

Are Subject Islands Subject to a Processing Account?

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1. Introduction

In previous work (Kluender 1991, 1992, 1998; Kluender and Kutas 1993b) I have argued for the possibility of accounting for weak islands, notably *wh*-islands, on the basis of general and independent facts of processing. These arguments were based on primary linguistic data – many of them drawn from the generative literature of the past thirty years – acceptability judgment tasks, and event-related brain potential (ERP) measurements of the on-line processing of various types of questions in English. In this work, it was further noted on the basis of primary linguistic data alone that similar facts seemed to apply in the case of complex noun phrase constraint (CNPC) violations as well. While this is not particularly surprising with regard to the complement clause subcase of the CNPC constraint (Chomsky 1986), as *wh*-islands are also complement clauses, it was a little more surprising that such factors would play a similar role in the amelioration of the relative clause subcase of the CNPC.

To be more specific, the reason this was surprising is that relative clauses have for over the past thirty years been consistently viewed as strong island contexts. That is, one might reasonably expect effects of processing to play a role in the acceptability and interpretability of *wh*-islands and the complement clause subcase of the CNPC, as both are considered weak island contexts. However, in the case of relative clauses, as with all strong island contexts, something above and beyond the structural configuration that pertains in weak island contexts, namely some additional factor like the empty category principle (ECP; Chomsky 1981), has been assumed to play a causal role. Thus one might not automatically expect purely syntactic factors such as these to be as susceptible to considerations of processing during comprehension.

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Nevertheless, despite the solid empirical base for claims about the influence of processing in weak island contexts, and the apparent reasonable soundness of extending this account to relative clause island contexts, there has never been much reason to believe that processing plays a huge role in the processing of other strong islands, such as subject islands and adjunct islands. In other words, while processing accounts of *wh*-islands and CNPC islands seem successful enough, there has never been any strong indication that the account could be exploited in any obvious way to allow more general coverage.

The purpose of this paper is to revisit this issue in light of some new ways of viewing subject island contexts. My claim here will be that while subject islands may not be subject to the exact same processing account as applies in complement (including *wh*-island) and relative clauses, the same general processing factors will apply in a slightly different way to subject islands to render them difficult-to-impossible to interpret. The extent to which this claim is true can give added teeth to the larger claim that in accounting for island phenomena, one should not *a priori* exclude processing facts from consideration as an explanatory mechanism.

The structure of the paper is as follows. In Section 2 I review the account of *wh*- and relative clause islands proposed in earlier work. In Section 3 I discuss what is known from child and adult language production studies, as well as from both comprehension and production studies of the elderly, with regard to the processing of subjects in general, and of complex subjects in particular. These data suggest that working memory constraints on storage and discourse reference play as big a role in the processing of subjects as they do in the processing of complement and relative clauses, but in a slightly altered way. Section 4 presents new data on variability in the acceptability and interpretability of subject island violations, marshalling independently required principles of processing to account for these facts. It further suggests that our ability to register these differences is dependent on processing factors that also play a role in the interpretation of other types of island violations, namely the presence of overt subjects and finite verb forms. I conclude in Section 5 with a summary of the analysis, a brief acknowledgement of remaining problems in extraction that need to be tackled, and a prognosis for the prospects of this general approach in future.

2. *Wh*- and relative clause islands

As the results of this research are covered extensively elsewhere (Kluender 1991, 1992, 1998; Kluender and Kutas 1993b), I will attempt only a summary here; I refer the reader to the sources above for additional details. The processing account of *wh*- and relative clause islands relies on two simple facts: (1) all processing studies to date consistently show that

comprehenders disprefer object *wh*-dependencies, and (2) the need to access discourse referents at clause boundaries imposes an extra processing burden. Both phenomena have been characterized as effects of verbal working memory in sentence processing. It is the interaction of these two effects that results in the perception of ungrammaticality under extraction from embedded contexts, enshrined in the syntactic literature as islandhood. Let us look at each of these effects in turn.

2.1. The dispreference for object dependencies

Over the past ten years or so, a substantial body of literature has accumulated demonstrating consistently that comprehenders find it taxing to maintain a long-distance relationship between two sentence constituents (or syntactic positions) necessary for successful sentence interpretation. This has been studied most intensively with regard to subject vs. object relative clauses and *wh*-questions.¹ Generally speaking, subject relative clauses and *wh*-questions are preferred over – and easier to process than – object relative clauses and *wh*-questions. The evidence comes from a variety of measures, including reading times (King and Just 1991), acceptability judgments (Kluender and Kutas 1993b; Kluender and Cowles 1997), ERP recording (Kluender and Kutas 1993a; King and Kutas 1995; Kluender et al. 1998; Fiebach et al. 2001), and neural imaging methods, either positron emission tomography (PET) or functional magnetic resonance imaging (fMRI). Compared to subject *wh*-dependencies, object *wh*-dependencies elicit longer reading times, lower acceptability ratings, slow anterior negative brain potentials, and increased activation in language-related areas of the brain (though the latter results have been somewhat inconsistent in terms of exactly which brain areas are activated).

All of these results point to an increase in processing load for object *wh*-dependencies. The interpretation given to these data generally involves two factors: the greater distance between an object filler and its gap than between a subject filler and its gap, and the permutation of canonical word order caused by displacing a syntactic object to the left within a sentence.

1. For the most part, these studies have been conducted either in English (SVO word order), or in other West Germanic languages like German and Dutch, with underlying SOV order. The question of whether object relative clauses in pre-nominal position are just as dispreferred in languages with SVO (Chinese) or SOV (Japanese and Korean) word order is currently under intense scrutiny. The reason this is so crucial is that the linear distance between object gaps and head nouns is actually shorter in pre-nominal relative clauses than the distance between subject gaps and head nouns. To date, the jury is still out on this important question, as the empirical results have thus far been inconclusive. We will therefore continue to assume that linear distance between filler and gap is a relevant processing factor.

There is some evidence that linear distance between filler and gap alone contributes to the overall difficulty of processing object dependencies relative to subject dependencies (Cooke et al. 2001; Fiebach et al. 2001).

(1) a. Subject *wh*-question

Who did they claim [___ had criticized him for voting that way] ?

b. Subject relative clause

The aide [who [they said [___ had criticized him] apologized.

(2) a. Object *wh*-question

Who did they claim [he had criticized ___ for voting that way]?

b. Object relative clause

The aide [who [they said [he had criticized ___] apologized.

However, it is certainly also the case that the non-canonical word order of object dependencies plays a significant role in impeding effortless comprehension (Cooke et al. 2001). Even in SOV languages in which grammatical relations are signaled more or less reliably by morphological case marking, there are processing consequences involved in displacing an object to the left, and these register as soon as that object is encountered (Kluender et al. 1998; Ueno and Kluender 2003).

Unsurprisingly, both of these factors are generally interpreted as exacerbating the verbal working memory storage costs involved in ordinary sentence comprehension. It certainly seems plausible on the face of things that linear distance between filler and gap alone produce extra verbal working memory storage costs. The exact nature of the problem involved in perturbations of canonical word order is not quite so transparent, however. Originally it was assumed that the ongoing indeterminacy of thematic role and grammatical function assignment with regard to displaced objects in English – at least until the position of the gap can be identified – was the root cause of the increase in processing load (Kluender and Kutas 1993a, 1993b; King and Kutas 1995). Too many such assignments critical to successful sentence interpretation remain ambiguous longer in object dependencies.

However, the finding that the comprehension of languages with more or less reliable morphological case marking of grammatical function is impaired in similar ways (Kluender et al. 1998; Ueno and Kluender 2003) led to the conclusion that any constituent out of expected order, regardless of the basic word order involved (i.e. SVO or SOV), must affect the parser in some tangible, non-trivial way. Whether this is an effect of frequency over a lifetime of processing experience with one's native language remains

to be seen. But what can be said without equivocation is that the parser gives every indication (as reflected in brain responses) of trying its best to put displaced object fillers back where they belong, regardless of whether or not they are transparently interpretable as theme objects when they are first encountered. If this is indeed the case, then there is perforce a working memory cost involved in trying to locate an appropriate syntactic position in a sentence to which to assign a displaced filler in order to restore it to its proper place in sentence structure.

2.2. Discourse referential processing at clause boundaries

The second processing effect mentioned at the beginning of this section has to do with referential processing at clause boundaries. It is now generally recognized (Gibson 1998, 2000) that referential processing of noun phrases and verbs anywhere within a sentence incurs a processing cost. The claim particular to island contexts is that this processing cost is especially acute and therefore critical at clause boundaries. It is generally recognized that crossing a clause boundary in sentence processing is a major hurdle in sentence comprehension: once a clause has been syntactically parsed, the specifics of the exact syntactic configuration tend to fade rapidly, to be replaced by a more general semantic representation of its content. The claim made by the processing account of islandhood is that the additional costs of referential processing at the boundary of a clause from which a constituent has been extracted impede the parser's attempt to reposition the extracted element within that clause. This is most easily demonstrated by drawing an explicit parallel between island and center-embedding contexts.

- (3) a. The woman [the man [the host knew__] brought __] left early.
b. The woman [someone [I knew__] brought __] left early.

The extra referential processing costs involved in attempting to access relevant discourse referents for the definite subject and head noun *the man* and the most deeply embedded subject *the host* in (3a) – both occurring at clause boundaries – severely impairs the parser's ability to assign the fillers *the woman* and *the man* to their respective gaps in the relative clauses. When these referential processing costs are reduced by instead using an indefinite (*someone*) and an indexical (*I*) pronoun – for which the necessity of accessing relevant discourse referents is drastically reduced relative to definite NPs like *the man* and *the host* – the filler-gap assignments are no longer problematic, and the multiple nested embeddings become readily interpretable (cf. Bever 1970).

While perhaps not quite as dramatic, similar improvements accrue in extractions from relative clauses as head nouns become less costly in terms

of their discourse processing requirements. Since the 1970s, there have been numerous examples in the generative literature showing improvements in extractions out of relative clauses with indefinite head nouns.

- (4) a. That's the campaign [that I finally thought of the aide
[who could spearhead __]].
- b. That's the campaign [that I finally thought of someone
[who could spearhead __]].
- c. That's the campaign [that I finally thought of someone
[to spearhead __]].

While (4b) is by no means perfect, it's fairly easy to interpret. In (4a), on the other hand, the assignment of the sentence-initial filler *the campaign* to the sentence-final gap is not quite so straightforward, impeded as it is by the presence of the intervening and competing definite NP head of the most deeply embedded relative clause, *the aide*. CNPC violations of this type can be further improved by not only reducing the referential requirements of the head noun, as in (4b), but also by simply eliminating overt subjects (in this case, in the form of the subject relative pronoun *who*) and finite verb forms from the relative clause altogether, as in the infinitival relative (4c).

The observation that overt subjects and finite verb forms exacerbate extraction from islands has been around at least since Ross's (1968) dissertation. However, Ross originally made this observation with regard to *wh*-islands, not relative clause islands. Here are his original examples.

- (5) He told me about a book which I can't figure out...
- | | |
|---------------------------|---------------------------------|
| a. whether to buy or not. | b. whether I should buy or not. |
| how to read. | how I should read. |
| where to obtain. | where I should obtain. |
| what to do about. | what I should do about. |

In each case, the *wh*-islands in (5b) are deemed to be degraded relative to those in (5a), due to the presence of overt subjects and finite verb forms in the embedded clauses of (5b).

Note that the subjects in (5b) are indexical pronouns like *I* (or *you*), shown above in (3) to reduce referential processing costs relative to definite NPs in center-embedding contexts. The contrasts between (4b) and (4c) and between (5a) and (5b) seem minimal and yet noticeable. This is due in part to an intervening discourse referent that is about as low-cost in terms of processing as one can find, namely an indexical pronoun. This is perhaps the best test case for demonstrating that the presence of even an otherwise relatively low-cost overt subject in an island context interferes with the

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assignment of an overarching filler-gap dependency. While the difference shown in (5) is confounded by an accompanying difference in finiteness of the embedded clause, infinitival relative clauses can be constructed in which the mere presence of an overt subject appears to affect the assignment of a filler to its gap:

- (6) a. That's the child [that I found a book
[for you to read out loud to __]].
b. That's the child [that I found a book
[to read out loud to __]].

(6a) appears slightly degraded relative to (6b), based on the mere presence of an overt indexical pronoun subject that does not share co-reference with the subject of the preceding relative clause *that I found a book*.

In any case, examples of contrasts in acceptability within *wh*-islands that seem entirely parallel to the relative clause island contrasts above in (4) are also fairly easy to construct.

- (7) a. That's the campaign [that I was wondering
[which aide could spearhead __]].
b. That's the campaign [that I was wondering
[who could spearhead __]].
c. That's the campaign [that I was wondering
[whether I could spearhead]].
d. That's the campaign [that I wondering
[whether to spearhead __]].

Obviously *wh*-islands do not have external head nouns, so the parallel between (7a) and (4a) must instead be based on the referential status of the *wh*-phrase in specifier position, i.e. as a previously mentioned or otherwise individuated discourse referent. However, similar to (4a), the assignment of the sentence-initial filler *the campaign* to the sentence-final gap is impaired by the presence of the intervening discourse-linked specifier phrase of the *wh*-complement (*which aide*). Again, similar to the difference between (4a) and (4b), *wh*-island violations like (7a) can be markedly improved by reducing discourse-linking and individuation as referential properties of the *wh*-specifier in the embedded clause, as is the case in (7b).

The difference between (4b) and (4c) involved three simultaneous changes: elimination of the relative pronoun *who* as specifier of the relative clause, concomitant omission of any overt subject whatsoever (which also happened to be the subject relative *wh*-pronoun), and the elimination of any finite verbal element from the clause. These modifications can be somewhat

better dissociated in *wh*-islands, as shown in examples (7b) through (7d). Relative to (7b), (7c) shows the effect of eliminating the *wh*-specifier *who* from the embedded clause²; relative to (7c), (7d) shows the effect of eliminating the overt subject and finiteness from the clause.

2.3. Summary

To sum up, in this section we have introduced two basic aspects of processing, both of which have been interpreted as involving verbal working memory demands, and that are relevant to *wh*- and relative clause island contexts. First, object *wh*-dependencies are dispreferred relative to both subject *wh*-dependencies and constructions containing no unbounded dependencies at all. This is in turn attributable to the increased storage costs associated with the greater distance between filler and gap in object than in subject dependencies – at least in those European languages in which this phenomenon has been extensively studied thus far – as well as with the non-canonical word order that results from displacing objects leftward from their canonical positions. The relative contributions of these two factors have not yet been definitively teased apart. In cases in which grammatical and thematic relations are unambiguously cued by surface-level morphological markers, object dependencies still seem to cause greater processing effort. Moreover, in languages with pre-nominal relative clauses, in which the linear distance between filler and gap is actually shorter in object than in subject relative clause configurations, there is at least some (albeit inconsistent) evidence that object relatives might still cause greater processing difficulty. If this turns out to be true, then neither linear distance between filler and gap nor non-canonical word order alone will succeed in accounting for the results.

The second factor involved in the processing of *wh*- and relative clause islands has to do with the costs involved in discourse referential processing at clause boundaries. As we have seen, discourse referential properties of head nouns (with regard to relative clause islands) and *wh*-specifiers (with regard to *wh*-islands) alike can interfere with the assignment of an object filler to its corresponding gap. Moreover, the presence of overt subjects and

2. Whether or not *whether* should be viewed as the head or the specifier of the embedded CP in (6c) is immaterial to the point being made here. Even if *whether* is considered to be the *wh*-specifier of CP in (6c), it nonetheless differs crucially from *who* in (6b) in terms of its discourse referential properties: while *who* is restricted to the set of humans, *whether* pertains only to alternative possible states of affairs. I assume here that the maximally unspecified restriction of *who* to human entities only nonetheless manifests more individuation than a restriction to possible states of affairs.

finite verb forms in either complement or relative clauses appears to contribute to this difficulty. It seems intuitively plausible that an overt subject would entail a greater discourse referential processing cost than a covert subject. Just like clause-external head nouns and clause-internal *wh*-specifiers, an overt subject in an island context occurs near the clause boundary and lies on the path between the extracted filler and its gap. In a context as sensitive as that of a syntactic island, this slight perturbation appears sufficient to interfere in noticeable ways with both acceptability and interpretation. What role finiteness is playing in these contexts is less clear, though semantic proposals have been put forth in the literature identifying **tense as a temporal manifestation of definite reference** (Partee 1984; Langacker 1991). If these proposals are valid, this suggests that some kind of discourse referential processing may be involved here as well. In any case, finite verb forms within islands also intervene between the extracted objects fillers and their gaps in the sentence complement.

All told, the alternative processing view of islands outlined in this section goes a fair distance in accounting for the traditional facts with regard to *wh*- and relative clause islands. It is particularly notable for the commonalities it uncovers with regard to the amelioration of extractions from these particular island contexts: both *wh*- and relative clause islands (i.e., both weak and strong islands) seem to improve under the same kinds of manipulations, for which there are reasonable processing explanations tied to verbal working memory demands and to discourse referential processing. What prevents the account from greater generality is the fact that it has never shown much promise of being profitably extended to other island contexts. In particular, it has never had very much to say about subject or adjunct islands.

There are still a number of puzzling problems with regard to adjunct islands that will have to be excluded from consideration here. For now, we turn to the case of subject islands and a reassessment of the degree to which they might be amenable to a processing account after all.

3. The processing of (complex) subjects

On the face of things, there would seem to be no clear reason why subjects should be more costly to working memory than any other sentence constituent. In English, at least, they often have the information structure status of topics, as evidenced by the fact that they are often pronouns (cf. this sentence). **The hallmark of topics is that they have already been activated in the discourse representation, and as such, one would assume that they are readily accessible to sentence comprehension processes.**

Note, however, that subject islands are by definition *complex* subjects: in order to extract anything other than a possessor from a subject, it has to

contain either complements, adjuncts, or both. This complexity is going to make the subject “heavy” in the sense that it is going to require multiple constituents, and consequently a fair amount of lexical material. This raises the likely possibility that complex subjects may place special demands on verbal working memory after all. It is already clear from a variety of processing studies that open-class words, particularly at the beginning of a sentence, entail greater processing effort than closed-class words (Garnsey 1985; Kutas, Van Petten, and Besson 198; Van Petten and Kutas 1990, 1991). The accumulation of a number of such open-class words as separate subconstituents within a larger subject constituent could easily pose a lexical processing burden in and of itself.

At the same time, the proliferation of subconstituents within the subject will of necessity increase the discourse referential processing load at the beginning of the sentence. It is thus reasonable to expect that these referential discourse demands might in turn interfere with any attempt to associate a filler extracted from a discourse- and lexically heavy subject with other syntactic positions in the same sentence. In short, the same processing factors that obtain in *wh*- and relative clause islands seem to obtain in subject islands as well. The difference lies in the fact that with *wh*- and relative clause islands, the filler-gap dependency has to be effected across the boundary of an embedded clause. With subject islands, on the other hand, the dependency does not extend across a CP boundary, but rather across the initial, syntactically complex constituent of the sentence.

In sum, the processing account of subject islands proposed here is also quite simple in its essentials. Subjects, especially complex subjects, are already difficult to process for reasons having to do with both verbal working memory storage and discourse referential processing costs. On top of this independently existing difficulty, attempts to maintain a simultaneous long-distance filler gap-dependency may push the verbal working memory system over threshold. The result would be the perceived ungrammaticality and uninterpretability of subject islands.

This chain of reasoning rests squarely on the assumption with which we started out, however, namely, that the processing of subjects is in itself costly to working memory. Is there any supporting evidence that this might be the case? There are a number of different data sources that can be drawn on in support of this proposal: production studies of child and adult language, and studies of language and ageing. We will treat each of these below in turn.

3.1. Child language production studies

This section draws heavily on the evidence presented in P. Bloom (1990, 1993), which outlines a processing account of why children preferentially omit subjects from their utterances in early stages of child

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language acquisition. There are two main points to Bloom's analysis. The first is that there exists a tradeoff between subject length and verb phrase length in early acquisition: the longer the subject, the shorter the verb phrase, and vice versa. The second point is that children not only omit subjects, but also try to reduce them in any way that they can.

With regard to the first point, the original insight about the relative size of subject vs. verb phrase in early child language came from L. Bloom (1970), who observed that when a 22-month-old child encoded the subject in a sentence with *make* as its predicate, some element of the verb phrase, either the verb, the object, or an adverbial, was omitted. P. Bloom (1990) reanalyzed these original data to show that the verb phrase was on average significantly longer in sentences with missing subjects than it was in sentences that contained them. P. Bloom (1990) found further support for this conclusion by reanalyzing data for Adam, Eve, and Sarah in the CHILDES data base, and again found that **the length of the verb phrase was significantly greater when there was no overt subject encoded in the sentence.** Moreover, there was a linear trend in verb phrase length as a function of subject size: utterances with no subjects had the longest VPs, those with pronoun subjects (in this case, the indexical pronouns *I* and *you* only) exhibited intermediate length VPs, and those with noun subjects showed the shortest verb phrase length.

The second point of Bloom's analysis is that in acquiring a language, children reduce subjects by whatever means they have available to them. For example, lexical noun subjects are significantly shorter than lexical noun objects in the speech of Adam, Eve, and Sarah (P. Bloom 1990). This is no doubt at least in part attributable to the fact that children are also more likely to omit articles from subjects than they are from objects (Gerken 1991). Moreover, children use far more pronouns in subject than in object position (P. Bloom 1990). Mazuka et al. (1986) even report that in both Japanese and English, some children go through a stage in which they reduce subjects to a schwa, as if they know that a phonological place-holder is required in subject position, but are not always able to fill it with lexical material.

All of these facts lead to the conclusion that subjects represent some sort of processing bottleneck in child language: children preferentially not only omit but also reduce subjects, especially when the verb phrase is substantial in terms of the lexical material it contains. There are two things to take note of here. One is that these results, drawn from studies of children around two years of age, do not treat of complex subjects at all, as the production and comprehension of complex subjects would be far beyond the ability of children in this age range. Nonetheless, given the limited working memory capacity available to children at this early age,

subjects seem as if by nature already complex enough for two-year-olds, in that they pose serious production problems.

The second thing to take note of is that these child language production data strikingly mirror adult comprehension data as reported in the event-related brain potential (ERP) literature on the N400, a negative ERP component peaking reliably around 400 ms after word onset. For our purposes here, the N400 can be taken roughly as an index of both lexical and referential processing load (cf. Kluender 1998). Open-class words (such as lexical nouns) elicit larger N400s than closed-class words (such as pronouns) (Garnsey 1985; Kutas, Van Petten, and Besson 1988). Furthermore, open-class words at the beginning of a sentence elicit larger N400s than open-class words at subsequent sentence positions: the amplitude of the N400 in response to open-class words decreases monotonically across the course of a sentence (Van Petten and Kutas 1990). This appears to be due to the incremental accrual of semantic and pragmatic context across the course of a sentence during its interpretation (Van Petten and Kutas 1991). The Van Petten and Kutas (1990, 1991) studies looked only at the sentence positions in which open-class words occurred, and not at the syntactic constituents they belonged to, or the grammatical relations that these constituents expressed. Nonetheless, it seems safe to assume, given the relatively rigid SVO word order of English, that the sentence-initial open-class words eliciting larger amplitude N400 components were likely to have been part of the subject phrase.

The question then arises whether these analogies between child sentence production and adult sentence comprehension are warranted. To answer this question, we next turn to studies of the use of subjects by fully competent adult speakers.

3.2. Adult production studies

Is there any evidence for processing difficulty with subjects in adult sentence production as well? In a reply to P. Bloom (1990) arguing for the psychological reality of a null subject grammar in child language acquisition, Hyams and Wexler (1993:440, Fig. 2) analyze the tradeoff between subject size and verb phrase length in the output of Italian-speaking adults as a basis for comparison with Bloom's data from the output of two-year-olds acquiring English. Hyams and Wexler report the exact same pattern of results as Bloom, namely a linear trend in verb phrase length as a function of subject size: utterances with null subjects have the longest VPs, utterances with pronominal subjects have intermediate length VPs, and utterances with lexical noun subjects have the shortest VPs. Hyams and Wexler use these data from Italian, a *pro*-drop language, to argue that the grammars of children learning English must also be *pro*-drop. For our present purposes, however, the point need merely be made that

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adults show the same trade-off between subject and verb phrase length as children do.

A similar finding comes from a production study (Ueno and Polinsky, in preparation) of Japanese, another *pro*-drop language. Ueno and Polinsky analyzed both Japanese child language data from the CHILDES database and adult corpus data from a variety of written Japanese texts of different genres. They found that in both child spoken and adult written Japanese, *pro*-drop occurs more frequently with transitive (two-place, SOV) than with intransitive (one-place, SV) predicates. This is equivalent to P. Bloom's (1990) finding that the verb phrase in the spoken output of two-year-olds acquiring English is significantly longer in sentences with missing subjects than in sentences containing overt subjects. In general, intransitive SV structures predominate in Japanese output, and transitive SOV structures when they occur are more prone to subject-drop, as if there were a constraint on the language to limit the number of arguments overtly expressed with the verb to one. Ueno and Polinsky argue that this is a processing constraint designed to reduce the number of arguments that need to be held in verbal working memory until the verb is encountered in a verb-final language.

On the other hand, Hyams and Wexler (1993: 440-441, fn. 29) propose that the tradeoff between subject and verb phrase length in adult Italian has nothing to do with processing, but attribute it instead to the informational status of the predicates of lexical NP, pronominal, and null subjects, respectively. In short, they suggest that lexical NP subjects are more likely to contain new information than pronominal subjects, which in turn are more likely to contain new information than null subjects. Conversely, the predicate of a lexical NP subject should contain more old information susceptible to pronominalization or elision than the predicate of a null subject. This is in turn argued to account for the fact that the predicate of a null subject will end up being longer, because it contains less old information that can be pronominalized or elided to begin with. The same reasoning applies to the difference in predicate/verb phrase length between null vs. pronominal, and pronominal vs. lexical NP subjects. This informational status interpretation of the adult Italian data can also account for the null subject findings in both child and adult Japanese production as well.

Is there any additional evidence that might decide between a processing vs. an informational status account of the subject/verb phrase length trade-off phenomenon in child and adult output? One relevant piece of evidence (Clark and Wasow 1998) is that in spontaneous, unmonitored speech, adult speakers of English produce more disfluencies with subjects than with objects. Clark and Wasow (1998) also looked at differences in the number of disfluencies upon initiation of simple vs. complex NPs. They found,

somewhat unsurprisingly, that competent adult native speakers hesitate by repeating definite and indefinite articles much more frequently when initiating complex NPs. This difference in disfluency rates between complex and simple NPs remains constant across sentence positions. However, overall, disfluency rates for both simple and complex NPs show a monotonic decrease across the course of sentence, in the order topic > subject > object > prepositional object. In other words, disfluency rates are higher at sentence-initial positions, and especially for complex NPs. This is of particular relevance to subject islands, which are by definition complex. It is also worth pointing out that the results from adult sentence production again mirror the results of adult comprehension studies using N400 amplitude as a measure of referential and lexical processing cost: the beginning of a sentence clearly entails elevated processing costs in both comprehension and production.

It's not clear how these disfluency results could be straightforwardly reduced to a difference in informational status between subjects and objects. Applying the same logic used by Hyams and Wexler (1993) in relation to the subject/verb phrase length trade-off, one would expect topics and subjects in spontaneous English speech to present less of an informational problem than objects, not more. This is because topics and subjects, which are also often topics in English, would be expected in the aggregate to contain more old information than constituents appearing within the informational focus of the sentence, by definition reserved for new information. Old information encoded in the topic and/or subject should thus be more accessible in the discourse representation than new information encoded in the object. On the informational status account, then, one would predict more production disfluencies with objects containing new information within the sentence focus than with topics and/or subjects containing old information, contrary to the empirical findings.

Another relevant piece of evidence pertinent to the analysis of subject islands comes from diary studies of the written output of adult native speakers of English across decades of the 19th and 20th centuries (Kemper 1987). Strikingly, Kemper found that adult writers of all ages produced embedded structures within the sentence predicate far more often than they produced complex subjects. This was as true of non-finite (gerundive and infinitival) constructions as it was of finite (*that*-, *wh*-, and relative) clauses. Clearly, there is something intrinsically difficult about the processing of complex subjects even in spontaneous written production.

Taken together, then, the findings from adult production studies lead to the conclusion that adult native speakers experience processing difficulty with subjects, and especially with complex subjects. Even in writing, where working memory demands should be less than in speaking, there seems to

be a strong dispreference for complex subjects. In this regard, the difficulty that children show with subjects – not only omitting but also reducing them by a variety of means – may not be a problem peculiar to child language acquisition. Instead, it may just be a manifestation of their more limited working memory capacity in the face of demanding processing tasks. One way of testing this notion is to look at other populations with limited working memory capacity. For this we turn to studies of language processing in the elderly.

3.3. Language processing studies of the elderly

In a series of studies over the past twenty years, Susan Kemper and her colleagues have demonstrated the effects of ageing, and particularly of diminishing working memory capacity, on the language skills of the elderly. Some interesting complex subject-object asymmetries have turned up in these studies. Kemper's (1987) diary study discussed in the previous section showed that complex subjects are produced in the writing of adult native speakers far less frequently than embeddings within the predicate. The frequency of both complex subjects and predicate embeddings decreases with age, but this decrease is no sharper for complex subjects than it is for predicate embeddings: complex subjects are produced less frequently than predicate embeddings at all ages, and this difference remains relatively constant with age. Kemper (1987) speculates that this may be due to the off-line nature of writing, which serves to mitigate the processing demands of producing complex subjects.

The story is somewhat different with regard to spoken production in the elderly, however. Kynette and Kemper (1986) examined the syntactic complexity of spontaneous speech samples from adults aged 50 to 90. Among other things, they found fewer complex subjects, i.e. subjects containing either relative clauses or noun phrase complements, in the speech of adults over 70 years of age. Following up on this finding, Kemper (1986) engaged elderly participants between the ages of 70 and 90 in a sentence repetition task. The participants were asked to repeat a variety of English sentence types as exactly as possible, including gerunds, *that*-clauses, *wh*-clauses, and relative clauses in either subject or object position; there was an additional manipulation of complex subject and object length (Kemper 1986:281). The elderly participants had far more difficulty repeating complex subjects than complex objects, and particular difficulty with long complex subjects. The typical compensatory strategy for repeating sentences containing long complex subjects was to simply eliminate one of the clauses, as shown in (8).

- (8) Stimulus: [That the ginger cookies were brown] surprised me.
- a. The cookies were brown.
 - b. The cookies surprised me.

In 92% (69/75) of these cases, the elderly eliminated the complex subject from the repetition, as in (8b). There was no similar tendency to eliminate complex objects, however: out of 29 abridged sentences with long complex objects, the complex object itself was eliminated in only 3 cases (11%).

Norman, Kemper, and Kynette (1992) tested the effect of including complex subjects (i.e. subject NPs modified by relative clauses, cf. Norman et al. 1992:260, Table 1) in reading passages. The number of clauses per sentence was also manipulated. In a timed reading comprehension test, the comprehension of elderly participants aged 75 to 92 was affected by the mere inclusion of complex subjects in the passages, as well as by increasing the number of clauses per sentence. When passages included both complex subjects and more clauses per sentence, the comprehension of elderly participants aged 60 to 92 (but not of a control group of college students) was impaired. In a separate untimed reading comprehension test taken by the same elderly participants about a year later, the presence of complex subjects in the passages significantly slowed down the reading times of participants aged 75 to 92 as well.

These studies of both the production and the comprehension of complex subjects by the elderly flesh out the larger picture presented in sections 3.1. and 3.2. By manipulating the syntactic position of overt, complex NPs, and by testing this manipulation on an adult, linguistically competent but memory-impaired population, Kemper's studies avoid the alternative interpretations proposed for the child and adult language production studies of subject processing difficulty. To be explicit, the difficulty that the elderly experience with complex subjects in spontaneous speech, in repetition, and in reading comprehension cannot be attributed to their having a different grammar from other, younger adults. Nor is it likely there was an information packaging problem in the repetition and reading comprehension tasks; the reading comprehension study results correlated significantly with three separate measures of working memory span. Thus it seems clear that this is a processing problem. If that is the case, and since a processing explanation is also fully consistent with the child language and normal adult production data, then the most general conclusion to be drawn from all the evidence presented in this section is that subjects are hard to process, and that they are hard to process for reasons of verbal working memory load.

This brings us back to the question with which we started out section 3: is there any evidence for the claim that the processing of subjects is in general costly to working memory, a claim on which the processing account

of subject islands crucially rests? There indeed seems to be a substantial amount of evidence from a variety of sources and populations confirming that this claim is true. Moreover, the nature of complex subjects, by definition containing multiple constituents, points to an additional problem of increased discourse referential processing load at the beginning of the sentence, where processing costs are already high. Add to this the extra storage problem of trying to associate an extracted filler with other syntactic positions in the sentence such as the gap inside the complex subject, and one has all the makings of a classic processing breakdown, resulting in failure of interpretation and the impression of ill-formedness.

As stated at the outset, these are roughly the same factors argued in section 2 to contribute to the uninterpretability and ungrammaticality of *wh*- and relative clause islands. However, that account was based in large part on demonstrated manipulations of the various properties of *wh*- and relative clause islands, resulting in perceived improvement in both the interpretability and acceptability of what should otherwise have been standard island violations. Is it possible to demonstrate the mitigation of island effects under such manipulations with subject islands as well? It is to this question that we turn next.

4. Variations in the acceptability of subject islands

Subject islands can in fact be made more transparent to extraction. The reason that this has barely been noticed before most likely has to do with the fact that, without closer investigation, most extractions from subject islands seem as crashingly bad as could be expected from an island configuration. However, as is the case with relative clause (i.e. other strong) islands, this may be largely attributable to the standard types of subject islands that one is used to seeing in the literature. For example, a typical subject island violation involves extraction out of a tensed sentential subject like (9).

(9) *Who does [that she can bake ginger cookies for ___]
give her great pleasure?

This example seems at first blush like a hopelessly irreparable violation. But merely changing the complex subject from tensed with an overt subject to non-finite with a null subject, while leaving lexical content otherwise the same, changes things noticeably, as shown in (10).

(10) Who does [being able to bake ginger cookies for ___]
give her great pleasure?

I am personally not sure what diacritic markings to place on this example. But note that it seems improved relative to (9) above, and close to if not fully interpretable.³

Thus the first clue that processing factors influence the acceptability of subject islands in much the same way as they influence the acceptability of *wh*- and relative clause islands comes from the recognition that eliminating overt subjects and finite verb forms from a subject island significantly improves both its interpretability and its acceptability. This is exactly what we saw with relative clause islands in (4) and with *wh*-islands in (7) above. In section 2 it was suggested that effects of overt subjecthood and finiteness represent additional discourse referential processing costs: overt subjects appear near clause boundaries, and both overt subjects and finite verb forms intervene between extracted constituents and their gaps inside the island. This appears to be as true in the case of subject islands as it was in the case of *wh*- and relative clause islands.

Extracting subconstituents out of the complex subjects of Kemper's (1986:281) gerundive stimulus sentences provides further evidence that subject island violations vary in acceptability and interpretation. First, as a basis of comparison, observe the results of extracting the subconstituents of a complex object, as shown in (11).

- (11) a. I like [baking ginger cookies for my grandchildren].
 b. Who do you like [baking ginger cookies for __]?
 c. What do you like [baking __ for your grandchildren]?

The extractions in (11b) and (11c) seem completely unproblematic, as one would generally expect to be the case when extracting out of a complement. Moreover, they also seem equally interpretable and acceptable. Now compare these examples with extractions of the same constituents from the same complex NP placed in subject position.

3. Note that changing the subject of (10) to an infinitival instead of a gerundive leaves the question more interpretable than with the tensed sentential subject island in (9), but also renders it less felicitous than the gerundive subject in (10), even with no overt subject. At present I have no explanation for this difference.

Who does [(for her) to be able to bake ginger cookies for __]
 give her great pleasure?

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- (12)a. [Baking ginger cookies for my grandchildren] tires me out.
b. Who does [baking ginger cookies for __] tire you out?
My grandchildren. >
c. What does [baking __ for your grandchildren] tire you out?
Ginger cookies.

(12b), if not quite as unproblematic as (11b), nonetheless seems relatively interpretable, as assessed by the relative felicity of the provided answer. The correct interpretation of (12c), on the other hand, seems more difficult to assemble and maintain, as assessed by the apparent oddness of the correct answer. What might be going on here?

There are a number of possibilities. The effect could be attributable to differences in animacy or thematic roles: (12b) involves extraction of an animate benefactive, while (12c) involves the extraction of an inanimate theme. But the reverse can also hold: the extraction of an inanimate theme in (13b) seems more interpretable than the extraction of an animate benefactive in (13c), as can be ascertained by again assessing the relative felicity of the intended answers to the questions.

- (13)a. [Providing the troops with adequate training]
will guarantee the success of the mission.
b. What will [providing the troops with __]
guarantee the success of the mission?
Adequate training. >
c. Who will [providing __ with adequate training]
guarantee the success of the mission?
The troops.

Another way to interpret the effects in (12) and (13) is in terms of grammatical relations: the relatively more interpretable examples in (12b) and (13b) involve the extraction of the NP objects of argument PPs, while the relatively less interpretable examples in (12c) and (13c) involve the extraction of direct object NPs. And indeed, if an instrumental oblique is added to the direct and indirect objects of a complex NP, the extraction results begin to look something like a reverse accessibility hierarchy for extraction from subjects, as demonstrated in (14).

- (14) a. [Cutting meat for her kids with a dull knife] drives her crazy.

- b. What does [cutting meat for her kids with ___]
drive her crazy?
A dull knife. >
- c. Who does [cutting meat for ___ with a dull knife]
drive her crazy?
Her kids. >
- d. What does [cutting ___ for her kids with a dull knife]
drive her crazy?
Meat.

Again, extraction of the direct object in (14d) seems to interfere most with the interpretability of the intended question. However, extraction of the oblique in (14b) now seems to yield the best results, while extraction of the indirect object in (14c) seems less felicitous and of more intermediate interpretability, in contrast to the relatively interpretable extraction of the indirect object in (12b).

Note that the examples in (14) degrade as the gap moves closer to the filler and farther away from the main clause predicate. This leads to the suspicion that what's causing the differences in interpretability is mere linear proximity of the gap to the main clause predicate – rather than a purported effect of grammatical relations on a reverse accessibility hierarchy for extraction from subjects in English, with which it is confounded. Linear proximity seems the simpler explanation of the two. On closer scrutiny, it also seems to be of more general application.

The word order of English guarantees that the main clause predicate will always precede the gap when the latter occurs in a complement phrase or clause. While it seems clear that fillers must be appropriately identified with their gaps in order to ensure successful sentence interpretation, a number of theoretical proposals and processing studies suggest that extracted fillers nonetheless gravitate toward main clause predicates, even when the actual gap position is more deeply embedded in the verb phrase.

Extraction from subject position in many ways presents the mirror image of extraction from a complement. One way in which this is true is that the gap in a complement will always follow the main clause predicate, while the gap in a subject will always precede it. Furthermore, the extractions in (12)-(14) all get progressively worse as the gap moves closer to the extracted filler. This is again the opposite of what is seen in extractions from complement positions, where the greater the distance between filler and gap, the greater the processing load incurred. Clearly, some other processing factor is compromised in these cases, and I would like to suggest that it is the association of the filler with the main clause

predicate. This would be one way in which extractions from both subject and complement positions would exhibit more similar behavior.

Here we can refer to an independently motivated but related processing principle designed to account for the attachment ambiguities of non-extracted constituents, Frazier's (1990) relativized relevance principle.

- (15) Other things being equal (e.g., all interpretations are grammatical, informative, and appropriate to discourse), preferentially construe a phrase as being relevant to the main assertion of the current sentence. (Frazier 1990:321).

This principle was not intended to account for the interpretation of extracted constituents. But let us just suppose, based on the demonstrated affinity of fillers for the main clause predicate when the latter precedes the gap, that there is independent, sometimes competing pressure for a filler to associate not only with its gap, but also with the main assertion of the current sentence, typically the main clause predicate.⁴ In the case of extractions from complex subjects, then, the extracted filler may find its gap long before it can associate with the main clause predicate – which is by hypothesis the case in (12c), (13c), and (14d). If the filler is still actively seeking out the main clause predicate after successful filler-gap association, then any intervening discourse referents will interfere with this operation, just as they do in the association of fillers with gaps in complement position (but crucially not with the main assertion of the sentence in such cases). For this reason, the more post-gap discourse referential processing that must occur before the main clause predicate is reached, the more difficult it will be to construe the filler-gap association in the subject island as relevant to the main assertion of the sentence. In other words, the farther the gap within the subject island is from the main clause predicate, and the more constituents that intervene between it and the main assertion, the less interpretable the entire sentence is going to be. Hence the infelicity of the

4. This will not be the case in extractions out of island contexts via clefting or relativization; cf. examples (4) – (7) in the main text. With respect to all the island configurations under discussion in this paper, Frazier's formulation of "main assertion" must crucially be maintained in preference to "main clause predicate," as I sometimes refer to it in the main text for ease of exposition with regard to subject islands. The recasting of relativized relevance as predicate proximity by Gibson et al. (1996) will yield the same results as long as the relevant domain for the extracted filler is determined by its status as specifier of the matrix clause, and not by the position of its associated gap in the embedded clause.

answers to the questions with extracted direct objects from subject position in (12c), (13c), and (14d), and the relative interpretability of the answers to the questions containing gaps within the complex subject immediately preceding the main clause verb, as in (12b), (13b), and (14b). This represents another way in which extractions from subject and complement positions behave in roughly parallel fashion: extractions from a complement do not tolerate discourse referents intervening between filler and gap at the complement boundary, while extractions from a subject do not tolerate discourse referents intervening between filler and main clause predicate within the complex subject.

However, let us not forget that (12)-(14) all involve gerundive subject islands with no overt subject and no finite verb forms present. It was this original manipulation that allowed the variability based on gap position within the subject island to emerge in (12)-(14). When overt subjects and finite verbs forms are present, as in (9), the position of the gap within the subject island and the consequent ability of the extracted filler to associate with the main clause predicate are immaterial, and unable to salvage the violation. This is because an overt subject and finiteness intervene between the filler and its gap in (9). Subject islands are thus similar to *wh*- and relative clause islands in that intervention effects between filler and gap are of critical importance; the additional requirement that the filler-gap dependency be relevant to the main assertion of the sentence is of secondary importance. Subject islands differ from *wh*- and relative clause islands in that overt subjecthood and finiteness are much more damaging to overall acceptability. This is because complex subjects are inherently more difficult to process, and filler-gap dependencies into them are harder to maintain in working memory without additional processing supports.

5. Conclusion

To summarize, instead of invoking innate grammatical constraints on hierarchical phrase structural configurations to account for the apparent ill-formedness and uninterpretability of subject islands, this proposal rests entirely on two independently required aspects of processing. Both figure into calculations of overall verbal working memory costs: the necessity of associating a displaced constituent with its gap, and the amount of discourse referential processing required along the way, particularly near clause boundaries. These are the exact same factors seen to play a role in the acceptability and interpretability of *wh*- and relative clause islands.

However, complex subjects present special processing difficulties, in that subjects in general are already inherently difficult to process, and complex subjects in particular contain multiple subconstituents that escalate discourse referential processing costs sentence-initially. There is thus an

additional requirement that constituents extracted from complex subjects maintain an association not only with their gaps, but also with the main clause predicate, such that the filler-gap dependency into the subject position can be construed as of some relevance to the main assertion of the sentence. This association, like the association of a filler with its gap, is sensitive to processing costs triggered by intervening discourse referents. If the gap occurs too early in the complex subject, the relevance of the filler-gap dependency to the main clause predicate is incrementally rendered more and more opaque as additional discourse referents intervene.

The most general characterization of *wh*-, relative clause, and subject islands, then, is that they all require the association of a displaced sentence element with some syntactic position, and this association is impacted by intervening discourse referential processing requirements. This is the exact same characterization of verbal working memory costs employed in other sentence processing contexts having nothing to do with island effects (Gibson 1998, 2000). The only structural information required is the relative position of filler, gap, main assertion of the sentence (usually the main clause predicate; cf. fn. 5), and intervening discourse referents within a sentence.

There is of course a range of extraction facts not yet covered by this processing account. A considerable amount of work remains to be done on adjunct islands, which for reasons of limited space and scope have been systematically excluded from consideration here, as have picture-NPs. Among other more perplexing problems to be investigated are the ability of parasitic gaps to salvage certain island violations, and the perennially exasperating *that*-trace effects. Yet the parsimony of the account provided for subject islands, a previously equally perplexing problem, and its good fit with earlier processing accounts of *wh*- and relative clause islands, may provide justifiable hope that these other unsolved cases may turn out to be just as subject to processing considerations in the end.

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