Isolation of independent processing factors in negative island contexts

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Introduction. Island phenomena [1] constitute a central issue in linguistic research. They have received syntactic [2], semantic [3] pragmatic [4], and processing explanations [5]. Negative islands (NIs) are no different. They were originally analyzed as a syntactic phenomenon, and it was claimed that only arguments could escape them (e.g. (1) Which car don't you drive on the Autobahn?) while adjuncts could not (e.g. (2) *How fast don't you drive on the Autobahn _?) [2,6]. Subsequent semantic research [3] showed that factors limiting the size of the set of possible answers to the question (e.g. d-linking [7] and modality [8]) improve NI sentences; other analyses have shown additional influences of pragmatic factors [9]. However, what all of these accounts have failed to take into consideration are the welldocumented independent processing costs associated with negation [10,11,12], extraction [13], and referentiality [14] in the psycholinguistics literature. In this paper, we investigate the effect of these various processing factors on the acceptability of negative island configurations and report results that are problematic for accepted accounts of NIs but compatible with a processing approach [5]. This approach receives additional support from the novel finding that NI-like effects are produced when configurations parallel to NIs are created not by negation, but by other lexical items associated with a processing cost such as the presupposition trigger *also* [15]. These results cannot easily be reconciled with a semantic account of NIs [3] or with any syntactic explanation, since the presupposition trigger *also* neither requires the same semantic operation as negation nor is it a standard 'barrier' to extraction. The advantage of investigating these processing factors in NIs is greater semantic transparency: in contrast to other island types, there is no embedding, and the island effect can simply be eliminated by removing a single morpheme (n't). We suggest that this transparency is instrumental in addressing the question of the true nature of island phenomena.

Experiment 1. Like <u>adjunct</u> extraction (2), <u>argument</u> extraction (1) involves both negation and extraction. If the phenomenon of NIs is at least partly attributable to these processing factors, an acceptability judgment study should reveal a drop in acceptability of NI constructions like (1) in contrast to other interrogatives, even in cases where the NI construction is predicted to be perfectly acceptable from the perspective of linguistic theory, as it involves both argument extraction and d-linking. <u>METHODS</u>. 28 native speakers of English judged the acceptability of English sentences (3) on a scale from 1-7. There were 6 conditions: positive (a) and negative (b) yes/no interrogatives, positive (c) and negative (d) subject *wh*-interrogatives, and positive (e) and negative (f) object *wh*-interrogatives (NIs). All experimental items were predicted to be fully grammatical and acceptable by linguistic accounts of NIs, as all extracted constituents were d-linked and crucially arguments of the verb. The presentation of the stimuli was counterbalanced and we used a factorial design and repeated measures ANOVA (*analysis of variance*). 36 filler sentences were added to each of the 6 lists of 24 experimental items. (3)

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a) Did the politician support the bill in the caucus?	b) Didn't the politician support the bill in the caucus?
c) Which politician supported the bill in the caucus?	d) Which politician didn't support the bill in the caucus?
e) Which bill did the politician support in the caucus?	f) Which bill didn't the politician support in the caucus?

<u>RESULTS.</u> An ANOVA with factors polarity (positive vs. negative) and question type (yes/no vs. subject *wh* vs. object *wh*) yielded a main effect of polarity ($p_{1,2} < 0.001$), a main effect of interrogative type ($p_{1,2} < 0.001$) and an interaction between the two ($p_{1,2} < 0.001$). The mean acceptability ratings were:

Mean rating (StdDev)	Yes/No-Question	Subject Wh-Question	Object Wh-Question
Positive	6.7 (0.8)	6.3 (1.1)	6.4 (1.0)
Negative	6.2 (1.2)	5.8 (1.3)	4.8 (1.5)

Subsequent multiple pair-wise comparisons (Tukey HSD) showed that the effects were driven by significant differences between negative object *wh*-interrogatives and all other positive and negative interrogative types (all $p \le 0.001$). There were also robust differences between negative subject *wh*-interrogatives vs. both positive y/n-interrogatives (p = 0.001) and positive object *wh*-interrogatives (p < 0.05) and *numerical drops* in acceptability between positive and negative polar interrogatives. Additional analysis and a follow-up study showed that the reported effects were not due to the object being animate vs. inanimate or plural vs. singular.

Discussion. As expected from independently known processing costs of negation and extraction, negative object *wh*-interrogatives showed a large drop in acceptability that was due to an interaction of the factors negation and extraction. A further prediction from a processing perspective is that the effects obtained in Experiment 1 should not be restricted to negation, but should replicate for lexical items that share with negation an increase in processing cost.

Experiment 2. The same item sets as in Experiment 1 were used but with 3 extra conditions: for all three interrogative types, a condition without negation but using *also* instead ((3g) *Did the politician also support the bill in the caucus?*; (3h) *Which politician also supported the bill in the caucus?*; (3i) *Which bill did the politician also support in the caucus?*) was added. We added 3 new item sets for a total of 27 item sets distributed over 9 lists in a counterbalanced and factorial design, intermixed with filler sentences. The same method described above was used. <u>RESULTS.</u> An ANOVA with factors intervener (none vs. negation vs. *also*) and interrogative type (yes/no vs. subject *wh* vs. object *wh*) yielded a main effect of intervener ($p_{1,2} < 0.001$), a main effect of interrogative type ($p_{1,2} < 0.001$) and an interaction between the two ($p_{1,2} < 0.001$). The mean acceptability ratings are shown below:

Mean rating (StdDev)	Yes/No-Question	Subject Wh-Question	Object Wh-Question
No Intervener	6.3 (1.0)	6 (1.3)	6.1 (1.3)
Negation	6.2 (0.9)	5.7 (1.3)	4.8 (1.5)
Also	5.8 (1.1)	5.3 (1.4)	4.8 (1.6)

Subsequent multiple pair-wise comparisons showed that the effects were mainly driven by significant differences between the mean ratings of object *wh*-interrogatives that included negation/*also* interveners and all other conditions (all $p \le 0.05$) except *also* subject *wh*-interrogatives.

A pilot study additionally investigated the effect of the presence of *also* and negation on the extraction of adjuncts (*How many problems did(n't) the student (also) solve during the exam?*). The 3 conditions were: (a) adjunct extraction *wh*-interrogative without negation or *also*, (b) with negation, (c) with *also*. 3 item sets were distributed over 3 lists in a factorial and counterbalanced design. 27 subjects rated the stimuli on a (1-7) scale. The results showed the same drop in acceptability for *wh*-interrogatives with adjunct extraction over both *also* and negation (mean rating <u>without *also/negation*</u>: 6.3; <u>with negation</u>: 3.8; <u>with also</u>: 3.8). A second pilot study indicated that both non-referential arguments (*How many purses ...?*) and adverbial adjunct extraction (*How fast...?*) caused a drop in acceptability to the same degree.

Discussion. Acceptability ratings for both object *wh*-interrogatives with both *n't* and *also* as interveners showed a large drop compared with other interrogative types. This result indicates that the drop in acceptability of NIs may be related to factors other than negation itself, though further understanding of commonalities between *also* and negation is needed. A possible lead may be that both negation (as suggested by e.g [12]) and *also* (as a presupposition trigger) impose conditions on their context.

Conclusion. There are three well-documented independent (as confirmed by current results) factors that contribute to processing costs: (i) negation/*also*; (ii) extraction; (iii) referentiality. Our results show the cost of negation and the cost of extraction in the case of argument extraction. The importance of referentiality (the adjunct/argument distinction) has been amply demonstrated in the generative literature on islands and is also reflected in the pilot studies reported above. The current results show that these factors affect not only ungrammatical adjunct extraction NIs but also grammatical structures involving argument extraction. By hypothesis then, traditional adjunct extraction NIs can be reduced to interactions of these three factors while the acceptability drop of argument extraction is due to the interactions of factors (i) and (ii). The systematic decrease in acceptability from positive yes/no to adjunct extraction over negation are not unrelated phenomena: negation in a subject *wh*-interrogative decreases acceptability from 6.7 to 5.8; negation plus object (argument) extraction decreases it to 4.8; negation plus extraction of a non-referential extracte decreases it further on the scale to 3.8. In conclusion, by focusing on NIs, one can discern the individual and interactive costs that lead to acceptability drops, and we hope these findings will help further the understanding of other island phenomena in future research.

References. [1] Ross 1967. Constraints on variables in syntax. [2] Rizzi 1990. Relativized Minimality. [3] Szabolsci & Zwarts 1993. Weak islands and an algebraic semantics for scope taking. [4] Kroch 1989 Amount quantification, referentiality, and long wh-movement; [5] Kluender 1998. On the distinction between strong and weak islands; [6] Ross 1984. Inner islands [7] Pesetzky 1987. Wh-in-situ; [8] Fox & Hackl 2006. The universal density of measurement; [9] Kuno & Takami 1997. Remarks on negative islands [10] Wason 1961. Response to affirmative and negative binary statements. [11] Carpenter et al. 1999. Time course of fMRI activation in language; [12] Staab 2007. Negation in context. [13] King & Just 1991. Individual differences in syntactic processing. [14] Warren & Gibson 2002. The influence of referential processing on sentence complexity [15] Schwarz 2007. Processing presupposed content.