# Linguistic Complexity, Locality and Resumption

## Theodora Alexopoulou and Frank Keller
*University of Edinburgh*

## 1. Introduction

We present an account of the gradience arising in the acceptability of structures involving the interaction between resumption and islands. Our analysis is based on the results of three magnitude estimation studies from English, Greek and German. The present section introduces the phenomena and summarizes the results of Alexopoulou and Keller (2002) for English and Greek. Section 2 reports results from an identical study for German. Section 3 presents a theoretical analysis of the results.

### 1.1. Background: Islands and resumption

**Strong and weak islands**   Unlike *that*-clauses (see (1a)), indirect questions (see (1b)) and complex NPs containing a relative clause (see (1c)) are islands for movement. Indirect questions are considered "weak" islands since examples like (1b) are judged more acceptable than examples like (1c).

(1)    a.  Who does John think Mary will choose *t*?
        b.?*Who did Mary wonder whether they will fire *t*?
        c. *Who did John meet the girl who will marry *t*?

Strong islands constrain movement crosslinguistically, while languages vary with respect to the status of weak islands. For example, examples like (2) are judged grammatical in Greek (Tsimpli 1995; Alexopoulou 1999).

(2)    Pion      anarotithikes an      tha apolisoune?
       who-acc wondered-2sg whether/if will fire-3pl
       Who did you wonder whether they will fire?

**Islands and resumptive pronouns**   Resumptive pronouns are excluded from questions crosslinguistically and, in particular, in English and Greek.[1]

1.    D-linking has been argued to improve the acceptability of resumptives in questions (Sells 1984; Iatridou 1995).

(3)    a.  Who did you fire *t*/*him?
       b.  Pion        *t*/*ton apelises?
           who-acc *t*/him  fire-2sg

However, resumption is often viewed as a "last resort" device "saving" island violations at least in cases like (4) (from Haegeman 1991) and (5) (from Sells 1984).[2]

(4)    This is the man whom Emsworth told me when he will invite him.

(5)    Which woman does no Englishman ever wonder whether she will make a good wife?

**Resumptives and embedding**    Erteschick-Shir (1992) argues that a resumptive pronoun becomes more acceptable as the extraction site becomes more deeply embedded, a claim that she illustrates with the examples in (6).

(6)    a.  This is the girl that John likes *t*/*her.
       b.  This is the girl that Peter said that John likes *t*/??her.
       c.  This is the girl that Peter said that John thinks that Bob likes *t*/?her.
       d.  This is the girl that Peter said that John thinks that yesterday his mother had given some cakes to ?*t*/her.

Similarly, Tsimpli (1999) argues that in Greek, a resumptive is acceptable when embedded at least one *that*-clause away from the matrix (see (7) and (3b)).

(7)    Pion       ipoptefthike i  Maria oti tha ton       kalesoume?
       who-acc suspect-3sg the Maria that will him-acc invite-1pl
       Who did Maria suspect we will fire?

The aim of Alexopoulou and Keller's (2002) experimental study was to establish the validity of these observations, provide a concrete empirical basis for terms like "strong" and "weak" and compare interactions between resumption, islands and non-island embedding by quantifying the effect of each of these factors and investigating their interactions from a crosslinguistic perspective.

### 1.2.  Experiments 1 and 2: Locality and resumption in English and Greek

The Experiment 1 of Alexopoulou and Keller (2002) investigated the interaction between embedding, islands and resumption in English. Three different types of clauses were used: complement clause with *that* (no island), complement clause with *whether* (weak island), and relative clause (strong island). Two levels of embedding were tested: single embedding (one

---

2.    Sells (1984) distinguishes "intrusive" pronouns, which appear in the place of an illicit trace, from "true" resumptive pronouns that may be bound by an operator in the absence of any principle excluding traces.

complement clause or relative clause) and double embedding (one complement clause embedding another complement clause or a relative clause). To have a standard of comparison, the experiment also included sentences without embedding (control condition, zero embedding). Example sentences are given in (8)–(10). Experiment 2 had an identical design but was conducted in Greek.

(8) **No island violation**
  a. Who will we fire *t*/him? **(zero embedding)**
  b. Who does Mary claim that we will fire *t*/him? **(single)**
  c. Who does Jane think that Mary claims that we will fire *t*/him? **(double)**

(9) **Weak island violation**
  a. Who does Mary wonder whether we will fire *t*/him? **(single)**
  b. Who does Jane think that Mary wonders whether we will fire *t*/him? **(double)**

(10) **Strong island violation**
  a. Who does Mary meet the people that will fire *t*/him? **(single)**
  b. Who does Jane think that Mary meets the people that will fire *t*/him? **(double)**

**Method**   The method used for Experiments 1 and 2 was magnitude estimation (ME) as proposed by Bard et al. (1996) and Cowart (1997). It is described in detail by Alexopoulou and Keller (2002) and is largely identical to the method of Experiment 3 in Section 2 below.

**Results**   Again, a detailed description of the statistical analyses carried out for Experiments 1 and 2 is presented by Alexopoulou and Keller (2002). Here, we will only provide a high-level summary of the findings.

   *That*-**clauses:** (i) In both English and Greek, embedding reduces the acceptability of gapped sentences. The effect of embedding leads to a significant drop in acceptability at the second level of embedding. (ii) Resumptive pronouns in simple (zero embedding) questions give rise to strong unacceptability; this effect is weaker in Greek (see the discussion of relative clauses below). (iii) There is a non-significant tendency that indicates that resumption can reverse the effect of embedding: resumptives in embedded questions are more acceptable than in non-embedded ones. (iv) In Greek resumptives are indistinguishable from gaps at the second level of embedding. In English, resumptives remain significantly worse than gaps throughout.

   *Whether*-**clauses:** (i) *Whether*-clauses induce lower acceptability in both English and Greek gapped questions, compared to both unembedded clauses and *that*-clauses. (ii) Resumption reverses the effect of the embedding for *whether*-clauses, leading to a statistically significant improvement of the embedded resumptives in Greek. (iii) No significant deterioration is induced by the introduction of a *that*-clause at level-2 of embedding. (iv) Resumptives and gaps are indistinguishable in Greek at both levels of embedding, while in English, resumptives remain less acceptable than gaps.

**Relative clauses:** (i) Extraction out of relative clauses gives rise to strong ungrammaticality. In both languages, such violations were as bad as agreement violations in filler items, known to be among the worst types of violations (Keller 2000). (ii) Unlike *that*- and *whether*-clauses, resumptive pronouns do not interact with strong island violation. (iii) Resumptives in simple (zero embedding) questions are better in Greek than in English. In English, such violations are as bad as extraction from a relative clause, whereas in Greek, they are significantly better than extraction from relative clauses.

## 2. Experiment 3: Locality and resumption in German

The aim of the present experiment was to test the crosslinguistic validity of Experiments 1 and 2 by investigating the interaction of the factors embedding, resumption, and island violation in German. In (11)–(13), we list an example stimulus for each experimental condition. These stimuli are closely parallel to the English ones in (8)–(10).

(11)  **No island violation**

    a.  Wen entlassen wir *t*/ihn? **(zero embedding)**
        who sack      we *t*/him
        Who will we sack?

    b.  Wen behauptet Petra, dass wir *t*/ihn entlassen? **(single)**
        who claims    Petra that we *t*/him sack
        Who does Petra claim that we will sack?

    c.  Wen denkt  Barbara, dass Petra behauptet, dass wir *t*/ihn
        who thinks Barbara that Petra claims    that we *t*/him
        entlassen? **(double)**
        sack
        Who does Barbara think that Petra claims that we will sack?

(12)  **Weak island violation**

    a.  Wen überlegt Petra, ob      wir *t*/ihn entlassen? **(single)**
        who ponders Petra whether we *t*/him sack
        Who does Petra ponder whether we will sack?

    b.  Wen denkt  Barbara, dass Petra überlegt, ob      wir *t*/ihn
        who thinks Barbara that Petra ponders  whether we *t*/him
        entlassen? **(double)**
        sack
        Who does Barbara think that Petra ponders whether we will sack?

(13)  **Strong island violation**

    a.  Wen trifft  Petra die Leute, die  *t*/ihn entlassen? **(single)**
        who meets Petra the people that *t*/him sack
        Who does Petra meet the people that will sack?

    b.  Wen denkt  Barbara, dass Petra die Leute  trifft,  die  *t*/ihn
        who thinks Barbara  that Petra the people meets that *t*/him

entlassen? **(double)**
sack
Who does Barbara think that Petra meets the people that will sack?

## 2.1. Method

**Subjects**   Twenty-two subjects were recruited over the Internet by postings to newsgroups and mailing lists. All subjects were self-reported native speakers of German.

**Materials**   The design crossed the following factors: *Embedding* (single or double embedding), *Island* (*that*-clause, *whether*-clause, relative clause), and *Resumption* (gap or resumptive). This resulted in *Embedding* $\times$ *Island* $\times$ *Resumption* $= 2 \times 3 \times 2 = 12$ cells. As controls, we also included stimuli without embedding (gap or resumptive), resulting in a total of 14 cells. Seven lexicalizations were used for each cell, yielding a total of 98 stimuli.

The stimulus set was divided into seven subsets of 14 stimuli by placing the items in a Latin square. A set of 14 fillers was used, covering the whole acceptability range.

**Procedure**   The method used was magnitude estimation (ME) as proposed by Bard et al. (1996) and Cowart (1997).

Subjects first saw a set of instructions that explained the concept of numerical ME using line length. Subjects were instructed to make length estimates relative to the first line they would see, the reference line. They were told to give the reference line an arbitrary number, and then assign a number to each following line so that it represented how long the line was in proportion to the reference line. Several example lines and corresponding numerical estimates were provided to illustrate the concept of proportionality. Then, subjects were told that linguistic acceptability could be judged in the same way as line length. Examples of sentences of varying acceptability were used to illustrate the task.

After reading the instructions, subjects took part in a training phase designed to familiarize them with the task. In the training phase, subjects were ask to use ME to judge the length of a set of lines. Then, a set of practice items (similar to the experimental items) were administered to familiarize subjects with applying ME to linguistic stimuli. Finally, subjects had to judge the experimental items. Each subject judged one set of 14 experimental stimuli and all 14 fillers, i.e., a total of 28 items.

The experiment was conducted over the web using WebExp 2.4 (Keller et al. 1998), an interactive software package for web-based psycholinguistic experimentation. Keller and Alexopoulou (2001) present a detailed discussion of the safeguards that WebExp puts in place to ensure the authenticity and validity of the data collected, and also present a validation study comparing web-based and lab-based judgment data (for a WebExp validation study using sentence completion data, see Corley and Scheepers 2002).
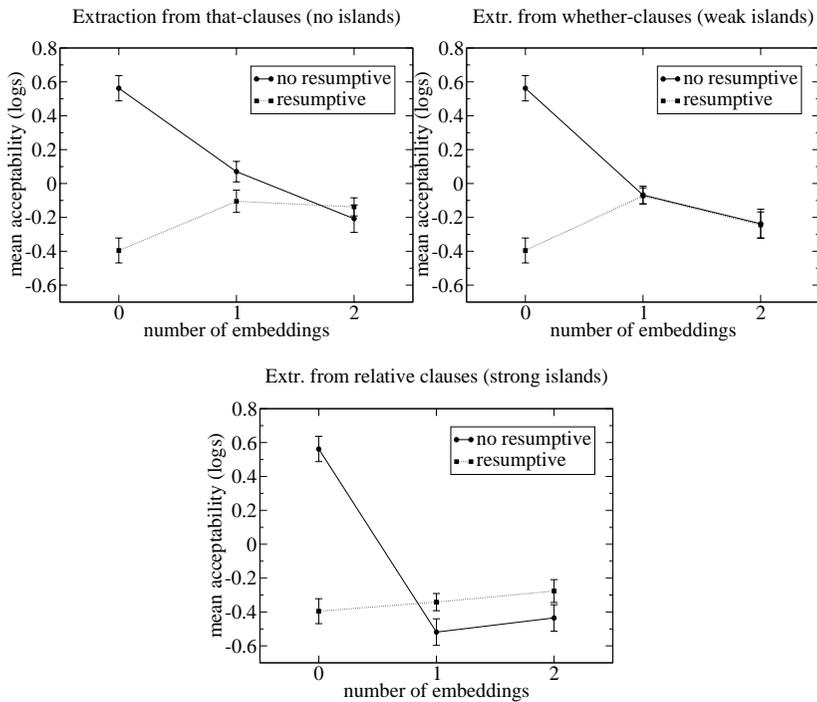
Extraction from that-clauses (no islands)

Extr. from whether-clauses (weak islands)

Extr. from relative clauses (strong islands)

Figure 1: Effect of embedding and resumption on extraction in German (*that-*, *whether-*, and relative clause conditions).

## 2.2. Results

The data were normalized by dividing each numeric judgment by the modulus value that the subject had assigned to the reference sentence. This operation creates a common scale for all subjects. Then the data were transformed by taking the decadic logarithm. This transformation ensures that the judgments are normally distributed and is standard practice for ME data (Bard et al. 1996). All analyses and figures are based on normalized, log-transformed judgments. Figure 1 graphs the mean judgments for all three island conditions.

An ANOVA yielded a main effect of *Embedding*, significant by subjects only ($F_1(1,21) = 4.345$, $p = .050$; $F_2(1,6) = 3.543$, $p = .109$). The main effect of *Island* was also significant ($F_1(2,42) = 20.829$, $p < .0005$; $F_2(2,12) = 89.284$, $p < .0005$), but the main effect of *Resumption* was not. We are mainly interested in an interaction of *Island* and *Resumption*, as this indicates that the acceptability of resumptives is sensitive to island violations. This interaction was significant ($F_1(2,42) = 3.722$, $p = .033$;

$F_2(2, 12) = 5.318$, $p = .022$). The interaction *Island/Embedding* was also significant ($F_1(3, 105) = 7.584$, $p = .002$; $F_2(2, 12) = 6.057$, $p = .015$). All other interactions failed to reach significance.

We conducted a Tukey post-hoc test to further investigate the interaction of *Island* and *Resumption*. This test revealed that there was no significant difference between the gap and the resumptive condition in the *that*-clause condition. The same result was found for the two island conditions (*whether*-clause and relative clause).

As a next step, we compared the conditions with single and double embedding to the control (no embedding). The appropriate statistic is Dunnett's test for comparing multiple conditions to a control condition. We will first report the results of comparing the gapped stimuli to the gapped control condition. For the *that*-clause condition, the control was significantly more acceptable than the single embedding condition, by subjects only ($t_{d_1}(21, 7) = 6.988$, $p < .01$; $t_{d_2}(7, 7) = 3.268$, $p > .05$). The control was also significantly more acceptable than the double embedding condition ($t_{d_1}(21, 7) = 7.200$, $p < .01$; $t_{d_2}(7, 7) = 8.710$, $p < .01$). The same pattern was obtained in the *whether*-clause condition, where the control was more acceptable than both the single and the double embedding condition ($t_{d_1}(21, 7) = 7.714$, $p < .01$; $t_{d_2}(7, 7) = 5.391$, $p < .01$ and $t_{d_1}(21, 7) = 8.437$, $p < .01$; $t_{d_2}(7, 7) = 5.398$, $p < .01$). Also, in the relative clause condition, the control was more acceptable than both levels of embedding ($t_{d_1}(21, 7) = 11.371$, $p < .01$; $t_{d_2}(7, 7) = 10.869$, $p < .01$ and $t_{d_1}(21, 7) = 9.490$, $p < .01$; $t_{d_2}(7, 7) = 10.369$, $p < .01$).

In a separate test, we compared the resumptive stimuli to the resumptive control condition. In the *that*-clause condition, we found that both the single and the double embedding condition were more acceptable than the control, by subjects only ($t_{d_1}(21, 7) = 3.340$, $p < .05$; $t_{d_2}(7, 7) = 2.406$, $p > .05$ and $t_{d_1}(21, 7) = 2.922$, $p < .05$; $t_{d_2}(7, 7) = 2.723$, $p > .05$). In the *whether*-clause condition, we found that the single embedding condition was significantly more acceptable than the control ($t_{d_1}(21, 7) = 4.083$, $p < .01$; $t_{d_2}(7, 7) = 3.355$, $p < .05$), while the control and the double embedding condition were not significantly different. In the relative clause condition, there was no significant difference between the control and the single and double embedding conditions.

## 2.3. Discussion

The experimental results for German show that embedding reduces the acceptability of gapped clauses. This is true for all three clause types. We also found that resumption can reverse the effect of embedding; in *that*- and *whether*-clauses, embedded resumptives were more acceptable than the unembedded control condition. No such effect was found for relative clauses. Crucially, however, resumptives were never more acceptable than gaps; they were at most equally acceptable. Hence, it cannot be claimed that resumptives "save" island violations. (Though there was a non-significant tendency

for resumptives to be better than gaps in relative clauses.) In English and Greek, it was found that extraction from *that*-clauses was more acceptable than extraction from *whether*-clauses. For German, however, the two clause types are very similar in acceptability (see Figure 1). We will return to this fact in Section 3.3 below.

Taking together Experiments 1–3, the most interesting overall finding is that the acceptability patterns are basically the same across all three languages, which indicates that the principles underlying these phenomena are crosslinguistically constant. This result demonstrates the importance of employing an experimental methodology for identifying crosslinguistic universals and the locus of crosslinguistic variation. For example, in English, the effect of resumption in *that*- and *whether*-clauses is of the same nature as in Greek and German, but manifests itself in a smaller reduction in unacceptability (compared to the unembedded control). It is rather unlikely that this fact would have been revealed by the standard informal collection of judgments, given that the acceptability of resumptives remains worse than the acceptability of gaps.

In the next section, we will present our hypotheses regarding the principles that underlie these phenomena and the gradient nature of the results within and across languages.

## 3. Locality conditions on movement vs. processing complexity

The data reveal a parallel between *that*- and *whether*-clauses, both of which contrast with *relative*-clauses: (i) The acceptability of both types of sentences converges at the second level of embedding, while they are still significantly better than extractions out of a relative clause (this is evidenced by the main effect of *Island* found in all three experiments). (ii) More interestingly, resumption reverses the effect of "embedding" in *that*- and *whether*-clauses, but not in relative clauses.

In the following sections, we argue that these results can be accounted for by three hypotheses: (i) Extraction out of a relative clause violates grammatical locality conditions (subjacency). (ii) Extraction out of *whether*-clauses does not involve any subjacency violations. Rather, on a par with *that*-clauses, the reduced acceptability of *whether*-clauses is a reflex of processing complexity due to the *memory cost* induced by embedding. In addition to memory cost, *whether*-clauses have a high *integration cost* that adds to their complexity and distinguishes them from *that*-clauses. (iii) Resumption reverses processing effects induced by processing complexity, but cannot reverse violations of grammatical principles.

### 3.1. Locality and resumption

We here adopt Cinque's (1990) proposals on locality, since he makes specific predictions about locality conditions associated with resumption, most

of which are confirmed by our data.[3] His proposal relies on a distinction between antecedent government chains and binding chains. The former are created by cyclic movement of an operator (e.g., a *wh*-phrase) leaving an empty category in situ that is a variable. Binding chains involve no movement; rather, a left peripheral operator binds a pronominal in its base position. The two types of chains conform to distinct locality conditions, distinguished by the two definitions of barriers given below. For the purposes of our discussion, direct selection roughly corresponds to an XP being subcategorized as a complement (L-marking), while indirect selection corresponds to θ-role assignment.

(14) **Barrier for government**
Every maximal projection that fails to be *directly* selected by a category nondistinct from [+V] is a barrier for government.

Strong islands like relative clauses are neither directly nor indirectly selected and, therefore, constitute barriers for both binding and government chains; resumption is thus not expected to "save" such violations, a prediction that is confirmed by the results obtained for relative clauses in Experiments 1–3. Our results therefore confirm Cinque's underlying theoretical position that locality conditions constrain chains rather than derivations and therefore cannot distinguish between BIND and MOVE operations.

Let us now turn to *whether*-clauses. The optionality between gaps and resumptives in Greek and German (see Figure 1) appears to confirm another one of Cinque's assumptions. He argues that, rather than variables (bound by an operator moved cyclically to the matrix Spec,CP), gaps in weak islands are empty pros, bound by a base-generated operator (at Spec,CP). Cinque's assumption is meant to capture two facts. First, that extraction out of indirect questions (and weak islands in general) is restricted to nominals, as indicated by (15).

(15) a. ?Which problem were you wondering how to phrase?
b. ?Which student did he wonder whether to consider intelligent?
c. How have you decided to phrase the problem?
d. *How are you wondering which problem to phrase?

The second fact relates to a parallel between gap extractions from weak islands and questions with overt resumptives in Italian (the facts reported for Italian are identical in Greek; see Alexopoulou and Kolliakou 2002). (16a) is ambiguous between a wide scope reading for the universal or a wide scope reading for the *wh*-phrase. If the *wh*-phrase is resumed by a pronominal as in (16b), only the latter reading is available. (The data below from Cinque (1990) are originally due to Longobardi (1986).)

---

3. Theories of subjacency rely on definitions of barriers and government. Such notions are absent from current minimalist theories; hence, it is not clear how older formulations of subjacency can be rephrased in minimalist terms. For the purposes of the current paper, we will therefore restrict ourselves to pre-minimalist formulations of subjacency.

(16)  a.  Quanti     pazienti ritieni      che debba  visitare *t* ogni
          how-many patients do-you-think that should visit     *t* each
          medico?
          doctor
          How many patients do you think each doctor should visit?
      b. ?Quanti     pazienti ritieni      che *li*   debba  visitare *t* ogni
          how-many patients do-you-think that *them* should visit     *t* each
          medico?
          doctor
          How many patients do you think each doctor should visit?

As in (16b), the wide scope reading for the universal is unavailable in (17), indicating that the gap is pronominal in nature.

(17)  Quanti     pazienti te   ne  sei andato prima che ogni  medico
      how-many patients you CL be  go        before that every doctor
      potesse visitare?
      could   visit
      How many patients did you go away before each doctor could visit?

Similarly, in Greek, the wide scope reading for the universal is unavailable (see (18)).[4]

(18) ?*Posus       fitites    anarotithikes  an tha exetasi       kathe
      how-many students wondered-2sg if  will examine-3sg each
      yatros?
      doctor-nom
      How many students did you wonder whether each doctor will examine?

Cinque's assumptions are compatible with the more general observation that d-linked phrases can more easily escape weak islands. Szabolcsi and Zwarts (1993) for example provide the following acceptability judgments that are meant to correlate with the degree of d-linking of the *wh*-phrase:

(19)  a.  Which man do you regret that I saw?
      b.  ?Who do you regret that I saw?
      c. ??What do you regret that I saw?
      d. ??How many books do you regret that I saw?
      e.  *Who the hell do you regret that I saw?

4.   Note also that, under the assumption that the empty category in (18) is an empty pro, the marginality of this example compared with (2) can be attributed to the badness of examples like (i).

(i)   ?*Posus      fitites     tha tus  exetasi      kathe yatros?
      how-many students will them examine-3sg each  doctor-nom
      How many students will each doctor examine?

Crosslinguistically, d-linking has been argued to improve the acceptability of resumptive pronouns in questions (Sells 1984; Iatridou 1995; Dobrovie-Sorin 1990). Therefore, the hypothesis that the empty category in questions out of *whether*-clauses is a pronominal is consistent with the effect of d-linking in these structures.

With respect to the results presented in this paper, Cinque makes two crucial predictions. He expects free variation between empty and overt pros. Moreover, since the gap is pronominal, overt resumption is not predicted to improve the acceptability of these structures. Both of his predictions are confirmed straightforwardly in the case of Greek and German.[5] (For a discussion of the fact that English pronominals remain significantly worse than gaps, see Section 3.3 below.)

We here assume that *whether*-clauses are directly selected and, on a par with *that*-clauses do not constitute barriers for government.[6] We further assume that in all three languages, the complementizer occupies the C position, thus making its specifier available as an "escape hatch." The question then is why cyclic movement is blocked in *whether*-clauses, but not in *that*-clauses and why extraction from *whether*-clauses is less acceptable than extraction from *that*-clauses. That cyclic movement is available in *that*-clauses can be seen by the absence of any d-linking requirement and the availability of wide scope readings for a universal in examples like (20).

(20)  Poses    bires ipe    o      Yanis    oti ipoloyise
      how-many beers said-3sg the-nom Yanis-nom that estimated-3sg
      i      Maria oti  tha pii      kathe kalesmenos?
      the-nom Maria that will drink-3sg each  guest-nom
      How many bottles of beer did Yanis say that Maria estimated each
      guest will drink?

In the next section we present a processing account that explains the effect of resumption in *that*- and *whether*-clauses and the differences between the two types of clauses.

## 3.2. Processing load and resumption as a last resort

Gibson (1998) assumes that syntactic predictions held in memory over longer distances induce a memory cost. His assumption captures well established memory limitations of the human parser, in particular beyond a second clause (Kimball 1973). Building on such facts, Dickey (1996) develops a hypothesis according to which information associated with a filler, in particular

---

5.    As pointed out to us by Ruth Kempson, if empty and overt pronominals alternate freely, we would expect pro drop subjects in English and German. We tentatively assume that empty and overt resumptives may only alternate freely in chains involving binding from A-bar positions.
6.    Cinque (1990) assumes that *whether*-clauses are only indirectly selected, thus constituting barriers for government but not for binding. It is not obvious that a clear distinction can be drawn between *that*- and *whether*-complements crosslinguistically.

its φ-features, deteriorates with embedding, causing processing difficulty. Resumptive pronouns counterbalance this processing difficulty because, unlike traces, they are specified for φ-features, and more importantly, they can access their antecedents anaphorically (like discourse anaphora). They are thus not as sensitive to the information in immediate memory as traces are.

We assume that the reduced acceptability of both *that*- and *whether*-clauses is due to memory cost associated with embedding. However, *whether*-clauses are less acceptable than *that*-clauses and exhibit a stronger resumption effect. Our conjecture is that these differences are due to the fact that *whether*-clauses involve extra processing complexity. According to Gibson (1998), in addition to memory cost, processing complexity may also arise due to an increased cost of integrating a new word or piece of structure. For example, new discourse referents have a higher integration cost than given ones. Following Szabolcsi and Zwarts (1993), we assume that unlike *that*-complements of "volunteer stance" verbs like *claim*, *think* or *say*, complements of a "non-stance" verb like *wonder*, introduce a Scope Element (the question operator) that interacts with the scope of the *wh*-element. We thus propose that the introduction of a scopal element increases the integration cost associated with *whether*-clauses and leads to a greater drop in acceptability than in *that*-clauses.[7] The higher integration cost puts strain on the computational system and information associated with the filler deteriorates rapidly, giving rise to resumption, in effect blocking cyclic movement.[8]

In short, resumption compensates for the memory cost associated with embedding or the higher integration cost in the case of *whether*-clauses. If what is at issue here is processing complexity, it is not surprising that resumption cannot "save" complex structures, but rather arises as a last resort, a "coping" strategy.

### 3.3. Gradience

According to the analysis presented here, the gradience in our results arises from violations of principles that belong to distinct modules. Strong island violations are grammatical violations, inducing strong unacceptability, on a par with other types of grammatical violations (e.g., agreement or case violations), thus surfacing as "hard constraints" in the sense of Keller (2000). By contrast, processing effects give rise to mild unacceptability, thus

---

7.    The contrast is not one between *that* and *whether*-clauses per se.    *That*-complements of "non-stance" verbs like *regret* are also weak islands. According to Szabolcsi and Zwarts (1993), they also introduce a scopal element.
8.    If the resumptive strategy is preferred from a processing point of view, why is it not generalized to questions with no embedding? We assume that pronominals are illicit variables for *wh*-operators (Lasnik and Stowell 1991). We thus depart from Mc-Daniel and Cowart (1999) who assume that what precludes resumptives from simple questions is the fact that overt resumption increases complexity. If this were the case, then resumption would be expected to be generally excluded from A-bar dependencies. However, resumption is obligatory in all non-quantificational A-bar dependencies in Greek (Tsimpli 1999).

surfacing as "soft constraints."

While this pattern is crosslinguistically constant, there are differences in the magnitude of the observed effects. For example, extraction from *that*- and *whether*-clauses is less acceptable in German. Unlike Greek and English questions, German ones also involve extraposition of the embedded CP, a fact that increases the processing complexity of these structures and induces a more dramatic drop in acceptability (thus also enhancing the effect of resumption). On the other hand, resumptives are more acceptable in simple questions in Greek than in English and German. We take the morphophonological weakness of Greek clitics to be responsible for this difference (see also Tsimpli 1999 and Cann et al. 2003). By contrast, English resumptives are not clitics; this, in conjunction with the milder processing effects induced by *that*- and *whether*-clauses in English compared to German, accounts for their lower acceptability in cases where overt pronouns are as acceptable as gaps in Greek and German.

## 4. Conclusion

We have presented an account of gradient acceptability arising from the interactions of islands, embedding and resumption. Our study demonstrates the importance of experimental methods for quantifying the effect of each factor. This approach enables reliable crosslinguistic comparisons and leads to an understanding of why gradience emerges in certain syntactic structures.

Our main theoretical claim is that resumption is a "coping" strategy that compensates for processing complexity, but cannot save grammatical violations (e.g., subjacency violations). If this is correct, then we predict that resumption would surface in other cases involving processing complexity (e.g., preposing of "heavy" constituents). However, resumption should be unable to "save" grammatical violations such as ECP violations.[9]

## References

Alexopoulou, Theodora, 1999. *The Syntax of Discourse Functions in Greek: A Non-configurational Approach*. Ph.D. thesis, University of Edinburgh.

Alexopoulou, Theodora and Frank Keller, 2002. Resumption and locality: A crosslinguistic experimental study. In *Papers from the 38th Meeting of the Chicago Linguistic Society*, volume 1: The Main Session. Chicago. To appear.

Alexopoulou, Theodora and Dimitra Kolliakou, 2002. On linkhood, topicalisation and clitic left dislocation. *Journal of Linguistics*, 38:193–245.

Bard, Ellen Gurman, Dan Robertson and Antonella Sorace, 1996. Magnitude estimation of linguistic acceptability. *Language*, 72(1):32–68.

Cann, Ronnie, Tami Kaplan and Ruth Kempson, 2003. Data at the grammar-pragmatics interface: The case of resumptive pronouns in English. *Lingua*, to appear.

Cinque, Guglielmo, 1990. *Types of A′-Dependencies*. Number 17 in Linguistic Inquiry Monographs. Cambridge, MA: MIT Press.

---

9.   We have here restricted ourselves to questions. It remains an matter of future research to investigate to which extent relative clauses will exhibit similar effects.

Corley, Martin and Christoph Scheepers, 2002. Syntactic priming in English sentence production: Categorical and latency evidence from an internet-based study. *Psychonomic Bulletin and Review*, 9(1):126–131.

Cowart, Wayne, 1997. *Experimental Syntax: Applying Objective Methods to Sentence Judgments*. Thousand Oaks, CA: Sage Publications.

Dickey, Michael Walsh, 1996. Constraints on the sentence processor and the distribution of resumptive pronouns. In Michael Walsh Dickey and Susanne Tunstall, editors, *Linguistics in the Laboratory*, number 19 in Occasional Papers in Linguistics, pp. 157–192. Amherst, MA: University of Massachusetts.

Dobrovie-Sorin, Carmen, 1990. Clitic doubling, *wh*-movement and quantification in Romanian. *Linguistic Inquiry*, 21(3):351–397.

Erteschick-Shir, Nomi, 1992. Resumptive pronouns in islands. In Helen Goodluck and Michael Rochemont, editors, *Island Constraints: Theory, Acquisition and Processing*, volume 15 of *Studies in Theoretical Psycholinguistics*, pp. 89–108. Dordrecht: Kluwer.

Gibson, Edward, 1998. Linguistic complexity: Locality of syntactic dependencies. *Cognition*, 68:1–76.

Haegeman, Lilian, 1991. *Introduction to Government and Binding Theory*. London: Blackwell.

Iatridou, Sabine, 1995. Clitics and island effects. *Penn Working Papers in Linguistics*, 2:11–31.

Keller, Frank, 2000. *Gradience in Grammar: Experimental and Computational Aspects of Degrees of Grammaticality*. Ph.D. thesis, University of Edinburgh.

Keller, Frank and Theodora Alexopoulou, 2001. Phonology competes with syntax: Experimental evidence for the interaction of word order and accent placement in the realization of information structure. *Cognition*, 79(3):301–372.

Keller, Frank, Martin Corley, Steffan Corley, Lars Konieczny and Amalia Todirascu, 1998. WebExp: A Java toolbox for web-based psychological experiments. Technical Report HCRC/TR-99, Human Communication Research Centre, University of Edinburgh.

Kimball, John, 1973. Seven principles of surface structure parsing in natural language. *Cognition*, 2(1):15–47.

Lasnik, Howard and Tim Stowell, 1991. Weakest crossover. *Linguistic Inquiry*, 22(4):687–720.

Longobardi, Giuseppe, 1986. L'estrazione dalle "isole" e lo scope dei sintagmi quantificati. In Klaus Lichem, Edith Mara and Susanne Knaller, editors, *Parallela 2: Aspetti della sintassi dell'italiano contemporaneo*. Tübingen: Gunter Narr.

McDaniel, Dana and Wayne Cowart, 1999. Experimental evidence of a minimalist account of English resumptive pronouns. *Cognition*, 70:B15–B24.

Sells, Peter, 1984. *Syntax and Semantics of Resumptive Pronouns*. Ph.D. thesis, University of Massachusetts at Amherst.

Szabolcsi, Anna and Frans Zwarts, 1993. Weak islands and an algebraic semantics for scope taking. *Natural Language Semantics*, 1:235–284.

Tsimpli, Ianthi Maria, 1995. Focusing in Modern Greek. In Katalin É. Kiss, editor, *Discourse Configurational Languages*, Oxford Studies in Comparative Syntax, pp. 176–206. Oxford: Oxford University Press.

Tsimpli, Ianthi Maria, 1999. Null operators, clitics and identification: A comparison between Greek and English. In Artemis Alexiadou, Geoffrey Horrocks and Melita Stavrou, editors, *Studies in Greek Syntax*, pp. 241–262. Dordrecht: Kluwer.