to bear stress and the CC is obtained. This raises the question of why no such stress constraint exists in P-stranding, for example, or indeed in any kind of extraction.

[3] The empirical facts are less clear when it comes to adnominal PPs, however. Even PPs that are usually regarded as modifiers can sometimes be extracted, as in *From which shelf am I not*

Let us now turn to the *Element Constraint*, illustrated in (7). As before, the constraint appears to be restricted to coordination structures, as no oddness arises in the comitative counterparts like (8), or in comparatives like (9).[4]

(7) a. * Which celebrity did you see [Priscilla and a picture of _]?
(cf. with 'Did you see Priscilla and a picture of Elvis?')
b. * Which celebrity did you see [a picture of _ and Priscilla]?
(cf. with 'Did you see a picture of Elvis and Priscilla?')

(8) a. Which celebrity did you see [the brother of _ with Priscilla]?
b. Which celebrity did you see [Priscilla with the brother of _]?

(9) a. Which celebrity did [[you enjoy the memoir of _ more] than [any other non-fiction book]]?
b. Which celebrity did you say that [[the sooner we take a picture of _], [the quicker we can go home]]?

The ATB exception to the CSC is illustrated by the acceptability of (10), where each conjunct hosts a gap, linked to the same filler. As already noted above in (1), the fact that multiple gaps can be linked to the same filler is not unique to coordination.

(10) a. Which celebrity did you buy [[a picture of _ and a book about _]]?
b. Which celebrity did you [[meet _ at a party] and [date _ for a few months]]?

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supposed to read any books? In many such extractions the PP can alternatively be parsed as VP modifier, which complicates judgements.

[4] Although Winter (2001: 83) and others claim that coordination imposes semantic scope islands, Chaves (2007: §3.6) shows that this is not the case, as illustrated in examples like those below.

(i) a. The White House is very careful about this. An official representative [[will personally read each document] and [reply to every letter]].
(∀ doc-letter >∃ representative / ∃ representative >∀ doc-letter)
b. We had to do this ourselves. By the end of the year, some student [[had proof-read every document] and [corrected each theorem]].
(∀ doc-theorem >∃ student / ∃ student >∀ doc-theorem)
c. Your task is to document the social interaction between [[each female] and [an adult male]].
(∀ female >∃ adult male / ∃ adult male >∀ female)

Gazdar (1981) and Gazdar et al. (1985) assumed that the coordination rule requires SLASH values to be structure-shared across conjuncts and the mother node, thus predicting both the Element Constraint and the ATB exceptions. The failure of movement-based grammar to predict multiple gap extraction facts was also seen as a major empirical advantage of GPSG/HPSG. A similar constraint is assumed in Pollard & Sag (1994: 202) and Beavers & Sag (2004: 60), among others, illustrated in (11). See Abeillé & Chaves (2020), Chapter 17 of this volume for more discussion about coordination.

(11) COORDINATION CONSTRUCTION (abbreviated)

$$\textit{coordinate-phr} \rightarrow \begin{bmatrix} \text{SYNSEM} \mid \text{NONLOCAL} \mid \text{SLASH } \boxed{1} \\ \text{DTRS} \left\langle \begin{bmatrix} \text{SYNSEM} \mid \text{NONLOCAL} \mid \text{SLASH } \boxed{1} \end{bmatrix}, \begin{bmatrix} \text{SYNSEM} \mid \text{NONLOCAL} \mid \text{SLASH } \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix}$$

Because the SLASH value $\boxed{1}$ is structure-shared between the mother and the daughters in (11), all three nodes must bear the same SLASH value. This predicts the CSC and the ATB exceptions straightforwardly. The failure of mainstream Chomskyan grammar to predict these and related multiple gap extraction facts in a precise way is regarded as one of the major empirical advantages of HPSG over movement-based accounts.

But the facts about extraction in coordination structures are more complex than originally assumed, and than (11) allows for. A crucial difference between the Conjunct Constraint and the Element Constraint is that the latter is only in effect if the coordination has a symmetric interpretation (Ross 1967; Goldsmith 1985; Lakoff 1986; Levin & Prince 1986), as in (12).[5]

(12) a. Here's the whiskey which I [[went to the store] and [bought _]].
b. Who did Lizzie Borden [[take an ax] and [whack _ to death]]?
c. How much can you [[drink _] and [still stay sober]]?

The coordinate status of (12) has been questioned since Ross (1967). After all, if these are subordinate structures rather than coordinate structures, then the possibility for non-ATB long-distance dependencies ceases to be exceptional. But as Schmerling (1972), Lakoff (1986), Levine (2001) and Kehler (2002) point out,

[5]In asymmetric coordination, the order of the conjuncts has a major effect on the interpretation. Thus, *Robin jumped on a horse and rode into the sunset* does not mean the same as *Robin rode into the sunset and jumped on a horse*. Conversely, in symmetric coordination the order of the conjuncts has no interpretational differences, as illustrated by the paraphrases *Robin drank a beer and Sue ate a burger* and *Sue ate a burger and Robin drank a beer*.

there is no empirical reason to assume that the examples in (12) are anything other than coordination structures.

Another reason to reject the idea that the SLASH values of the daughters and the mother node are are simply equated in ATB extraction is the fact that sometimes multiple gaps are 'cumulatively' combined into a 'pluralic gap'.[6] As an example, consider the extractions in (13). There are two possible interpretations for such extractions: one in which the *ex situ* signs (i.e. the gap signs) and the filler phrase are co-indexed, and therefore co-referential, and a second reading in which the two *ex situ* phrases are not co-indexed even though they are linked to the same filler phrase. Rather, the filler phrase refers to a plural referent composed by the referents of the *ex situ* signs, as indicated by the subscripts in (13). For different speakers, the preferred reading is the former, and in other cases, the latter, often depending on the example.

(13) a. [What]$_{\{i,j\}}$ did Kim eat $__i$ and drink $__j$ at the party?
(answer: 'Kim at pizza and drank beer')

b. [Which city]$_{\{i,j\}}$ did Jack travel to $__i$ and Sally decide to live in $__j$?
(answer: 'Jack traveled to London and Sally decided to live in Rome')

c. [Who]$_{\{i,j\}}$ did the pictures of $__i$ impress $__j$ the most?
(answer: 'Robin's pictures impressed Sam the most')

d. [Who]$_{\{i,j\}}$ did the rivals of $__i$ shoot $__j$?
(answer: 'Robin's rivals shot Sam')

e. [Who]$_{\{i,j\}}$ did you send nude photos of $__i$ to $__j$?
(answer: 'I sent photos of Sam to Robin')

In conclusion, the non-ATB exceptions in (12) suggest that the coordination rule should not constrain SLASH at all, as argued for in Chaves (2003). Rather, the Element Constraint, its ATB exceptions in (10a,b) and the asymmetric non-ATB exceptions in (12) are more likely to be the consequence of an independent semantic-pragmatic constraint that requires the filler phrase to be 'topical' relative to the clause (Lakoff 1986; Kuno 1987; Kehler 2002; Kubota & Lee 2015). Thus, if the coordination is symmetric, then the topicality requirement distributes over each conjunct, to require that the filler phrase be topical in each conjunct. Consequently, extraction must be ATB in symmetric coordination. No distribution needs to take place in asymmetric coordination, and thus both ATB and non-ATB

[6] See for example Munn (1998; 1999), Postal (1998: 136, 160), Kehler (2002: 125), Gawron & Kehler (2003), Zhang (2007), Chaves (2012a), and Vicente (2016).

extraction is licit in asymmetric coordination. For an attempt to transfer some of Kuno's and Kehlers' insights into HPSG see Chaves (2003). In the latter proposal, the coordination rule is like most other rules in the grammar in that it says nothing about the SLASH values of the mother and the daughters, along the lines of Levine & Hukari (2006: 354). In other words, the constraints on SLASH in (11) are unnecessary. Rather, pragmatics is the driving force behind how long-distance dependencies propagate one or more conjuncts, depending on the coordination being interpreted symmetrically or not. See Abeillé & Chaves (2020), Chapter 17 of this volume for more discussion.

Let us take stock. The CSC does not receive a unitary account in modern HPSG, given that the Conjunct Constraint and the Element Constraint are of a very different nature. Whereas the former does not admit ATB extraction, and is predicted by a traceless analysis, the latter allows ATB extraction as seen by the contrast between (3.1c) and (10). Upon closer inspection, the Element Constraint and the ATB exceptions are semantic-pragmatic in nature. As we shall see, a similar conclusion is plausible for various other island phenomena.

4 Complex NP Constraint

The Complex NP Constraint concerns the difficulty in extracting out of complex NPs formed with either relative clauses (14) or complement phrases (15).

(14) a. * [What]$_i$ does Robin know [someone who has _$_i$]?
(cf. with 'Does Robin know someone who has a drum kit?')

b. * [Which language]$_i$ did they hire [someone [who speaks _$_i$]]?
(cf. with 'Did they hire someone who speaks Arabic?')

(15) a. * [Which book]$_i$ do you believe the claim [that Robin plagiarized _$_i$]?
(cf. with 'Do you believe the claim that Robin plagiarized *this book*?')

b. * What$_i$ did you believe [the rumor [that Ed disclosed _$_i$]]?
(cf. with 'Did you believe [the rumor [that Ed disclosed *that*]]?')

It is tempting to prevent extractions out of adnominal clauses by simply stipulating that the SLASH value of the modifier must be empty, as (4) illustrates. Perhaps, along the lines of Fodor (1978; 1983b), Berwick & Weinberg (1984), and Hawkins (1999; 2004), processing difficulties lead to the grammaticization of such a constraint, effectively blocking any modified head from hosting any gaps.

(16) HEAD-MODIFIER CONSTRUCTION (abbreviated)

$$\textit{head-mod-phr} \rightarrow \begin{bmatrix} \text{HEAD-DTR } \boxed{1} \\ \text{DTRS} \left\langle \boxed{1}, \begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{LOC} \mid \text{MOD } \boxed{1} \\ \text{NONLOC} \mid \text{SLASH } \{\} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

However, the robustness of the CNPC has been challenged by various counterexamples over the years (Ross 1967; Pollard & Sag 1994; Kluender 1998; Postal 1998; Sag et al. 2007). The sample in (17) involves acceptable extractions from NP-embedded complement CPs (some of which are definite), and (18) involves acceptable extractions from NP-embedded relative clauses.[7]

(17) a. The money which I am making [the claim [that the company squandered _]] amounts to $400,000.
(Pollard & Sag 1994: 206, 207)

b. Which rebel leader did you hear [rumors [that the CIA assassinated _]]?

c. Which company did Simon spread [the rumor [that he had started _]]?

d. What did you get [the impression [that the problem really was _]]?
(Kluender 1998)

(18) a. This is the kind of weather$_i$ that there are [many people [who like _ $_i$]].
(Erteschik-Shir & Lappin 1979)

b. Violence is something$_i$ that there are [many Americans [who condone _ $_i$]].
(McCawley 1981: 108)

c. There were several old rock songs$_i$ that she and I were [the only two [who knew _ $_i$]].
(Chung & McCloskey 1983)

d. This is the chapter$_i$ that we really need to find [someone [who understands _ $_i$]].
(Kluender 1992: 238)

[7] Counterexamples to the CNPC can be found in a number of languages, including Japanese and Korean (Kuno 1973; Nishigauchi 1999), Ahan (Saah & Goodluck 1995), Danish (Erteschik-Shir 1973: Chapter 2), Swedish (Allwood 1976; Engdahl 1982) Norwegian (Taraldsen 1982) and Romance languages (Cinque 2010). In some languages that support verb constructions, the CNPC is not active, which goes with the analysis as complex predicates Abeillé & Vivès (2019).

e. Which diamond ring did you say there was [nobody in the world [who could buy $__i$]]?
(Pollard & Sag 1994: 206)

f. John is the sort of guy that I don't know [a lot of people [who think well of $__i$]].
(Culicover 1999: 230)

In the above counterexamples, the relative clauses contribute to the main assertion of the utterance, rather than expressing background information. For example, (18a) asserts 'There are many people who like this kind of weather' rather than 'This the kind of weather', and so on. Some authors have argued that it is precisely because such relatives express new information that the extraction can escape the embedded clause (Erteschik-Shir & Lappin 1979; Kuno 1987; Deane 1992; Goldberg 2013). If this is correct, then the proper account of CNPC effects is not unlike that of the CSC. In both cases, the information structural status of the clause that contains the gap is crucial to the acceptability of the overall long-distance dependencies.[8]

In addition to pragmatic constraints, Kluender (1992; 1998) proposed that processing factors also influence the acceptability of CNPC violations. Consider for example the acceptability hierarchy in (19); more specific filler phrases increase acceptability, whereas the presence of more specific phrases between the filler and the gap seem to cause increased processing difficulty, and therefore lower the acceptability of the sentence. The symbol '<' reads as 'is less acceptable than'.

(19) a. What do you need to find the expert who can translate _ ? <
b. What do you need to find an expert who can translate _ ? <
c. What do you need to find someone who can translate _ ? <
d. Which document do you need to find an expert who can translate _ ?

[8] Although it is sometimes claimed that such island effects are also active in logical form and semantic scope (May 1985; Ruys 1993; Fox 2000; Sabbagh 2007; Bachrach & Katzir 2008), there much reason to be skeptical. For example, the universally quantified noun phrase in (i) is embedded in a relative clause can have wide scope over the indefinite *someone*, constituting a semantic CNPC violation. Note that these relatives are not presentational, and therefore are not specially permeable to extraction.

(i) a. We were able to find someone who was an expert on each of the castles we planned to visit. (Copestake et al. 2005: 304)
b. John was able to find someone who is willing to learn every language that we intend to study. (Chaves 2014)

There is on-line sentence processing evidence that CNPC violations with more informative fillers are more acceptable and are processed faster at the gap site than violations with less informative fillers (Hofmeister & Sag 2010), as in (20).

(20) a. ? Who did you say that nobody in the world could ever depose _ ?
b. Which military dictator did you say that nobody in the world could ever depose _ ?

The same difference in reading times is found in sentences without CPNP violations, in fact. For example, (21b) was found to be read faster at *encouraged* than (21a). Crucially, that critical region of the sentence is not in the path of any filler-gap dependency.

(21) a. The diplomat contacted the dictator who the activist looking for more contributions encouraged to preserve natural habitats and resources.
b. The diplomat contacted the ruthless military dictator who the activist looking for more contributions encouraged to preserve natural habitats and resources.

Given that finite tensed verbs can be regarded as definite, and infinitival verbs as indefinite (Partee 1984), and given that finiteness can create processing difficulty (Kluender 1992; Gibson 2000), then acceptability clines like (22) are to be expected. See Levine & Hukari (2006: Chapter 5) and Levine (n.d.: 308) for more discussion.

(22) a. Who did you wonder what Mary said to _ ? <
b. Who did you wonder what to say to _ ? <
c. Which of the people at the party did you wonder what to say to _ ?

4.1 On D-Linking

The amelioration caused by more specific (definite) *wh*-phrases as in (19d), (20b) and (22c) has been called a 'D-Linking' effect (Pesetsky 1987; 2000). It purportedly arises if the set of possible answers is pre-established or otherwise salient. But there are several problems with the D-Linking story. First, there is currently no non-circular definition of D-Linking; see Pesetsky (2000: 16), Ginzburg & Sag (2000: 247–250), Chung (1994: 33, 39) and Levine & Hukari (2006: 242, 268–271). Second, the counterexamples above are given out of the blue, and therefore cannot evoke any preexisting set of referents, as D-Linking requires. Furthermore,

nothing should prevent D-Linking with a bare *wh*-item, as Pesetsky himself acknowledges, but on the other hand there is no experimental evidence that context can lead to D-linking of a bare *wh*-phrase (Sprouse 2007; Villata et al. 2016).[9]

Kluender & Kutas (1993), Sag et al. (2007), Hofmeister (2007b), Hofmeister (2007a) and Hofmeister & Sag (2010) argue that more definite *wh*-phrases improve the acceptability of extractions because they resist memory decay better than indefinites, and are compatible with fewer potential gap sites. In addition, Kroch (1989) and Levine & Hukari (2006: 270) point out that D-Linking amelioration effects may simply result from the plausibility of background assumptions associated with the proposition.

4.2 On memory limitations

Sprouse et al. (2012a) use *n*-back and serial recall tasks to argue that there is no evidence that working memory limitations correlate with island acceptability, and therefore that the 'processing-based' account of islands put forth by Kluender (1992; 1998), Kluender & Kutas (1993), Hofmeister & Sag (2010) and others is unfounded. To be sure, it cannot be stressed enough that the accounts in Kluender (1992) and Hofmeister & Sag (2010) are not strictly based on performance, and involve other factors as well, most notably plausibility and pragmatic factors. See in particular Hofmeister et al. (2013: 49), where it is argued that at least some extraction constraints may be due to a combination of syntactic, semantic, pragmatic, and performance factors. Basically, if the correct location of a gap is syntactically, semantically, or pragmatically highly unlikely in that particular utterance, then it is less likely for the sentence to be acceptable. Indeed, there is independent experimental evidence that speakers attend to probabilistic information about the syntactic distribution of filler-gap dependencies (van Schijndel et al. 2014), and that gap predictability is crucial for on-line processing of islands (Michel 2014).[10] But as Sprouse et al. (2012b) point out, there is no reason to believe that *n*-back and serial recall tasks are strongly correlated to working memory capacity to begin with. Second, one of the main points of Hofmeister

[9] For more detailed criticism of D-Linking see Hofmeister et al. (2007).

[10] More broadly, there is good evidence that speakers deploy probabilistic information when processing a variety of linguistic input, including words (Altmann & Kamide 1999; Arai & Keller 2013; Creel et al. 2008; DeLong et al. 2005; Kutas & Hillyard 1984), lexical categories (Gibson 2006; Levy & Keller 2013; Tabor et al. 1997), syntactic structures (Levy et al. 2012; Lau et al. 2006; Levy 2008; Staub & Clifton 2006), semantics (Altmann & Kamide 1999; Federmeier & Kutas 1999; Kamide et al. 2003), and pragmatics (Ni et al. 1996; Mak et al. 2008; Roland et al. 2012).

& Sag (2010) is that the literature on experimental island research has not systematically controlled for multiple factors that can impact the processing and comprehension of complex sentences. If the experimental items are excessively complex, then readers are more likely to give up understanding the utterances and subtler effects will not be measurable. Phillips (2013b), however, regard such concerns as irrelevant. Although it is unclear to what extent expectations and processing constraints contribute to island effects, it is likely that they play some role in CNPC effects, as well as other island types discussed below.

5 Right Roof Constraint

Rightward movement is traditionally regarded as being clause bounded. Such *Right Roof Constraint* (Ross 1967) effects are illustrated in (23), in which a phrase appears *ex situ* in a position to the right of its *in situ* counterpart; see Akmajian (1975), Baltin (1978), and Stowell (1981), among others.

(23) a. * I [met a man [who knows $__i$] yesterday] [all of your songs]$_i$.
b. * [[That a review $__i$ came out yesterday] is catastrophic] [of this article]$_i$.
c. * It was believed $__x$ that [there walked into the room] $__y$ [by everyone]$_x$ [a man with long blond hair]$_y$.
(Rochemont 1992)

When treated as a form of extraction, rightward movement has been predominantly accounted for via a feature EXTRA(POSED) (Keller 1995; van Noord & Bouma 1996; Van Eynde 1996; Keller 1994; Müller 1999; Kim & Sag 2005), rather than by SLASH. Thus, RRC island effects can be easily modeled by stipulating that the EXTRA value of an S node must be empty. One way to do so is to state that any S dependent (valent or adjunct) must be [EXTRA {}]. Thus, no extraposed element may escape its clause. However, the oddness of (23) may not be due any such syntactic stipulation, given the acceptability of counterexamples like (24). Note that the adverbial interveners in such examples do not require parenthetical prosody. Conversely, even strong parenthetical prosody on the adverbs in (23) fails to improve those data.

(24) a. I've [been requesting [that you pay back _] [ever since May]] [the money I lent to you a year ago].
(Kayne 2000: 251)

b. I've [been wanting to [meet someone who KNOWS _] [ever since I was little]] [exactly what happened to Amelia Earhart].
c. I've been wondering if it is possible _] [for many years now] [for anyone to memorize the Bible word for word].
(Chaves 2014: 861)

The durative semantics of *I've been wanting/requesting/wondering* raises an expectation about the realization of a durative adverbial expression like *ever since* or *for many years* that provides information about the durative semantics of the main predicate. Hence, the adverb is cued by the main predication, in some sense, and coheres much better in a high attachment than with a lower one.

The fact that the RRC is prone to exceptions has been noted by multiple authors as the sample in (25) illustrates. In all such cases, a phrase is right-extracted from an embedded clause, which should be flat out impossible if extraposition is clause-bounded. Again, the adverbial interveners in (25) do not require any special prosody, which means that these data cannot be easily discarded as parenthetical insertions.

(25) a. I have [wanted [to know _] for many years] [exactly what happened to Rosa Luxemburg].
(attributed to Witten 1972 in Postal 1974: 92n)
b. I have [wanted [to meet _] for many years] [the man who spent so much money planning the assassination of Kennedy].
(attributed to Janet Fodor (p.c.) in Gazdar 1981: 177)
c. Sue [kept [regretting _] for years] [that she had not turned him down].
(Van Eynde 1996)
d. She has been [requesting that he [return _] [ever since last Tuesday]] [the book that John borrowed from her last year].
(Kayne 2000: 251)
e. Mary [wanted [to go _] until yesterday] [to the public lecture].
(Howard Lasnik 2007 course handout[11])

Further evidence against a syntactic account of RRC comes from corpora (Müller 2004; 2007) and experimental findings (Strunk & Snider 2008; 2013), which confirm that extraposition does not always obey island constraints. The counterexamples in (26a–c) are adapted from Strunk & Snider (2008) and Strunk & Snider (2013), and those in (26d–f) are from Chaves (2014: 863).

[11]http://ling.umd.edu/~lasnik/LING819%202007/Multiple%20Sluicing%20819%20.pdf; Retr. 2009.

(26) a. [In [what noble capacity _]] can I serve him [that would glorify him and magnify his name]?
b. We drafted [a list of basic demands _] last night [that have to be unconditionally met or we will go on strike].
c. For example, we understand that Ariva buses have won [a number of contracts for routes in London _] recently, [which will not be run by low floor accessible buses].
d. Robin bought [a copy of a book _] yesterday [about ancient Egyptian culture].
e. I'm reading [a book written by a famous physicist _] right now, [who was involved in the Manhattan Project].
f. I saw [your ad in a magazine _] yesterday [on the table at the dentist office].

Grosu (1973b), Gazdar (1981) and Stucky (1987) argued that the RRC is the result of performance factors such as syntactic and semantic parsing expectations and memory resource limitations, not grammar proper. Indeed, we now know that there is a general well-known tendency for the language processor to prefer attaching new material to the more recent constituents (Frazier & Clifton 1996; Gibson et al. 1996; Traxler et al. 1998; Fodor 2002; Fernández 2003). Indeed, eye-tracking studies like Staub et al. (2006) indicate that the parser is reluctant to adopt extraposition parses. This explains why extraposition in written texts is less common in proportion to length of the intervening material (Uszkoreit et al. 1998): the longer the structure, the bigger the processing burden. Crucially, however, the preference for the closest attachment can be weakened by many factors (Fernández 2003; Desmet et al. 2006; De Vicenzi & Job 1993; Carreiras 1992). For example, Levy et al. (2012) show that relative clause extraposition creates significant processing difficulty when compared with non-extraposed counterparts of the same sentences, but that a preceding context that sets up a strong expectation for a relative clause modifying a given noun can facilitate comprehension of an extraposed relative clause modifying that noun. In other words, in spite of a larger processing burden, some extrapositions can be made easier to process by parsing expectations.

A detailed account of extraposition island phenomena does not exist in any framework, as far as I am aware. But the line of inquiry first proposed by Grosu (1973b), Gazdar (1981) and Stucky (1987), and later experimentally supported by Levy et al. (2012), Strunk & Snider (2008), and Strunk & Snider (2013) seems to be on the right track. If so, then there is no syntactic constraint on EXTRA.

Rather, RCC effects are to a large extent the result of difficulty in integrating the extraposed phrase in its *in situ* position.

5.1 Freezing

A related island phenomenon also involving rightward displacement, first noted in Ross (1967: 305), is *Freezing*: leftward extraction (27a) and extraposition (27b) cause low acceptability when they interact, as seen in (28). In (28a) there is extraction from an extraposed PP, in (28b) there is extraction from an extraposed NP, and in (28c) an extraction from a PP crossed with direct object extraposition.

(27) a. Who$_j$ did you [give [a picture of _$_j$] [to Robin]]?
b. Did you [give _$_i$ [to Robin] [a picture of my brother]$_i$]?

(28) a. * Who$_j$ did you [give a picture _$_i$] [to Robin] [of _$_j$]$_i$?
b. * Who$_j$ did you [give _$_i$ [to Robin] [a picture of _$_j$]$_i$]?
c. * Who$_j$ did you [give _$_i$ [to _$_j$] [a picture of my brother]$_i$]?

Fodor (1978: 457) notes that (28c) has a syntactically highly probable temporary alternative parse in which *to* combines with the NP *a picture of my brother*. The existence of this local ambiguity likely disrupts parsing, especially as it occurs in a portion of the sentence that contains two gaps in close succession. Indeed, constructions with two independent gaps in close proximity are licit, but not trivial to process, as seen in (29), specially if the extraction paths cross (Fodor 1978), as in (29b).

(29) a. * This is a problem which$_i$ John$_j$ is difficult to talk to _$_j$ about _$_i$.
b. * Who$_j$ can't you remember which papers$_i$ you sent copies of _$_i$ to _$_j$?

A similar analysis is offered by Hofmeister et al. (2015: 477), who note that constructions like (28c) must cause increased processing effort since the point of retrieval and integration coincides with the point of reanalysis. The existence of a preferential alternative parse that is locally licit but globally illicit can in turn lead to a "digging-in" effect (Ferreira & Henderson 1991; 1993; Tabor & Hutchins 2004), in which the more committed the parser becomes to a syntactic parse, the harder it is to backtrack and reanalyze the input. The net effect of these factors is that the correct parse of (28c) is less probable and therefore harder to identify than that of (28b), which suffers from none of these problems, and is regarded to

be more acceptable than (28c) by Fodor (1978: 453) and others. See Chaves (2018) for experimental evidence that speakers can adapt and to some extent overcome some of these parsing biases.

Finally, prosodic and pragmatic factors are likely also at play in (28), as in the RRC. Huck & Na (1990) show that when an unstressed stranded preposition is separated from its selecting head by another phrase, oddness ensues for prosodic reasons. Finally, Huck & Na (1990) and Bolinger (1992) also argue that freezing effects are also in part due to a pragmatic conflict created by extraposition and extraction: *wh*-movement has extracted a phrase leftward, focusing interest on that expression, while at the same time extraposition has moved a constituent rightward, focusing interest on that constituent as well. Objects tend to be extraposed when they are discourse new, and even more so when they are heavy (Wasow 2002: 71). Therefore, the theme phrase *a picture of John* in (28c) is strongly biased to be discourse new, but this clashes with the fact that an entirely different entity, the recipient, is leftward extracted, and therefore is the *de facto* new information that the open proposition is about. No such mismatch exists in (28a) or (28b), in contrast, where the extraposed theme is more directly linked to the entity targeted by leftward extraction.

6 Subject islands

Extraction out of subject phrases like (30) is broadly regarded to be impossible in several languages, including English (Ross 1967; Chomsky 1973), an effect referred to as a *Subject Island* (SI). This constraint is much less severe in languages like Japanese , German, and Spanish, among others (Stepanov 2007; Jurka et al. 2011; Goodall 2011; Sprouse et al. 2015; Fukuda et al. 2018; Polinsky et al. 2013).

(30) a. * Who did stories about terrify John?
(Chomsky 1977: 106)

b. * Who was a picture of laying there?
(Kayne 1981: 114)

c. * Who do you think pictures of would please John?
(Huang 1982: 497)

d. * Who does the claim that Mary likes upset Bill?
(Lasnik & Saito 1992: 42)

e. * Which candidate were posters of all over the town?
(Lasnik & Park 2003)

However, English exceptions were noticed early on, and have since accumulated in the literature. In fact, for Ross (1967), English extractions like (31a) are not illicit, and more recently Chomsky (2008: 147) has added more such counterexamples. Other authors noted that certain extractions from subject phrases are naturally attested, as in (31b,c). Indeed, Abeillé et al. (2018) shows that extractions like those in (31c) are in fact acceptable to native speakers, and that no such island effect exists in French either.[12]

(31) a. [Of which cars]$_i$ were [the hoods _$_i$] damaged by the explosion?
(Ross 1967: 4.252)

b. They have eight children [of whom]$_i$ [five _$_i$] are still living at home.
(Huddleston et al. 2002: 1093)

c. Already Agassiz had become interested in the rich stores of the extinct fishes of Europe, especially those of Glarus in Switzerland and of Monte Bolca near Verona, [of which]$_i$, at that time, [only a few _$_i$] had been critically studied.
(Santorini 2007)

English exceptions to the SI constraint are not restricted to PP extractions, however. Although Ross (1967) claimed NP extractions from NP subjects like (32) are illicit, it was arguably premature to generalize from such a small sample.

(32) a. The hoods of these cars were damaged by the explosion.

b. *Which cars were the hoods of damaged by the explosion?
(Ross 1967)

Indeed, a number of authors have noted that some NP extractions from subject NPs are either passable or fairly acceptable, as illustrated in (33). See also Pollard & Sag (1994: 195, ft. 32), Postal (1998), Sauerland & Elbourne (2002: 304), Culicover (1999: 230), Levine & Hukari (2006: 265), Chaves (2012b: 470, 471), and Chaves & Dery (2014).

(33) a. [What]$_i$ were [pictures of _$_i$] seen around the globe?
(Kluender 1998: 268)

b. It's [the kind of policy statement]$_i$ that [jokes about _$_i$] are a dime a dozen.
(Levine et al. 2001: 204)

[12]For completeness, other authors argue that PP extractions from NP subjects are illicit, such as Lasnik & Park (2003: 653), among many others.

c. There are [certain topics]$_i$ that [jokes about $__i$] are completely unacceptable.
(Levine & Sag 2003: 252, ft. 6)

d. [Which car]$_i$ did [some pictures of $__i$] cause a scandal?
(Jiménez–Fernández 2009: 111)

e. [What]$_i$ did [the attempt to find $__i$] end in failure?
(Hofmeister & Sag 2010: 370)

f. [Which president]$_i$ would [the impeachment of $__i$] cause outrage?
(Chaves 2012b)

g. I have a question$_i$ that [the probability of you knowing the *answer to* $__i$] is zero.
(Chaves 2013)

Whereas SI violations involving subject CPs are not attested, those involving infinitival VP subjects like (34) are. See Chaves (2012b: 471) for more natural occurrences.

(34) a. The eight dancers and their caller, Laurie Schmidt, make up the Farmall Promenade of nearby Nemaha, a town$_i$ that [[to describe $__i$ as tiny] would be to overstate its size].
(Huddleston et al. 2002: 1094, ft.27)

b. In his bedroom, [which]$_i$ [to describe $__i$ as small] would be a gross understatement, he has an audio studio setup.

c. They amounted to near twenty thousand pounds, [which]$_i$ [to pay $__i$] would have ruined me. (Benjamin Franklin, William Temple Franklin and William Duane. 1834. Memoirs of Benjamin Franklin, vol 1. p.58)

Incidentally, subject phrases are not extraposition islands either, as in (35). See also Guéron & May (1984). Odd examples like *[*Pictures* _] *frighten people* [*of John*] from Drummond (2009), are more likely due to a digging-in effect, caused by speakers assuming that the subject is syntactically and semantically complete by the end of the verb phrase.

(35) a. [The circulation of a rumor $__i$] has started [that Obama will not seek re-election]$_i$.

b. [A copy of a new book $__i$] arrived yesterday [about ancient Egyptian culture]$_i$.

c. [Concerns about the deaths $__i$] were raised [of two diplomatic envoys recently abducted in Somalia]$_i$.

6.1 Clausal Subject Constraint

Let us now consider SI effects involving more complex subjects. Infinitival subject clauses seem to impose no SI constraint, an observation going back to Kuno & Takami (1993), but noted elsewhere a few times:

(36) a. This is something [which]$_i$ – for you to try to understand $__i$ – would be futile.
(Kuno & Takami 1993: 49)

b. I just met Terry's eager-beaver research assistant [who]$_i$ – for us to talk to $__i$ about any subject other than linguistics – would be absolutely pointless.
(Levine & Hukari 2006: 265)

c. There are [people in this world]$_i$ that – for me to describe $__i$ as despicable – would be an understatement.
(Chaves 2012b: 471).

Infinitival subjects contrast dramatically with finite subjects. The latter are renowned for being particularly hard to extract from, as in (37). Ross (1967) dubbed this extreme kind of SI the *Sentential Subject Constraint* (SSC). See also Chomsky (1973), Huang (1982), Chomsky (1986), and Freidin (1992).[13]

(37) a. * [Who]$_i$ did [that Maria Sharapova beat $__i$] surprise everyone?
(cf. with 'That Maria Sharapova beat Serena Williams surprised everyone')

b. * [Who]$_i$ did [that Robin married $__i$] surprise you?
(cf. with 'Did that Robin married Sam surprise you?')

There are some functional reasons for why clausal SI violations may be so strong. First, subject clauses are notorious for being particularly difficult to process, independent of extraction. Clausal subjects are often stylistically marked

[13] That said, Chaves (2013) reports that some native speakers find SSC violations like (i) to be fairly acceptable, again raising some doubt about the robustness of English SI effects:

(i) [Which actress]$_i$ does [whether Tom Cruise marries $__i$] make any difference to you?

and difficult to process, as (38a) illustrates. Thus, it is extremely hard to embed a clausal subject within another clausal subject, even though such constructions ought to be perfectly grammatical, like (38b, c). In addition, it is known that tense can induce greater processing costs (Kluender 1992; Gibson 2000).

(38) a. That the food that John ordered tasted good pleased him.
(Cowper 1976; Gibson 1991)

b. * That that Jill left bothered Sarah surprised Max.
(Kimball 1973)

c. * That that the world is round is obvious is dubious.
(Kuno 1974)

Interestingly, clausal subjects become more acceptable if extraposed as shown in (39). The explanation offered by Fodor et al. (1974: 356–357) is that speakers tend to take the initial clause in the sentence to be the main clause. Thus, *that* is taken to be the subject, but the remainder of the structure does not fit this pattern. Thus, a sentence like (39a) causes increased processing load because it has a different structure than the parser expects. This processing problem does not arise in the counterpart in (39b).[14]

(39) a. ? That [it is obvious that [the world is round]] is dubious.

b. It is dubious that [it is obvious that [the world is round]].
(Kuno 1974)

Indeed, Fodor & Garrett (1967), Bever (1970), and Frazier & Rayner (1988) also show that extraposed clausal subject sentences like (40a) are easier to process than their *in-situ* counterparts like (40b). Not surprisingly, the former are much more frequent than the latter, which explains why the parser would expect the former more than the latter.

(40) a. It surprised Max that Mary was happy.

b. That Mary was happy surprised Max.

[14] See Gibson (2006) for online evidence that the word *that* is preferentially interpreted as a determiner even in syntactic contexts where it cannot be a determiner. The use of 'determiner' corresponds to the traditional term, referring to a certain category of prenominal constituent rather than to the whole nominal phrase including the noun and all its dependents. Gibson's evidence suggests that both top-down (syntactic) expectations are independent from bottom-up (lexical) frequency-based expectations in sentence processing. Thus, clausal subject phrase starting with the complementizer *that* is likely to be misparsed as a matrix clause with sentence-initial pronominal or determiner *that*.

Note that embedded conditionals like (41a) are also exceedingly difficult to parse, although perfectly syntactically well-formed. However, such structures can become more acceptable with fewer embeddings to strain working memory, and with judicious use of prosodic cues that indicate the relevant structure, as illustrated by the acceptability of (41b). This is evidence that the oddness of (41) is at least in part due to performance.

(41) If – if every time it snowed there was no school – then there wouldn't be classes all winter.

If we add a filler-gap dependency to a sentence that already is complex by virtue of having a clausal subject, the resulting structure may be too difficult to parse. This point is illustrated by the contrast in (42).

(42) a. ?* What does that he will come prove?
b. What does his coming prove?
(Lewis 1993)

As argued by Davies & Dubinsky (2009), the low acceptability of extraction in subject-auxiliary inversion sentences with clausal subjects is more likely to be the result of extragrammatical factors than of grammatical conditions. For example, not all extractions like (43b) are unacceptable, as Delahunty (1983: 382–387) and Davies & Dubinsky (2009: 115) point out.

(43) a. That the food that John ordered tasted good pleased me.
b. * Who did that the food that John ordered tasted good please _ ?

The evidence discussed so far suggests that sentences involving extraction and clausal subjects are odd at least in part due to the likely cumulative effect of various sources of processing complexity. Sentences with sentential subjects are unusual structures, which can mislead the parser into the wrong analysis. A breakdown in comprehension can occur because the parser must hold complex incomplete phrases in memory while processing the remainder of the sentence. The presence of a filler-gap dependency will likely only make the sentence harder to process. It is independently known that the more committed the parser becomes to a syntactic parse, the harder it is to reanalyze the string (Ferreira & Henderson 1991; 1993; Tabor & Hutchins 2004). For example, unless prosodic or contextual cues are employed to boost the activation of the correct parse, (6.1) will be preferentially misanalysed as having the structure [NP [V [NP]]].

(44) Fat people eat accumulates.

The garden-path effect that the digging-in causes in example (6.1) serves as an analogy for what may be happening in particularly difficult subject island violations. In both cases, the sentences have exactly one grammatical analysis, but that parse is preempted by a highly preferential alternative which ultimately cannot yield a complete analysis of the sentence. Thus, without prosodic cues indicating the extraction site, sentences like (45) induce a significant digging-in effect as well.

(45) a. * Which problem will a solution to be found by you?
b. * Which disease will a cure for be found by you?

This also explains why SI violations like (46) are relatively acceptable: the processing cost of an NP-embedded causal is smaller than the processing cost incurred by processing a clausal subject.[15] Clausal subjects are unusual structures, inconsistent with the parser expectations (Fodor et al. 1974), and the presence of filler-gap dependency in an NP-embedded clausal subject is less likely to cause difficulty for the parse to go awry than a filler-gap dependency in a clausal subject.[16]

(46) a. [Which puzzle]$_i$ did the fact that nobody could solve $__i$ astonish you the most?
b. [Which crime]$_i$ did the fact that nobody was accused of $__i$ astonish you the most?
c. [Which question]$_i$ did the fact that none of us could answer $__i$ surprise you the most?
d. [Which joke]$_i$ did the fact that nobody laughed at $__i$ surprise you the most?

[15] For claims that NP-embedded clausal SI violations are illicit see Lasnik & Saito (1992: 42), Phillips (2006: 796), and Phillips (2013a: 67).

[16] Clausen (2010; 2011) provide experimental evidence that complex subjects cause a measurable increase in processing load, with and without extraction. Moreover, it is known that elderly adults have far more difficulty repeating sentences with complex subjects than sentences with complex objects (Kemper 1986). Similar difficulty is found in timed reading comprehension tasks (Kynette & Kemper 1986), and in disfluencies in non-elderly adults (Clark & Wasow 1998). Speech initiation times for sentences with complex subjects are also known to be longer than for sentences with simple subjects (Ferreira 1991; Tsiamtsiouris & Cairns 2009), and sentences with center-embedding in subjects are harder to process than sentences with center-embedding in objects (Amy & Noziet 1978; Eady & Fodor 1981). Finally, Garnsey (1985), Kutas et al. (1988), and Petten & Kutas (1991) show that the processing of open-class words, particularly at the beginning of sentences, require greater processing effort than closed-class words.

6.2 Accounts of SI effects

This complex array of effects suggests that the SI constraint is not due to a single factor (Chomsky 2008; Chaves 2013; Jiménez–Fernández 2009), be it grammatical or otherwise. One possibility is that SIs are partly due to pragmatic and processing constraints, perhaps not too different from those that appear to be active in the island effects discussed so far. As Kluender (2004: 495) notes: "Subject Island effects seem to be weaker when the *wh*-phrase maintains a pragmatic association not only with the gap, but also with the main clause predicate, such that the filler-gap dependency into the subject position is construed as of some relevance to the main assertion of the sentence". Indeed, many authors (Erteschik-Shir 1981; Van Valin 1986; Kuno 1987; Takami 1992; Deane 1992; Goldberg 2013) have argued that extraction is in general restricted to the informational focus of the proposition, and that SIs (among others) are predicted as a consequence. In a nutshell, since subjects are typically reserved for topic continuity, subject-embedded referents are unlikely to be the informational focus of the utterance. Although it is not easy to construct sentences where a dependent of the subject can be easily deemed as the informational focus, it is by no means impossible. For instance, (47a) is particularly acceptable because whether or not an impeachment causes outrage crucially depends on who is impeached (cf. with *Would the impeachment of Donald Trump cause outrage?*). Similarly, in (47b) whether or not an attempt failed or succeeded crucially depends on what was attempted (cf. with *The attempt to find the culprit ended in failure*).

(47) a. Which President would [the impeachment of _] cause outrage? (Chaves 2012b)

b. What did [the attempt to find _] end in failure? (Hofmeister & Sag 2010: 370)

Although experimental research has confirmed that sentences with SI violations tend to be less acceptable than grammatical controls (Sprouse 2009; Goodall 2011; Crawford 2011; Clausen 2011; Sprouse et al. 2015), and that their acceptability remains consistently low during repeated exposition (Sprouse 2009; Crawford 2011), other research has found that the acceptability of SI violations is not consistently low, and can be made to increase significantly (Hiramatsu 2000; Clausen 2011; Chaves & Dery 2014; Chaves 2012a). This mixed evidence is consistent with the idea that SI effects are very sensitive to the particular syntax, semantics, and pragmatics of the utterance in which they occur. If the items are too complex, or stylistically awkward, or presuppose unusual contexts, then SI effects

are strong. For example, if the extraction is difficult to process because the sentence gives rise to local garden-path and digging-in effects, and is pragmatically infelicitous in the sense that the extracted element is not particularly relevant for the proposition (i.e. unlikely to be what the proposition is about) or comes from the presupposition rather than the assertion, then we obtain a very strong SI effect. Otherwise, the SI effect is weaker, and in some cases nearly non-existent like (47), (34), or the pied-piping examples studied by Abeillé et al. (2018). The latter involve relative clauses, in which subjects are not strongly required to be topics, in contrast to the subjects or main clauses.

This approach also explains why subject-embedded gaps often become more acceptable in the presence of a second non-island gap: since the two gaps are co-indexed, then the fronted referent is trivially relevant for the main assertion, as it is predicated by the main verb. For example, the low acceptability of (48a) is arguably caused by the lack of plausibility of the described proposition: without further contextual information, it is unclear how the attempt to repair an unspecified thing x is connected to the attempt causing damage to a car.

(48) a. * What did [the attempt to repair _] ultimately damage the car?
b. What did [the attempt to repair _] ultimately damage _ ?
(Phillips 2006)

The example in (48a) becomes more acceptable if it is contextually established that x is a component of the car. In contrast, (48b) is felicitous even out-of-the-blue because it conveys a proposition that is readily recognized as being plausible according to world knowledge: attempting to fix x can cause damage to x. If Subject Island effects are indeed contingent on how relevant the extracted subject-embedded referent is for the assertion expressed by the proposition, then a wide range of acceptable patterns is to be expected, parasitic or otherwise. This includes cases like (49), where both gaps are in SI environments. As Levine & Sag (2003), Levine & Hukari (2006: 256) and Culicover (2013: 161) note, cases like (49) should be completely unacceptable, contrary to fact.

(49) This is a man who [friends of _] think that [enemies of _] are everywhere.

The conclusion that SI effects are contingent on the particular proposition expressed by the utterance and its pragmatics thus seems unavoidable (Chaves & Dery 2019). In order to test this hypothesis, Chaves & Dery (2019) examine the acceptability of sentences like (50), which crucially express nearly-identical truth conditions and have equally acceptable declarative counterparts. This way, any

source of acceptability contrast must come from the extraction itself, not from the felicity of the proposition.

(50) a. Which country does the King of Spain resemble [the President of _]?
b. Which country does [the President of _] resemble the King of Spain?

The results indicate that although the acceptability of the SI counterpart in (50b) is initially significantly lower than (50a), it gradually improves. After eight exposures, the acceptability of near-truth-conditionally-equivalent sentences like (50) becomes non-statistically different. What this suggests is that SI effects are at least in part probabilistic: the semantic, syntactic and pragmatic likelihood of a subject-embedded gap likely matters for how acceptable such extractions are. This is most consistent with the claim that – in general – extracted phrases must correspond to the informational focus of the utterance (Erteschik-Shir 1981; Van Valin 1986; Kuno 1987; Takami 1992; Deane 1992; Goldberg 2013), and in particular with the intuition that SI violations are weaker when the extracted referent is relevant for the main predication (Kluender 2004: 495).

7 Adjunct islands

Ross (1967) and Cattell (1976) noted that adjunct phrases often resist extraction, as illustrated in (51), a phenomenon usually referred to as *The Adjunct Island Constraint* (AIC).

(51) a. * What$_i$ did John die [whistling _ $_i$]?
b. * What$_i$ did John build [whistling _ $_i$]?
c. * Which club$_i$ did John meet a lot of girls [without going to _ $_i$]?
(Cattell 1976: 38)
d. * Who$_i$ did Mary cry [after John hit _ $_i$]?
(Huang 1982: 503)

Although a constraint on SLASH could effectively ban all extraction from adjuncts, the problem is that the AIC has a long history of exceptions, noted as early as Cattell (1976: 38), and by many others since, including Chomsky (1982: 72), Engdahl (1983), Hegarty (1990: 103), Cinque (1990), Pollard & Sag (1994), Culicover (1997: 253), and Borgonovo & Neeleman (2000). A sample of representative counterexamples is provided in (52).

(52) a. Who did he buy a book [for _]?

b. Who would you rather [sing with _]?
c. What temperature should I wash my jeans [at _]?
d. That's the symphony that Schubert [died without finishing _].
e. Which report did Kim [go to lunch without reading _]?
f. A problem this important, I could never [go home without solving _ first].
g. What did he [fall asleep complaining about _]?
h. What did John [drive Mary crazy trying to fix _]?
i. Who did you [go to Girona in order to meet _]?
j. Who did you go to Harvard [in order to work with _]?

Exceptions to the AIC include tensed adjuncts, as noted by Grosu (1981: 88), Deane (1991: 29), Kluender (1998), Levine & Hukari (2006: 287), Goldberg (2006: 144), Chaves (2012b: 471), Truswell (2011: 175, ft.1) and others. A sample is provided in (53).[17]

(53) a. These are the pills that Mary died [before she could take _].
b. This is the house that Mary died [before she could sell _].
c. The person who I would kill myself [if I couldn't marry _] is Jane.
d. Which book will Kim understand linguistics better [if she reads _]?
e. This is the watch that I got upset [when I lost _].
f. Robin, Pat and Terry were the people who I lounged around at home all day [without realizing were _ coming for dinner].
g. Which email account would you be in trouble [if someone broke into _]?
h. Which celebrity did you say that [[the sooner we take a picture of _], [the quicker we can go home]]?

To be sure, some of these sentences are complex and difficult to process, which in turn can lead speakers to prefer the insertion of an "intrusive" resumptive

[17] Truswell (2011) argues that the AIC and its exceptions are best characterized in terms of event-semantic constraints, such that the adjunct must occupy an event position in the argument structure of the main clause verb. However, recent experimental research has been unable to validate Truswell's acceptability predictions (Kohrt et al. 2018), and moreover, such an account incorrectly predicts that extractions from tensed adjuncts is impossible (Truswell 2011: 175, ft. 1).

pronoun at the gap site, but they are certainly more acceptable than the classic tensed AIC violations examples like Huang's (51d). Acceptable tensed AIC violations are more frequent in languages like Japanese, Korean, and Malayalam.

Like Subject Islands, AIC violations sometimes improve "parasitically" in the presence of a second gap as in (54). First of all, note that these sentences express radically different propositions, and so there is no reason to assume that all of these are equally felicitous. Second, note that (54a, c) describe plausible states of affairs in which it is clear what the extracted referent has to do with the main predication and assertion, simply because of the fact that *document* is predicated by *read*. In contrast, (54b) describes an unusual state of affairs in that it is unclear what the extracted referent has to do with the main predication *read the email*, out of the blue. Basically, what does reading emails have to do with filing documents?

(54) a. Which document did John read _ before filing _ ?
b. * Which document did John read the email email before filing _ ?
c. Which document did John read _ before filing a complaint?

If AIC violations were truly only salvageable parasitically, then counterexamples like (55a) should not exist. As Levine & Sag (2003) and Levine & Hukari (2006: 256) note, both gaps reside in island environments and should be completely out and less acceptable than (55b, c), contrary to fact.

(55) a. What kinds of books do [the authors of _] argue about royalties [after writing _]?
b. * What kinds of books do [authors of _] argue about royalties after writing malicious pamphlets?
c. * What kinds of books do authors of malicious pamphlets argue about royalties [after writing _]?

In (55a), there is no sense in which the gap inside the subject is parasitic on the gap inside the adjunct, or vice-versa – under the assumption that neither gaps is supposed to be licit without the presence of a gap outside an island environment. In conclusion, the notion of parasitic gap is rather dubious. See Levine & Hukari (2006) for a more in-depth discussion of parasitism and empirical criticism of null resumptive pronoun accounts.

As in the case of other island phenomena discussed so far, it is doubtful that any purely syntactic account can describe all the empirical facts. Rather, extractions out of adjuncts are licit to the degree that the extracted referent can be interpreted as being relevant for the assertion.

8 Superiority effects

Contrasts like those below have traditionally been taken to be due to a constraint that prevents a given phrase from being extracted if another phrase in a higher position can be extracted instead (Chomsky 1973; 1980). Thus, the highest *wh*-phrase is extractable, but the lowest is not.

(56) a. Who _ saw what?
b. * What did who see _ ?

(57) a. Who did you persuade _ to buy what?
b. * What did you persuade who to buy _ ?

Several different kinds of exceptions to this *Superiority Constraint* (SC) have been noted in the literature. First, it is generally recognized that *which*-phrases are immune to the SC:

(58) a. I wonder which book which of our students read _ over the summer?
b. Which book did which professor buy _ ?

Pesetsky (1987) proposed to explain the lack of SC effects in (58) by stipulating that *which*-phrases are interpreted as indefinites which do not undergo LF movement. Rather, they require "D-linking" and obtain wide scope via an entirely different semantic mechanism called unselective binding. In order for a phrase to be D-linked, it must be associated with a salient set of referents. But as Ginzburg & Sag (2000: 248ff.) note, there is no independent evidence for saliency interpretational differences between *which* and other *wh*-phrases like *what* and *who*. For example, it is implausible that speakers have a specific referent in mind for the *which*-phrases in examples like (59).

(59) a. I don't know anything about cars. Do you have any suggestions about which car – if any – I should buy when I get a raise?
b. I don't know anything about cars. Do you have any suggestions about what – if anything – I should buy when I get a raise? (Ginzburg & Sag 2000: 248)

Furthermore, there are acceptable SC violations involving multiple *wh*-questions such as those in (60). See Bolinger (1978), Kayne (1983) and Pesetsky (1987:

109) for more such examples and discussion.[18]

(60) a. Who wondered what WHO was doing _ ?
b. What did WHO take _ WHERE?
c. Where did WHO take WHAT _ ?

Finally, there are also SC violations that involve echo questions like (61) and reference questions like (62). See Ginzburg & Sag (2000: Chapter 7) for a detailed argumentation that echo questions are not fundamentally different, syntactically or semantically, from other uses of interrogatives.

(61) a. What did Agamemnon break?
b. What did WHO break _ ?

(62) a. What did he break?
b. What did WHO break _ ?

There are two different, yet mutually consistent, possible explanations for SC effects in HPSG circles. One potential factor concerns processing difficulty (Arnon et al. 2007). Basically, long-distance dependencies where a *which*-phrase is fronted are generally more acceptable and faster to process than those where *what* or *who* if fronted, presumably because the latter are semantically less informative, and thus decay from memory faster, and are compatible with more potential gap sites before the actual gap. The second potential factor is prosodic in nature. Drawing from insights by Ladd (1996: 170–172) about the English interrogative intonation, Ginzburg & Sag (2000: 251) propose that in a multiple *wh*-interrogative construction, all *wh*-phrases must be in focus except the first. Crucially, focus is typically – but not always – associated with clearly discernible pitch accent. Thus, (56) and (57) are odd because the second *wh*-word is unnaccented. In this account, a word like *who* has two possible lexical descriptions, shown in (63).

[18]Fedorenko & Gibson (2010) and others have found no evidence that the presence of a third *wh*-phrase improves the acceptability of a multiple interrogative, even with supporting contexts. However, the examples in (60) require peculiar intonation phrasings and contours, which may be difficult to elicit with written stimuli.

(63) a. *Ex situ* interrogative *who*:

$$\begin{bmatrix} \textsc{phon} & \langle \text{who/WHO} \rangle \\ \textsc{synsem} & \begin{bmatrix} \textsc{loc} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{head} & \textit{noun} \\ \textsc{spr} & \langle\rangle \\ \textsc{comps} & \langle\rangle \end{bmatrix} \\ \textsc{cont} & \begin{bmatrix} \textsc{ind} & i \\ \textsc{restr} & \{\} \end{bmatrix} \\ \textsc{store} & \left\{ \boxed{1} \begin{bmatrix} \textsc{ind} & i \\ \textsc{restr} & \{\textit{person}(i)\} \end{bmatrix} \right\} \end{bmatrix} \\ \textsc{nonloc} & \begin{bmatrix} \textsc{wh} & \{\boxed{1}\} \\ \textsc{rel} & \{\} \\ \textsc{slash} & \{\} \end{bmatrix} \end{bmatrix} \\ \textsc{arg-st} & \langle\rangle \end{bmatrix}$$

b. Optionally *ex situ* interrogative *who*:

$$\begin{bmatrix} \textsc{phon} & \langle \text{WHO} \rangle \\ \textsc{synsem} & \begin{bmatrix} \textsc{loc} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{head} & \textit{noun} \\ \textsc{spr} & \langle\rangle \\ \textsc{comps} & \langle\rangle \end{bmatrix} \\ \textsc{cont} & \begin{bmatrix} \textsc{ind} & i \\ \textsc{restr} & \{\} \end{bmatrix} \\ \textsc{store} & \left\{ \begin{bmatrix} \textsc{ind} & i \\ \textsc{restr} & \{\textit{person}(i)\} \end{bmatrix} \right\} \end{bmatrix} \\ \textsc{nonloc} & \begin{bmatrix} \textsc{wh} & \{\} \\ \textsc{rel} & \{\} \\ \textsc{slash} & \{\} \end{bmatrix} \end{bmatrix} \\ \textsc{arg-st} & \langle\rangle \end{bmatrix}$$

Since only the (optionally accented) lexical entry in (63a) is specified with a non-empty WH value, the theory of extraction proposed in Ginzburg & Sag (2000) predicts that (63a) must appear *ex situ*. In contrast, the accented lexical entry in (63b) is can appear *in situ*. For more discussion see Levine & Hukari (2006: 261).

A related range of island phenomena concern extraction from *whether*-clauses, which is traditionally assumed to be forbidden, as (64) illustrates.

(64) a. * Which movie did John wonder whether Bill liked _ ?

b. * Which movie did John ask why Mary liked _ ?

But again, the oddness of (64) is unlikely to be due to syntactic constraints, given the existence of passable counterexamples like (65).

(65) a. He told me about a book which I can't figure out whether to buy _ or not.
(Ross 1967)

b. Which glass of wine do you wonder whether I poisoned _ ?
(Cresti 1995: 81)

c. Who is John wondering whether or not he should fire _ ?

d. Which shoes are you wondering whether you should buy _ ?
(Chaves 2012b)

As noted by Kroch (1989), the reduced acceptability of an example like (66a) is better explained simply by noting the difficulty of accommodating its presupposition in (66b).

(66) a. How much money was John wondering whether to pay?

b. There was a sum of money about which John was wondering whether to pay it.

9 The Left Branch Condition

Ross (1967) discovered that the leftmost constituent of an NP cannot be extracted, as in (67), a constraint he dubbed as the *Left Branch Condition* (LBC).[19]

(67) a. * Whose$_i$ did you meet [_ $_i$ friend]?
(cf. with '*You met whose friend?*')

b. * Which$_i$ did you buy [_ $_i$ book]?
(cf. with '*You bought which book?*')

c. * How much$_i$ did you find [_ $_i$ money]?
(cf. with '*You found how much money?*')

These facts are accounted for in versions of HPSG like Sag (2012) where Determiner Phrases (DPs) are not valents of the nominal head. If the DP is not listed in the argument structure of the nominal head, then there is no way for the DP to appear in SLASH. Rather, the DP selects the nominal head:

[19] As in other island environments discussed above, the LBC is not operative in constraining semantic scope, as illustrated below.

(i) Someone took a picture of each student's bicycle.
(Copestake et al. 2005: 303)

(68)
$$\begin{bmatrix}\textsc{phon} & \langle\ \textit{the}\ \rangle \\ \textsc{synsem} & \begin{bmatrix}\textsc{loc} & \begin{bmatrix}\textsc{cat} & \begin{bmatrix}\textsc{head} & \begin{bmatrix}\textit{determiner} \\ \textsc{select}\ \mathrm{N}' & \begin{bmatrix}\textsc{ind} & i \\ \textsc{restr} & \{\boxed{1}\}\end{bmatrix}\end{bmatrix} \\ \textsc{spr} & \langle\rangle \\ \textsc{comps} & \langle\rangle\end{bmatrix} \\ \textsc{cont} & \begin{bmatrix}\textsc{ind} & i \\ \textsc{restr} & \{\}\end{bmatrix} \\ \textsc{store} & \left\{\begin{bmatrix}\textit{the-rel} \\ \\ \textsc{var} & i \\ \textsc{arg} & \boxed{1}\end{bmatrix}\right\}\end{bmatrix} \\ \textsc{non-loc} & \begin{bmatrix}\textsc{wh} & \{\} \\ \textsc{rel} & \{\} \\ \textsc{slash} & \{\}\end{bmatrix}\end{bmatrix} \\ \textsc{arg-st} & \langle\rangle\end{bmatrix}$$

Analogously, in Sag (2012: 133), genitive DPs combine with nominal heads and bind their X-ARG index via a dedicated construction, not as valents. For example, in nominalizations like *Kim's description of the problem* the DP *Kim's* is not a valent of *description*, and therefore the genitive DP cannot appear in SLASH. Rather, gentive DPs are instead constructionally co-indexed with the agent role of the noun *description* via X-ARG. Moreover, the clitic *s* in *Kim's* must lean phonologically on the NP it selects, and therefore cannot be stranded for independently motivated phonological reasons, predicting the oddness of **It was Kim who I read 's description of the problem.*

There are various languages which do not permit extraction of left branches from noun phrases, but have a particular PP construction that appears to allow LBC violations. This is illustrated below in (9), with French data.

(69) a. Combien$_i$ a-t-il vendu [_ $_i$ de livres]?
how-many has-he sold of books
'How many books did he sell?'

b. Quels$_i$ avez-vous acheté [_ $_i$ livres]?
how-many have-you bought books
'How many books have you bought'

But the LBC violation is only apparent. The *de livres* is in fact a post-verbal *de*-N′ nominal, and thus no LBC violation occurs in (9a). See Abeillé et al. (2004) for details. Finally, Ross (1967) also noted that some languages do not obey the LBC

at all. A small sample is given in (70). However, the languages in question lack determiners, and therefore it is possible that the extracted phrase is has a similar independent status to the French *de-N′* phrase in (9).

(70) a. Jaką$_i$ kupiłeś [_ $_i$ książkę]
what you-bought book
'Which book did you buy?' (Polish)

b. Cju$_i$ citajes [_ $_i$ knigu]?
whose you-are-reading book
'whose book are you reading?' (Russian)

c. Ki-nek$_i$ akarod, hogy halljam [_ $_i$ a hang-já-t]?
who-DAT you-want that I-hear the voice-POSS.3SG-ACC
'Whose voice do you want me to hear?' (Hungarian)

10 The Complementizer Constraint

Perlmutter (1968) noted that subject phrases have different extraction properties than that of object phrases, as illustrated in (71). The presence of the complementizer hampers extraction of the subject, but not of the complement.[20]

(71) a. * [Who]$_i$ did Tom say (?that) _ $_i$ had bought the tickets?
b. * [Who]$_i$ do you believe (?that) _ $_i$ got you fired?
c. [The things]$_i$ that they believe (?that) _ $_i$ will happen are disturbing to contemplate.
d. * [Who]$_i$ did you ask if _ $_i$ bought the tickets?
e. * [Who]$_i$ do you expect for _ $_i$ to fire you?

Bresnan (1977) and others also noted that Complementizer Constraint effects can be reduced in the presence of an adverbial intervening between the complementizer and the gap:

[20] There is no evidence that the Complementizer Constraint applies at the semantic level, however. The subject phrase of the embedded clause that can outscope the subject phrase of the matrix:

(i) a. Some teacher claimed that each student had cheated.
b. Every teacher claimed that a student had cheated.

(72) a. [Who]$_i$ did Tom say that – as far he could remember – _$_i$ had bought the tickets?

b. [Who]$_i$ do you believe that – for all intents and purposes – _$_i$ got you fired?

c. [Who]$_i$ do you think that after years and years of cheating death _$_i$ finally died?

In Bouma et al. (2001) and Ginzburg & Sag (2000), extracted arguments are typed as *gap-ss* rather than *canon-ss*. Only the latter are allowed to correspond to *in situ* signs and to reside in valence lists. However, subject extraction is different. If a subject phrase is extracted, then the list SUBJ contains the respective *gap-ss* sign. If one assumes that the lexical entry for the complementizer *that* requires S complements specified as [SUBJ ⟨ ⟩] then the oddness of (71) follows. For Bouma et al. (2001) and Ginzburg & Sag (2000), the adverbial circumvention effect in (72) is the result of assuming that the construction which allows the adverb to combine with the clause forces the mother node to be [SLASH { }], a rather *ad-hoc* account.[21]

A simpler account of the Complementizer Constraint has emerged recently, however, in principle compatible with any theory of grammar. For Kandybowicz (2006; 2009) and others, the Complementizer Constraint is prosodic in nature. Complementizers must cliticize to the following phonological unit, but if a pause is made at the gap site then the complementizer cannot do so. Accordingly, if the pronunciation of *that* is produced with a reduced vowel [ðət] rather than [ðæt] then the Complementizer Constraint violations in (71) improve in acceptability. Though promising, Ritchart et al. (2016) found no experimental evidence for amelioration of the Complementizer Constraint effects either with phonological reduction of the complementizer or with contrastive focus. Further research is needed to determine the true nature of Complementizer Constraint effects.

11 Island circumvention via ellipsis

Ellipsis somehow renders island constraints inactive, as in (73). A deletion-based analysis of such phenomena such as Merchant (2001) relies on moving the *wh*-phrase before deletion takes place, but since movement is assumed to be sensitive to syntactic island constraints, the prediction is that (73) should be illicit, contrary to fact.

[21] Except that in French, when the subject of the complement CP is extracted, the complementizer is *qui* instead of *que*, which could easily be captured by such an account.

(73) a. Terry wrote an article about Lee and a book about someone else from East Texas, but we don't know who$_i$ (*Terry wrote an article about _ $_i$ Lee and a book about _ $_i$).
[CSC violation]

b. Bo talked to the person who discovered something, but I still don't know what$_i$ (*Bo talked to the person who discovered _ $_i$).
[CNPC violation]

c. That he'll hire someone is possible, but I won't divulge who$_i$ (*that he'll hire _ $_i$ is possible).
[SSC violation]

d. She bought a rather expensive car, but I can't remember how expensive (*she bought a _ car).
[LBC violation]

The account adopted in HPSG is one in which remnants are assigned an interpretation based on the surrounding discourse context (Ginzburg & Sag 2000; Culicover & Jackendoff 2005; Jacobson 2008; Sag & Nykiel 2011). See Nykiel & Kim (2020), Chapter 20 of this volume for more detailed discussion. In a nutshell, the *wh*-phrases in (73) are "coerced" into a proposition-denoting clause via a unary branching construction that taps into contextual information. This straightforwardly explains not only why the antecedent for the elided phrase need not correspond to overt discourse – e.g. sluices like *What floor?* or *What else?* – but also why the examples in (73) are immune to island constraints: there simply is no island environment to begin with, and thus, no extraction to violate it.

12 Conclusion

HPSG remains relatively agnostic about many island types, given the existence of robust exceptions. It is however clear that many island effects are not purely due to syntactic constraints, and are more likely the result of multiple factors, including pragmatics, semantics and processing difficulty. To be sure, it is yet unclear how these factors can be brought together are articulate an explicit and testable account of island effects. In particular, it is unclear how to combine probabilistic information with syntactic, semantic and pragmatic representations, although one fruitful avenue of approach to this problem may be via *Data-Oriented Parsing* (Neumann & Flickinger 2003; 2015; Arnold & Linardaki 2007; Bod et al. 2003;

Bod 2009).

From its inception, HPSG has been meant to be compatible with models of language comprehension and production (Sag 1992; Sag & Wasow 2010; 2015), but not much work has been dedicated to bridging these worlds; see Wasow (2020), Chapter 27 of this volume. The challenge that island effects posit to any theory of grammar is central to linguistic theory and cognitive science: how to integrate theoretical linguistics and psycholinguistic models of on-line language processing so that fine-grained predictions about variability in acceptability judgements across nearly isomorphic clauses can be explained.

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