Structural, functional and processing perspectives on linguistic island effects

Yingtong Liu[a]*, Elodie Winckel[b]*, Anne Abeillé[c], Barbara Hemforth[c], Edward Gibson[d]

[a] Department of Linguistics, Harvard University
[b] Department of English and American Studies, Friedrich-Alexander Universität Erlangen-Nürnberg
[c] Université de Paris, LLF, CNRS
[d] Department of Brain and Cognitive Sciences, MIT

* Co-first-author: Contributed equally.

Abstract:

Ross (1967) observed that "island" structures like "Who do you think [NP the gift from __] prompted the rumor?" or "Who did you hear [NP the statement [S that the CEO promoted __]]?" are not acceptable, despite having what seem to be plausible meanings in some contexts. Ross (1967) and Chomsky (1973) hypothesized that the source of the unacceptability is in the syntax. Here, we summarize how theories of discourse, frequency, and memory from the literature might account for such effects. We suggest that there is only one island structure -- a class of coordination islands -- that is best explained by a syntactic/semantic constraint. We speculate that all other island structures are likely to be explained in terms of discourse, frequency, and memory.

Keywords:
Syntactic islands; long-distance dependencies; filler-gap dependencies; discourse constraints; usage-based grammar; syntactic constructions; Focus-background conflict; linguistic interference; linguistic encoding

1. Introduction

Going back to Ross (1967) and Chomsky (1973), the discovery of unacceptable long-distance dependency structures such as "Who do you think [NP the gift from __] prompted the rumor?" or "Who did you hear [NP the statement [S that the CEO promoted __]]?" have played a major role in theories of the potential innate structure of syntax in the human mind. In this article, we summarize the evidence and arguments, focusing on experimental research in English over the past 15 years. Current evidence provides little support for the innate syntax view. We speculate that most of these "island" structures are likely to be explained in terms of discourse, frequency, and memory.

1.1 Filler-gap constructions

Filler-gap constructions are structures that involve a displaced constituent -- a "filler" -- that appears in a position other than its canonical position in a declarative clause. The canonical

1

position of the filler in a declarative is known as the "gap" site, which we will indicate with an underscore _. Such constructions include *wh*-questions, relative clauses, exclamatives, clefts and topicalizations in English and many other languages. For example, the declarative form of a simple clause is provided in (1a), along with a *wh*-question version of this clause in (1b), where the fronted filler (*what*) is the patient (object). A corresponding relative clause is provided in (1c), an exclamative is in (1d), an *it*-cleft is in (1e), and a topicalization structure is in (1f)[1].

(1) a. Mary bought the apple.
  b. wh-question: What did Mary buy __?
  c. relative clause: I like the apple that Mary bought __.
  d. exclamative: What an apple Mary bought __!
  e. it-cleft: It was the apple that Mary bought __.
  f. topicalization: The apple, Mary bought __.

Some variants of these constructions do not involve an overt filler (as in the English relative clause: *I like the apple Mary bought*). In some languages filler-gap dependencies have a bound pronoun instead of a gap and do not display the same constraints. We mostly focus on English here and so we will not discuss such alternatives further.

1.2 The definition of syntactic island

1.2.1 The behavioral observation: an unacceptable filler-gap dependency

While the filler-gap relationships in (1) are acceptable, some others are less so. Originally, syntactic islands were defined as syntactic environments that block filler-gap dependencies (Ross, 1967).[2]. Some commonly discussed types of islands are provided in (2) for *wh*-questions: (a) a complex NP island; (b) a subject island; (c) a *wh*-island; (d) a coordination island; and (e) an adjunct island (Ross 1967; Chomsky 1973).[3]

(2) a. * Who did you hear [NP the statement [S that the CEO promoted __]]?

---

[1] The notation of "filler" and "gap" originated from the movement-based generative theories (Ross, 1967; Chomsky, 1977) which we use for ease of exposition in this article. An element is not necessarily "fronted" as a result of an operation that has moved that element: some frameworks simply assume that different constructions are characterized with different word orders and that the dependency is between a "filler" and a head ("buy" or "bought" in the examples in (1)) (Müller 2016), e.g. Lexical Functional Grammar (Bresnan et al. 2015), Head-driven Phrase Structure Grammar (HPSG, Pollard & Sag 1994), Construction Grammar (Goldberg 1995). The current paper does not settle this question, and the structural, functional or processing approaches can be adapted to different formal analyses of filler-gap dependencies.

[2] The name "island" derives from a movement or displacement metaphor for long-distance dependencies between two positions. The idea of an "island" is a location from which we cannot move easily (perhaps because, in the metaphor, we need to be on land to move from one place to another).

[3] Some studies divide islands into two categories -- strong and weak islands, though the distinction is not always sharp, see Szabolcsi & Lohndal (2017) and Szabolci & den Dikken (2006).

b. * Who do you think [NP the gift from __] prompted the rumor?
c. * What did you wonder [S whether John bought __]?
d. * What did John buy [NP a shirt and __]?
e. * What did you worry [S if John bought __]?

(Examples from Sprouse et al. 2016)

The acceptability of these examples contrasts with examples with no filler-gap dependency, but a similar structure (3) and with examples that include an "in-situ" wh-phrase as in (4), which are licensed in particular contexts, such as trying to assess what someone said (an "echo-question"):[4]

(3)   a. Did you hear [NP the statement [S that the CEO promoted Elizabeth]]?
        b. Do you think [NP the gift from Elizabeth] prompted the rumor?
        c. Did you wonder [S whether John bought that jacket]?
        d. Did John buy [NP a shirt and a jacket]?
        e. Did you worry [S if John bought a jacket]?

(4)   a. You heard [NP the statement [S that the CEO promoted who]]?
        b. You think [NP the gift from who] prompted the rumor?
        c. You wondered [S whether John bought what]?
        d. John bought [NP a shirt and what]?
        e. You worried [S if John bought what]?

1.2.2 The traditional theoretical interpretation: Ungrammaticality

The motivation for discussing these kinds of unacceptable sentences was that they were originally assumed to not be generated by the grammar, and are hence **ungrammatical**. This is why we have prefixed each example in (2) with an asterisk, indicating that the researcher judged that the source of the unacceptability is in the grammar.

The notion "grammaticality" is a theoretical notion: it means that a sentence is hypothesized by a researcher not to be generated by the grammar of the target language. The behavioral dependent measure that syntax researchers usually work with is "acceptability": whether a sentence sounds acceptable ("good", "ok") or not in a particular context. Acceptability is a

---

[4] Some linguists have argued that island constraints may apply to similar constructions in languages without filler-gap dependencies in the syntax, such as Mandarin (e.g., Huang, 1982). Experimental evidence for this approach is provided by Lu et al. (2020) who found a locality constraint on "why" questions in Mandarin. But as shown by Cheng (2009), all other Chinese wh-words (e.g., "who", "what", "where") allow dependencies that would be unacceptable in English fronted wh-questions as in (2) (Chaves & Putnam, 2020), suggesting a difference between "why" and the other wh-words. The same appears to hold for Japanese (Nishigauchi, 1990: 99) which has been argued since Ross (1967) to allow extractions from subjects (contrary to English), so the Japanese equivalent of (4b) is acceptable (see recent experimental evidence in Omaki et al. 2020).

continuous, gradable notion: sentences can be fully acceptable or partially acceptable, all the way down to completely unacceptable.

The sentences in (1), (3) and (4) are all relatively acceptable to many speakers of English. We might measure this with a rating scale, such as a "Likert" scale from 1 to 5 or 1 to 7. In practice, it doesn't matter much what kind of scale we use when measuring acceptability: a binary scale (acceptable vs. unacceptable); a scale from 1-5, 1-7 or 1-10 are all commonly used in the literature (Weskott & Fanselow, 2011; Sprouse et al., 2013). Ratings on these scales are highly correlated across materials. It might seem that one might get more precision with a wider scale, but in practice this is not true. Hence any kind of scale works equally well, such that a participant simply evaluates the item against their language model, and gives it the required rating for each trial. The limitation in ratings is being consistent across many materials. If an experimental participant is rating many materials (say 10 to 100 items), it is difficult to be consistent across all items.

Factors that we know affect acceptability ratings include lexical frequency and world knowledge. See e.g., the examples in (5):

(5) a. The horse bothered the donkey
    b. The zebu aggressed the zonkey.[5]
    c. The dog bit the boy
    d. The boy bit the dog.
    e. The girl ate the pizza.
    f. The pizza ate the girl.

(5a), (5c), and (5e) all describe plausible events and use frequent English words to do so. (5b) is comparable in meaning to (5a) but uses three low-frequency words (zebu, zonkey and aggress), and people will rate this sentence correspondingly lower than (5a). Sentences (5d) and (5f) describe implausible events, and are rated low on an acceptability scale accordingly.

When world knowledge (including the local context) and lexical frequency cannot explain the unacceptability of a sentence form, syntacticians argue that the grammar of the language may be the source. For example, incorrect verbal agreement between the subject noun phrase (6a), or between an auxiliary verb and its following verb (6c) result in materials that English speakers will rate as unacceptable:

(6) a. * The horses bothers the donkey.
    b. The horses bother the donkey.
    c. * The horse seems to bothering the donkey.
    d. The horse seems to be bothering the donkey.

---

[5] Thanks to Kyle Mahowald for informing us about zebus.

When the noun phrase "horses" is plural, it needs plural agreement on the verb as in (6b), not singular agreement as in (6a). And when the infinitival form of "be" is missing in (6c), an ungrammatical form results, even though the meaning is probably clear in each of (6a) and (6d). Such materials are usually rated as unacceptable, even though they can be interpreted easily.[6]

In order to parsimoniously account for acceptability judgments across syntactic constructions, Chomsky (1965) proposed that each sentence has two levels of representation -- a deep structure and a surface structure. The sentence we produce and hear is the surface form which is transformed from the deep structure. In the case of long-distance dependency constructions, it was proposed that such constructions are transformed from their corresponding canonical declarative order. For instance, the *wh*-question *What did Mary eat* (6b) is transformed from (6a), via fronting the filler *what*; similarly, the deep structure of the topicalization construction *The apple, the girl ate* (7b) is (7a), and the object *the apple* is moved to the beginning of the whole clause during transformation.

      (6) a. Mary ate <u>what</u>?   (Deep Structure)
          b. What did Mary eat __? (Surface Structure)

      (7) a. The girl ate <u>the apple</u>.   (Deep Structure)
          b. <u>The apple,</u> the girl ate.   (Surface Structure)

Based on this movement hypothesis, Chomsky (1973; 1977; 1981; 1986a) argued for a structural account of island effects, originally called "Subjacency". According to the Subjacency constraint, movement (= extraction) is disallowed between two positions when there are two or more intervening bounding nodes, for instance, S(entence) (=IP in more modern versions) and NP (=DP) in English (see also Huang 1982; Rizzi 1990). Thus, the unacceptability of (2a-c &

---

[6] There are also materials that are more acceptable than grammatical controls, but not generated by the grammar, such as the "missing-verb-phrase" examples (Gibson & Thomas, 1999; Futrell, Gibson & Levy, 2020; example attributed to J Fodor) in (ii):

(i). The patient who the nurse who the clinic had hired admitted met Jack.
(ii). * The patient who the nurse who the clinic had hired met Jack.

Sentence (ii) is missing a verb phrase associated with one of the preceding subject noun phrases, yet is often perceived as more acceptable than its grammatical control (i).

There are also examples where the compositional meaning is absurd, but which seem perfectly plausible (so-called "depth-charge" materials, Paape et al., 2020; Zhang, Ryskin & Gibson, 2021):

(iii). No head injury is too trivial to be ignored.

These and other grammatical "illusion" materials -- which only exist in complex meaning environments -- potentially provide evidence for how the language processor works in constructing meaning. One proposal for which there is gathering evidence is the communication-based "noisy-channel" hypothesis, whereby people are guessing what was meant, given what was said, and in complex environments, they may not notice errors by the speaker (Shannon, 1948; Levy, 2008b; Gibson, Bergen & Piantadosi, 2013; Futrell, Gibson & Levy, 2020).

5

2e) can be attributed to the filler *who/what* moving across at least two bounding nodes in the transformation.

Construction-independence of unacceptability. An important property of the syntactic approach to the explanation of islands is that island effects are proposed to be similarly impossible across all sorts of filler-gap constructions with different meanings, e.g., *wh*-questions, relative clauses, clefts, topicalization (Chomsky 1964; Chomsky 1973; see Schütze, Sprouse & Caponigro 2015). In other words, island effects are proposed to be independent of constructions and meaning. However, we see that this assumption of similar judgments across different constructions is incorrect. The canonical example of unacceptable long-distance extractions is in *wh*-questions, but often similar extractions from relative clauses are acceptable. See Section 3 where we develop this further.

Innateness and learnability issues. In the Minimalist Program and its precursors, constraints on long-distance dependencies are unlearnable and hence innate, because of the classic poverty of the stimulus argument as proposed by Chomsky (1973; 1981; 1986b): Since these constraints are purely structural and hold across various constructions, children are unlikely to be exposed to the right input across all those different constructions. They are only exposed to examples of acceptable sentences, and there is no instruction of direct negative evidence for them to learn which long-distance dependencies are ungrammatical/unacceptable. Thus, island constraints (and constraints on other long-distance dependencies, such as anaphor resolution) must be innate (Hoekstra & Kooij 1988; Newmeyer 1991; see Ambridge et al. 2014 for a critical view).[7]

1.2.3 Sprouse's definition of syntactic islands: a super-additive interaction in complexity between two factors

More recently, Sprouse (2007) suggested that island effects can be defined more quantitatively, such that the unacceptability of an island sentence goes beyond the additive badness of two components of complexity of a sentence (see also Sprouse et al. 2016 a.o.). Specifically, Sprouse et al. suggested that there is a super-additive interaction between the components that contribute to the processing difficulty of the island structure. For example, they consider two factors that might contribute to the unacceptability of an extraction from an NP, as in (2a): (a) the extraction site: subject vs. object position; and (b) the presence of the complex NP *the statement that...*. They refer to extractions from subject position as "short" extractions, and those from object position as "long" extractions. Thus this 2x2 comparison would be as in (8a-d), with possible acceptability results for such a comparison in Figure 1.

---

[7] Pearl & Sprouse (2013) propose a computational model trained with trigram frequencies of non-terminal syntactic categories (e.g., NP, CP, IP, etc.) calculated from child directed speech corpora to simulate adult acceptability judgment data reported in Sprouse et al. (2012). This model shows super-additive effects for extraction phenomena on certain wh-dependencies. However, as the authors acknowledge, their proposal does not extend to other constructions such as relative clauses or clefts etc., and it makes the wrong predictions for other kinds of constructions, such as parasitic gaps and across-the-board constructions. Thus although the model provides an interesting idea of how to approach the learnability problem of unacceptable long-distance phenomena, its applicability is restricted.

6

(8) a. short, simple: Who heard [that the CEO promoted the manager]?
    b. short, complex: Who heard [the statement [that the CEO promoted the manager]]?
    c. long, simple: Who did you hear [that the CEO promoted __]?
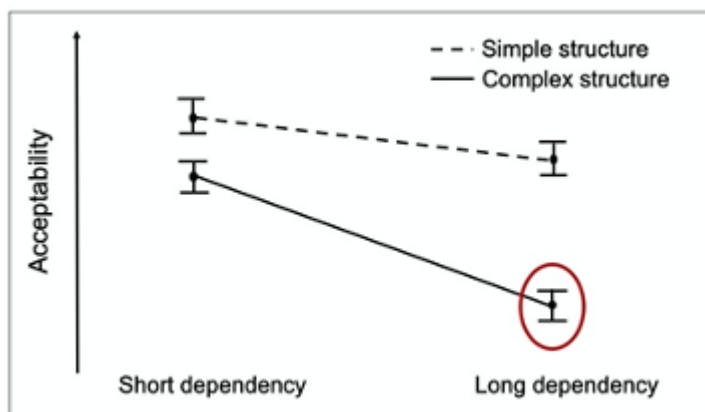   d. long, complex: Who did you hear [the statement [that the CEO promoted __]]?

Figure 1. Illustration of an island effect as defined by Sprouse et al. (2016): a super-additive interaction between dependency length (short vs. long) and complexity of the structures (complex vs. simple), such that the long-dependency/complex structure is much the worst of the four conditions.

Under Sprouse et al.'s definition, the unacceptability of (8d) (= 2a) is not explained by the additive weights of the two factors. The super-additivity is what makes it an "island" effect. Sprouse et al. interpret this super-additivity as evidence for syntactic constraints making them syntactic islands. Following Sprouse et al., some additional constraints beyond complexity of the constructions must be underlying the super-additivity and they claim that they are syntactic in nature.[8]

1.2.4 Problems with the assumption that syntactic islands are ungrammatical

According to the original claim, filler-gap constructions in island configurations are **ungrammatical**, independent of lexical, plausibility, and construction differences. However, many acceptable examples have been provided in the linguistic literature (including by Ross himself) and are found in well-edited corpora for most of the islands above, such as (9) - (13). These various kinds of exceptions to each type of island cast doubt on a purely syntactic explanation of unacceptable filler-gap constructions.

Counterexamples to the Complex NP island:

---

[8] Almeida (2014) proposes the idea that there may be super-additivity in a 2x2 comparison with one condition much the worst, even if the worst of the four is still quite acceptable. He refers to such interactions as "subliminal" islands. But these are not traditional syntactic islands, because the examples are fully acceptable, and thus cannot be ungrammatical.

(9) a. The funds that I have [hopes [the bank will squander __]] amount to more than a billion. (Ross 1967: 139)

    b. Which Middle East country did you hear [rumors [that we had infiltrated __]] ? (Pollard & Sag 1994: 206)

    c. Violence is something that there are [many Americans [who condone __]]. (McCawley 1981: 108)

Counterexamples to the Subject island:
(10) a. Of which cars were [the hoods __] damaged by the explosion? (Ross 1967: 242)

    b. In his bedroom, which [to describe _ as small] would be a gross understatement, he has an audio studio setup. (Chaves 2012: 17)

Counterexamples to the Wh-island :
(11) a. He told me about a book which I can't figure out [whether to buy _ or not]. (Ross 1967: 27)

    b. How many points are the judges arguing about [whether to deduct _]? (Kroch 1998: 8)

Counterexamples to the Coordination island:
(12) a. How much can you [drink _ and still stay sober] ? (Lakoff 1986, ex. 2)

    b. How many lakes can we [destroy _ and not arouse public antipathy] ? (Pollard & Sag 1994: 201)

Counterexamples to the Adjunct island:
(13) a. What are you working so hard [in order to achieve _]? (Truswell 2007; Boeckx 2012: 24)

    b. That's the symphony that Schubert died [without finishing _]. (Pollard & Sag 1994: 201)

The main problem with the notion of "syntactic island" is that its definition typically presumes that the source of the unacceptability is due to syntactic constraints. Such a definition is contradicted by the existence of the counterexamples above, along with many others.

Let us consider Sprouse's (2007) definition of syntactic island specifically, because it has received some attention in the recent generative syntactic literature. As with the original definition, the primary problem with Sprouse's definition is that it presumes that we can interpret the source of the super-additivity between two factors as coming from the syntax. However, this is not necessarily the case. We have no prior reason to think that the source of any super-additivity might be coming from violations of syntactic constraints, from violations of discourse constraints, or from overworking the processing system. *Finding such an interaction simply means there is some additional factor contributing to the additional complexity of a specific combination of conditions, but we don't know what it is:* it doesn't differentiate among the possible explanations. Many variants of each kind of explanation are equally possible after

such an observation. We need independent reasons to interpret an observed super-additive interaction as coming from any source, including the syntax.[9]

Moreover, it should be kept in mind that no experiment controls all factors: all an experiment can do is control the factors that the experimenter was aware of. For example, the design in (8) is intended to control for processing difficulty as a potential source of the observed interaction, but it actually doesn't. A potential confound is the number of NPs between the *wh*-filler and its dependent position (the gap-site). In the "short" conditions in (8a) and (8b), the *wh*-filler is adjacent to the the gap-site, corresponding to a length of zero, whereas in the "long / simple" condition, the distance between the *wh*-filler and the gap-site is two NPs (*you*, *the CEO*), but in the "long / complex" condition, the distance between the *wh*-filler and the gap-site is three NPs (*you, the statement, the CEO*).[10] Thus, processing complexity is as good as a potential explanation for the observed interaction. Moreover, aspects of discourse function are also potentially confounded in this design (cf. Goldberg 2006; Abeillé et al. 2020a). Thus interpreting such an interaction as coming from the syntax is an inferential error. For example, see Keshev & Meltzer-Asscher (2019) who showed that an interaction obtained in this paradigm for *wh*-islands is probably due to unmatched processing factors across conditions, not likely to grammatical rules. We come back to this specific example in section 4.2.2.

This is not to say that the experimental design in (8) is inadequate: it controls some factors but not others. We need independent reasons to interpret an observed super-additive interaction as coming from syntax. Finding such an interaction doesn't determine the source of the effect. Each source is equally well on the table after such an observation.

1.2.5 A simpler definition of island configuration: an unacceptable filler-gap dependency

As a consequence of the uncertainty of understanding the source of an island configuration, we will adopt the simplest definition of "island" structure: an unacceptable filler-gap dependency, with no claim about the source of the unacceptability. We adopt this simpler definition so that we can continue to refer to the relevant configurations as "island configurations" independent of their theoretical interpretations. The problem with Sprouse's definition is that one needs to understand **why** a filler-gap configuration is unacceptable in order to label it correctly, and our understanding may change over time. It is therefore simpler to use a definition of island configuration that doesn't depend on our understanding of the source of the unacceptability.

---

[9] Sprouse et al. (2012) provide a published example of this fallacy. They test a resource theory of acceptability of island effects, and find no evidence for that theory. They then conclude: "We believe that the results of the experiments presented in this article provide strong support for grammatical theories of island effects because we can find no evidence of a relationship between processing resource capacity and island effects." (p. 118).

[10] No matter how one counts distance, the distance is confounded in Sprouse et al.'s design in (8). If we instead count words rather than NPs, there are more words between the *wh*-filler and gap-site for the complex / long versions relative to the simple / long, but no difference for the simple conditions. If we only count NPs or words between the embedded verb "hear" and the gap site, then the distance is longer for the long / complex condition relative to the long / simple condition, but again there is no difference for the "short" conditions.

9

1.3 An island effect that researchers agree on: Extractions of full conjuncts

Whereas there is disagreement in the literature about how to explain most island effects, there is no disagreement with respect to certain conjunct islands as in (14) (Ross 1967) and (15) (Chaves 2012; Chaves & Putnam 2020), where one (or several) of the full conjuncts have been extracted:

(14) a. * Who did you invite Mark and __ ?
  b. * Who did you invite __ and Mark?
  c. * Who did you invite __ and __ ?

(15) * What did the market crash wipe out the whole investment let alone __ ?

It does not seem to be possible to extract one or more full conjuncts, in any language. Consequently, researchers unanimously explain these phenomena in terms of syntax, sometimes called the "conjunct constraint" (Sag, 2010). In an analysis without movement (a "traceless" analysis), the definition of coordination as a construction that necessarily implies (at least) two conjuncts can account for the ill-formedness of (14) and (15): the coordination in (14a+b) and (15) has only one conjunct, and in (14c) no conjunct at all (Sag 2010: 511; Chaves 2012: 505–507).[11]

---

[11] The label "coordination island" also sometimes refers to a second kind of case, namely, fronting **part of** a conjunct (Grosu, 1973). This type of fronting is unacceptable in many cases, as in (i).

(i) * The lute which Henry [plays __] and [sings madrigals] is warped.

This constraint on extraction is called the Element constraint and has two types of counterexamples in English (and in head-final languages as well) (Goldsmith 1985; Lakoff 1986; Kehler 2002; Chaves 2012). First, Across-The-Board (ATB) extractions like (ii) are possible if the fronted element corresponds to a gap in all conjuncts (Ross 1967; de Vries 1992).

(ii) a. What did Peter [buy _ last week] and [throw away _ yesterday] ?
  b. Which famous scientist did Peter read [a book by _] and [a newspaper article about _]?

Second, extraction out of one conjunct is ameliorated when the two conjuncts stand in an asymmetrical discourse relation (their ordering cannot be reversed with the same meaning) (Kehler 2002), as in (iii).

(iii) a. Here's the whisky which I [went to the store] and [bought __]. (Ross 1967: 168)
  b. What was the maximum amount that I can [contribute __] and [still get a tax deduction]?

ATB extractions and extractions out of an asymmetrical conjunct are unproblematic provided the structure complies with the discourse, processing and performance factors. For example, Goldberg (2013) argues that in asymmetrical conjuncts one of the two conjuncts is backgrounded.

In the remainder of the paper, we summarize three major types of theories to account for all other island phenomena: (a) structural / syntactic accounts in Section 2; (b) functional / discourse accounts in Section 3; and (c) processing accounts in Section 4.[12]

2. Pure syntactic / structural accounts: the "generative" approach[13]

2.1 Super-additivity effects in acceptability ratings

As discussed above, Sprouse et al. (2016) investigated the potential sources of the unacceptability of four kinds of island structures (*whether*, complex NP, subject and adjunct islands) in matrix/embedded *wh*-questions and relative clauses in English and Italian. To do so, they manipulated two factors in each: dependency length (short vs. long) and the existence of some feature of the island structure in the sentence (island vs. non-island structures).

For English *wh*-dependencies, significant interactions were found for *whether*, complex NP, and adjunct islands; as for subject islands, *wh*-questions formed by bare-*wh*-fillers (*who/what*) didn't yield a significant interaction (p=.062), while the interaction for *wh*-questions formed by complex fillers (*which car*) was significant. As for English relative clauses, the authors found a significant interaction for *wh*-island and complex NP island, while no significant interaction was observed for adjunct islands. The results for subject-islands were mixed -- the interaction was significant in the first experiment, but not so in the replication. The authors concluded that (i) the results could be captured by (variants of) the structural accounts (e.g. Chomsky 1986a); (ii) island effects vary across dependency types -- wh-dependencies and relative clauses should not be treated the same in analyses.

Like Sprouse et al. (2016), Dillon & Hornstein (2013) investigated a variant of a complex NP island. Each experiment was designed to manipulate construction type (declarative vs. interrogative) and gap location (object of the verb *open* vs. inside a complex NP structure, *a clumsy attempt to open __*). The results showed a significant interaction between construction type and gap location, thus the authors ascribed the unacceptability of (16d) to the syntactic category of the extraction domain -- a variant of complex NP structures.

(16) a. Mary heard someone clumsily attempt to open the door.
    b. Mary heard [a clumsy attempt to open the door].
    c. What did Mary hear someone clumsily attempt to open __?
    d. What did Mary hear [a clumsy attempt to open __]?

---

[12] Another approach is Hawkins (1999) which focuses on how and why language processing shapes grammar which includes constraints on filler-gap constructions/island phenomena. For example, it is argued that English subject-extracted relative clauses must include a lexical complementizer (unlike object-extracted relative clauses), because without the lexical complementizer there would always be difficult ambiguity with a main clause.

[13] For a review of formal semantic accounts of islands, see Szabolci & Lohndal (2017).

But as discussed above, the observation of such interaction effects leaves open the source: it could potentially originate in any of syntax, discourse, or processing. These researchers do not provide independent reasons that these effects might be due to structural constraints.

2.2 Mismatch between acceptability ratings and reading times for subject islands

Phillips (2006) provides evidence that is claimed to support a structural account of the unacceptability of subject islands. First, he found that extraction out of an infinitival clause modifying a subject (17a) was rated as similarly unacceptable to extraction out of a finite clause modifying a subject (17b). Second, he observed longer reading times on the embedded verb for implausible compared to plausible subjects for the infinitival clause modifiers (e.g., for *expand(ed)* in (18b) vs. (18a)) but there was no such difference for extraction from the finite clause modifiers (18c-d). Because people are sensitive to plausibility differences in on-line reading times for the infinitival versions, he concluded that the unacceptability in the rating experiment could not be due to processing difficulty. He therefore concluded that the unacceptability of the materials in (17) must be due to their syntactic structure.

(17) Sample item for the rating task
a. Infinitival clause modifier:
The outspoken environmentalist worked to investigate what the local campaign to preserve __ had harmed the annual migration.
b. Finite clause modifier:
The outspoken environmentalist worked to investigate what the local campaign that preserved __ had harmed the annual migration.

(18) Sample item for the on-line reading experiment
Infinitival clause modifier:
a. The school superintendent learned which schools the proposal to expand dramatically and innovatively upon the current curriculum would overburden __ during the following semester. [expand a school = plausible]
b. The school superintendent learned which high school students the proposal to expand dramatically and innovatively upon the current curriculum would motivate __ during the following semester. [expand a student = implausible]
Finite clause modifier:
c. The school superintendent learned which schools the proposal that expanded dramatically and innovatively upon the current curriculum would overburden __ during the following semester. [expand a school = plausible]
d. The school superintendent learned which high school students the proposal that expanded dramatically and innovatively upon the current curriculum would motivate __ during the following semester. [expand a student = implausible]

Unfortunately, Phillips' conclusion doesn't follow. First, Chaves and Dery (2019: 27–28) observe that several of the finite clause modifiers in Phillips' materials are ill-formed irrespective of the

extraction, making the conclusions potentially less compelling.[14] Second, the sets of materials in the acceptability judgement experiment and those in the on-line experiment were not matched in an important way known to affect complexity: bare-*wh*-fillers (*what/who*) were used in the acceptability judgement task (14), whereas *which*-NPs (*which schools*) were used in the on-line experiment (18). Hofmeister & Sag (2010) have shown higher acceptability ratings for extractions involving materials with *which*-NPs compared to bare-*wh*-fillers, so it is possible that the low acceptability of the materials in the ratings experiment were in part due to the use of bare-*wh*-fillers. An underspecified syntactic source for the unacceptability of the materials in (17) is therefore not evident. And third, even if Phillips could rule out a specific processing component, that wouldn't necessarily imply a syntactic source: the source could be a discourse effect or some other processing effect.

Phillips (2006) also evaluated versions of his materials with an extra so-called "parasitic" gap, and found that these materials were rated as quite acceptable. The source of the acceptability of parasitic gap materials is an open question in the literature; we discuss this question with respect to island-hood in section 4.3.

3. Functional / Discourse accounts

As we have seen in the previous sections, syntactic approaches to islands focus on the purely syntactic aspect of Filler-Gap constructions (the "movement" from the gap site to the filler position). However, Filler-Gap constructions (e.g., *wh*-questions, clefts) are not only characterized by word order, but also by their specific discourse status. This has led some linguists, as early as in the 1970s, to study discourse factors that might explain island phenomena.

One of the most important differences with structural accounts is that functional accounts assume that fronting is licenced by syntax, even in island configurations.[15] What creates the island effect is not fronting, but the fact that the pragmatic requirements that typically lead to use fronting are not met. In other words: there's no good reason to use this Filler-Gap construction in the particular context. Sentences showing an island effect are therefore not ungrammatical, but rather infelicitous, because they are not in adequation with the specific context of the construction.

---

[14] Chaves and Dery (2019) cite problematic cases from Phillips's materials, such as the supposedly plausible "the struggle that battled the deadly disease", which is not very plausible. Given that the non-extracted counterparts were not always plausible, this may have led to low ratings from the participants.

[15] It is possible to integrate some of the theoretical spirit of the functional accounts into the generative syntactic framework via the use of covert functional phrases (i.e. FocP, TopP). But it remains unclear (i) why children are born with these covert functional heads rather than learn the functions of these constructions via language exposure and social interaction; and (ii) how these covert functional phrases can capture the gradiency in sentence acceptability.

3.1 Information structure and extraction

Approaches based on information structure (or discourse status) predict that acceptability of extraction should be gradient and should depend on the discourse status of the gap site, and for some proposals, on the discourse status of the extracted element as well.

3.1.1 The focus approach (Erteschik-Shir)

In response to Ross's seminal work (Ross 1967), Erteschik-Shir argued that only certain elements are accessible for long-distance dependencies (gaps) and that their accessibility mainly depends on discourse factors. She states: "Extraction can occur only out of clauses or phrases which can be considered dominant in some context." (Erteschik-Shir 1973: 22). The notion of "dominance" should be understood here as an equivalent of the more modern notion of focus, i.e., the element that carries the main (and usually new) information of the utterance.

Let us illustrate her argument with the example of the subject island exemplified in (19) (=2b): In general,[16] the main subject is the topic of the utterance. The relevant information will thus typically not be the subject, but what is said about it. Since the subject is not "dominant", fronting part of it is not allowed. This would explain why a subject island effect arises.

(19) * Who do you think [NP the gift from __] prompted the rumor?

3.1.2 The topic approach (Kuno)

In Kuno's opinion, "Only those constituents in a sentence that qualify as the topic of the sentence can undergo extraction processes [...]." (Kuno 1987: 23). He calls this rule the **Topichood Condition for Extraction**. Note that his definition of NP topichood is more that of a discourse topic: it means that the NP is a good candidate to be the subject of the next utterance (hence a continuation topic).[17]

For example, in (20a), the continuation topic "she" could potentially refer to Mary as well as to Marilyn Monroe. However, according to Kuno, it is more likely to be interpreted as an anaphor to Mary, evidence that Marilyn Monroe is an unlikely (discourse) topic in this context. The Topichood Condition for extraction would then explain why an extraction of the corresponding element, as in (20b), is unacceptable.

(20) a. I want to buy Mary's portrait of Marilyn Monroe. She's such a great artist.
    b. *It is Marilyn Monroe who I want to buy [Mary's portrait of __].

---

[16] That is, in a context which Erteschik-Shir (2006; 2007) calls the "canonical f[ocus]-structure".

[17] This is not the usual definition of a sentence topic: the sentence topic that contributes to information structure is usually defined as what the utterance is about.

Kuno's approach is quite different from Erteschik-Shir's: It is usually assumed that topic and comment (i.e. what is said about the sentence topic) are in complementary distribution, and that the focus domain is part of the latter. In both approaches however, the relationship between discourse status and the extraction constraint is not spelled out explicitly: if a specific discourse criterion is not met, then fronting is not licensed, but there is no explanation about where the interface between pragmatics and syntax lies.

3.1.3 An attempt to reconcile the focus and topic approaches: salience

Deane (1991) attempts to resolve the differences between Erteschik-Shir's and Kuno's approaches by appealing to the notion of "salience". According to Deane, both focus and topic are cognitively "salient". The focused element is salient because it is relevant and it is marked as such by the addresser (e.g. through prosodic stress). The topic on the other hand is salient because it is central to the discourse (we need to know what we are talking about). Furthermore, since the topic has most probably been mentioned before in the discourse, it has been cognitively activated. Salient elements imply some cognitive costs. Yet, fronting is an operation that also poses a significant cognitive cost. This operation is facilitated when the fronted elements are already salient, because they are more easily accessible. So it is easier to extract a subject (Who left early ?), which is usually a sentence topic, than an adjunct (When did your neighbour leave?), which is (by default) less salient. Since the complement of the subject in (19) and the complement of the object in (20b) are not salient, they are not easily accessible for extraction.

A similar idea leads Goldberg (2013) to assert that elements that are neither focused nor topical -- she calls them backgrounded elements -- are islands to extraction: "**Backgrounded Constituents are Islands (BCI)**". Since she assumes backgroundedness to be a gradient property, the violation of the BCI is gradient accordingly: that is why fronting out of an "island" can be more or less acceptable depending on the context.

This approach however, as well as the preceding ones, predicts no difference across Filler-Gap constructions. As long as the fronting does not target a focus or topic, a penalty by extraction is expected.[18]

3.1.4 The discourse-clash approach

The solution may lie in completely dispensing with linking island phenomena to fronting, in order to keep only their discourse function (which may or may not involve fronting). This is the approach proposed by Abeillé et al. (2020a) who define their Focus-Background Conflict (FBC) constraint as follows: "A focused element should not be part of a backgrounded constituent."

---

[18] Note that backgroundedness/salience in Goldberg's BCI account is gradient, so it's possible that differences in salience of the domain of extraction in distinct constructions (e.g., *wh*-question vs. relative clause) can explain some of the cross-construction variation in island effects, although the theory is not yet fully developed with respect to this question.

(Abeillé et al. 2020a: 3), in which "backgrounded" should be understood as presupposed or non-focus.

Indeed, the inconsistency in defining an element as both focus and non-focus is underlined by several linguists (Simonenko 2015; Rizzi 2017). The case of direct questions is suggestive: the fronted element is the one about which the inquirer defines herself as being ignorant and in search of information; she cannot therefore introduce it as part of a presupposition at the same time (Simonenko 2015). By analogy, the same rationale can be extended to any form of focus, as suggested in Abeillé et al. (2020a). As a consequence, types of fronting that do not involve focusing should not be affected by the FBC constraint. This is the case, for example, for relatives in which the fillers are not (necessarily) focused.

Empirical studies corroborate this dichotomy between focusing and topicalizing fronting constructions in English (experimental studies by Sprouse et al., 2016, and Abeillé et al., 2020a), French (corpus studies by Abeillé & Winckel, 2020; experimental studies by Abeillé et al., 2020a; and Abeillé et al., 2020b) Italian (experimental studies by Sprouse et al., 2016) and Norwegian (experimental studies by Kush et al., 2018; 2019).

The corpus studies in Abeillé & Winckel (2020) reveal that fronting the complement of a subject noun (claimed to lead to a subject island effect) are very common in relative clauses in French (actually even the most common usage in written corpora). However, they did not find a single occurrence of such fronting for interrogatives.

The experimental results of Abeillé et al. (2020a) aimed to replicate Sprouse et al.'s (2016) experiments on subject islands for English (see section 2.1) with some important differences in the materials tested: their material is more similar across conditions (all fillers inanimate, same preposition, same semantic content), they added ungrammatical controls to their design, and most importantly, they compared extraction of the whole nominal complement (so-called "pied-piping", (21a)) with extraction of the embedded NP (preposition stranding, (21b)), while Sprouse et al. only tested preposition stranded versions.

(21) a. subject, pied-piping
The dealer sold a sportscar, of which [the color _] delighted the baseball player because of its surprising luminance.
     b. subject, P-stranded
The dealer sold a sportscar, which [the color of _] delighted the baseball player because of its surprising luminance.

The results of Abeillé et al. (2020a) for English show a clear contrast between *wh*-questions and relative clauses with pied-piping, such that there is a penalty when extracting out of the subject in *wh*-questions but not in relative clauses.[19] Sprouse et al. (2016) obtained the same contrast

---

[19] With preposition stranding, they reproduce the results of Spouse et al. with a penalty when extracting out of the subject in both constructions. The authors attribute this to processing factors that have nothing to do with islands.

in Italian, and Abeillé et al. (2020a) found the same contrast in French. Furthermore, Abeillé et al. (2020b) compared relative clauses with another focalizing construction, *it*-clefts in English and *c'est*-clefts in French: they reproduced their previous results on relative clauses (no interaction), whereas clefts in both languages showed interaction effects. In Norwegian, Kush et al. (2018; 2019) tested a series of potential islands environments first as *wh*-questions, then as topicalizations. They found that extractions out of adjuncts show the same contrast across constructions, with interaction effects in *wh*-questions but not in topicalizations. Kush et al. (2018; 2019) showed further results on extractions out of adjuncts in English (similar results can be found in Sprouse et al. 2016; Gibson et al. 2021). Figure 2 illustrates many of these findings.

Finally, Tollan & Palaz (2021) looked at so-called that-trace effects. For wh-questions, it is unacceptable to front the subject of an embedded clause introduced by "that", whereas it is fine to front the subject when the embedded clause has no lexical complementizer, as illustrated in (22):

(22) wh-question
a. * Which family member did Lucy think that _could drive grandad home?
b. Null wh: Which family member did Lucy think _could drive grandad home?

Tollan & Palaz (2021) observed that this effect is greatly reduced for relative clauses, as in (23), and they posit an explanation based on information structure following a similar line of explanation as the FBC.

(23) Relative clause
a. The family member who Lucy thought that _could drive grandad home knew Pat.
b. Null RC: The family member who Lucy thought _ could drive grandad home knew Pat.

The FBC may also be able to account for some contrasts among focalizing constructions, not accounted for in the syntactic litterature, for example the preference for indefinites when questioning the complement of a noun (Erteschik-Shir, 1973; Davies & Dubinsky, 2003; see Keller, 2000, for experimental evidence): because indefinite NPs introduce new entities (unlike definite NPs), the questioned element more likely belongs to the focal domain in (24a) than in (24b), which results in (24a) being more acceptable than (24b). As expected under the FBC, no such contrast holds in (24c) which is a relative clause:

(24) a. Which actress did you buy [a picture of __]?

    b. # Which actress did you buy [that picture of __]?

    c. That is the actress who I bought [a / that picture of __].
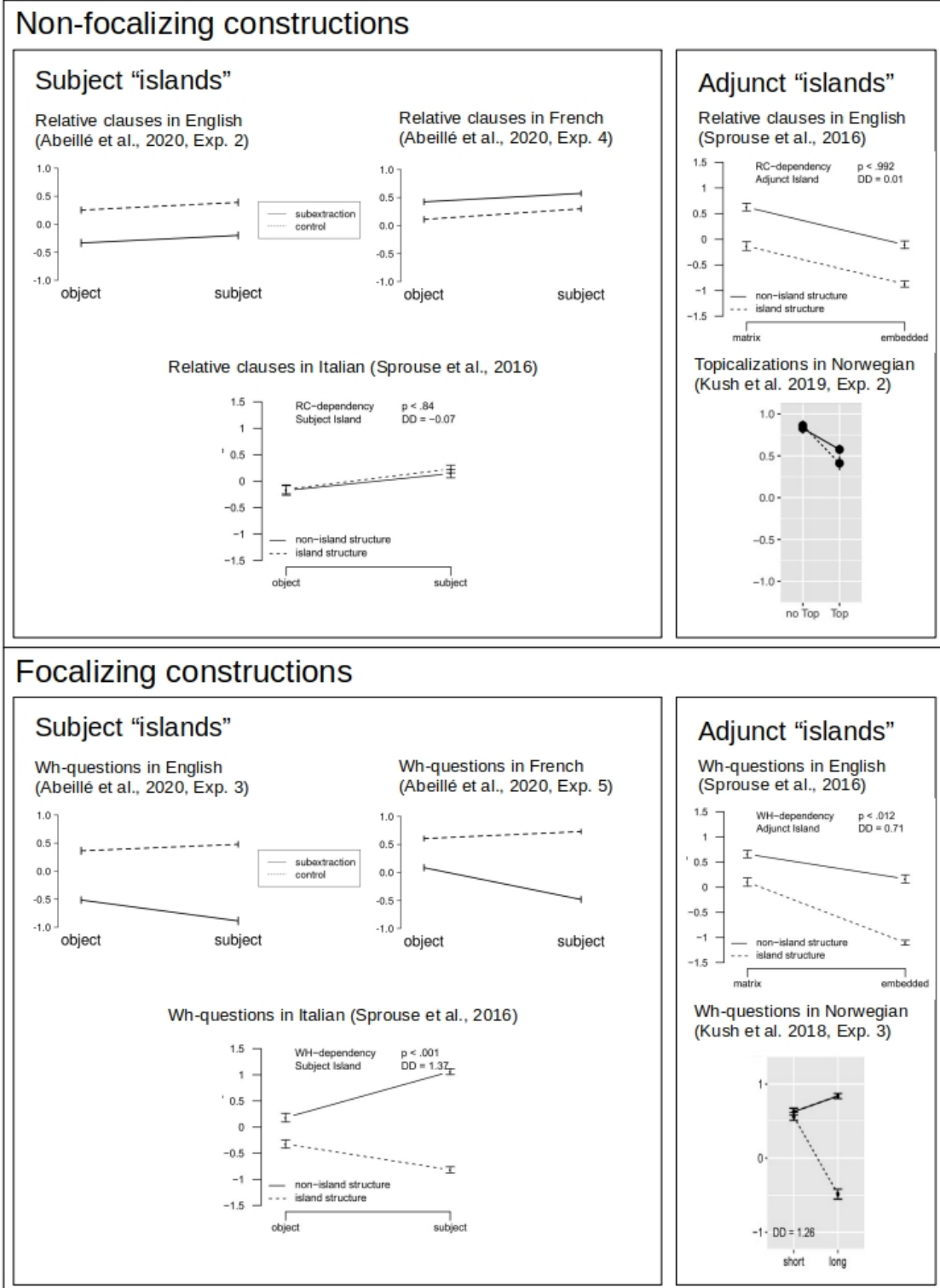
Figure 2. Focalizing and non-focalizing constructions in different languages. Two-by-two comparisons show a clear contrast such that non-focalizing constructions do not have an interaction and focalizing constructions have an interaction.

18

3.2 Relevance

An element of a sentence can be more or less related to the main question under discussion. This property, called relevance, depends on our world-knowledge. Kuno (1987) has convincingly illustrated the importance of relevance by using the following contrast:

(25) a. What did you see [pictures of __]?
     b. * What did you see [a book about __]? (Kuno 1987)
     c. What did you read [a book about __]?

Although (25b) is less natural than (25a), the syntactic environment cannot be the source of the acceptability difference, since it is the same in both sentences. However, as Kuno (1987) points out, seeing a picture is synonymous with seeing what is in the picture. It is difficult to imagine under what circumstances one could see a photograph without seeing the person or object it represents. The same is not true for the subject of a book: one can see an object that one identifies as a book without seeing what the book is about. Thus, the contrasts in (25) originate in the fact that the subject of the image is more relevant for the action of seeing an image than the subject of a book is for the action of seeing a book. On the other hand, (25c) is fine, where the verb for the direct object "book" is "read" rather than "see"..

Kluender (2004: pp. 121–122) takes a similar position and says that the relationship between the filler and the main clause predicate is as important as the relationship between the filler and the gap. Chaves & King (2019) tested Kuno's hypothesis on examples similar to (25). In a first norming experiment, they asked English speakers to judge how relevant an item was for a given action (26a). In a second experiment, participants were asked to provide acceptability judgments using the same material, this time as an interrogative (26b). The authors found a strong correlation between the relevance score and the acceptability judgments: the more relevant an element was considered to be for a given action, the more acceptable its fronting was judged to be.

(26)
a. How much does the topic of a comment matter when posting / misreading a comment?
b. What did Kayla post / misread a comment about?

Chaves & King define what they call the Relevance Presupposition Condition as follows: "the referent that is singled out for extraction in [an Unbounded Dependency Construction] must be highly relevant (e.g. part of the evoked conventionalized world knowledge) relative to the main action that the sentence describes. Otherwise, extraction makes no sense from a Gricean perspective, as there is no reason for the speaker to draw attention to a referent that is irrelevant for what the sentence contributes to the discourse." (Chaves & Putnam 2020: 286)

4. Processing accounts

19

The earliest processing-based accounts of island phenomena were provided by Pritchett (1991), Kluender (1991) and Kluender & Kutas (1993a; 1993b), who proposed that the memory load associated with processing adjunct islands (28b) and wh-islands (28c) can end up exceeding a limited capacity (see also Kluender 2004). Kluender & Kutas (1993a; 1993b) provided event-related potential (ERP) and reading-time data for materials including non-extracted main-clause versions like (27) and corresponding extracted main-clause versions like (28):

(27) a. simple-clause-embedded, no-extract-main-clause
Have you forgotten [that you faxed a copy of that contract to the corporate office on Friday]?
    b. if-clause-embedded, no-extract-main-clause
Have you forgotten [if he dragged her to the movie that weekend]?
    c. object-extraction, no-extract-main-clause
Have you forgotten [who he dragged _ to the movie that weekend]?

(28) a. simple-clause-embedded, Wh-extract-main-clause
Who has she forgotten [that the boss referred that matter to _ for further study]?
    b. Adjunct island: if-clause-embedded, extract-main-clause
What have you forgotten [if he dragged her to _ that week-end]?
    c. Wh-island: object-extraction, extract-main-clause
What$_i$ have you forgotten [who$_j$ he dragged _j to _i that weekend]?

These experiments were 2x2 designs, comparing simple clauses to if-clauses and object extraction, similar to those in Sprouse et al. (2016), as discussed in Section 2. And similar to Sprouse et al., Kluender & Kutas (1993a; 1993b) found interactions (super-additivity) between the construction type and extraction. However, Kluender & Kutas interpreted these interactions as support for a working memory account.

Sprouse et al. (2012) correctly observed that Kluender & Kutas had no independent measure of working memory, so it was difficult to evaluate the claim that the observed interactions were due to working memory constraints. In an attempt to evaluate Kluender & Kutas' claim, Sprouse et al. (2012) defined verbal working memory as working memory scores measured by n-back tasks or serial recall tasks. Sprouse et al. found that individual working-memory resources as measured by these tasks did not correlate with acceptability judgments of island constructions. Based on these results, they argued that working memory was not a likely explanation for the unacceptability of island structures. Rather, they argued that the unacceptability of gaps inside of various island structures are best explained by structural accounts.

One concern with this interpretation is that the working memory tasks used in Sprouse et al. (2012) may not reflect comprehension difficulties due to working memory capacity in sentence processing (Hofmeister, Staum & Sag 2012; Hofmeister, Casasanto & Sag 2012; Hofmeister, Casasanto & Sag 2013). Relatedly, there is no evidence that these working memory tasks predict comprehension difficulties of sentences that are known to be difficult due to working memory limitations (e.g., multiply nested structures) (Gibson and Scontras 2013). If Sprouse et

20

al. could show that their memory tasks predict parsing difficulties in other phenomena that have been shown to be due to working memory, this would be stronger evidence for their interpretation. It would obviously also be more convincing for a working memory based argument to show that tasks that have been shown to correlate with comprehension difficulty also predict interindividual differences in island effects.

4.1 Working-memory based accounts

Two aspects of cognitive costs that are associated with processing sentences are thought to contribute to the complexity of some island effects:[20]

(a) Encoding aspects of a linguistic structure in memory (Vasishth & Lewis 2006; Hofmeister 2007; Hofmeister 2011; Hofmeister & Sag 2010).

(b) Retrieving aspects of a linguistic structure at the endpoints of syntactic dependencies, in order to integrate the meaning in memory (Gibson 1998; Gibson 2000; Fiebach, Schlesewsky & Friederici 2001; Gordon, Hendrick & Johnson 2001; Warren & Gibson 2002; Grodner & Gibson 2005; Van Dyke & Lewis 2003; Van Dyke & McElree 2006; Lewis & Vasishth 2005; Lewis, Vasishth & Van Dyke 2006; Acheson, Postle & MacDonald 2010; Boston, 2012; Hsiao, Gao & MacDonald 2014; Futrell, Levy & Gibson 2020). The current evidence suggests that the difficulty of retrieving an earlier dependency site is most affected by interference of potentially similar elements in the interim (Gordon, Hendrick & Johnson 2001; Lewis, Vasishth & Van Dyke 2006). The existence of such retrieval difficulty gives rise to many behavioral effects, including the difficulty of processing nested syntactic structures (Gibson 1998; Gibson 2000); the difficulty of processing object-extracted relative clauses compared to subject-extracted relative clauses in English (King & Just 1991; Grodner & Gibson 2005; Pozniak & Hemforth 2015); and preferences for short dependencies in examples of temporary ambiguity in various constructions across languages (e.g. Stowe 1986; Frazier 1987; Clifton & Frazier 1989; Hawkins 1999; Futrell, Mahowald & Gibson 2015).

4.1.1 Island effects explained by weak encoding associated with a bare pronoun wh-word

Hofmeister (2007; 2011) observed that semantically rich fillers, such as *the ruthless military dictator* (29b), led to faster reading times at the verb (*encouraged*) than semantically simple fillers like *the dictator* in (29a).

(29) 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.

---

[20] There is evidence that maintaining aspects of the structure in memory also contributes to cognitive complexity of a linguistic structure (Chomsky & Miller 1963; Gibson 1998; Gibson 2000), but this maintenance cost has not been proposed to affect the complexity of island structures.

21

Based on these findings, Hofmeister proposed that semantically informative fillers can help parsing long-distance dependencies and increase acceptability. Semantically informative fillers can facilitate downstream retrieval of the corresponding linguistic representations from memory (at the gap site), due to increased activation and resistance to interference (Hofmeister & Sag 2010). Specifically, processing constituents that syntactically depend on or modify a representation in memory reactivates (or pre-activates) that representation, leading to a boost to the activation level and making the representation easier to access. In addition, semantically rich fillers provide more distinguishing features, which help to reduce interference with other discourse representations in memory at that time (Anderson & Reder 1979; Reder 1980; Bradshaw & Anderson 1982; Anderson 1983; Wiseman, MacLeod & Lootsteen 1985; Reder, Charney & Morgan 1986; McDaniel et al. 1988).

Three kinds of island phenomena have been claimed to be explainable in terms of differences in encoding complexity on the *wh*-filler. In particular, Hofmeister & Sag (2010) and Hofmeister (2011) showed that processing costs (as measured by reading times) and acceptability ratings of complex NP islands, *wh*-islands and adjunct islands can be greatly improved by employing complex fillers (*which*-NP vs. *what/who*).[21]

For instance, in *wh*-islands, RTs were significantly shorter in the WHICH condition (30b) than the BARE condition (30a) in the spillover PP region (*after the annual...*). There was no significant difference of RT between the WHICH condition (30b) with island violation and the BASELINE condition (30c) without island structures, suggesting that the unacceptability of the BARE condition could be due to parsing difficulties associated with the semantic features of the filler (cf. Donkers, Hoeks & Stowe 2011; Tollan & Heller 2016):

(30) Albert learned that the managers dismissed the employee with poor sales after the annual performance review.
a. BARE: Who did Albert learn [whether they dismissed __ after the annual performance review]?
b. WHICH: Which employee did Albert learn [whether they dismissed __ after the annual performance review]?
c. BASELINE: Who did Albert learn [that they dismissed __ after the annual performance review]?

In addition, Hofmeister et al. (2013) showed that Superiority effects as in (31) can be reduced to processing difficulty that arises from memory retrieval and similarity-based interference. The authors found that as the semantic richness/informativity of *wh*-elements increases from (31a) to (31d), acceptability ratings increase and RT decrease at the verb *signed* and the following spillover region (32) in parallel ways. Sentences with only bare *wh*-word (31a) were rated the

---

[21] Besides filler type, Hofmeister & Sag (2011) showed that having an indefinite NP ('a report that...' vs. 'the report that...') inside the filler-gap dependency improves acceptability for wh-questions, consistent with the discourse clash approach of Abeillé et al. (2020).

lowest and read the slowest, while sentences including two *which*-NPs (31d) were judged as most acceptable and read the fastest. The two conditions including both a bare *wh*-word and a *which*-NP (31b-c) received intermediate ratings and reading times[22]. The authors further demonstrated that the acceptability amelioration effect holds not only for *which*-NPs, but also for other complex *wh*-phrases, such as *what book*.[23]

(31) a. ??Mary wondered what who read.
    b. Mary wondered which book who read.
    c. Mary wondered what which boy read.
    d. Mary wondered which book which boy read.

(32) Ashley disclosed (what/which agreement) (who/which diplomat) **signed after receiving permission** from the president.

4.1.2 Island effects explained by difficult retrieval from memory

Interference-based accounts attribute the unacceptability of extractions out of some island structures to processing difficulties due to retrieval across interfering constituents in the sentence. The magnitude of the interference effects may depend on factors such as the prominence of the interfering element and its similarity to the target constituent to be retrieved (Friedmann, Belletti & Rizzi 2009; Gordon, Hendrick & Johnson 2001; Keshev & Meltzer-Asscher 2019; Lewis, Vasishth & Van Dyke 2006; Van Dyke 2003; Van Dyke & McElree 2006; Vasishth & Lewis 2006; Villata, Tabor & Franck 2018).

Interference effects in filler-gap and cataphora dependencies across island structures.

Sprouse et al. (2016) demonstrated an interaction in acceptability ratings for *wh*-islands (33) relative to controls. They attributed this interaction to a syntactic factor, but as observed above, it could also result from other uncontrolled factors in the experimental design.

(33) What do you wonder [whether John bought __]?

Keshev & Meltzer-Asscher (2019) suggest that one uncontrolled factor is the complexity of the material between the filler and the gap: the extra *wh*-item between the filler and the gap could result in extra processing difficulty for the *wh*-island materials. In order to test this idea, Keshev

---

[22] The condition (b) was judged significantly more acceptable than (a) in Expt 2 and 4, but not in Expt 1 in Hofmeister et al. (2013). The authors concluded the results of Expt 1 were spurious null results.

[23] A related proposal for why semantically rich fillers lead to shorter retrieval times at the gap site of wh-dependencies is the D-linking hypothesis (Chung 1994; Pesetsky 2000), according to which semantically restrictive *wh*-phrases narrow down the list of candidate answers/focus alternatives -- a question starting with *which article* limits its answer to the set of articles, whereas a *what* question can target all non-human entities. It is claimed that this reduces the computational effort for answering a question for interrogatives with semantically richer *wh*-phrases.

& Meltzer-Asscher (2019) compared (Hebrew) materials with a long-distance filler-gap dependency (34) to matched materials with a long-distance anaphoric dependency as in (35):

(34) *Wh-island:*
ha-safranit mekira et ha-student ha-mitkaše še-ha-profesor ha-kašuax hisik **matai** ha-metargelet telamed (oto). oto=her=optional resumptive pronoun
'The librarian knows the weak student$_i$ that the strict professor gathered **when** the assistant will teach (her $_i$.'

(35) *Cataphora*
axrey še-ha-safraniyot hikiro ota, ha-profesor ha-kašuax hisik **matai** ha-metargelot yelamdu et ha-studentit ha-mitkaša.
'After librarians met the her$_i$, the strict professor gathered **when** the assistants will teach the weak student$_i$.'

Keshev & Meltzer-Asscher found a similar interaction in both filler-gap and cataphora dependencies. Thus, the unacceptability of extraction out of *wh*-islands may be best captured by encoding or retrieval interference, rather than ungrammaticality (c.f. Yoshida et al. 2014). These findings reveal that island phenomena may not be as special as initially claimed by structural accounts -- instead, they seem to be intrinsically similar to other types of filler-gap dependencies and even cataphora.

Interference effects in (Featural) Relativized Minimality

Rizzi (2013) proposes a structural account of interference effects. Relativized Minimality (Rizzi 1990) requires that no relation can hold between the extracted X and its trace Y if there is an intervening element Z that possesses some syntactic characteristics/features with X. Rizzi (2013) explains the unacceptability of wh-islands and relative clause islands through this same constraint ("Featural" Relativized Minimality, see also Friedmann, Belletti & Rizzi 2009; Villata, Tabor & Franck 2018). Example (36) illustrates this hypothesis: in (36a) *whether* is the intervening element between *what* and its trace, and both *whether* and *what* are syntactically similar -- [+wh] specifiers in A'-positions. In (36b) *who* is the intervening element.

(36) a. Wh-islands: * What$_{+WH}$ do you wonder [whether$_{+WH}$ John bought __]?
          X   Z   Y
    b. RC-islands: * What$_{+WH}$ do you look for the man [who$_{+WH}$ bought __]?
              X   Z   Y

Rizzi's account cannot explain observed interference effects in cataphora (Keshev & Meltzer-Asscher 2019, see above). Furthermore, interference effects were attested even when the interfering element/marking does not appear between the filler and the gap, but merely in the same sentence (Koesterich, Keshev & Meltzer-Asscher 2021).

Another piece of evidence that cannot easily be explained with Relativized Minimality comes from Atkinson et al. (2016), who tested interrogatives with extraction out of an embedded question (*wh*-islands). Their results show that participants give lower acceptability judgments to sentences with an intervening who (37a) than with an intervening which + N (37b).

(37)
a. **Which+WH athlete+N** did she wonder [**who+WH** would recruit ___]?
b. **Which+WH athlete+N** did she wonder [**which+WH coach+N** would recruit ___]?

Atkinson et al.'s results are unexpected under Featural Relativized Minimality, since there is more syntactic similarity between the filler and the intervening *which*-N in (37b) than between the filler and the intervening *who* in (37a). Instead these results corroborate Hofmeister et al.'s (2013) hypothesis that the semantic richness of the *wh*-elements increase acceptability ratings.

4.2 Lexical and construction frequency effects in some islands

It has been claimed that factive and manner-of-speaking verbs block wh-dependencies (38b-c) - so-called factive and manner-of-speaking islands, whereas verbs like say allow them (38a).

(38) a. Bridge verb
What did John say/think that Mary bought?
    b. Factive verb
?? What did John know/notice that Mary bought?
    c. Manner-of-speaking verb
?? What did John whisper/mutter that Mary bought?

Some previous studies attributed the unacceptability of examples like (38b) and (38c) to discourse (Ambridge & Goldberg 2008), syntactic (e.g., Kiparsky & Kiparsky 1970; Stowell 1981; Snyder 1992) or semantic factors (e.g., Kiparsky & Kiparsky 1970). But Liu et al. (2021) found that the observed sentence acceptability ratings are most simply explained by two factors: (i) verb-frame frequency -- the joint probability of the verb and it taking a sentence complement P(matrix verb, sentence complement), such that both filler-gap dependencies and their corresponding declaratives formed by verbs of lower verb-frame frequencies are less acceptable (cf. Dąbrowska 2008; Hale 2001; Hale 2003; Jurafsky 2003; Kothari 2008; Levy 2008a; Verhagen 2007); (ii) construction type, such that wh-questions and it-clefts are less acceptable than canonical declaratives. Liu et al. did not find any evidence of interactions between verb-frame frequency and construction type (wh-question or it-cleft vs. declarative), and hence no evidence for an independent factor that would cause acceptability degradation solely in filler-gap constructions but not in declaratives. Thus, the authors conclude that the low acceptability of filler-gap constructions formed by certain sentence complement verbs is due to

infrequent linguistic exposure (cf. Hsu & Griffiths 2016; Kidd, Lieven & Tomasello 2010; Navarro, Dry & Lee 2012; Voorspoels et al. 2015; Xu & Tenenbaum 2007).[24]

4.3 "Parasitic" gaps

Some unacceptable filler-gap dependencies seem to improve when there is a second dependency position ("gap"): the second gap has been called a "parasitic gap" (Engdahl, 1982). The competing theories discussed in this paper have different approaches to these phenomena.

According to the structural approach, the gap inside the island structure is proposed to be something other than a gap -- a silent pronoun -- and is only acceptable because it takes advantage of the other (licensed) gap (e.g., Cinque, 1990).

(39) This is a bill that [the senators who objected to __] would probably not benefit from __. (Chaves & Dery, 2014)

This view is challenged by the fact that materials often improve when both gaps are in two constructions considered as islands. See (40) with a gap as part of a subject (a subject island) and in an adjunct (an adjunct island) and (41) with a gap in both adjuncts.

(40) What kind of books do [the authors of __] argue about royalties [after writing __]? (Levine & Hukari, 2006, p. 256)

(41) [Which AC unit] did you drive Alex crazy [complaining about __] yesterday [after buying __ from Craigslist]? (Chaves & Putnam, 2020)

Discourse-based approaches often explain examples with one gap by some kind of pragmatic infelicity (see section 3.2 on relevance): the version with two gaps makes the extracted element more relevant for the proposition as a whole, since it plays two roles at the same time, hence making the sentence more acceptable.

The double gap effect may be best explained by a processing approach. For example, Chaves proposes that the gap-filling process reactivates the referent in the comprehender's memory, such that accessing this piece of information is later facilitated (Chaves, 2012a; Chaves & Dery, 2014, 2019; Culicover & Winkler, in press). This is supported by independent evidence from processing in Vasishth and Lewis (2006). Furthermore, having a second gap where the gap is most expected, as in (38), avoids a potential filled-gap effect.

---

[24] Building on Liu et al. (2019) (an earlier version of Liu et al., 2021), Richter & Chaves (2020) suggest that frequency is perhaps not a good explanation for island effects like those in (38). In their study, Richter & Chaves found that verb-bias towards an S or NP-complement did not predict the acceptability of their materials very well. But they did not investigate Liu et al.'s verb-frame frequency account: they only looked at verb-bias. In comparing the two approaches, Liu et al. (2021) found that verb-frame frequency is a better predictor of acceptability than verb-bias for their Experiment 2, with 45 of Richter & Chaves's verb set.

5. Summary and Conclusion

Ever since Ross (1967) first noticed the unacceptability of a variety of filler-gap structures in English, there have been numerous attempts to explain the unacceptability of these materials. We discussed three major types of approaches to island structures in this paper: structural accounts, functional/discourse accounts, and processing accounts. These approaches differ in the answers they provide to a number of general questions about the human capacity of language processing as summarized in Table 1.

	Structural accounts (e.g. Chomsky 1977; Chomsky 1986a)	Functional accounts (e.g. Goldberg 2006; Goldberg 2013; Abeillé et al. 2020a)	Processing accounts (e.g. Hofmeister & Sag 2010; Liu et al. 2021)
The source of the island	Structural rules governing movement, as part of the innate language faculty (e.g., Subjacency).	Inaccessibility of the gap site, or clash of function between the filler-gap construction and the domain containing the gap.	Processing difficulties, due to factors such as high working-memory load or low linguistic exposure.
Is gradience of island effects predicted?	Not straight-forwardly, but see Chomsky (1986a), Müller (1998), Uriagereka (2012)	Yes	Yes
Where grammar comes from	Innate language faculty	Exposure and statistical generalizations	Not at issue in these approaches
Prediction of cross-construction variation	No	Only for the discourse clash version, due to distinct functions of different constructions.	There is no explicit account predicting cross-construction variation, but such variation is possible, depending on the processing difficulty associated with each specific construction.
Prediction of cross-linguistic variation	Yes (e.g., Bounding nodes, the core concept of Subjacency, vary across languages).	No explicit account. Human communication is expected to use a strategy based on salient and backgrounded	To the extent that constructions vary in their usage across languages, this kind of

		information cross-linguistically. However, the details might differ cross-linguistically.	account is consistent with cross-linguistic variation (e.g., topicalization is more frequent in Norwegian than English (Kush, Lohndal & Sprouse 2019). In addition, differences in word order predict differences in processing difficulty across languages.
Learnability of the relevant grammatical knowledge	Some constraints are unlearnable	Grammatical knowledge is mostly learnable	Not at issue in these approaches

Table 1. The three approaches discussed in this paper and their prediction with respect to six major questions about the grammatical knowledge at the root of island effects

Chomsky's (1973, 1977, 1986) original approach was to suggest that there are possibly innate constraints on syntactic "movement", applying across constructions, possibly parameterized across languages. While this account was elegant in its simplicity and for its initial coverage of the original examples, it ended up not being able to account for many kinds of examples across many constructions. Furthermore, it had the additional weakness of requiring the assumption of innate structure, because, if the judgments were correct, then the system would not be learnable. The current state of the art suggests that this structure-based approach may be incorrect in its assumption of cross-construction uniformity of acceptability judgements. This may lead to a somewhat less elegant system than what Chomsky originally proposed, but it has the huge advantages of (a) empirical coverage; and (b) learnability.

Whereas the conjunct islands discussed in section 1.3 are still understood to be explained by a structural / meaning constraint, there is no strong evidence that structure is the source of the unacceptability of any other island structure. Rather, the current set of results from corpus studies and experiments suggests a more nuanced view, with gradient acceptability and cross construction variation, suggesting an important role of discourse, frequency, and memory constraints in explaining island phenomena as well as their counter-examples. We speculate that all of these island structures may eventually be fully explained in terms of discourse, frequency and memory constraints.

REFERENCES

Abeillé, Anne, Barbara Hemforth, Elodie Winckel & Edward Gibson. 2020a. Extraction from subjects: Differences in acceptability depend on the discourse function of the construction. *Cognition* 204. 104293. https://doi.org/10.1016/j.cognition.2020.104293 (21 August, 2020).

Abeillé, Anne, Barbara Hemforth, Elodie Winckel & Edward Gibson. 2020b. The subject island as a case of focus-background conflict. Talk presented at the Linguistic Evidence, Eberhard Karls Universität Tübingen, Tübingen.

Abeillé, Anne & Elodie Winckel. 2020. French subject island? Empirical studies of "dont" and "de qui." *Journal of French Language Studies* 1–26. https://doi.org/10.1017/S0959269520000137. https://www.cambridge.org/core/product/identifier/S0959269520000137/type/journal_article (21 August, 2020).

Acheson, Daniel J., Bradley R. Postle & Maryellen C. MacDonald. 2010. The interaction of concreteness and phonological similarity in verbal working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 36(1). 17–36. https://doi.org/10.1037/a0017679. http://doi.apa.org/getdoi.cfm?doi=10.1037/a0017679 (2 April, 2021).

Almeida, Diego. 2014. Subliminal wh-islands in brazilian Portuguese and the consequences for Syntactic theory. *Revista da ABRALIN* 13(2). https://doi.org/10.5380/rabl.v13i2.39611. http://revistas.ufpr.br/abralin/article/view/39611 (16 June, 2020).

Ambridge, Ben & Adele E. Goldberg. 2008. The island status of clausal complements: Evidence in favor of an information structure explanation. *Cognitive Linguistics* 19(3). https://doi.org/10.1515/COGL.2008.014. https://www.degruyter.com/view/j/cogl.2008.19.issue-3/cogl.2008.014/cogl.2008.014.xml (7 June, 2020).

Ambridge, Ben, Julian M. Pine & Elena V. M. Lieven. 2014. Child language acquisition: Why universal grammar doesn't help. *Language* 90(3). e53–e90. https://doi.org/10.1353/lan.2014.0051. http://muse.jhu.edu/content/crossref/journals/language/v090/90.3.ambridge.html (9 June, 2020).

Anderson, John R. 1983. *The architecture of cognition*. Harvard, MA: Harvard University Press.

Anderson, John R. & Lynne Reder. 1979. An elaborative processing explanation of depth of processing. In Laird Cermak & Fergus Craik (eds.), *Levels of processing in human memory*, 385–404. Hillsdale, NJ: Lawrence Erlbaum.

Atkinson, Emily, Aaron Apple, Kyle Rawlins & Akira Omaki. 2016. Similarity of wh-Phrases and Acceptability Variation in wh-Islands. *Frontiers in Psychology* 6. https://doi.org/10.3389/fpsyg.2015.02048. http://journal.frontiersin.org/Article/10.3389/fpsyg.2015.02048/abstract (30 March, 2021).

Boeckx, Cedric. 2012. *Syntactic islands* (Key Topics in Syntax). Cambridge and New York: Cambridge University Press.

Boston, Marisa Ferrara. 2012. A Computational Model of Cognitive Constraints in Syntactic

Locality. PhD dissertation, Cornell University.
[https://conf.ling.cornell.edu/Marisa/MarisaFerraraBostonDissertation.pdf]

Bradshaw, Gary L. & John R. Anderson. 1982. Elaborative encoding as an explanation of levels of processing. *Journal of Verbal Learning and Verbal Behavior* 21(2). 165–174. https://doi.org/10.1016/S0022-5371(82)90531-X. https://linkinghub.elsevier.com/retrieve/pii/S002253718290531X (25 March, 2021).

Bresnan, Joan, Ash Asudeh, Ida Toivonen & Stephen Wechsler. 2015. *Lexical-functional syntax* (Blackwell Textbooks in Linguistics). Second edition. Malden, MA : Chichester, West Sussex: Wiley-Blackwell.

Chaves, Rui P. 2012. On the grammar of extraction and coordination. *Natural Language and Linguistic Theory* 2(30). 465–512.

Chaves, Rui P. & Jeruen E. Dery. 2019. Frequency effects in subject islands. *Journal of linguistics* 55(3). 475–521. https://doi.org/10.1017/S0022226718000294.

Chaves, Rui P. & Adriana King. 2019. A usage-based account of subextraction effects. *Cognitive Linguistics* 30(4). 719–750. https://doi.org/10.1515/cog-2018-0135. https://www.degruyter.com/doi/10.1515/cog-2018-0135 (20 July, 2020).

Chaves, Rui P & Michael T Putnam. 2020. *Unbounded dependency constructions: theoretical and experimental perspectives*.

Cheng, Lisa Lai-Shen. "Wh-in-situ, from the 1980s to Now." Language and Linguistics Compass 3.3 (2009): 767-791.

Chomsky, Noam. 1964. Current issues in linguistic theory. In Jerry A. Fodor & Jerrold J. Katz (eds.), *The structure of language: readings in the philosophy of language*, 50–118. Prentice Hall. Englewood Cliffs, NJ.

Chomsky, Noam. 1965. *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press.

Chomsky, Noam. 1973. Conditions on transformations. In Steven Anderson & Paul Kiparsky (eds.), *A festschrift for Morris Halle*, 232–285. New York: Winston.

Chomsky, Noam. 1977. On wh-movement. In Peter W. Culicover, Thomas Wasow & Adrian Akmajian (eds.), *Formal syntax*, 71–132. New York: Academic Press.

Chomsky, Noam. 1981. *Lectures on Government and Binding*. Berlin: Mouton de Gruyter.

Chomsky, Noam. 1986a. *Barriers*. Mass.: MIT Press.

Chomsky, Noam. 1986b. *Knowledge of Language: Its Nature, Origin, and Use*. Greenwood Publishing Group.

Chomsky, Noam & George A. Miller. 1963. Introduction to the formal analysis of natural language. In R. Duncan Luce, Robert R. Bush & Eugene Galanter (eds.), *Handbook of mathematical psychology*, vol. 2, 269–321. New York: John Wiley.

Chung, Sandra. 1994. Wh-Agreement and 'Referentiality' in Chamorro. *Linguistic Inquiry* 25(1). 1–44. www.jstor.org/stable/4178847 (2 April, 2021).

Cinque, Guglielmo. 1990. Types of Ā-dependencies. Cambridge MA: MIT Press.

Clifton, Charles & Lyn Frazier. 1989. Comprehending sentences with long distance dependencies. In Gregory N. Carlson & Michael K. Tannenhaus (eds.), *Linguistic structure in language processing*, 272–317. Dordrecht: Kluwer.

Culicover, Peter and Suzanne Winkler. In press. The uninvited guest, Linguistic review.

Dąbrowska, Ewa. 2008. Questions with long-distance dependencies: A usage-based perspective. *Cognitive Linguistics* 19(3). 391–425. https://doi.org/10.1515/COGL.2008.015.

https://www.degruyter.com/document/doi/10.1515/COGL.2008.015/html (3 April, 2021).

Davies, W.D. & Dubinsky, Stan. (2003). On extraction from NPs. Natural Language and Linguistic Theory, 21, 1-37.

Deane, Paul. 1991. Limits to Attention: A Cognitive Theory of Island Phenomena. *Cognitive Linguistics* 2(1). 1–63.

Dillon, Brian & Norbert Hornstein. 2013. On the structural nature of island constraints. In Jon Sprouse & Norbert Hornstein (eds.), *Experimental Syntax and Island Effects*, 208–220. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781139035309.011. https://www.cambridge.org/core/product/identifier/9781139035309%23c00870-904/type/book_part (31 March, 2021).

Donkers, Jantien, John C. J. Hoeks & Laurie A. Stowe. 2011. D-linking or set-restriction? Processing *Which* -questions in Dutch. *Language and Cognitive Processes* 28(1–2). 9–28. https://doi.org/10.1080/01690965.2011.566343. http://www.tandfonline.com/doi/abs/10.1080/01690965.2011.566343 (2 April, 2021).

Engdahl, E. 1982. Restrictions on Unbounded Dependencies in Swedish. In E. Engdahl & E. Ejerhed, editors, Readings on Unbounded Dependencies in Scandinavian Languages, Stockholm: Almquist & Wiksell International, 151-174.

Erteschik-Shir, Nomi. 1973. *On the nature of island constraints*. MIT.

Erteschik-Shir, Nomi. 2006. What's What? In Gisbert Fanselow, Caroline Féry, Matthias Schlesewsky & Ralf Vogel (eds.), *Gradience in Grammar: Generative Perspectives*, 317–335. Oxford: Oxford University Press.

Erteschik-Shir, Nomi. 2007. *Information Structure: The Syntax-Discourse Interface*. Oxford University Press. Oxford.

Fiebach, Christian J., Matthias Schlesewsky & Angela D. Friederici. 2001. Syntactic working memory and the establishment of filler-gap dependencies: Insights from ERPs and fMRI. *Journal of Psycholinguistic Research* 30. 321–338.

Frazier, Lyn. 1987. Syntactic processing: evidence from Dutch. *Natural Language and Linguistic Theory* 5. 519–559.

Friedmann, Naama, Adriana Belletti & Luigi Rizzi. 2009. Relativized relatives: Types of intervention in the acquisition of A-bar dependencies. *Lingua* 119(1). 67–88. https://doi.org/10.1016/j.lingua.2008.09.002. https://linkinghub.elsevier.com/retrieve/pii/S0024384108001563 (30 March, 2021).

Futrell, R., Gibson, E., & Levy, R.P. (2020). Lossy-Context Surprisal: An Information-Theoretic Model of Memory Effects in Sentence Processing. Cognitive Science 44, e12814, DOI: 10.1111/cogs.12814

Futrell, Richard, Roger Levy & Edward Gibson. 2020. Dependency locality as an explanatory principle for word order. *Language* 96(2). 371–413.

Futrell, Richard, Kyle Mahowald & Edward Gibson. 2015. Large-scale evidence of dependency length minimization in 37 languages. *Proceedings of the National Academy of Sciences* 112(33). 10336–10341. https://doi.org/10.1073/pnas.1502134112. http://www.pnas.org/lookup/doi/10.1073/pnas.1502134112 (2 April, 2021).

Gibson, Edward. 1998. Linguistic complexity: Locality of syntactic dependencies. *Cognition* 68.

1–76.

Gibson, Edward. 2000. The dependency locality theory: A distance-based theory of linguistic complexity. In Alec Marantz, Yasushi Miyashita & Wayne O'Neil (eds.), *Image, Language, Brain*, 95–126. MIT Press.

Gibson, E., Bergen, L., & Piantadosi, S. T. (2013). Rational integration of noisy evidence and prior semantic expectations in sentence interpretation. Proceedings of the National Academy of Sciences, 110(20), 8051–8056. https://doi.org/10.1073/pnas.1216438110

Gibson, Edward, Barbara Hemforth, Elodie Winckel & Anne Abeillé. 2021. Acceptability of extraction out of adjuncts depends on discourse factors. Poster presented at the 34th Annual CUNY Sentence Processing Conference, virtually at the University of Pennsylvania. https://www.cuny2021.io/2021/02/24/148/.

Gibson, Edward & Gregory Scontras. 2013. Working memoryand syntactic islands revisited. Poster presented at the 26th Annual CUNY Conference on Human Sentence Processing, University of Florida, Gainesville, Florida.

Gibson, E. & Thomas, J. (1999). Memory limitations and structural forgetting: The perception of complex ungrammatical sentences as grammatical. Language and Cognitive Processes 14(3): 225-248.

Goldberg, Adele E. 1995. *Constructions: A Construction Grammar Approach to Argument Structure*. University of Chicago Press.

Goldberg, Adele E. 2006. *Constructions at Work*. Oxford: Oxford University Press.

Goldberg, Adele E. 2013. Backgrounded constituents cannot be extracted. In Jon Sprouse & Norbert Hornstein (eds.), *Experimental Syntax and Island Effects*. Cambridge University Press.

Goldsmith, John A. 1985. A Principled Exception to the Coordinate Structure Constraint. In *Papers from the General Session at the Twenty-First Regional Meeting*, vol. 21(1), 133–143.

Gordon, Peter C., Randall Hendrick & Marcus Johnson. 2001. Memory interference during language processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 27(6). 1411–1423. https://doi.org/10.1037/0278-7393.27.6.1411. http://doi.apa.org/getdoi.cfm?doi=10.1037/0278-7393.27.6.1411 (30 March, 2021).

Grodner, Daniel & Edward Gibson. 2005. Consequences of the Serial Nature of Linguistic Input for Sentential Complexity. *Cognitive Science* 29(2). 261–290. https://doi.org/10.1207/s15516709cog0000_7. http://doi.wiley.com/10.1207/s15516709cog0000_7 (2 April, 2021).

Grosu, Alexander. 1973. On the Nonunitary Nature of the Coordinate Structure Constraint. Linguistic Inquiry 4, 88–92.

Hale, John T. 2001. A probabilistic earley parser as a psycholinguistic model. In *Second meeting of the North American Chapter of the Association for Computational Linguistics on Language technologies 2001 - NAACL '01*, 1–8. Pittsburgh, Pennsylvania: Association for Computational Linguistics. https://doi.org/10.3115/1073336.1073357. http://portal.acm.org/citation.cfm?doid=1073336.1073357 (3 April, 2021).

Hale, John T. 2003. *Grammar, Uncertainty and Sentence Processing*. Baltimore: John Hopkins University Ph.D. Thesis. https://courses.cit.cornell.edu/jth99/hale-diss.pdf.

Hawkins, John A. 1999. Processing Complexity and Filler-Gap Dependencies across Grammars.

Language 75(2). 244. https://doi.org/10.2307/417261. http://lingo.stanford.edu/sag/L222B/papers/Hawkins1999.pdf.

Hoekstra, Teun & Jan G. Kooij. 1988. The innateness hypothesis. In John A. Hawkins (ed.), *Explaining language universals*, 31–55. Oxford, UK: Blackwell.

Hofmeister, Philip. 2007. *Representational complexity and memory retrieval in language comprehension*. Stanford, CA: Stanford University Ph.D. Thesis.

Hofmeister, Philip. 2011. Representational complexity and memory retrieval in language comprehension. *Language and Cognitive Processes* 26(3). 376–405. https://doi.org/10.1080/01690965.2010.492642. http://www.tandfonline.com/doi/abs/10.1080/01690965.2010.492642 (6 May, 2020).

Hofmeister, Philip, Laura Staum Casasanto & Ivan A. Sag. 2012. Misapplying working-memory tests: A reductio ad absurdum. *Language* 88(2). 408–409. https://doi.org/10.1353/lan.2012.0033. http://muse.jhu.edu/content/crossref/journals/language/v088/88.2.hofmeister01.html (2 April, 2021).

Hofmeister, Philip, Laura Staum Casasanto & Ivan A. Sag. 2013. Islands in the grammar? Standards of evidence. In Jon Sprouse & Norbert Hornstein (eds.), *Experimental Syntax and Island Effects*, 42–63. Cambridge: Cambridge University Press.

Hofmeister, Philip & Ivan A. Sag. 2010. Cognitive constraints and island effects. *Language* 86(2). 366–415.

Hofmeister, Philip, Laura C. Staum & Ivan A. Sag. 2012. How do individual cognitive differences relate to acceptability judgments? A reply to Sprouse, Wagers, and Phillips. *Language* 88(2). 390–400.

Hsiao, Yaling, Yannan Gao & Maryellen C. MacDonald. 2014. Agent-patient similarity affects sentence structure in language production: evidence from subject omissions in Mandarin. *Frontiers in Psychology* 5. https://doi.org/10.3389/fpsyg.2014.01015. http://journal.frontiersin.org/article/10.3389/fpsyg.2014.01015/abstract (5 April, 2021).

Hsu, Anne & Thomas L. Griffiths. 2016. Sampling Assumptions Affect Use of Indirect Negative Evidence in Language Learning. (Ed.) Robert C Berwick. *PLOS ONE* 11(6). e0156597. https://doi.org/10.1371/journal.pone.0156597. https://dx.plos.org/10.1371/journal.pone.0156597 (5 April, 2021).

Huang, C.-T. J. 1982. *Logical relations in Chinese and the theory of grammar: Ph.D Thesis*. Cambridge, Mass.: MIT Ph.D. Thesis.

Jin, Dawei. 2019. A semantic account of quantifier-induced intervention effects in Chinese why-questions. Linguistics and Philosophy 43, 345–387 (2020). https://doi.org/10.1007/s10988-019-09270-x

Jurafsky, Dan. 2003. Probabilistic modeling in psycholinguistics: Linguistic comprehension and production. In Rens Bod, Jennifer Hay & Stefanie Jannedy (eds.), *Probabilistic linguistics*. Cambridge, MA: MIT Press.

Kehler, Andrew. 2002. *Coherence, reference, and the theory of grammar* (CSLI Lecture Notes no. 104). Stanford, CA: CSLI Publications.

Keller, Frank. 2000. Gradience in grammar. PhD dissertation, University of Edinburgh.

Keshev, Maayan & Aya Meltzer-Asscher. 2019. A processing-based account of subliminal wh-island effects. *Natural Language and Linguistic Theory* 37(2). 621–657.

Kidd, Evan, Elena V.M. Lieven & Michael Tomasello. 2010. Lexical frequency and exemplar-based learning effects in language acquisition: evidence from sentential complements. *Language Sciences* 32(1). 132–142. https://doi.org/10.1016/j.langsci.2009.05.002. https://linkinghub.elsevier.com/retrieve/pii/S0388000109000254 (5 April, 2021).

King, Jonathan & Marcel Adam Just. 1991. Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language* 30(5). 580–602. https://doi.org/10.1016/0749-596X(91)90027-H. https://linkinghub.elsevier.com/retrieve/pii/0749596X9190027H (2 April, 2021).

Kiparsky, Paul & Carol Kiparsky. 1970. FACT. In Manfred Manfred & Karl E. Heidolph (eds.), *Progress in Linguistics*. Berlin: De Gruyter. https://www.degruyter.com/view/book/9783111350219/10.1515/9783111350219.143.xml (28 August, 2020).

Kluender, Robert. 1991. *Cognitive constraint on variables in syntax*. San Diego: University of California.

Kluender, Robert. 2004. Are subject islands subject to a processing account? In B. Schmeiser, V. Chand, A. Kelleher & A. Rodriguez (eds.), *Proceedings of the WCCFL*, vol. 23, 101–125. Somerville, MA: Cascadilla Press.

Kluender, Robert & Marta Kutas. 1993a. Bridging the Gap: Evidence from ERPs on the Processing of Unbounded Dependencies. *Journal of Cognitive Neuroscience* 5(2). 196–214.

Kluender, Robert & Marta Kutas. 1993b. Subjacency as a processing phenomenon. *Language and Cognitive Processes* 8. 573–633.

Koesterich, Niki, Maayan Keshev & Aya Meltzer-Asscher. 2021. Encoding interference in filler-gap and filler-resumptive dependencies. Talk presented at the 34th Annual CUNY Conference on Human Sentence Processing, virtually at the University of Pennsylvania. https://mkeshev.files.wordpress.com/2021/03/cuny2021_interferencerptalk.pdf.

Kothari, Anubha. 2008. Frequency-based expectations and context influence bridge quality. In Michael Grosvald & Dionne Soares (eds.), *Proceedings of WECOL 2008*. UC Davis Department of Linguistics.

Kroch, Anthony S. 1998. Amount quantification, referentiality, and long wh- movement. In *University of Pennsylvania Working Papers in Linguistics*, vol. 5(2), Article 3. Philadelphia, PA: University of Pennsylvania.

Kuno, Susumu. 1987. *Functional syntax – anaphora, discourse and empathy*. Chicago, IL & London: The University of Chicago Press.

Kush, Dave, Terje Lohndal & Jon Sprouse. 2018. Investigating variation in island effects: A case study of Norwegian wh-extraction. *Natural Language & Linguistic Theory* 36(3). 743–779. https://doi.org/10.1007/s11049-017-9390-z. http://link.springer.com/10.1007/s11049-017-9390-z (23 March, 2021).

Kush, Dave, Terje Lohndal & Jon Sprouse. 2019. On the island sensitivity of topicalization in Norwegian: An experimental investigation. *Language (Baltimore)* 95(3). 393–420.

Lakoff, George. 1986. Frame Semantic Control of the Coordinate Structure Constraint. In *Papers from the 22nd Regional Meeting of the Chicago Linguistic Society, Ch*. Chicago, IL: Chicago Linguistic Society.

Levy, Roger. 2008a. Expectation-based syntactic comprehension. *Cognition* 106(3). 1126–1177.

https://doi.org/10.1016/j.cognition.2007.05.006.
https://linkinghub.elsevier.com/retrieve/pii/S0010027707001436 (7 June, 2020).

Levy, Roger.. 2008b. A noisy-channel model of rational human sentence comprehension under uncertain input. Proceedings of the Conference on Empirical Methods in Natural Language Processing - EMNLP '08, 234. https://doi.org/10.3115/1613715.1613749

Lewis, Richard L. & Shravan Vasishth. 2005. An activation-based model of sentence processing as skilled memory retrieval. *Cognitive Science* 29. 375–419.

Lewis, Richard L., Shravan Vasishth & Julie A. Van Dyke. 2006. Computational principles of working memory in sentence comprehension. *Trends in Cognitive Sciences* 10(10). 447–454. https://doi.org/10.1016/j.tics.2006.08.007.
https://linkinghub.elsevier.com/retrieve/pii/S1364661306002142 (2 April, 2021).

Liu, Yingtong, Rachel Ryskin, Richard Futrell & Edward Gibson. 2019. Verb frequency explains the unacceptability of factive and manner-of-speaking islands in English. In *Proceedings of the 41st Annual Conference of the Cognitive Science Society*, 685–691. Montreal, QB.

Liu, Y., Ryskin, R., Futrell, R., & Gibson, E. (2021). A Verb-frame Frequency Account of Constraints on Long-Distance Dependencies in English. Cognition, 104902. DOI: 10.1016/j.cognition.2021.104902

Lu, Jiayi, Cynthia K. Thompson, and Masaya Yoshida. "Chinese wh-in-situ and islands: A formal judgment study." Linguistic Inquiry 51.3 (2020): 611-623.

McCawley, James D. 1981. The syntax and semantics of English relative clauses. *Lingua* 53(2–3). 99–149. https://doi.org/10.1016/0024-3841(81)90014-0.
https://linkinghub.elsevier.com/retrieve/pii/0024384181900140 (18 October, 2021).

McDaniel, Mark A., Paul K. Dunay, Brian J. Lyman & Mary Louise E. Kerwin. 1988. Effects of Elaboration and Relational Distinctiveness on Sentence Memory. *The American Journal of Psychology* 101(3). 357. https://doi.org/10.2307/1423084.
https://www.jstor.org/stable/1423084?origin=crossref (3 April, 2021).

Müller, Stefan. 2016. *Grammatical theory: From transformational grammar to constraint-based approaches. Fourth revised and extended edition* (Textbooks in Language Sciences). Berlin: Language Science Press. https://doi.org/10.5281/ZENODO.3992307.
https://zenodo.org/record/3992307 (2 April, 2021).

Navarro, Daniel J., Matthew J. Dry & Michael D. Lee. 2012. Sampling Assumptions in Inductive Generalization. *Cognitive Science* 36(2). 187–223. https://doi.org/10.1111/j.1551-6709.2011.01212.x. http://doi.wiley.com/10.1111/j.1551-6709.2011.01212.x (5 April, 2021).

Nishigauchi, Taisuke. "Construing wh." Quantification in the Theory of Grammar. Springer, Dordrecht, 1990. 116-176.

Newmeyer, Frederick J. 1991. Functional explanation in linguistics and the origins of language. *Language & Communication* 11(1–2). 3–28. https://doi.org/10.1016/0271-5309(91)90011-J. https://linkinghub.elsevier.com/retrieve/pii/027153099190011J (30 March, 2021).

Paape, D., Vasishth, S., & von der Malsburg, T. (2020). Quadruplex negatio invertit? The on-line processing of depth charge sentences. Journal of Semantics, 37(4), 509–555.
https://doi.org/10.1093/jos/ffaa009

Pesetsky, David Michael. 2000. *Phrasal movement and its kin* (Linguistic Inquiry Monographs

37). Cambridge, Mass: MIT Press.

Phillips, Colin. 2006. The Real-Time Status of Island Phenomena. *Language* 82(4). 795–823.

Pollard, Carl J. & Ivan A. Sag. 1994. *Head-driven phrase structure grammar* (Studies in Contemporary Linguistics). Stanford, California: Center for the Study of Language and Information u.a.

Pozniak, Céline & Barbara Hemforth. 2015. *Processing subject and object relative clauses in French and Mandarin Chinese*.

Pritchett, Bradley L. 1991. Subjacency in a Principle-Based Parser. In Robert C. Berwick, Steven P. Abney & Carol Tenny (eds.), *Principle-Based Parsing* (Studies in Linguistics and Philosophy), vol. 44, 301–345. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-011-3474-3_12. http://link.springer.com/10.1007/978-94-011-3474-3_12 (30 March, 2021).

Reder, Lynne M. 1980. The Role of Elaboration in the Comprehension and Retention of Prose: A Critical Review. *Review of Educational Research* 50(1). 5–53. https://doi.org/10.3102/00346543050001005. http://journals.sagepub.com/doi/10.3102/00346543050001005 (2 April, 2021).

Reder, Lynne M., Davida H. Charney & Kim I. Morgan. 1986. The role of elaborations in learning a skill from an instructional text. *Memory & Cognition* 14(1). 64–78. https://doi.org/10.3758/BF03209230. http://link.springer.com/10.3758/BF03209230 (2 April, 2021).

Richter, Stephanie, and Rui Chaves. 2020. "Investigating the Role of Verb Frequency in Factive and Manner-of-speaking Islands." Proceedings of the Cognitive Science Society. 2020.

Rizzi, Luigi. 1990. *Relativized minimality* (Linguistic Inquiry Monographs). Vol. 16. Cambridge, Mass.: MIT Press.

Rizzi, Luigi. 2013. Locality. *Lingua* 130. 169–186. https://doi.org/10.1016/j.lingua.2012.12.002. https://linkinghub.elsevier.com/retrieve/pii/S0024384112002768 (30 March, 2021).

Rizzi, Luigi. 2017. Uniqueness Of Left Peripheral Focus, "Further Explanation", And Int. In Laura R. Bailey & Michelle Sheehan (eds.), *Order and structure in syntax I: Word order and syntactic structure*, 333–343. Berlin: Language Science Press. https://doi.org/10.5281/ZENODO.1117718. https://zenodo.org/record/1117718 (23 February, 2021).

Ross, John Robert. 1967. *Constraints on variables in syntax*. Cambridge. MA.: MIT Ph.D Thesis. http://hdl.handle.net/1721.1/15166.

Sag, Ivan A. 2010. English filler-gap constructions. *Language* 86(3). 486–545. https://doi.org/10.1353/lan.2010.0002.

Schütze, Carson T., Jon Sprouse & Ivano Caponigro. 2015. Challenges for a theory of islands: A broader perspective on Ambridge, Pine, and Lieven. *Language* 91(2). e31–e39. https://doi.org/10.1353/lan.2015.0014. https://muse.jhu.edu/content/crossref/journals/language/v091/91.2.schutze.html (7 June, 2020).

Shannon, C. E. (1948). A mathematical theory of communication. The Bell System Technical Journal, 27(3), 379–423.

Simonenko, Alexandra. 2015. Semantics of DP islands: The case of questions. *Journal of Semantics* 32(3).

Snyder, William. 1992. Wh-extraction and the lexical representation of verbs. Unpublished manuscript. MIT, Cambridge, MA, ms. http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=A0BA5EE6A9CDDBCD75A7FE4BAF68C7E5?doi=10.1.1.728.1025&rep=rep1&type=pdf (2 April, 2021).

Sprouse, Jon. 2007. *A program for Experimental Syntax: Finding the relationship between acceptability and grammatical knowledge*. University of Maryland Ph.D. Thesis.

Sprouse, Jon, Ivano Caponigro, Ciro Greco & Carlo Cecchetto. 2016. Experimental syntax and the variation of island effects in English and Italian. *Natural Language & Linguistic Theory* 34(1). 307–344. https://doi.org/10.1007/s11049-015-9286-8. http://link.springer.com/10.1007/s11049-015-9286-8 (6 June, 2020).

Sprouse, Jon, Matt Wagers & Colin Phillips. 2012. A test of the relation between working-memory capacity and syntactic island effects. *Language* 88(1). 82–123. https://doi.org/10.1353/lan.2012.0004. http://muse.jhu.edu/content/crossref/journals/language/v088/88.1.sprouse.html (6 June, 2020).

Sprouse, J., Schütze, C. T., & Almeida, D. (2013). A comparison of informal and formal acceptability judgments using a random sample from Linguistic Inquiry 2001–2010. Lingua, 134, 219–248.

Stowe, Laurie A. 1986. Parsing WH-constructions: Evidence for on-line gap location. *Language and Cognitive Processes* 1(3). 227–245. https://doi.org/10.1080/01690968608407062. http://www.tandfonline.com/doi/abs/10.1080/01690968608407062 (18 March, 2020).

Stowell, Timothy A. 1981. *Origins of phrase structure*. Cambridge, MA: MIT Ph.D. Thesis. http://www.ai.mit.edu/projects/dm/theses/stowell81.pdf (2 April, 2021).

Szabolcsi, Anna & Terje Lohndal. 2017. Strong vs. Weak Islands. In Martin Everaert & Henk C. van Riemsdijk (eds.), *The Wiley Blackwell Companion to Syntax, Second Edition*, 1–51. Hoboken, NJ, USA: John Wiley & Sons, Inc. https://doi.org/10.1002/9781118358733.wbsyncom008. http://doi.wiley.com/10.1002/9781118358733.wbsyncom008 (13 July, 2020).

Tollan, Rebecca & Bilge Palaz. 2021. The dual nature of subjecthood: Unifying subject islands and that-trace effects. Talk presented at the 34th Annual CUNY Conference on Human Sentence Processing, virtually at the University of Pennsylvania. https://www.cuny2021.io/wp-content/uploads/2021/02/CUNY_2021_abstract_67.pdf.

Tollan, Rebecca & Daphna Heller. 2016. Elvis Presley on an island: wh dependency formation inside complex NPs. In *Proceedings of the 46th Meeting of the North East Linguistic Society*. University of Massachusetts, Amherst, MA.: GSLA.

Truswell, Robert. 2007. Tense, Events, and Extraction from Adjuncts. In *Proceedings from the Annual Meeting of the Chicago Linguistic Society*, vol. 43(2), 233–247. Chicago, IL: Chicago Linguistic Society.

Van Dyke, J. 2003. Distinguishing effects of structure and decay on attachment and repair: A cue-based parsing account of recovery from misanalyzed ambiguities. *Journal of Memory and Language* 49(3). 285–316. https://doi.org/10.1016/S0749-596X(03)00081-0. https://linkinghub.elsevier.com/retrieve/pii/S0749596X03000810 (2 April, 2021).

Van Dyke, Julie A. & Richard L. Lewis. 2003. Distinguishing effects of structure and decay on attachment and repair: A cue-based parsing account of recovery from misanalyzed

ambiguities. *Journal of Memory and Language* 49(3). 285–316. https://doi.org/10.1016/S0749-596X(03)00081-0. https://linkinghub.elsevier.com/retrieve/pii/S0749596X03000810 (5 April, 2021).

Van Dyke, Julie A. & Brian McElree. 2006. Retrieval interference in sentence comprehension. *Journal of Memory and Language* 55(2). 157–166. https://doi.org/10.1016/j.jml.2006.03.007. https://linkinghub.elsevier.com/retrieve/pii/S0749596X0600043X (2 April, 2021).

Vasishth, Shravan & Lewis. 2006. Argument-head distance and processing complexity: explaining both locality and antilocality effects. *Language* 82(4). 767–794.

Verhagen, Arie. 2007. *Constructions of Intersubjectivity*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199226702.001.0001. https://oxford.universitypressscholarship.com/view/10.1093/acprof:oso/9780199226702.001.0001/acprof-9780199226702 (5 April, 2021).

Villata, Sandra, Whitney Tabor & Julie Franck. 2018. Encoding and retrieval interference in sentence comprehension: Evidence from agreement. *Frontiers in Psychology* 9. 2. https://doi.org/10.3389/fpsyg.2018.00002. https://www.frontiersin.org/article/10.3389/fpsyg.2018.00002.

Voorspoels, Wouter, Daniel J. Navarro, Amy Perfors, Keith Ransom & Gert Storms. 2015. How do people learn from negative evidence? Non-monotonic generalizations and sampling assumptions in inductive reasoning. *Cognitive Psychology* 81. 1–25. https://doi.org/10.1016/j.cogpsych.2015.07.001. https://linkinghub.elsevier.com/retrieve/pii/S0010028515000493 (5 April, 2021).

Vries, Gertrud de. 1992. *On Coordination and Ellipsis*. Catholic University of Brabant Ph.D. Thesis.

Warren, Tessa & Edward Gibson. 2002. The influence of referential processing on sentence complexity. *Cognition* 85(1). 79–112. https://doi.org/10.1016/S0010-0277(02)00087-2. https://linkinghub.elsevier.com/retrieve/pii/S0010027702000872 (11 February, 2021).

Weskott, T., & Fanselow, G. (2011). On the informativity of different measures of linguistic acceptability. Language, 249–273.

Wiseman, Sandor, Colin M. MacLeod & P. J. Lootsteen. 1985. Picture recognition improves with subsequent verbal information. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 11(3). 588–595. https://doi.org/10.1037/0278-7393.11.3.588. http://doi.apa.org/getdoi.cfm?doi=10.1037/0278-7393.11.3.588 (3 April, 2021).

Xu, Fei & Joshua B. Tenenbaum. 2007. Word learning as Bayesian inference. *Psychological Review* 114(2). 245–272. https://doi.org/10.1037/0033-295X.114.2.245. http://doi.apa.org/getdoi.cfm?doi=10.1037/0033-295X.114.2.245 (5 April, 2021).

Yoshida, Masaya, Nina Kazanina, Leticia Pablos & Patrick Sturt. 2014. On the origin of islands. *Language, Cognition and Neuroscience* 29(7). 761–770. https://doi.org/10.1080/01690965.2013.788196. http://www.tandfonline.com/doi/abs/10.1080/01690965.2013.788196 (14 June, 2020).