1. Introduction

Sentences like (1a) in which an adjunct wh-phrase has been extracted over negation are judged less acceptable than sentences like (1b) in which an object wh-phrase has been extracted. In the absence of negation, the two wh-extractions are equally acceptable (2a-b). Likewise, in the absence of wh-extraction, negative yes/no-questions seem perfectly acceptable (3).

(1) a. How precisely didn’t the student report her results __?
    b. Which results didn’t the student report ___ very precisely?
(2) a. How precisely did the student report her results ___?
    b. Which results did the student report ___ very precisely?
(3) Didn’t the student report her results very precisely?

The term negative island has been used to refer to the degraded acceptability of constructions like (1a) (Ross 1984), and various accounts have been provided for the contrast in (1a-b). In particular, negative islands have been attributed to global constraints within syntax (Rizzi 1990; 1992) or semantics (Szabolcsi & Zwarts 1993; Abrusan 2008).

In other work (Gieselma et al. 2011, in preparation), we have argued against global grammatical constraints and in favor of a new approach to negative islands in which a multiplicity of factors may play a role. In particular, we have used experimental studies of acceptability to isolate the various processing factors that figure in negative island contexts and cumulatively lead to the perception of unacceptability (inspired by suggestions in Ross (1987) and J. D. Fodor (1983)). These factors include independent processing costs of negation, extraction and referentiality (see Gieselma et al. 2011, in preparation). In addition to its processing cost, negation imposes restrictions on
the discourse context (see Givón 1978; Potts 2010; Nieuwland & Kuperberg 2008; Staab 2007; Tian et al. 2010). The relation between the processing cost and the discourse conditions of negation remains largely uninvestigated: prior work on negative islands has considered neither the pragmatic requirements nor the processing cost of negation, and work on negation processing has not addressed negative islands.

In this paper, we investigate the hypothesis that, rather than the syntactic or semantic properties of negation, it is the processing costs underlying the pragmatic demands of negation that lead to the perception of negative island violations (together with other processing factors, for which see Gieselman et al. 2011, in preparation). We test our hypothesis experimentally by using acceptability judgments to compare wh-extraction across both negation and the presupposition trigger also, i.e., another lexical item that imposes further requirements on the discourse context. Our novel results are inconsistent with the view that negative islands are a strictly syntactic or semantic phenomenon. We argue instead for an explanation based on the processing demands induced by pragmatic requirements to interpret a negative sentence with respect to its discourse context.

2. Background

There are three factors that play a role in the perception of negative island violations: the presence of negation, extraction of a wh-expression over negation and the level of referentiality of the extracted constituent (the more referential an expression, the more acceptable the sentence). In other work (Gieselman et al. 2011, in preparation), we have provided evidence from acceptability judgment studies that negation is the most prominent factor in negative island contexts. Our results showed robust effects of extraction (object vs. subject wh-questions) and of referentiality (which NP vs. how many NP) only in the presence of negation, while effects of negation were evident even in the absence of these other factors.

We further argued on the basis of our results that negative islands are not likely due to a global grammatical constraint. Crucially, though grammatical and felicitous, sentence types in which negation and extraction (Which project didn’t the intern complete?) or negation and referentiality interact (How many interns didn’t complete the project?) lead to robust drops in acceptability. This is not expected under a grammatical account relying on a global constraint and raises questions about possible alternative explanations.

Given the prominent role that negation appears to play in negative islands, and given the fact that the effects of negation are apparent even in the absence of grammatical violations, we set out to investigate the specific properties of negation that might interact with other factors to yield negative island effects.
Let us start by considering the role that negation plays in prominent theoretical accounts of negative islands. The perhaps best-known syntactic explanation (Rizzi 1990; 1992) for the contrast in (1-2) relies on syntactic assumptions about negation, while the most prominent semantic account (Szabolcsi & Zwarts 1993) relies on the function of negation as a logical operator.

The idea behind the syntactic account is that negation is a selective barrier to extraction, and that only referential expressions can escape this barrier. Referential expressions (e.g. which project) differ from non-referential expressions (e.g. how) in having theta-roles and therefore, according to Rizzi, in being assigned referential indices. Non-referential expressions leave traces without indices. Under the assumption that the properties of negation justify its syntactic placement in the A'-specifier position of the TP (tense phrase), negation can function as a potential antecedent governor for the trace of the extracted wh-phrase. Since the principle of relativized minimality rules out a syntactic configuration in which a potential antecedent governor (here: negation) interrupts the antecedent government relationship between an extracted constituent and a non-referential trace, sentences like (1a) featuring non-referential argument extraction over negation are ruled out. Negation does not interrupt the binding relationship between an extracted constituent and a referential trace, and hence sentences like (1b) are grammatical.

Turning to the semantic account, the acceptability of sentences with extraction over negation depends on the denotation domain of the extracted constituent. Extracted constituents whose denotation ranges over sets of individuals can take scope over negation because the Boolean operation required by negation, namely the computation of the complement set, is defined in this case. By denoting sets of individuals, referential arguments such as which NP expressions can be extracted over negation, rendering (1b) acceptable. The complement set cannot be computed in the case of expressions that denote partially ordered and non-individuated domains, resulting in ungrammaticality (1a).

In a nutshell, in the syntactic account of negative islands, the syntactic position of negation is crucial to the argument, while in the semantic account the nature of the logical function of negation is crucial for the explanation. Note that in either account, negation has an effect only in combination with both of the other two factors, extraction and (non)-referentiality. The evidence from our previous studies of negative islands that negation plays a role in and of itself, and in combination with either extraction or with non-referentiality, calls for an investigation of other dimensions of negation that might underlie these effects.

Such dimensions include the processing cost associated with negation and conditions on the use of negation. Over the past 50 years, the processing difficulty associated with negation has been demonstrated with a diverse range of experimental techniques. The cost of negation is reflected in higher error rates (e.g. Wason 1961), longer response times (e.g. Slobin 1966), greater cortical
activation (Carpenter et al. 1999) and larger brain responses (Staab 2007) to simple negative sentences in comparison with affirmative sentences.

The requirements of negation on the discourse context are easily demonstrated. Imagine asking a new colleague on Monday morning what she did over the weekend, assuming that you hadn’t talked to her about it before and don’t know her well. If she replies with something like I didn’t go to the mountains you might frown and ask her if she was supposed to go to the mountains (cf. Givón 1978). Conversely, the same statement without negation – I went to the mountains over the weekend – would not be an awkward response, as it constitutes a discourse move that can easily be accepted.

The importance of discourse context for the integration of negation into the truth conditions of a sentence has been most convincingly demonstrated by means of event-related brain potential (ERP) experiments. Fischler et al (1983) recorded ERPs while participants read sentences such as A robin isn’t a bird/tree without supporting context that would help situate the assertion. Participants had to judge the truth of the sentences they read. The most curious finding concerned the N400 component (Kutas & Hillyard 1980). The N400 is a negative voltage deflection in the averaged waveform thought to index aspects of semantic processing, and was therefore predicted to be sensitive to the truth of the stimulus sentence. This prediction was borne out with respect to positive sentences but not with respect to negative sentences. This finding was interpreted as evidence that negation isn’t processed on line but is integrated into the truth conditions of the sentence later on, perhaps as late as 1500 ms after completion of the sentence (Kaup et al. 2006). Subsequent ERP research provided evidence that in pragmatically plausible contexts (With proper equipment, scuba-diving isn’t very dangerous and often good fun), as opposed to pragmatically implausible contexts (Bulletproof vests aren’t very dangerous and used worldwide for security), negation is indeed integrated into the truth conditions of a sentence on line, as reflected in the amplitude of the N400 component (Nieuwland & Kuperberg 2008; see also Staab 2007).

In summary, previous grammatical or semantic accounts of negative islands refer to the syntactic or semantic properties of negation that figure into a global constraint, in conjunction with other factors. However, we know from previous investigations that negation in and of itself, as well as in combination with extraction or with non-referentiality, has noticeable processing consequences that do not register as ungrammaticality. This calls for an explanation that is independent of a global grammatical constraint.

3. Acceptability Rating Study

We hypothesize that the prominence of the factor negation in creating negative islands is related to the processing cost of its contextual requirements. The idea
is that, as soon as the parser encounters negation, it switches into a different mode of processing. Within this new mode of processing, the sentence is evaluated against the available context on line to ensure correct interpretation of the sentence within that context. This process requires memory resources to retrieve the context.

By hypothesis, in negative islands this processing cost interacts with the well-known processing cost of extraction. While extraction is a syntactic notion indicating the displacement of a constituent to a non-canonical position, it also has a well-established processing correlate: it is thought to tax the limited resources of working memory (e.g. Just & Carpenter 1992; Waters & Caplan 1996; Kluender 1998; Lewis & Vasishth 2006). As shown in (4), which movie has to be held in verbal working memory until it can be integrated into the sentence as the object of the verb watch.

(4) Which movie did the kids watch __ on the internet?

In syntactic and semantic accounts of negative islands, the syntactic operation of extraction across negation is restricted to certain types of constituents (namely, referential ones) because of the specific syntactic and semantic properties of negation that figure into a global constraint. However, if it were instead the processing cost of extraction that interacts with the (pragmatic) processing cost of negation, then we would expect (i) an interaction of negation and extraction even when an unequivocally referential argument is extracted, and (ii) an interaction of extraction with any intervening lexical element that comes with its own pragmatic requirements, such as a presupposition trigger. The first prediction is borne out in Gieselman et al. (2011, in preparation). In this paper we focus on testing prediction (ii).

We conducted an acceptability judgment study comparing the effects of negation to those of a presupposition trigger in the context of extraction. Our aim was to investigate whether an element that is syntactically and semantically different from sentential negation but pragmatically similar to it would interact with extraction in the same way that negation does in negative island contexts. To this end, we chose the presupposition trigger also to compare to negation.

With regard to pragmatic similarity, although we do not wish to claim that negation is itself a presupposition trigger, it nonetheless exhibits similar discourse conditions to those required for also (see Tian et al. 2010 for a similar point). If someone is asked out of the blue What did you do over the weekend? and responds either I didn’t go to the mountains or I also went to the mountains, both answers seem infelicitous and would lead to additional follow-up questions (Were you supposed to go to the mountains? / So what else did you do? etc.). Secondly, the presupposition trigger also is known to be resistant to accommodation, in contrast to other presupposition triggers like definite determiners, or verbs such as stop, which do allow accommodation (for an
overview on presupposition accommodation see Kadmon 2001 pp.151 – 204; Beaver & Zeevat 2007). Given the ERP results in Fischler et al. (1983) and in Nieuwland & Kuperberg (2008) showing that negation cannot be integrated into the truth conditions of a sentence without providing plausible context, we assume that the discourse conditions of negation likewise cannot be easily accommodated. Finally, there is self-paced reading time evidence that not fulfilling the presuppositions of also incurs processing costs (Schwarz 2007). This same relationship has been demonstrated inversely for negation: its associated processing costs are mitigated when appropriate context is provided (Glenberg et al. 1999). In other words, both negation and also seem to be associated with processing costs related to discourse conditions.

With regard to the semantic distinctness, negation introduces a Boolean operator into the semantic representation while also behaves like a presupposition trigger without affecting the truth conditions of the sentence.

As to the syntactic distinctness of also, while Rizzi (1990; 1992) assumes that negation occupies the A’-specifier position of TP, to the best of our knowledge there is no serious claim in the literature that also occupies an equivalent specifier position in the phrase structure tree. Therefore also should not interrupt the antecedent government relationship between an extracted element and its trace in the same way that negation is claimed to.

In sum, we chose also as a relevant comparison for negation because it is (i) pragmatically similar in imposing discourse conditions that are difficult to accommodate out of the blue, (ii) similar from a processing perspective in that it is associated with a recognized cost when such discourse conditions are not met, and yet (iii) semantically and syntactically distinct. Thus if it turns out that also interferes with extraction in the same way that negation does, this can only be attributed to the pragmatic similarities that they share. If on the other hand when inserted into the same syntactic environment as negation in a negative island context, also does not interfere with extraction in like manner, this must be attributed to its distinct semantic and/or syntactic profile.

3.1 Methods

3.1.1 Participants
28 native speakers of English were recruited and given course credit for their participation.

3.1.2 Material
A total of 27 sets of nine parallel questions were constructed. Each set contained yes/no-questions (5a) containing negation (5b) or also (5c), subject wh-questions (5d) containing negation (5e) or also (5f), and object wh-questions (5g) likewise containing negation (5h) or also (5i).
(5) a. Did the kids watch the movie on the internet?
b. Didn’t the kids watch the movie on the internet?
c. Did the kids also watch the movie on the internet?
d. Which kids watched the movie on the internet?
e. Which kids didn’t watch the movie on the internet?
f. Which kids also watched the movie on the internet?
g. Which movie did the kids watch on the internet?
h. Which movie didn’t the kids watch on the internet?
i. Which movie did the kids also watch on the internet?

Yes/no-questions were included in the design to isolate the effects of negation and also on question formation; there is no extraction over negation/also in subject wh-questions while there is in object wh-questions. The stimulus questions all contained a subject consisting of a determiner and a noun, an object consisting of a determiner and a noun, a main verb and an adjunct consisting of a preposition, a determiner and a noun (5). Item sets differed in lexical realization, and thus every item set had a different verb, subject and object, but two of the 24 different prepositional phrases were used repeatedly. All questions in all item sets were crafted across conditions to be as pragmatically plausible and felicitous as possible, and they contained no grammatical violations.

The experimental sentences were supplemented by 54 filler sentences. All filler sentences were questions in order to conceal the purpose of the experiment. There were positive, negative and also yes/no-questions and wh-questions, and fillers were used to create a balanced design with respect to grammaticality (ranging over different levels of acceptability), intervener (negation, also, none) and question type (wh vs. yes/no).

The experimental stimuli were submitted to a Latin square design, resulting in nine lists such that every subject saw only one item per set and three different lexicalizations of the same condition. Every list contained 27 stimulus items and 54 filler sentences randomly interspersed between the stimuli. Each of the nine lists consisting of 81 sentences was also presented in reverse order such that the design included 18 lists total. Each participant was randomly assigned to one of the 18 lists.

3.1.3 Procedure
Participants were run in 15-minute sessions. The experiment was performed on a computer in the computer lab of the Linguistics Department at UCSD. After giving informed consent, participants were instructed on a website to use their intuitions as a native speaker of English to judge the naturalness of some English sentences presented to them on the computer screen. There was no time pressure in terms of submitting the rating. Both during the experiment as well as during training trials, participants saw one sentence at a time. Underneath the sentence was a series of buttons numbered from one to seven. Participants were
instructed to choose one of the lower numbers for ‘bad’ sentences and one of the higher numbers for ‘good’ sentences, in accordance with their judgment.

3.1.4 Analysis
A repeated measures analysis of variance (ANOVA) with two within-group factors was conducted. One factor was QUESTION TYPE, with three levels: yes/no-question, subject wh-question and object wh-question. The other factor was INTERVENER, again with three levels: negation vs. also vs. none. The Tukey HSD method was used to compute subsequent multiple pair-wise comparisons.

3.2 Results
As mentioned above, if also does not interact with extraction, this must be attributable to its divergent semantic and/or syntactic properties. If on the other hand also interacts with extraction in the same way as negation, this must be due to processing costs associated with its pragmatic requirements not being met. This would in turn suggest that it is the pragmatic rather than the semantic or syntactic properties of negation that interfere with extraction in negative islands.

Mean acceptability ratings and standard deviations are reported in Table 1; the same data are presented in graphic form in Figure 1. Both indicate that while the ratings for all question types with no intervener don’t differ much, the presence of both negation and also seems to lower acceptability ratings in general, but most notably in the case of object wh-questions.

<table>
<thead>
<tr>
<th></th>
<th>Yes/No</th>
<th>Subject Wh</th>
<th>Object Wh</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Intervener</td>
<td>6.3 (1.0)</td>
<td>6.0 (1.3)</td>
<td>6.1 (1.4)</td>
</tr>
<tr>
<td>Negation</td>
<td>6.2 (0.9)</td>
<td>5.7 (1.3)</td>
<td>4.8 (1.3)</td>
</tr>
<tr>
<td>Also</td>
<td>5.8 (1.1)</td>
<td>5.3 (1.4)</td>
<td>4.8 (1.5)</td>
</tr>
</tbody>
</table>

Table 1: Mean acceptability ratings with (standard deviations)

The repeated measures ANOVA revealed a main effect of intervener type ($F_1(2,54) = 24.424$, $p < 0.001$, $\eta^2_{partial} = 0.47$; $F_2(2,52) = 25.737$, $p < 0.001$, $\eta^2_{partial} = 0.5$), a main effect of question type ($F_1(2,54) = 26.643$, $p < 0.001$, $\eta^2_{partial} = 0.5$; $F_2(2,52) = 27.677$, $p < 0.001$, $\eta^2_{partial} = 0.51$) and an interaction between the two ($F_1(4,108) = 5.59$, $p < 0.001$, $\eta^2_{partial} = 0.17$; $F_2(4,104) = 9.938$, $p < 0.001$, $\eta^2_{partial} = 0.27$).

Subsequent multiple pair-wise comparisons showed that the main effect of intervener type was mainly due to significantly higher ratings for object wh-questions with no intervener compared to negative object wh-questions ($p < 0.001$) and object wh-questions containing also ($p < 0.001$). The main effect of question type was mainly driven by questions with interveners (negation or also): also object wh-questions were rated significantly lower than also yes/no-questions ($p = 0.008$), and negative object wh-questions were rated lower than
both negative yes/no-questions (p < 0.001) and negative subject wh-questions (p = 0.049). The interaction was due to robust differences between negative object wh-questions vs. all no-intervener and negative yes/no- and subject wh-questions, no-intervener object wh-questions, and also yes/no-questions (all p ≤ 0.049); and by robust differences between also object wh-questions vs. all yes/no-questions and no-intervener subject and object wh-questions (all p ≤ 0.008). Finally, also subject wh-questions were rated significantly lower than positive yes/no-questions (p = 0.008) and negative yes/no-questions (p < 0.001).

![Figure 1](image)

**Figure 1:** Mean acceptability ratings are plotted on the y-axis; question type is plotted on the x-axis. In the following order, blue indicates the mean ratings of questions with no intervener, red indicates the mean ratings of questions with negation and green indicates the mean ratings of questions with also.

### 3.3 Discussion

Our study compared the effects of the presupposition trigger *also* and negation in the context of extraction (yes/no- and subject wh-questions vs. object wh-questions) on acceptability ratings. We found a similar pattern of results for negation and *also*. Replicating an earlier study (Gieselmann *et al.* 2011, in preparation), we found that negative object wh-questions receive lower acceptability ratings than object wh-questions without negation (i.e. with no intervener). Interestingly, *also* object wh-questions lead to a quantitatively equal drop in acceptability compared to object wh-questions with no intervener. The interaction of both *also* and negation with extraction was revealed in robust pairwise differences between *also* yes/no-questions vs. *also* object wh-questions and between negative yes/no-questions vs. negative object wh-questions.
To exclude the possibility that extraction over any adverb leads to drops in acceptability, we conducted a follow-up study. We wanted to know whether a different type of intervener, one that is not a presupposition trigger and that is semantically relatively vacuous, such as just in its temporal reading, gives rise to the same type of intervention effects as negation and also did in the study reported above. Just should not impose conditions on the discourse in the same way that also and negation do.

We found that while yes/no-questions with just (6d) were not significantly different (p = 0.99) from object wh-questions with just (6h), both yes/no-questions with also (6c) and yes/no-questions with negation (6b) received significantly higher ratings than object wh-questions with also (6g; p = 0.003) and negation (6f; p < 0.001), respectively.

(6)  
a. Did the homeowner replace the cabinets during the remodeling?  
b. Didn’t the homeowner replace the cabinets during the remodeling?  
c. Did the homeowner also replace the cabinets during the remodeling?  
d. Did the homeowner just replace the cabinets during the remodeling?  
e. Which cabinets did the homeowner replace during the remodeling?  
f. Which cabinets didn’t the homeowner replace during the remodeling?  
g. Which cabinets did the homeowner also replace during the remodeling?  
h. Which cabinets did the homeowner just replace during the remodeling?

We take these results to show that while both also and negation interact with extraction, just does not. This rules out the logical possibility that all adverbs interfere with extraction. With regard to intervention effects, the common denominator between negation and also must therefore be the requirements they place on the discourse context and not their syntactic or semantic properties.

4. General Discussion

In this paper, we investigated some of the factors at play in the linguistic phenomenon of negative islands, with special focus on the role of negation. We presented the results of an experiment comparing the effects of negation with those of the presupposition trigger also in the context of referential argument extraction on acceptability ratings. While negation and also are very different semantically and syntactically, they have certain pragmatic similarities. There is evidence that the pragmatic requirements of both negation (Glenberg et al. 1999) and also (Schwarz 2007) are related to their processing costs. Extraction is a syntactic notion but also has processing correlates (Frazier & D’Arcais 1989; Frazier & Clifton 1989; King & Kutas 1995; Kluender 1998; a.o.). If it is true as we hypothesized that the processing cost of negation is related to its discourse requirements, and that it is this pragmatically driven processing cost
that interacts with extraction to cause acceptability drops in negative island contexts, then the same interaction should be seen in the case of extraction over also. This prediction was borne out, as the results showed equivalent drops in acceptability for extraction over both also and negation in comparison to control wh-questions with no interveners. Crucially, these drops in acceptability were triggered by the extraction of referential arguments, and therefore occurred in the absence of any recognized violation of semantic or syntactic constraints.

These results demonstrate that negative island-like effects can be observed with non-negative elements such as the presupposition trigger also. We take this as an indication that it is perhaps the pragmatic processing requirements of negation rather than its syntactic or semantic properties that create the phenomenon known as negative islands.

These findings predict that elements that do not constrain the discourse context to the same degree should not interfere with extraction. This prediction was confirmed in a follow-up experiment comparing the effects of extraction over negation and also to the effects of extraction over just in its temporal meaning. A further prediction of this study is that other elements that impose conditions on the discourse that cannot easily be accommodated should intervene with extraction just as negation and also do. Additional research will be required to determine whether this is indeed the case.

References


Simone Gieselman
University of California, San Diego
Linguistics Department
9500 Gilman Drive
La Jolla, CA 92093-0108
simoeneg@gmail.com