

## RESEARCH

## The cost of raising quantifiers

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The main proposal of this paper is that *quantifier raising* (QR) is not subject to QR-specific locality or domain restrictions but that differences observed between overt and covert movement are the result of an increased processing burden associated with multiple steps of covert movement and the lack of a cue for the parser to initiate a search for a covert dependency. One of the main observations is that QR from different types of clausal complements is gradient and speakers' acceptance of non-local inverse scope tracks syntactic complexity defined over clausal domains. The account develops a preliminary algorithm for calculating processing costs based on the complexity of the structure, which in turn is reflected in the number of steps QR has to undergo in a cyclic movement approach to inverse scope.

**Keywords:** quantifier raising; Scope Economy; processing; Restructuring; clause size

## 1 Introduction

The domain of quantifier scope or quantifier raising (QR) is often claimed to be the clause where the quantifier originates in, even in languages that are not characterized as scope-rigid. Although indefinite QPs are not (or less) restricted in where they take scope, universal QPs seem to be clause-bound, as illustrated in (1) (see, among others, Farkas 1981; Fodor & Sag 1982; Abusch 1994; Beghelli 1995; Fox 1995; 2000; Farkas & Giannakidou 1996; Szabolcsi 1997; Johnson 2000; Cecchetto 2004). For instance, (1a,b) are typically seen as pragmatically ill-formed as they imply that Sue is married to every man. If the QP every man could undergo non-clause-bound QR, no such infelicity should arise since the interpretation would be that different people make claims about different men being married to Sue.

- (1) a. Fox (2000: 62; \* $\forall \gg \exists$ )  
#Someone said that every man is married to Sue.  
b. Fox (2000: 62; \* $\forall \gg \exists$ )  
#Someone said that Sue is married to every man.  
c. Johnson (2000: 188; \* $\forall \gg \exists$ )  
I told someone you would visit everyone.  
d. Cecchetto (2004: 350; \* $\forall \gg \exists$ )  
A technician said that John inspected every plane.

Clause-boundedness effects for QR have always been puzzling, for at least three reasons. First, such judgments are not absolute but relative and gradient, and speakers do sometimes allow inverse scope across finite clauses. Second, as shown in (2a,b), QR crucially differs from overt A'-movement (*wh*-movement, topicalization) in that the latter can escape

from finite clauses via successive cyclic movement, raising the question of why covert movement obeys different locality constraints from overt movement.

- (2) a. Johnson (2000: 188)  
It's Mary that I told someone \_\_\_\_ you would visit \_\_\_\_.
- b. Cecchetto (2004: 350)  
What did a technician say \_\_\_\_ that John inspected \_\_\_\_?

Third, when scope in Antecedent Contained Deletion (ACD) contexts is considered, QR out of finite clauses appears to be generally possible. Since examples like (3) allow a large Ellipsis antecedent as indicated, assuming QR is required to resolve ACD, such examples must involve QR of *every committee/book* + the relative clause to a position above the matrix verb, thus across finite clause boundaries.

- (3) a. Wilder (1997)  
John said that you were on every committee that Bill did ~~say that you were on~~.  
QR: [every committee that Bill did]<sub>QP</sub> » [<sub>VP</sub> say that you were on ~~every committee that Bill did~~ ]
- b. Syrett & Lidz (2011: 321 (26))  
Clifford said that Goofy read every book that Scooby did ~~say that Goofy read~~.

Finally, the definition of “clause” in a clause-boundedness restriction poses several challenges. As noted in Farkas & Giannakidou (1996), (certain) subjunctives (despite being finite) are more permeable to scope than indicatives, at least in Greek. In English, an area of extensive variation is found when QR out of infinitives is considered. Hornstein (1994; 1995) and Cecchetto (2004) state that QR is only possible out of Restructuring infinitives, which are assumed to involve a mono-clausal configuration. Cecchetto’s evidence for this distinction in Italian is given in (4). Since infinitives combining with the modal verb *want* allow Clitic Climbing as in (4a), they are classified as Restructuring infinitives. Such infinitives also allow inverse scope in (4b). Infinitives combining with a verb like *admit*, on the other hand, prohibit Clitic Climbing, (4c), hence they are Non-Restructuring infinitives, and according to Cecchetto inverse scope as in (4d) is also excluded.

- (4) *Italian* (Cecchetto 2004: 371–372)
  - a. Gianni lo vuole fare.  
Gianni it wants do.INF  
'Gianni wants to do it.'
  - b. Almeno uno studente vorrebbe licenziare ogni professore.       $\forall \gg \exists$   
'At least one student would like to fire every professor.'
  - c. \*Almeno un poliziotto la ha ammessa di sorvegliare.  
At least one policeman it has admitted to control  
'At least one policemen has admitted to control it.'
  - d. Almeno un poliziotto ha ammesso di sorvegliare ogni uscita.       $*\forall \gg \exists$   
'At least one policeman has admitted to controlling every exit.'

Regarding English, the Restructuring/QR connection has, however, been contested by Kennedy (1997), Moulton (2007), as well as most of the native speakers I have consulted.<sup>1</sup>

<sup>1</sup> A reviewer notes that the availability of inverse scope differs depending on what quantifier is used in the matrix clause, in particular, QPs that imply a plurality facilitate the inverse scope interpretation. This seems to be in line with the results of experimental studies (see section 3.1) which show that inter- and intra-sentential contextual information can have an effect on the availability of inverse scope.

Examples such as (5) allow inverse scope, although only *try* and *intend* would typically be considered as Restructuring predicates.<sup>2</sup>

- (5) Kennedy (1997: 674): “although QR is in general clause-bounded, it can move quantified DPs out of nonfinite clauses (possibly as a marked option) [...] Each of these sentences has an interpretation in which the embedded quantifier has wide scope with respect to the indefinite subject of the matrix clause”
- [41] At least two American tour groups **expect** to visit every European country this year.
- [42] Some agency **intends** to send aid to every Bosnian city this year.
- [43] At least four recreational vehicles **tried** to stop at most AAA approved campsites this year.
- [44] Some congressional aide **asked** to see every report.
- [45] More than two government officials are **obliged** to attend every state dinner.
- [46] A representative of each of the warring parties is **required** to sign every document.
- [47] At least one White House official is **expected** to attend most of the hearings.

As in finite contexts, ACD with wide Ellipsis resolution and resulting wide scope of the ACD containing QP is again possible for most speakers.

- (6) a. Tim believes the students to know everything Joe does [~~believe the students to know~~].
- b. Cecchetto (2004: 388, (93))  
A middle school teacher claimed to be about to catch each problem student John did [~~claim to be about to catch~~]. \*A»E

There are two basic directions for how the difference between overt and covert movement and the (apparent) difference between QR in ACD contexts and QR in non-ACD contexts has been addressed. First, QR across a finite clause boundary (and possibly a Non-Restructuring infinitive) can be excluded by syntactic locality in conjunction with an Economy constraint on scope (Fox 2000; Cecchetto 2004; Takahashi 2011; Wurmbrand 2013), and by allowing ACD to “lift” that constraint (Cecchetto 2004). Second, the difficulty of non-clause-bound QR can be seen as the result of a Processing Economy condition (Anderson 2004; Tanaka 2015a; b; Wurmbrand 2016) triggering higher processing costs for steps of QR spanning finite clause boundaries and by ACD reducing those costs or facilitating the inverse scope interpretation despite the costs. This article will follow and extend the second type of approach.

The syntactic Scope Economy approaches are summarized in section 2. In section 3, I provide an overview of several experimental studies on scope and summarize their findings. One of the main conclusions is that every step of QR, even QR in simple clauses, incurs a processing cost, and that the cost increases with syntactic complexity. Similar to center embedding and garden path constructions, increasing syntactic complexity leads to a point where the cost is too overwhelming for speakers to see a parse with inverse scope. In section 4.1, I lay out a syntactic approach reflecting different degrees of complexity of embedded complements, which will then form the basis for the calculation of the processing costs. The mapping between syntactic structure and processing as relevant

<sup>2</sup> Since some of these examples involve eventive predicates, an account of the wide scope interpretation as a *scope illusion* (Fox & Sauerland 1997) does not seem to be applicable. As Fox & Sauerland (1997) argue, scope illusions arise only in generic contexts where a generic operator (an implicit or explicit adverbial) binds the indefinite QP.

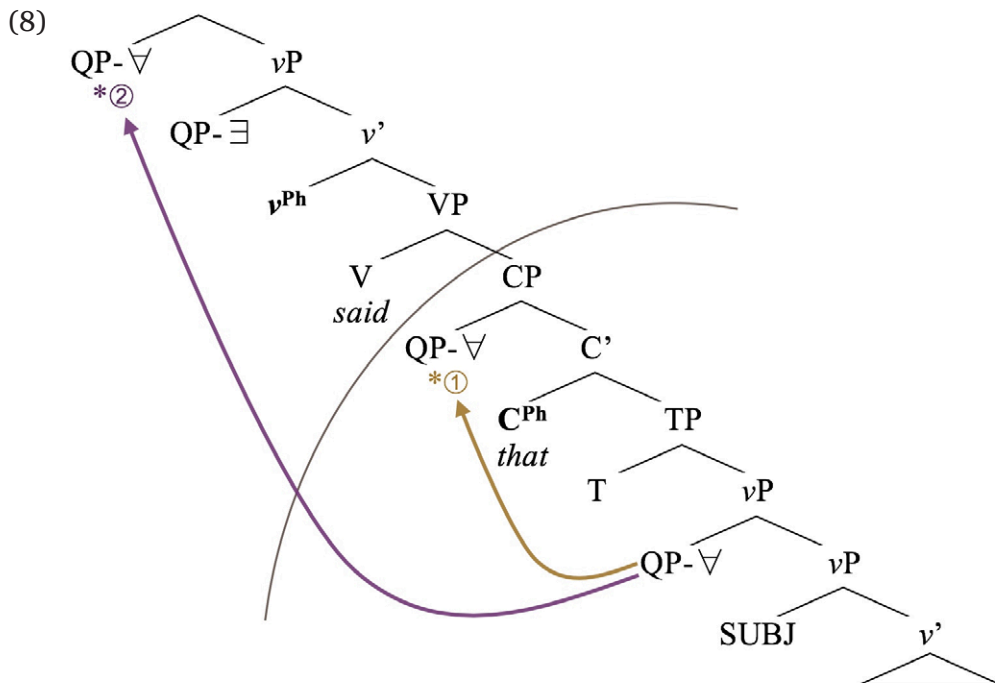
for scope is detailed in section 4.2, and section 4.3 provides a preliminary algorithm for calculating QR-related processing costs.

## 2 Syntactic Scope Economy

A syntactic approach to clause-boundedness phenomena of QR is to employ a combination of locality and a QR-specific Economy condition, such as the one in (7) (see Fox 2000; Cecchetto 2003; 2004; Takahashi 2011; Wurmbrand 2013).

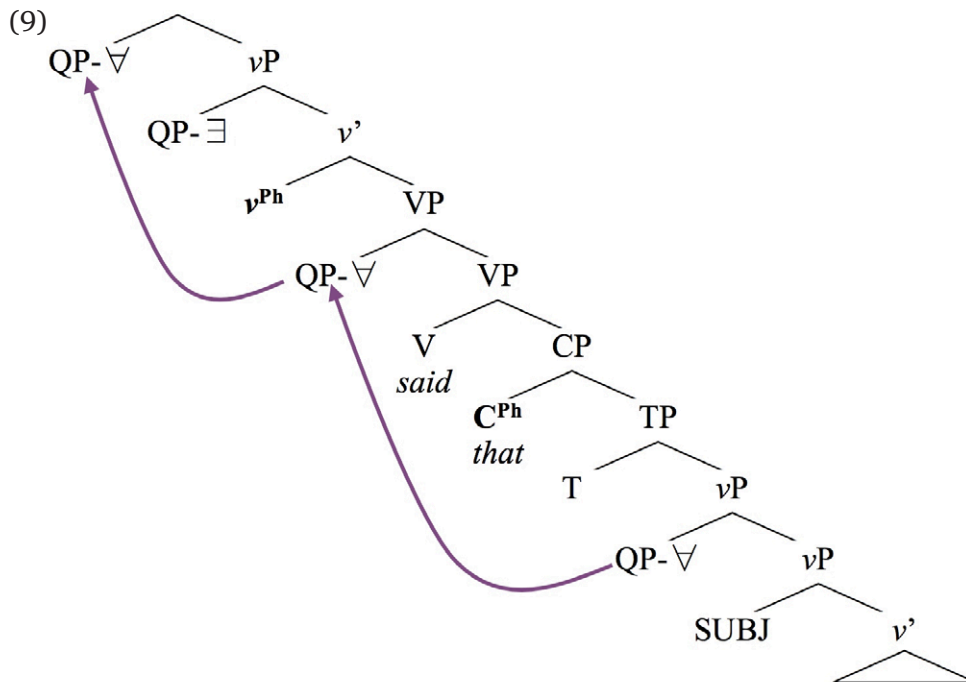
(7) Scope-shifting operations (SSOs) cannot be semantically vacuous (Fox 2000: 3).

Assuming that CPs are domains (e.g., phases) for syntactic movement, locality requires that movement out of a finite CP (and for Cecchetto 2004 also out of a Non-Restructuring CP) applies successive cyclically through Spec,CP. In other words, direct movement of QP- $\forall$  from the embedded Spec,vP to position  $\textcircled{2}$  in (8) is excluded. Although the accounts mentioned differ in some of the specifics, the general mechanism for blocking non-clause-bound QR is the same. Takahashi (2011) and Wurmbrand (2013) relate locality to the inaccessibility of material in spelled out domains (to escape Spell-Out of TP, QP- $\forall$  would have to move to the phase edge, Spec,CP). Cecchetto (2004), on the other hand, assumes that LF Spell-Out does not apply cyclically, but that locality is defined over the number of phase heads (marked with  $^{ph}$  in the trees) crossed—only one phase head may be crossed in a single step of movement (in derivation  $\textcircled{2}$  in (8) two phase heads would be crossed— $v^{ph}$  and  $C^{ph}$ , which is illicit). Furthermore, since QR, in contrast to overt A'-movement, is also subject to Scope Economy, each step of QR must be motivated semantically. As shown in (8), locality and Scope Economy then lead to an unresolvable dilemma. Locality requires movement through Spec,CP (position  $\textcircled{1}$ ), but Scope Economy prohibits this step, since this movement does not change any scope relations in the embedded clauses.



To allow QR in ACD contexts, Cecchetto (2004) defines semantic motivation as: i) scope over another quantified noun phrase (QNP), ii) resolving a type mismatch, and iii) solving an infinite regress problem in an ACD configuration. This has the welcome effect that movement of QP- $\forall$  to Spec,CP as in (8) is excluded, but movement above the matrix V as

in (9) is allowed if it is motivated by ACD resolution. Since in Cecchetto's account, no LF Spell-Out of completed phases takes place, movement from the embedded  $vP$  to the matrix VP is possible. As shown in (9), this movement step satisfies Cecchetto's formulation of locality since only one phase head ( $C^{Ph}$ ) is crossed. It also satisfies Scope Economy in a context such as (3) (but crucially not (1)), since this movement serves to resolve an ACD configuration.



Cecchetto's approach thus derives the difference between (1) and (3), with the exception of the speaker variation. As for infinitives, the situation is not so clear. Restructuring infinitives are assumed to lack a clausal domain (in particular a CP), whereas Non-Restructuring infinitives involve a CP. The lack of clause-boundedness effects in Restructuring thus follows. The behavior of Non-Restructuring infinitives in English, on the other hand, which we have seen in section 1 allow QR, requires a special treatment. Furthermore, as we will see section 3.3, there is also a difference between Restructuring infinitives and simple predicates, which is not expected in this approach. Theoretically, the analysis raises the question of why semantic motivation to satisfy Scope Economy includes ACD resolution, but not, for instance, scope over an intentional matrix verb, tense, or context operators in the CP, which can also lead to different interpretations (recall that the derivation in (9) can only apply in ACD contexts). Including ACD resolution as a way to satisfy Scope Economy may also pose a look-ahead problem, depending on how exactly ACD resolution works—a movement step not changing the interpretation (such as ① in (9)) is allowed if this leads to ACD resolution but crucially not when this leads to a different scope relation in the next step. In the next section, I summarize several experimental results of QR, which also pose questions for a syntactic Scope Economy approach and will lay the groundwork for the proposal developed in this paper.

### 3 Processing Scope Economy

In this section, I discuss the major findings regarding the processing of scope ambiguity and inverse scope. To understand the behavior of scope in complex clauses, it is necessary to first lay out the behavior of QR in simple clauses. Since my account will be based on the conclusions drawn in Anderson (2004), I provide a detailed overview of this work in

section 3.1. Section 3.2, summarizes some of the experimental results of QR from finite clauses and islands, and section 3.3 presents a summary of an experiment investigating QR from infinitives. The sum of observations and conclusions will then be put together in an account that applies a processing algorithm to specific syntactic structures.<sup>3</sup>

### 3.1 QR in simple clauses and Ellipsis

Based on a series of experiments (offline questionnaires and online self-paced reading experiments), Anderson (2004) shows that to adequately model speaker's behavior regarding scope it is necessary to consider both syntactic complexity and extra-grammatical processing factors. A common strategy used in Anderson's experiments is to diagnose the interpretation of sentences like (10) via the choice of a paraphrase as in (10a) (participants are asked to choose the paraphrase corresponding to their initial interpretation of the sentence) or the answer to a comprehension question as in (10b). If (10a.ii) or (10b.ii) is chosen, one can conclude that the speaker has an inverse scope interpretation in mind, since only the inverse scope interpretation is compatible with multiple referents corresponding to the indefinite QP. For all experiments involving the strategies in (10), the counting of inverse scope was done conservatively in that only 'several' answers, which unambiguously indicate inverse scope, were counted as evidence for inverse scope. Since 'one' answers are, in principle, compatible with both surface and inverse scope, those answers are less informative and the rates for inverse scope may in fact be slightly higher than the results given. However, this does not affect the main conclusions reached in this work.

- (10) Anderson (2004: 51, (47))  
 A cashier greeted every customer.
- a.
    - i. One cashier greeted customers.
    - ii. Several cashiers greeted customers.
  - b. How many cashiers greeted customers?
    - i. One.
    - ii. Several.

The first noteworthy observation from Anderson's experiments is that inverse scope is not easily available, not even in simple sentences such as (10). In an initial offline questionnaire experiment employing the strategy in (10a), sentences such as (10) are predominantly interpreted as involving surface scope:

Anderson (2004: 53): "Perceivers chose the paraphrase corresponding to the surface-scope interpretation in 81% of cases, a value that is significantly different from the chance value of 50% (*z-test*,  $p < 0.001$ ). Twelve participants chose the surface-scope paraphrase for all of the items, and one item (*A student solved every puzzle.*) earned a surface-scope response from all participants. No participant had a surface-scope response rate of less than 46%, and no item had a surface-scope response rate of less than 50%."

The availability of inverse scope increases, if the same sentences are embedded in linguistic contexts favoring inverse scope interpretations. Using a  $2 \times 2$  design, Anderson compared the distribution of scope in ambiguous and non-ambiguous sentences embedded in contexts biasing for surface or inverse scope. The full paradigm of one stimulus item illustrating

<sup>3</sup> To date, there is no account that has tested all the constructions I am interested in in a uniform experimental setting. The accounts available, together, cover the phenomena, but this is, of course, not ideal and raises the question of whether the results are directly comparable. The account I will provide is hence preliminary and subject to further testing, which is intended for the future. I will note such shortcomings in the course of the discussion.

the four conditions is given in (11), with the test sentences highlighted. The items in (11a,b) involve situations which favor a surface scope interpretation—the president of the gourmet club is looking for a (possibly single) volunteer among the club’s members to test the recipes. The context in (11c,d) is different in that multiple members are required to test the recipes, which favors an inverse scope interpretation of the test sentences.<sup>4</sup> Furthermore, each of the two contexts is given with an ambiguous and unambiguous test sentence. In (11a), the test sentence includes a definite subject (rather than an indefinite QP) which does not scopally interact with the object QP, hence the highlighted sentence in (11a) only leads to a surface scope interpretation. In (11c), the indefinite QP in the test sentence is modified by *different*, which in relation to the object requires a low scope interpretation of that QP. In contrast, the test sentences in (11b,d) are ambiguous.

(11) Anderson (2004: 271–272, Item 2-1)

- a. *Surface scope bias; unambiguous surface scope test sentence*  
 The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. The president of the club requested that someone volunteer to test the recipes to make sure that the instructions were correct. After a short discussion, **the helpful member tested every recipe**. Who tested the recipes?  
 The club member.      The club’s president.
- b. *Surface scope bias; ambiguous test sentence*  
 The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. The president of the club requested that someone volunteer to test the recipes to make sure that the instructions were correct. After a short discussion, **a helpful member tested every recipe**. How many club members tested recipes?  
 One.                      Several.
- c. *Inverse scope bias; unambiguous inverse scope test sentence*  
 The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. Members who nominated recipes were required to test the recipes to make sure that the instructions were correct. **A different member tested every recipe**.  
 One.                      Several.
- d. *Inverse scope bias; ambiguous test sentence*  
 The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. Members who nominated recipes were required to test the recipes to make sure that the instructions were correct. **A helpful member tested every recipe**.  
 One.                      Several.

The results of three of the experiments in Anderson (2004), Experiments (Exp) 2, 7, 12, are given in Table 1. As shown, the two items with unambiguous test sentences were nearly

<sup>4</sup> Other contexts that favor inverse scope are cases like *A guard is standing in front of every building*, where in a normal setting, only the inverse scope interpretation is felicitous. As pointed out by a reviewer, such cases could be very useful for testing long QR from different types of complements. As far as I am aware this has not been done yet.

**Table 1:** Responses to comprehension question (Anderson 2004: 62, Table 1).

Condition	Example item	Surface scope ( <i>One response, correct answer</i> )	Inverse scope ( <i>Several response, incorrect answer</i> )
<i>Surface scope bias, unambiguous surface scope</i>	(11a)	Exp 2: 0.99 (correct) Exp 7: 0.95 Exp 12: 0.96	Exp 2: 0.01 (incorrect) Exp 7: 0.05 Exp 12: 0.04
<i>Surface scope bias, ambiguous</i>	(11b)	Exp 2: 0.81 ( <i>one</i> ) Exp 7: 0.68 Exp 12: 0.69	Exp 2: 0.19 ( <i>several</i> ) Exp 7: 0.32 Exp 12: 0.31
<i>Inverse scope bias, unambiguous inverse scope</i>	(11c)	Exp 2: 0.04 ( <i>one</i> ) Exp 7: 0.08 Exp 12: 0.12	Exp 2: 0.96 ( <i>several</i> ) Exp 7: 0.92 Exp 12: 0.88
<i>Inverse scope bias, ambiguous</i>	(11d)	Exp 2: 0.47 ( <i>one</i> ) Exp 7: 0.44 Exp 12: 0.51	Exp 2: 0.53 ( <i>several</i> ) Exp 7: 0.56 Exp 12: 0.49

always associated with the expected interpretations—surface scope in (11a) and inverse scope in (11c), showing that the participants responded correctly to the questionnaire.<sup>5</sup> The results also show a significant effect of context: for the two ambiguous conditions, (11b,d), surface scope was significantly more frequent in contexts with a surface scope bias (81%) than in contexts with an inverse scope bias (47%). Thus, the context clearly plays a role in the choice between surface and inverse scope, however, at the same time, it is not the case that the interpretation is solely determined by the context. The rate of surface scope in the ambiguous surface scope biasing context (11b)—81%—is the same as in the questionnaire which presented the test sentences without any context (see above). It can therefore be concluded that ambiguous sentences retain ambiguity, even when the context favors a particular interpretation, and that speakers have access to both interpretations. Furthermore, although an inverse scope biasing context raises the accessibility of inverse scope in an ambiguous sentence, (11d), to 53% (compared to 19% in cases without a biasing context), the rate of inverse scope still remains clearly lower than the rate of surface scope in a surface biasing context (81%). Put differently, the strong default preference for surface scope remains visible in these cases, as the surface scope rate still reaches 47%, despite the inverse scope bias. Overall, these results show that context plays a role in the choice of scope but does not eliminate ambiguity, and that inverse scope is generally disfavored.

Since QR in simple predicates is always allowed by the notion of syntactic Scope Economy introduced in the previous section (e.g., to solve a type mismatch), syntactic Scope Economy would not be an issue in any of the conditions in (11). Thus, an additional factor must be at work to yield the different patterns in Table 1. Anderson (2004) suggests that this factor is based on extra-grammatical considerations, which, importantly, operate on syntactic structure involving QR to derive inverse scope. Employing a syntactic approach to scope in general (though without the notion of Scope Economy) allows the formulation of increased complexity in inverse scope contexts: to derive inverse scope, covert movement is necessary, which yields a more complex syntactic configuration than a surface scope

<sup>5</sup> The test condition ambiguity showed a significant effect: for the two conditions with an inverse scope bias, (11c,d), inverse scope was significantly more frequent in the non-ambiguous case (96%) than in the ambiguous case (53%).



structure without movement. Anderson indeed argues for such a notion of complexity which she proposes to combine with the Processing Economy condition in (12).

(12) *Processing Scope Economy* (Anderson 2004: 48, (46))

The human sentence processing mechanism prefers to compute a scope configuration with the simplest syntactic representation (or derivation).

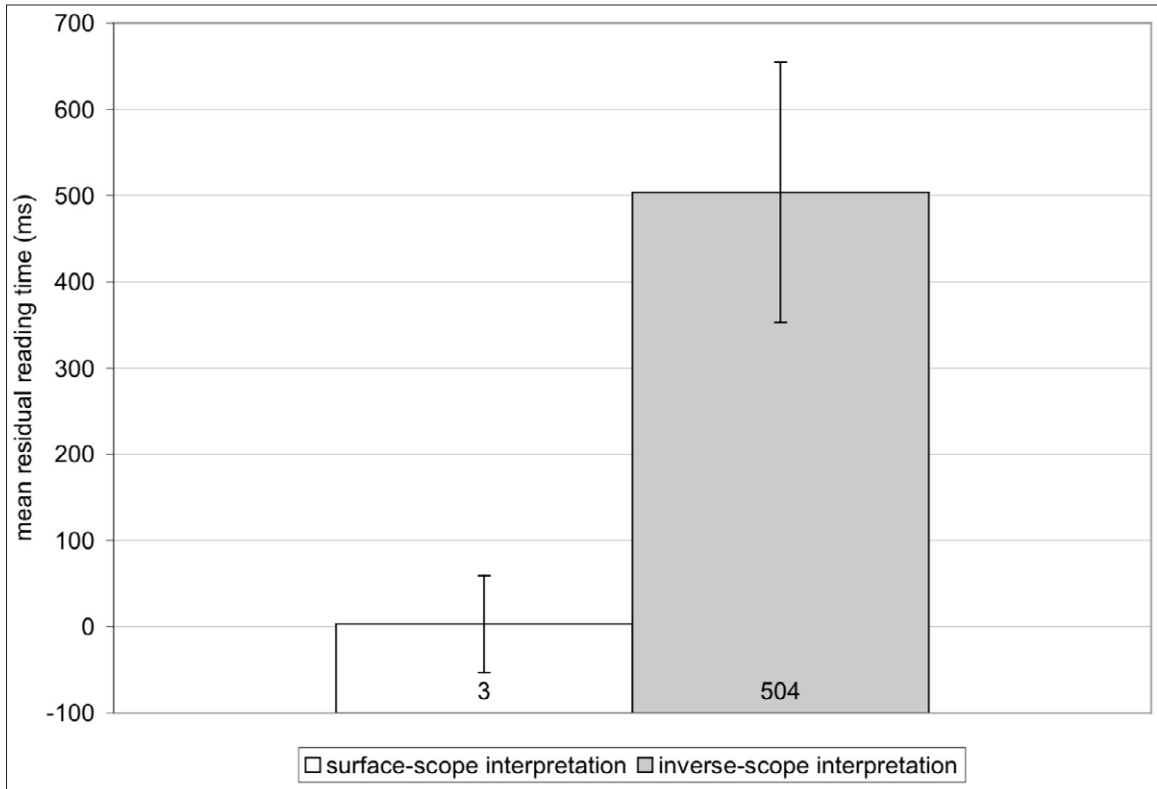
Computing a more complex configuration is possible but incurs a processing cost.

That such a syntactically based processing account is the most plausible way to derive the data is demonstrated by a range of further experiments. Note first that all conditions in (11) introduce a plural set of individuals (the members of the gourmet club) corresponding to the indefinite QP in the context already. Since multiple participants are already part of the context, retrieving those, as is necessary for the inverse scope interpretation, should not pose a significant problem. Thus, a semantic parsimony approach (Altmann & Steedman 1988; Crain & Steedman 2005) according to which inverse scope interpretations are disfavored since they require the referentially more complex retrieval of multiple individuals for a singular QP (whereas a surface scope interpretation is compatible with a single referent) does not seem to be applicable for these data.<sup>6</sup> In particular, the fact that in the ambiguous surface scope bias condition, (11b), the proportions of surface and inverse scope are identical to the ones in the experiment where no context was given at all might prove problematic in such an account.

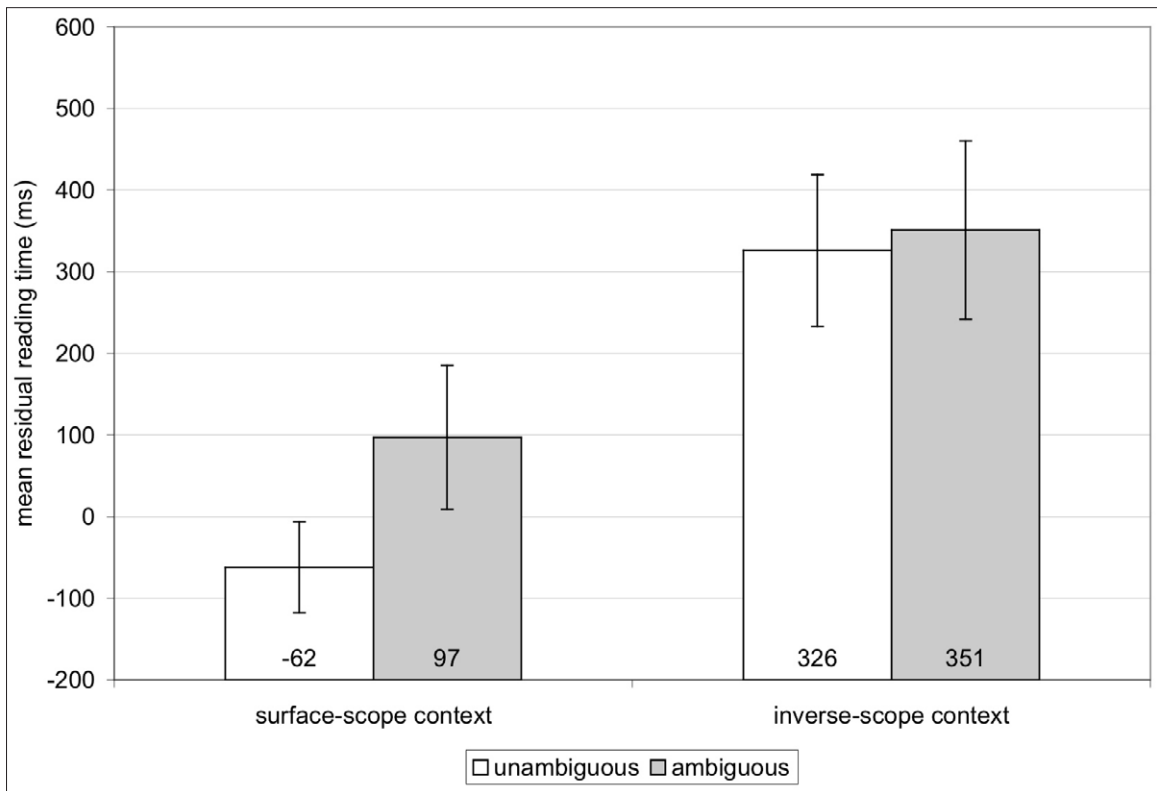
Another way to approach the difficulty of inverse scope would be, following parallel processing models (MacDonald 1994; Spivey & Tanenhaus 1998; Trueswell 1996, among others), to relate it to competing analyses for an ambiguous sentence which cause difficulty for the parser when settling for one interpretation. Several of the online self-paced reading experiments in Anderson (2004) cast doubt on such an approach. The main findings are that quantified sentences (sentences with two quantifiers) are read significantly slower i) when the participant has an inverse scope interpretation in mind as diagnosed by the answer to the comprehension question; and ii) when the sentences appear in contexts biasing for inverse scope. Figure 1 shows that ambiguous sentences for which participants choose the ‘several’ answer were read significantly more slowly than sentences that had received the ‘one’ answer. Figure 2 gives the mean residual reading times for one of the experiments (Experiment 7), which included ambiguous and unambiguous sentences (such as (11)). As shown, both ambiguous and unambiguous sentences involve higher reading times in contexts that bias for the inverse scope interpretation—reading times showed a significant main effect of context, but there was no effect of ambiguity. Since a similar slowdown is observable for ambiguous and unambiguous inverse scope biasing sentences, the slowdown cannot be attributed to competing analyses for those sentences. That participants used only one parse for the unambiguous inverse scope sentences in this experiment is supported by the answers to the comprehension question, which, as shown in Table 1, again yielded almost only inverse scope answers (92%—i.e., participants performed near ceiling). Rather, these results support the view that inverse scope always comes at a cost, even when it is the only interpretation available.

Although syntactic Scope Economy is not involved in the phenomena discussed so far in this section, it may still be the case that it is in other constructions. There are two noteworthy configurations for which syntactic Scope Economy has been employed—clause-boundedness

<sup>6</sup> The study also contains a series of experiments with test sentences of the form *Every member tested a recipe*, which I cannot survey here. It is shown that inverse scope is equally costly in these cases, which is unexpected under semantic parsimony approach since the inverse scope interpretation is in fact less complex referentially than the surface scope interpretation.



**Figure 1:** Mean residual reading times for quantified sentences; ambiguous, contingent on comprehension question response (Anderson 2004: 111, Figure 8).



**Figure 2:** Mean residual reading times for quantified sentences; ambiguous and unambiguous (Anderson 2004: 111, Figure 7).

effects of QR and scope restrictions in Ellipsis. The first empirical domain is the main focus of this paper; the second area has also been covered in Anderson (2004), which is the last major contribution of this work I summarize here.

Ellipsis raises the interesting issue illustrated in (13): ambiguous sentences such as (13a), appear to become unambiguous when followed by an elliptical sentence with a subject that does not scopally interact with the object QP, such as the definite DP subject in (13b) (see (Sag 1976; Williams 1977; Hirschbühler 1982; Fox 1995; 2000). This phenomenon has been accounted for by employing syntactic Scope Economy (Fox 1995; 2000) which is schematized in (13c–e). A condition on Ellipsis is that the antecedent and elided structure must be parallel in some way. For our purpose, this parallelism could be defined via scope relations or the application of QR: if the object takes scope over the subject in the antecedent clause, it must also do so in the elliptical clause. A derivation such as (13c) violates parallelism since  $QP-\forall$  only takes scope over the subject in the antecedent clause, but not the elliptical clause. However, since the subject of the elliptical clause does not scopally interact with the object, QR as in (13d) is blocked by Scope Economy. The only successful derivation is (13e) which yields a surface scope interpretation in the antecedent clause.

- (13) Fox (2000: 30, (20), (21))
- |    |  |                        |
|----|--|------------------------|
| a. | A boy admires every teacher.   | $\forall \gg \exists$  |
| b. | A boy admires every teacher. Mary does, too.   | $*\forall \gg \exists$ |
| c. | $*QP-\forall \gg QP-\exists \gg t_{QP-\forall}$ Mary $\gg QP-\forall$                      | *Parallelism           |
| d. | $*QP-\forall \gg QP-\exists \gg t_{QP-\forall}$ $QP-\forall \gg$ Mary $\gg t_{QP-\forall}$ | *Scope Economy         |
| e. | $QP-\exists \gg QP-\forall$ Mary $\gg QP-\forall$  | ✓Surface scope         |

Anderson (2004) reports the results of several experiments which were conducted to test scope in contexts where a sentence following the test sentence disambiguates or is predicted by syntactic Scope Economy to disambiguate the test sentence. One full sample item with the options tested in Experiments 7, 9, and 12 is given in (14). As shown, these experiments include Ellipsis sentences with non-quantificational subjects, either as different sentences (Experiments 7, 9) or as part of a conjunction with the test sentences (Experiment 12).

- (14) *Inverse scope bias; ambiguous test sentence*
- The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. Members who nominated recipes were required to test the recipes to make sure that the instructions were correct.
- |     |  |          |
|-----|--|----------|
| a.  | A helpful member tested every recipe. The club's president did, too.     | Exp 7, 9 |
| b.  | A helpful member tested every recipe, and the club's president did, too. | Exp 12   |
|     | How many club members tested recipes?                                    |          |
| i.  | One.   |          |
| ii. | Several.   |          |

The test sentences were again embedded in surface or inverse biasing contexts as in (11) ((14) only gives the inverse scope context). Restricting our discussion to the ambiguous conditions (test sentences as in (11b,d)), Table 2 summarizes the response rates of the comprehension questions for these experiments. The rates from Experiment 2 are repeated in Table 2 as a baseline.

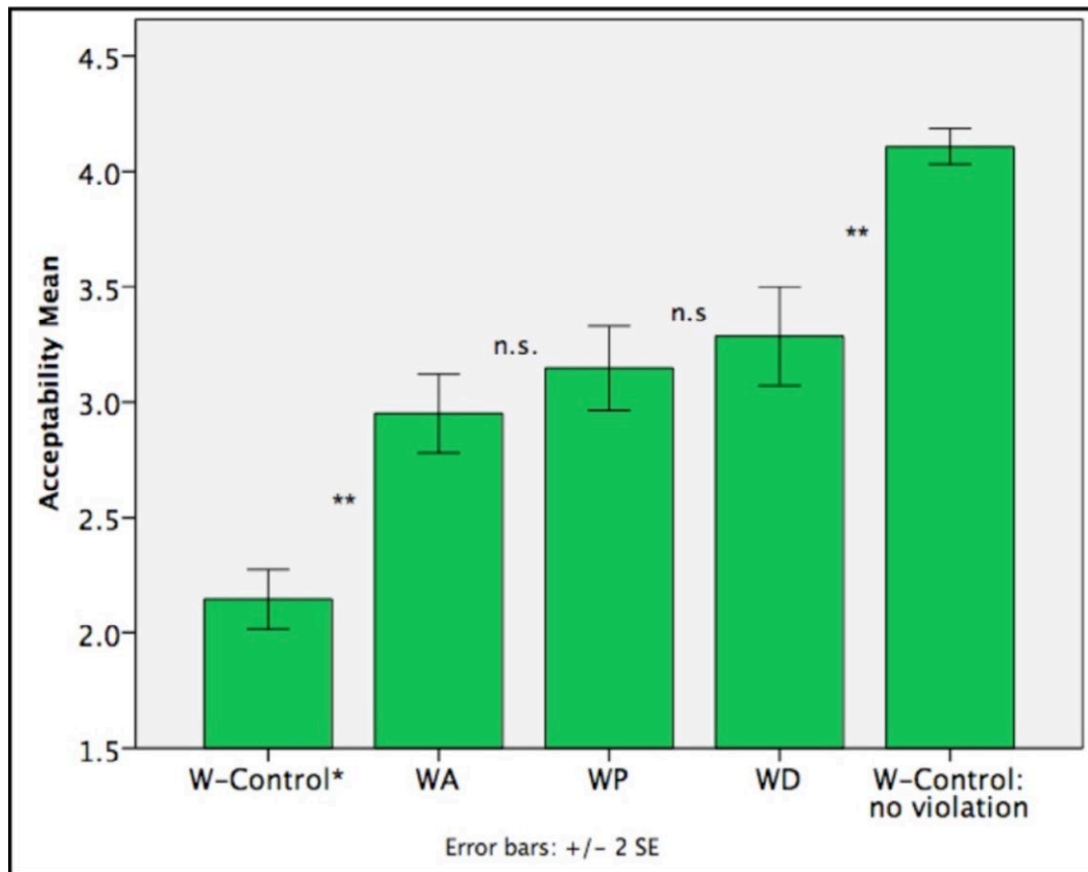
**Table 2:** Responses to comprehension question in ambiguous conditions (Anderson 2004).

Ambiguous conditions	Surface scope (One)	Inverse scope (Several)
<i>A helpful member tested every recipe.</i> (no continuation sentence)	Exp 2: 0.81 (surface bias) 0.47 (inverse bias)	Exp 2: 0.10 (surface bias) 0.53 (inverse bias)
<i>A helpful member tested every recipe.</i> <i>The club's president did, too.</i>	Exp 7: 0.68 (surface bias) 0.44 (inverse bias) Exp 9: 0.66 (surface bias) 0.33 (inverse bias)	Exp 7: 0.32 (surface bias) 0.56 (inverse bias) Exp 9: 0.34 (surface bias) 0.67 (inverse bias)
<i>A helpful member tested every recipe, and</i> <i>the club's president did, too.</i>	Exp 12: 0.69 (surface bias) 0.51 (inverse bias)	Exp 12: 0.31 (surface bias) 0.49 (inverse bias)

As shown in Table 2, the response rates are very similar, independently of whether Ellipsis is involved or not. In other words, an Ellipsis sentence did not seem to have any effect on the scope of the test sentences. In all experiments, the surface scope answer was chosen roughly two thirds of the time in cases with a surface scope bias and about half of the time in cases with an inverse scope bias. In contrast to truly unambiguous test sentences (which, as we have seen in Table 1, yielded near ceiling surface scope rates), quantificational test sentences followed by (non-parallel) Ellipsis retain their ambiguity and only show the by now familiar strong default preference for surface scope. As noted in Anderson (2004), this behavior is unexpected under a syntactic Scope Economy account in which inverse scope should be ungrammatical in Ellipsis cases such as (14) since either parallelism or syntactic Scope Economy would be violated. The distribution in Table 2 is predicted, on the other hand, under a processing approach in which inverse scope is costly but in principle still available for sentences followed by non-parallel Ellipsis. Finally, one question remaining for a processing approach is why speakers feel that there is a difference in the availability of inverse scope in cases such as (13a) vs. (13b). Anderson (2004) suggests that this is an issue of acceptability vs. grammaticality. Like center-embeddings or garden path effects, speakers may treat grammatical sentences as unacceptable when the processing burden is too high. In addition to the “regular” processing cost associated with an inverse scope interpretation (cf. (12)), an inverse scope interpretation in an Ellipsis sentence like (13b) could be seen to further complicate processing due to lack of syntax–semantics parallelism. More specifically, the two clauses are parallel in syntax (*A boy admires every teacher. Mary admires every teacher*) but, under an inverse scope interpretation, not parallel semantically—the antecedent clause involves multiple boys admiring teachers, whereas the elliptical clause only involves one individual admiring teachers. If the processor’s preferred interpretation of an Ellipsis sentence is a parallel interpretation, an inverse scope interpretation in the antecedent clause would create an additional processing burden, leading to the difference in judgment between (13a) and (13b).

### 3.2 QR from finite clauses and islands

The availability of inverse scope across certain clause boundaries is investigated in Tanaka (2015a; b). Tanaka examined overt *wh*-extraction and QR from different types of adjuncts via acceptability judgment tasks, as well as a follow-up experiment on QR from finite clauses and subjunctive complements. One of the main observations in this work is that overt extraction from different types of islands shows different degrees of acceptability. The islands tested were temporal *during* PPs (WD), (15a), bare participial gerunds (WP; omitted here—see fn. 9), non-finite *after* clause gerunds (WA), (15b), and absolute islands such as complex NPs (W-Control\*), (15c).



**Figure 3:** Mean acceptability of *wh*-extraction (Tanaka 2015b: 120, Figure 4.6).<sup>7</sup>

- (15) a. Which comedy film did Rob burst out laughing [<sub>PP</sub> during t]. WD  
 b. Which student did he burst out laughing [<sub>XP</sub> after meeting t]. WA  
 c. Who did you hear [the rumour Connie is getting married to t]. W-Control\*

As shown in Figure 3, extraction from *after* gerunds shows a significantly milder island effect than extraction from absolute islands; *after* gerunds are significantly stronger domains than *during* PPs;<sup>8</sup> and both conditions (WA and WD) are significantly degraded compared to non-island (locality obeying) *wh*-extraction (W-Control: no violation). The distribution is summarized in the scale in (16).

- (16) *wh*: absolute island »<sub>sig</sub> *after* gerund »<sub>sig</sub> *during* PP »<sub>sig</sub> no locality violation

The same syntactic contexts were then used to test covert movement, (17a,b), with the results in Figure 4 which follow the same hierarchy as overt *wh*-movement in (16): inverse scope, like overt *wh*-movement, is hardest/impossible with quantifiers originating in an absolute island (Q-Control\*). QR from an *after* gerund (QA) is more acceptable than from an absolute island, but less acceptable than QR from a *during* PP (QD) (the differences

<sup>7</sup> The details of the calculation are (Tanaka 2015b: 120): “Error bars represent standard error for each condition. A significance level of each difference between adjacent conditions is indicated as follows: n.s. = non-significant, \* =  $p < 0.0055$  ( $0.05 / 9$  [corrected to 10, after including the additional comparison, see fn. 7; Tanaka, p.c.]: manually adjusted by Bonferroni Correction), and \*\* =  $p < 0.001$ .”

<sup>8</sup> The value for the comparison of *after* gerunds and *during* PPs is not given in Tanaka (2015b), but was provided to me by the author:  $t(79) = 3.812$ ,  $p < 0.001$ .

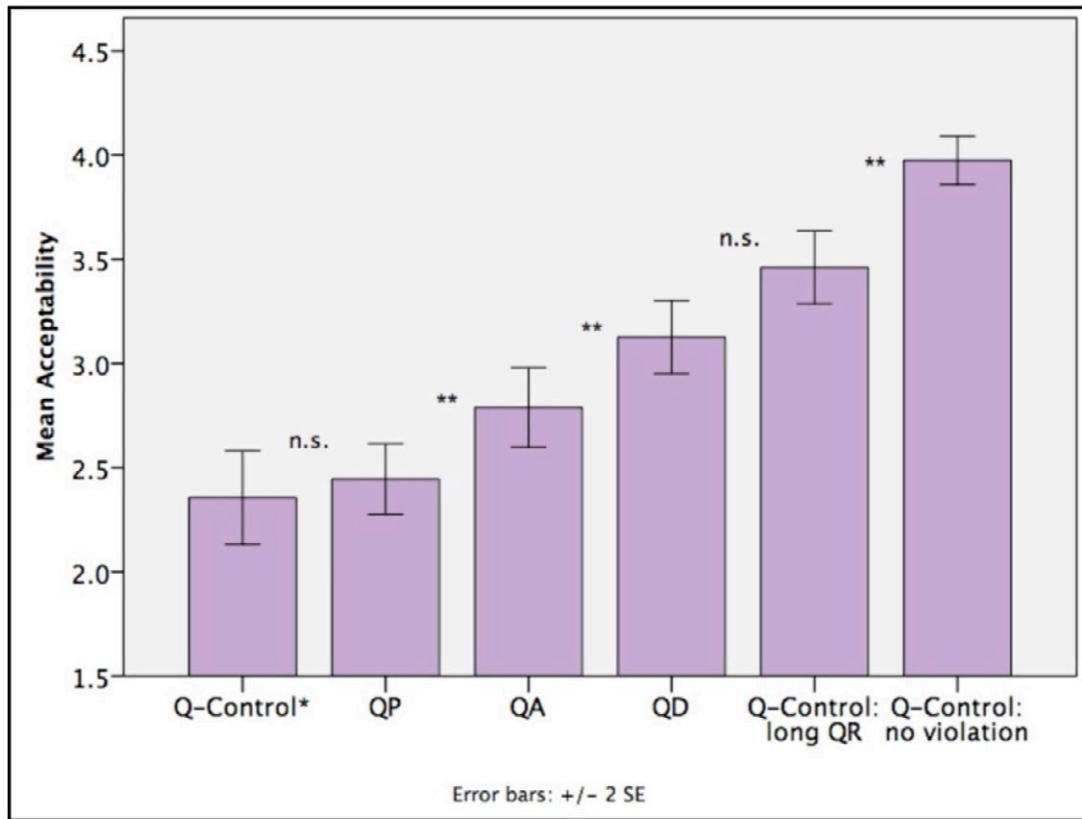


Figure 4: Mean acceptability of QR (Tanaka 2015b: 125, Figure 4.9).<sup>9</sup>

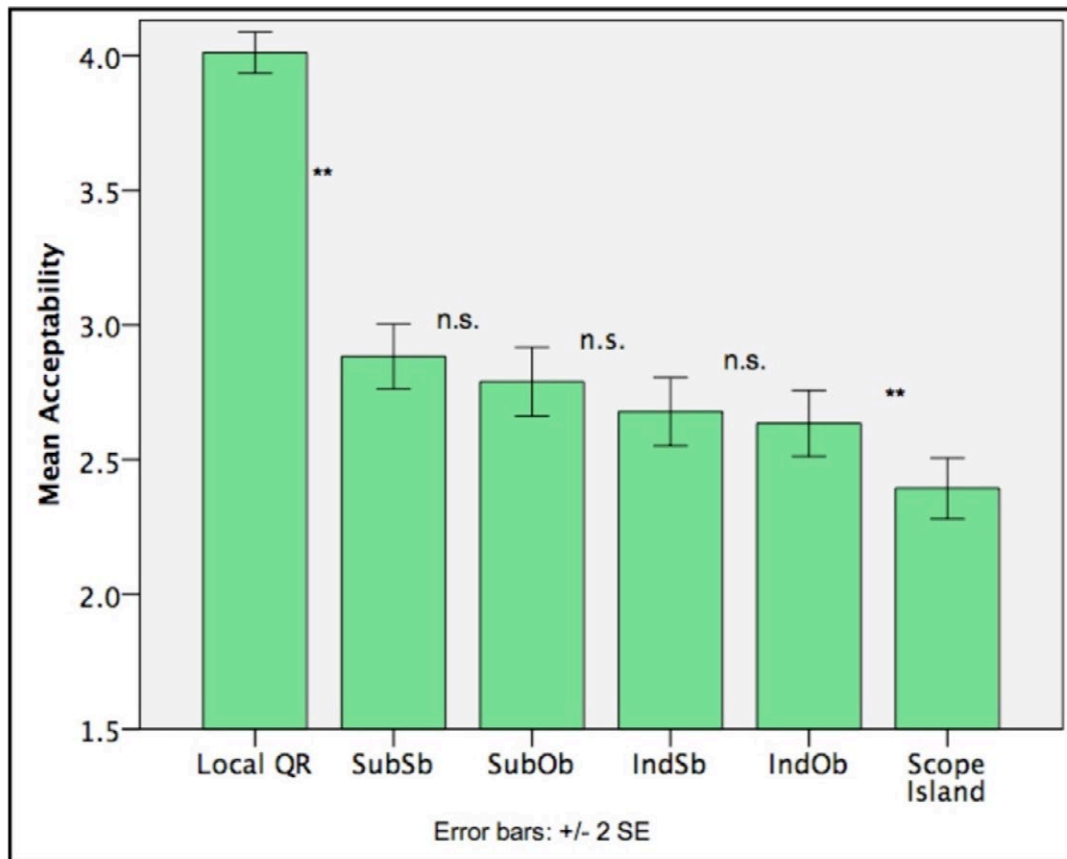
were significant). Both islands are stronger boundaries for QR than configurations without any island.<sup>10</sup>

- (17) a. One of the guys burst out laughing [<sub>PP</sub> during each comedy film]. QD
- b. A professor burst out laughing [<sub>XP</sub> after meeting each student]. QA

As shown in Figure 4, the experiment also included another condition, namely QR from non-island finite clauses (Q-Control: long QR), and the acceptability rate of such “long” QR was higher than the rate of QR from all of the islands, but still (significantly) lower than the rate of QR in simple clauses. To confirm the higher acceptability of QR across

<sup>9</sup> The significance levels used are as follows: \* =  $p < 0.0038$  ( $0.05 / 13$ : adjusted by Bonferroni Correction) and \*\* =  $p < 0.001$ .

<sup>10</sup> The study also contains a bare participial gerund condition (configurations such as *Which audiobook did she burst out laughing [listening to t]?*), which displays the same behavior as the other two weak adjunct island conditions in *wh*-extraction contexts (it ranks between *after* gerunds and *during* PPs), but which, in QR contexts, gives significantly worse results than *after* gerunds and shows no significant difference to strong island violations. Tanaka (2015b) proposes that the *wh*/QR difference is due to a redefined notion of syntactic Scope Economy which penalizes QR in bare participial gerunds, since, by assumption, these clauses do not contain a temporal operator whereas *after* gerunds and *during* PPs do, and crossing such an operator satisfies Scope Economy. It is not clear, however, that the temporal structure of bare participial gerunds is tenseless—the matrix and embedded events are ordered temporally in that the event time interval of the main predicate must be included in the event time interval of the gerund, that is, the gerund is interpreted like a *while* clause. Since the structure and semantics of these types of gerunds is rather controversial, I have to set it aside in this paper. A possible direction for deriving the strong island-like violation of QR in bare participial gerunds would be to assume a sideward movement derivation for the subject, which, depending on the structure and attachment location of the adjunct could be seen to force wide scope of the subject. Thus, the lack of inverse scope in these constructions is not caused by a restriction on QR of the object but rather by independent properties of the subject.



**Figure 5:** Mean acceptability of QR (Tanaka 2015b: 159, Figure 5.6).<sup>11</sup>

finite clause-boundaries, Tanaka conducted a follow-up study the results of which are summarized in Figure 5 and (18). QR from indicative and subjunctive clauses is more acceptable/easier than QR out of an island (the difference is significant), but it is also judged significantly worse compared to QR within a simple predicate (local QR). Within the group of QR from finite and subjunctive complements, the only significant result is between the SubjSb and IndSb conditions ( $p < 0.01$ ), that is, extraction of a subject was significantly easier from a subjunctive than from an indicative clause.

(18) QR: scope island »<sub>sig</sub> finite indicative ><sub>not-sig</sub> / »<sub>sig</sub> subjunctive »<sub>sig</sub> simple clause

These results show that QR from finite complements needs to be distinguished from movement that violates a clear syntactic locality condition such as an island.<sup>12</sup>

That QR from finite complements is not straightforwardly ungrammatical has also been found in the experiments reported in Syrett & Lidz (2011) and Syrett (2015). Examples such as (3b) (repeated as (19)) are usually interpreted with an embedded Ellipsis

<sup>11</sup> SubSb/IndSb refer to QR of a subject out of a subjunctive/indicative complement; SubOb/IndOb refer to QR of an object out of a subjunctive/indicative complement; the significance levels are \* =  $p < 0.05$ , \*\* =  $p < 0.01$ .

<sup>12</sup> A further consequence of this experiment is that in subjunctives, subject QR is more acceptable than object QR. This contradicts, for instance, the suggestion in Kayne (1998) that subject QR triggers a *that*-trace effect and is hence not possible. The results of Tanaka's experiments show that this is not correct (furthermore, as pointed out by Tanaka, such a difference would also not be expected if the *that* trace effect is seen as a PF condition).

resolution, (19a), but “a third of the adults accessed the supposedly ungrammatical matrix interpretation [(19b), SW] at least once, and 4 adults accessed this interpretation at least half of the time, providing explicit justifications for doing so that referenced the matrix interpretation” (Syrett & Lidz 2011: 326). Similarly, Syrett (2015) shows that examples such as (19c) allow inverse scope as follows: “Of the 40 participants, 16 (40%) appeared to never access the wide scope. However, 24 (60%) did so at least once, and 15 (37.5%) did so for three or four of the test items.” (Syrett 2015: 588).

- (19) a. Clifford said that Goofy read every book that Scooby did ~~read~~.  
 b. Syrett & Lidz (2011: 321 (26))  
 Clifford said that Goofy read every book that Scooby did ~~say that Goofy read~~.  
 c. Syrett (2015: 585, (14))  
 Someone said he could jump over every frog that Jessie did.

Furthermore, relevant for the current paper, Syrett & Lidz (2011) show that ACD with Ellipsis resolution requiring QR across a finite clause-boundary also poses significant processing difficulties. The availability of embedded and matrix Ellipsis resolution was tested in the configurations in (20) via truth-value judgment tasks. Participants were asked to rate such (in principle ambiguous) statements in situations in which the matrix and embedded Ellipsis interpretations yield different truth values. The results are summarized in Table 3, showing the acceptance rates of statements that are true only under the embedded Ellipsis interpretation (second column) or the matrix Ellipsis interpretation (third column). The baseline results for VP Ellipsis (VPE, see the first row of the table below) show that adults accept both embedded and matrix antecedents for VPE at a high rate (in fact the matrix readings received a higher acceptance rate than the embedded readings). However, when ambiguous ACD is involved as in (20b–d), which could in principle be resolved in two ways (though the contexts given to participants disambiguate), the acceptance of matrix readings drops significantly. In case of infinitives, matrix readings are still accepted at a rate of 50%, but in finite contexts, these rates are below 20%.

- (20) a. Clifford asked Goofy to read the [big/small] books because Scooby did.  
 [test sentence 3: VPE]  
 b. Miss Piggy wanted to drive every car that Kermit did.  
 [test sentence 8: ACD INF]  
 c. Clifford asked Goofy to read every book that Scooby did.  
 [test sentence 10: ACD INF]  
 d. Clifford said that Goofy read every book that Scooby did.  
 [test sentence 14: ACD FIN]

The clear bias for embedded Ellipsis resolution in contexts that require QR shows that non-local QR also does not come “for free” in ACD contexts. The large differences between

**Table 3:** Percentages of acceptance of puppet’s (true) statements (Syrett & Lidz 2011: 314, 318, 324).

Adults performance	Embedded	Matrix
VPE (no QR)	81%	94%
ACD (infinitive)	68%	50%
ACD (finite)	88%	19%



the VPE and ACD conditions in the rate of matrix Ellipsis resolution (94% vs. 50% or 19%) can be taken to be a direct reflection of the additional burden imposed by QR. Similar to the difference between indicatives and subjunctives noted in Tanaka (2015b), we see here again that the cost inflicted by QR is gradient with respect to clause type: QR from infinitives is less costly (hence more available) than QR from finite clauses. Lastly, although ACD with matrix Ellipsis resolution is difficult, it seems to nevertheless be easier than “plain” QR out of finite clauses. I will thus assume that ACD essentially acts as an inverse scope biasing context in that it makes strenuous long QR less bothersome, very similar to the QR enabling contexts we have seen in Anderson’s experiments.

### 3.3 QR from non-finite clauses

In the introduction, we saw that different types of infinitives impose (clause) boundaries of different strengths: in terms of permeability for QR, Restructuring infinitives are grouped with simple clauses, whereas Non-Restructuring infinitives are grouped with finite clauses. In the previous section, we have seen a first indication that a more nuanced distinction is needed for different types of finite clauses—indicatives vs. subjunctives. This difference in clause-boundedness effects is also noted in Farkas & Giannakidou (1996) who show that in Greek, QR is not possible across an indicative clause boundary, but is possible from certain subjunctive clauses.<sup>13</sup> An interesting pilot experiment conducted by K. Moulton (consisting of two pen-and-paper questionnaires) shows further that QR out of different types of infinitives is not a binary option, and, most importantly, that the grouping of Restructuring and simple predicates is not sufficient (see Moulton 2007). The experiments confirm the claim in Kennedy (1997) that QR out of Non-Restructuring infinitives is possible but more difficult than QR out of Restructuring infinitives. Crucially, the latter is also significantly more difficult than QR within a simple predicate.<sup>14</sup>

The questionnaires followed the experimental design used in Anderson (2004), and a sample example is given in (21). Since inverse scope is highly restricted in out of the blue contexts, even in simple predicates (see section for 3.1), Moulton, following Anderson, used contexts biased towards inverse scope interpretations. As shown in (21), speakers were presented with a short story, followed by a comprehension question targeting surface or inverse scope. As before, a ‘several’ answer unambiguously indicates that the speaker had an inverse scope interpretation in mind, and only those answers were counted in the inverse scope rates.

(21) *Sample Item:*

The restaurant was very busy on Saturday night. The head chef needed all his assistant chefs to pitch in. When he returned from the market, he was pleased that an assistant chef {prepared}/{had begun/helped/decided to prepare} every dish.  
How many assistant chefs prepared/had begun/helped/decided to prepare dishes?  
One        Several

The mean proportions of the different categories are given in (22), and the paired t-tests of both items analysis and subjects’ performance in (23).

<sup>13</sup> Specifically, long QR is acceptable from what I will classify as tenseless and future clauses in section 4.1, but not from clauses that require a CP-domain (conditional, speech and attitude contexts).

<sup>14</sup> Unfortunately, Moulton did not test QR out of finite complements. The degree of difference between Non-Restructuring infinitives and finite clauses is thus not known at this point and subject to further testing.

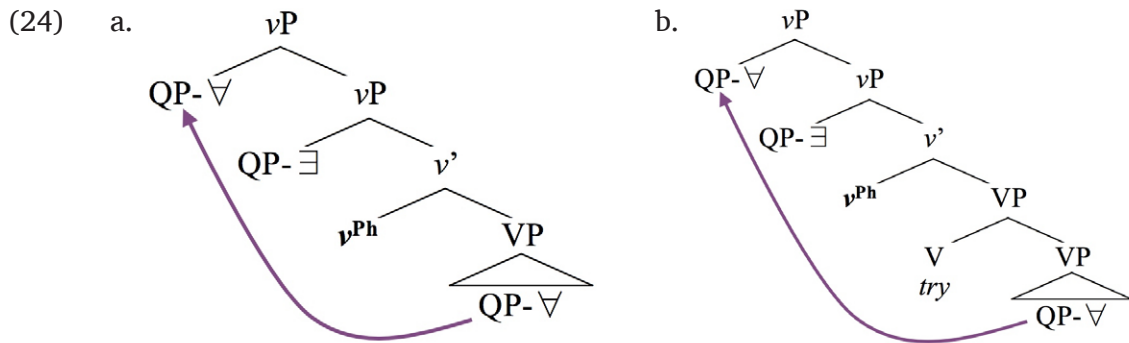
(22)	Mean Proportion of inverse scope responses	
	a. Mono-clausal	.71
	b. Restructuring: <i>begin, start, try</i>	.61
	c. Implicative Restructuring: <i>dare, help, manage</i>	.61
	d. Non-Restructuring: <i>choose, decide, hope, promise, want</i>	.49
(23)	a. <i>Paired t-tests on an items analysis:</i>	
	Mono-clausal (a) & Non-Restructuring (d):	significant (p < .003)
	Mono-clausal (a) & Restructuring (b):	significant (p < .03)
	<hr/>	
	Implicative (c) & Non-Restructuring (d):	not significant (p = .087)
	Mono-clausal (a) & Implicative (c):	not significant (p = .088)
	Restructuring (b) & Non-Restructuring (d):	not significant (p = .12)
	Restructuring (b) & Implicative (c):	not significant (p = .844)
	b. <i>Paired t-tests on subjects performance:</i>	
	Mono-clausal (a) & Non-Restructuring (d):	significant (p < .001)
	Mono-clausal (a) & Implicative (c):	significant (p = .05)
	<hr/>	
	Implicative (c) & Non-Restructuring (d):	not significant (p = .057)
	Restructuring (b) & Non-Restructuring (d):	not significant (p = .059)
	Mono-clausal (a) & Restructuring (b):	not significant (p = .069)
	Restructuring (b) & Implicative (c):	not significant (p = .959)

As indicated in (23), there are two significant effects: inverse scope from Non-Restructuring infinitives *and* from Restructuring infinitives was significantly harder than inverse scope within a simple predicate. The former may not be surprising in light of the claims found in the literature, however, the second finding is not expected in any of the syntactic accounts. As for the relation between Restructuring and Non-Restructuring, the results are not entirely conclusive, but they are suggestive.<sup>15</sup> Although further testing is clearly necessary, these initial results can nevertheless be seen as suggestive of the following difficulty scale: simple predicate » Restructuring complement > Non-Restructuring complement.

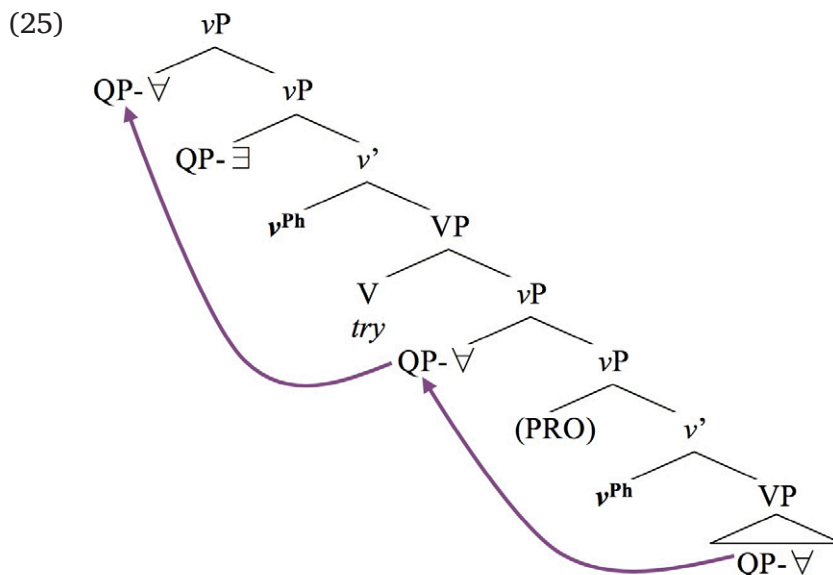
To illustrate the issues arising for syntactic Scope Economy accounts consider the derivations in (24). The structure in (24a) represents a simple predicate with two quantificational arguments. Assuming that the subject can be interpreted in situ, inverse scope requires nothing beyond the first step of QR, which is motivated by type reasons. If Restructuring infinitives, following Wurmbrand (2001), are bare VPs as in (24b), which is also what Cecchetto (2004) assumes, no difference arises between (24a) and (24b). In both derivations, one single step of QR takes place, and the two constructions can therefore not be distinguished in their QR potential.<sup>16</sup>

<sup>15</sup> One reason for this may be the choice of verbs, e.g., *want* is a typical Restructuring predicate. Furthermore, the Non-Restructuring predicates only include future selecting verbs and no speech or attitude verbs. As I will lay out in section 4.1, there are two degrees of Size Restructuring, and finer grained distinctions may have been conflated by the choice of verbs.

<sup>16</sup> A derivation such as (24b) is based on the assumption that only  $\nu$ P and CP count as phases. There are reasons to assume that the structure in (24b) is too simplistic for Restructuring (see Wurmbrand 2015a; Wurmbrand & Shimamura 2017), and that a Restructuring complement, whether VP or  $\nu$ P, constitutes a separate domain (Bobaljik & Wurmbrand 2005; Shimamura & Wurmbrand 2014). This can be derived under a contextual approach to phasehood, where the top (extended) projection of a lexical verb functions as a separate phase (see Wurmbrand 2014a; 2015a; Bošković 2014). QR would then not apply in one single step, but the derivation would be like in (25) as far as QR is concerned (inverse scope would require two steps of QR).



A similar issue arises for approaches in which Restructuring infinitives are  $\nu$ P as in (25) (see Wurmbrand 2013; Wurmbrand & Shimamura 2017 for recent analyses motivating a type of  $\nu$ P in Restructuring infinitives). In this case, two steps of QR are necessary—the first step would be driven by the need for a semantic type mismatch resolution and the second step by the need for a different scope relation. Thus, both steps meet (syntactic) Scope Economy. Since there is also no locality violation (each step only crosses one phase head), QR in (25) could again not be distinguished from QR in (24a) and the difference observed in (22)/(23) would be left unexplained.



At this point, we do not have experimental evidence for Italian to determine whether Italian restructuring cases such as (4b) also show an increased difficulty of QR compared to inverse scope in simple predicates. The following data provided in Cecchetto (2004), however, lend at least initial plausibility to the hypothesis that this may also be the case in Italian, and that inverse scope is not equally available in configurations such as (25) as opposed to (24a). Cecchetto also discussed perception verb constructions, which involve ECM into a  $\nu$ P complement. As shown in (26), there is a difference in the availability of inverse scope depending on whether the lower QP originates as a subject or an object, which is reminiscent of the difference noted for QR from English subjunctives in Tanaka (2015b) (cf. (18)). Cecchetto (2004: 369, fn. 17) notes: “I believe that inverse scope is better in (i) [= (26a), SW] than in (ii) [= (26b), SW], as the theory I am arguing for predicts. [...] However, I must say that inverse scope is harder in (i) [= (26a), SW] than in (38) [= (26c), SW], in which the QNP that takes wide scope is in the subject position of the ECM clause. Presently, I have no explanation for this contrast.”

(26) *Italian*

- a. Cecchetto (2004: 369, fn. 17, (i);  $??\forall\gg\exists$ )  
 Almeno un giornalista ha visto il commissario picchiare ognuno dei pacifisti.  
 ‘At least one journalist has seen the police officer beating each of the pacifists.’]
- b. Cecchetto (2004: 369, fn. 17, (ii);  $*\forall\gg\exists$ )  
 Almeno un giornalista ha visto che il commissario picchiava ognuno dei pacifisti.  
 ‘At least one journalist has seen that the police officer was beating each of the pacifists.’
- c. Cecchetto (2004: 368, (38);  $?\forall\gg\exists$ )  
 Almeno un pacifista ha visto ognuno dei poliziotti tirare una pietra.  
 ‘At least one pacifist has seen each of the policemen throwing a stone.’

There are two noteworthy points. First, according to Cecchetto’s judgment, inverse scope in (26c) is not easily available (cf. the ?), which supports the hypothesis that QR spanning two verbal predicates (the matrix and embedded  $\nu$ Ps, like in Restructuring complements) is harder than QR in simple predicates (of course this should be seen as a hypothesis, which should be confirmed by further experimental studies). Second, (26a) corresponds essentially to the structure in (25), namely a configuration in which two steps of QR are necessary for the embedded object to achieve scope over the matrix subject. Since both steps are motivated (by type mismatch resolution and different scopal properties), the difference is again not derivable from syntactic Scope Economy.

The obvious difference between (24a) and (25) would be the number of steps involved for the lower QP to take scope over the higher QP. Syntactic Scope Economy accounts do not seem to offer a way to relate this difference to the graded acceptability we find regarding inverse scope. I nevertheless disagree with Moulton who states that neither syntactic nor processing accounts can account for the significant difference in the availability of inverse scope between simple predicates and Restructuring complements. In what follows, I will show that a processing account operating on syntactic structure has exactly the properties needed to put all the observations summarized in this section together in a uniform account.

**3.4 Summary**

The conclusions reached in the above studies on scope are summarized in (27). The approach to inverse scope I take in this paper, which the data presented in this section support, is that an inverse scope interpretation is derived by (successive cyclic) QR. Costs associated with inverse scope can then be formulated as costs arising for the operation QR. In the following sections, I will present an account that aims to implement these observations.

- (27)
- a. QR is costly, even in simple clauses.
  - b. The cost of QR is observable as increased reading times of sentences with inverse scope (even when the inverse scope interpretation is the only interpretation available) and, for ambiguous sentences, a (possibly significantly) higher rate of surface scope than inverse scope.
  - c. ACD with a non-local Ellipsis resolution is costly (in contrast to non-local VPE without QR).
  - d. Additional factors (e.g., lack of parallelism in Ellipsis, islands) increase the processing burden, which may lead to unacceptability of an inverse scope interpretation.
  - e. Scope biasing contexts and ACD facilitate the acceptability of inverse scope. In both cases, acceptability rates increase, however, the cost may still be detectable through reading times.

- f. QR across clause/predicate-boundaries increases the processing burden along the syntactic complexity scale (see 4.1); the more steps of QR inverse scope requires, the less acceptable it is (up to possible unacceptability of an inverse scope interpretation).

## 4 QR and syntactic complexity

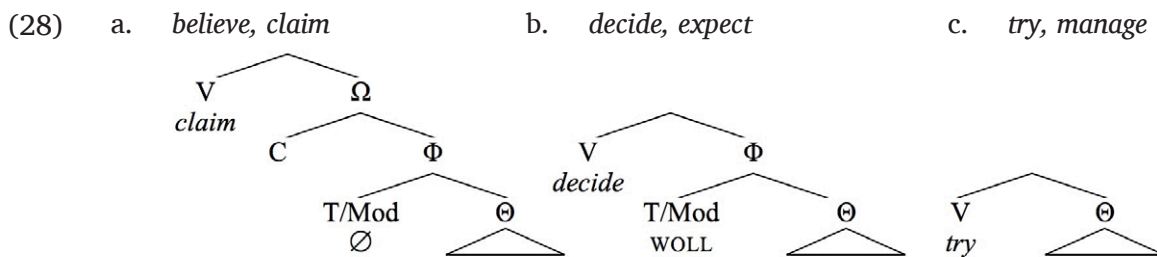
### 4.1 The domains of complement clauses

Before proposing a specific processing algorithm, I need to take a short detour laying out the structure of different types of complements. In previous works, I have shown that there is a cross-linguistically stable split of embedded clauses (both finite and non-finite) into three types of complements which consistently display different morphological, syntactic, and semantic properties (Wurmbrand 2001; 2014b; c; 2015a; b). Based on the temporal and aspectual composition of complementation structures, three semantic types of complements can be defined. The first type are complements of attitude (*believe*) or speech predicates (*claim*), which involve a short reference time interval, the NOW of the propositional attitude holder, and some form of context operator or binder. The short attitude holder reference time interval is responsible for triggering a simultaneous, present-like interpretation of the complement, which is observable, for instance, in the impossibility of perfective aspect forms (e.g., in Bosnian/Croatian/Serbian or Greek) or the non-progressive form in English: like simple present tense statements (*They are sleeping*/*\*sleep right now*), *claim*-type complements require the use of progressive/imperfective to refer to a non-generic eventive situation (*They claim to be sleeping*/*\*sleep*). The second type of embedded contexts are complements to verbs like *decide* or *expect*, which trigger a shift of the embedded time interval to the future with respect to the matrix time. Like simple future statements, these complements can occur with non-progressive/perfective forms (e.g. *They decided to sleep*). The third type of complementation involves complements to verbs like *try*, *begin*, or *manage*, which form a single temporal domain with the matrix clause and only allow a simultaneous interpretation of the matrix and embedded times.

Approaching complementation from a syntactic perspective, the same classes emerge when, for instance, the cross-linguistic distribution of traditional Restructuring properties such as Clitic Climbing are considered: some languages allow Clitic Climbing only out of tenseless (*try*-type) complements, whereas other languages allow it from tenseless (*try*) and future (*decide*) complements. Clitic Climbing out of attitude/speech complements is very rare and not attested robustly in any language. An important observation is that the distribution of Clitic Climbing and other properties follows a clear implicational dependency: whenever Clitic Climbing out of future complements is possible in a language, it is also possible out of tenseless complements in that language, or in other words, there is no language in which future complements are more transparent than tenseless complements. The conclusion is that there is an implicational transparency scale of the form: attitude/speech » future » tenseless (non-/semi-intensional).

Such (apparent) gradient behavior of transparency poses a challenge for most traditional analyses of Restructuring which are built on a binary distinction between Restructuring and Non-Restructuring. The view of variable clause size I have been following, on the other hand, paired with a semantically motivated determination of clause structure, provides the tools to predict the implicational Restructuring hierarchy. The key assumptions are that the semantic properties map directly to syntactic structure (meaning reflects a structural property) and that languages have the option of constructing complements smaller than full CP complement clauses. Specifically, the building of clauses can stop at the completion of the theta-level (e.g. *vP*) or the tense/modal/aspect level (e.g., *TP*), provided that these “bonsai” clauses lead to well-formed interpretations in that all properties required

by the matrix verb are recoverable from the structure. In such a system, the minimal structures of the three types of complementation are as in (28). I use the labels given in Grohmann (2003) to refer to the three clausal domains:  $\Omega$  for the CP/A'-domain;  $\Phi$  for the tense/modal/aspect/agreement domain, and  $\Theta$  for the theta domain. Attitude and speech verbs have to combine with CPs to host the attitude reference time interval and context operator or binders. Future selecting verbs, on the other hand, can omit the CP-domain but must minimally include a TP-domain to host the future element. Finally, tenseless, non-intensional verbs can combine with just a  $vP$ . This yields exactly the implicational hierarchy observed. *Claim*-type complements are full clauses and hence show the least transparency. *Decide*-type complements are minimally TPs that can lack the A'-domain and are hence transparent for any operation that is hindered by CPs but not for operations that are hindered by TPs. Lastly, *try*-type complements can lack both the A'- and tense-domains and are therefore the most transparent complements.



The important consequence of this approach is that the Restructuring scale reduces to a syntactic complexity scale which shows effects in all languages, even when a language does not show the standard (Italian based) Restructuring diagnostics such as Clitic Climbing. The current paper is not the place to motivate this approach—I can only give a schematic summary of the variation that has led, misleadingly, to the claim that there is a Restructuring parameter, or the like. For instance, to derive differences in the availability of cross-clausal Clitic Climbing and scrambling, I have proposed a freezing mechanism which traps these elements in the first target position they reach. If the target position is within the  $\Theta$  domain, as for instance in French or Brazilian Portuguese, clitics are necessarily clause/predicate bound, even in Restructuring contexts such as (28c). Importantly, although these languages do not allow cross-clausal Clitic Climbing, they can nevertheless be shown to involve Restructuring in the sense that certain clausal domains are not projected as in (28b,c) (see Modesto 2013; Wurmbrand 2014b; 2015b for Brazilian Portuguese). Evidence for such reduced structures must then come from other properties, for instance, negative concord or NPI licensing, the distribution of subjects, finiteness, temporal elements, negation, and many others. If the target position is within the  $\Phi$  domain, as in Italian or Spanish, Clitic Climbing is possible in tenseless contexts, (28c), but not in future contexts, (28b). Lastly, if the target position is within the  $\Omega$  domain, as in Polish or German, Clitic Climbing and Scrambling are possible in tenseless contexts, (28c), as well as in future contexts, (28b). Finally, this approach correctly predicts that infinitives involving an  $\Omega$  domain (e.g., an embedded complementizer or *wh*-phrase is present) never allow Restructuring (which has been shown in several works, e.g., Wurmbrand 2001; Bondaruk 2004; Dotlačil 2004; Marušič 2005).

This summary of complementation is obviously very sketchy, but for the current paper, the essential point is that different types of complements, in any language, can differ in size—i.e., show different structural complexity defined by the three clausal domains as in (28). This provides us with the necessary tools to tackle the question of why inverse scope shows the gradation and variability that is observed.

## 4.2 Counting steps—towards a processing account

In this section, I provide the basic account for the observation in (27f): QR across clause/predicate-boundaries increases the processing burden along the syntactic complexity scale; the more steps of QR inverse scope requires, the less acceptable it is (up to possible unacceptability of an inverse scope interpretation). As mentioned above, this paper follows approaches that derive inverse scope via QR. Specifically, I propose that QR is an A'-operation with the same domain and locality restrictions as overt A'-movement. In other words, there is no special clause-boundedness restriction and also no syntactic Scope Economy requirement for QR. Instead QR can apply in a step-by-step fashion from one cyclic domain to the next. For the moment, I leave open whether these domains are phases or domains as defined in the previous section based on Grohmann (2003). This system thus allows, in principle, an unbounded sequence of QR steps. Furthermore, following Anderson (2004), I assume that QR is always costly for the parser, and, following Tanaka (2015b), that each step of QR comes with a reduction that adds to the processing costs.<sup>17</sup> In section 4.3.2, I provide further details and a possible motivation for these costs.

Building on the complementation approach described in the previous section, we arrive at the syntactic complexity scale in Table 4. Although QR has not been directly tested for all of the distinctions in the table via uniform experiments yet, the available evidence is nevertheless suggestive of at least the plausibility of the hypothesis that the difficulty of QR correlates with the syntactic complexity as indicated. As shown, one cut is made by syntactic locality—absolute islands (such as complex NP islands) block movement in syntax and hence both A'-movement and QR yield (true) ungrammaticality (leaving open whether strong islands incur processing penalties in addition to the syntactic locality violation). I propose that complement clauses allow successive cyclic movement in syntax—both overt and covert, but that covert movement accumulates higher processing costs (calculated based on syntactic complexity), which obscure the inverse scope interpretation and make it less accessible (I return to differences between overt and covert movement below).

Let us start with simple clauses and complement clauses, which is the main focus of this paper (I comment on adjuncts below). Within a simple predicate/clause, inverse scope requires only a single step (see (24a) and hence no domains are crossed. Assuming that each step of QR incurs a processing cost (see section 4.3.2), simple QR ends up with a penalty of 1 ( $\Theta$ ). The number of steps required for an embedded QP to take scope over the matrix subject differs depending on the type of complement. QR from a tenseless restructuring complement requires two steps of covert movement (see (25) and fn. 16), hence a cost of 2  $\Theta$ . Based on the structures in (28), the number of steps and penalties are then as specified in Table 4 (the numbers refer to QR of an embedded object QP).<sup>18</sup>

Variable clause-size together with a processing approach that is dependent on syntactic complexity predicts differences for inter-clausal QR from subjunctive vs. indicative complements, insofar as these distinctions correlate with structural differences in a language. Cross-linguistically, subjunctive tends to occur in future and tenseless complements (though

<sup>17</sup> The specific syntax—processing linking algorithm used in Tanaka (2015b) cannot be adopted in the current paper since it does not yield the gradient acceptability found in the domain of the syntactic complexity scale (see Table 4 below). As pointed out in fn. 9, Tanaka employs Processing Economy and a modified version of Scope Economy. The latter predicts, contrary to fact, that QR out of finite clauses, as well as *decide* and *claim*-type infinitives should only show a very mild violation, since these configurations contain tense operators which would sanction syntactic Scope Economy (and there is no island violation).

<sup>18</sup> The situation is similar for QR in the perception verb complements in Italian. If the lower quantifier is the embedded object as in (26a), (at least) two steps of QR are necessary to take scope over the matrix subject: movement to the embedded Spec,vP and movement to the matrix Spec,vP. Thus, two penalties incur. If, on the other hand, the lower quantifier is the embedded subject as in (26c), only one step of QR is necessary, thus incurring a lower processing cost, which is reflected in the difference reported between (26a) and (26c).

**Table 4:** Syntactic complexity of complement clauses and QR.

<b>absolute island</b>	<b>attitude/speech complement</b>	<b>future complement</b>	<b>tenseless complement</b>	<b>simple predicate</b>
	<b>indicative</b>	<b>subjunctive</b>		
movement impossible; syntactic locality violation	✓QR in syntax			
	3 domains, 4 steps: ΘΘΘΘ	2 domains, 3 steps: ΘΘΘ	1 domain, 2 steps: ΘΘ	within 1 domain, 1 step: Θ
	← least acceptable		→ most acceptable	

there are language-specific idiosyncrasies), whereas attitude and speech predicates more commonly combine with indicative complements. The syntax and semantics of subjunctives is rather controversial, but one trend is to represent subjunctives as complements that lack a contentful or domain/phase inducing CP (see works arguing that subjunctive markers are IP elements rather than complementizers; e.g., Terzi 1992; 1997; Philippaki-Warbuton 1994; Rivero 1994; Giannakidou 2009; or works suggesting deficient and/or non-phasal CPs; e.g., Alboiu 2007; Wurmbrand 2013). Either approach predicts, as specified in Table 4, that QR is easier (more acceptable) across subjunctive clauses than indicative clauses, which we have seen is exactly the outcome of Tanaka (2015b)’s experiment in (18), as well as the data presented in Farkas & Giannakidou (1996).<sup>19</sup>

The assumption that each step of QR incurs a cost is also reflected in differences between QR by an embedded object vs. an embedded subject (see for instance the higher acceptance rates of subject QR compared to object QR in both the subjunctive and the indicative conditions in (18), as well as the discussion of (26) for Italian perception verb contexts; Farkas & Giannakidou 1996 also provide similar observations from Greek). Since subjects already occur at the edge of the embedded vP, whereas objects first have to get to that position, QR by an object will always involve one more step than QR by a subject, and if subject and object extraction are equally available, QR by a subject is predicted to be less costly.

Returning to the general issue of the availability of inverse scope, a structure–processing mapping as in Table 4 allows us to define a threshold for acceptability or parseability of inverse scope (which may vary among individual speakers). For speakers who do not accept inverse scope out of finite clauses, a QR processing burden of 4 reductions appears to be too much. As pointed out by a reviewer, this effect could be seen as a kind of garden path effect where the inverse scope (the “right” path) is simply too hard to see for speakers due to the complexity of the structure. Thus, as in the case of non-parallel Ellipsis as in (13), inverse scope is not ungrammatical, but simply unacceptable when the threshold for tolerable processing costs is reached (in other words, it’s not a competence issue but a performance issue). Furthermore, like in the case of garden path sentences where certain handholding can help guide the speaker onto the correct parse, there are also factors that can help access the inverse scope interpretations—as we have seen in section 3, among those are inverse scope biasing contexts and ACD (I return to this point in the next subsection).

<sup>19</sup> According to Farkas & Giannakidou (1996), long QR in Greek is only possible from subjunctive clauses, however, not all subjunctives allow QR across it—complements to verbs like *efxome* ‘wish’, *protino* ‘suggest’, or *parakalo* ‘ask for, beg’ prohibit QR outside the complement. For the approach here, this means that these verbs combine with a CP (like indicative clauses), despite occurring with subjunctive morphology. Verbs like ‘suggest’ involve a speech component as well as a future component, which can be seen as the reason for involving a C-domain. Similarly, the syntax of conditionals and counterfactuals is more complex and may require a C-domain.



A final (somewhat open) question is whether overt and covert movement impose the same processing costs or whether covert movement yields higher costs. The fact that sentences such as (29a) with overt long *wh*-movement are considered grammatical, whereas inverse scope in the parallel (29b) is very difficult to access for speakers and in many cases not available at all, may suggest that covert movement imposes a higher processing burden. Processing effects such as acceptability decrease and slower reading times have also been observed for *wh*-movement across finite clause boundaries (see for instance Kluender & Kutas 1993; Gibson 1998; Fiebach et al. 2002; Frazier & Clifton Jr 2002; Sprouse et al. 2012), but with the exception of Tanaka (2015b)'s study of extraction from islands, no direct comparisons of the processing of overt and covert movement is available. Since the difference between (29a,b) is quite palpable, even if overt movement also shows certain processing effects, the extent of the burden seems to be different.

- (29) a. What did a technician say {what} that John inspected {what}?  
 b. {every plane} A technician said {every plane} that John inspected every plane.

If further experimental studies confirm that there is indeed a quantitative difference, this difference could be related to the way parsing proceeds in overt vs. covert movement. Overt *wh*-movement involves a filler-gap dependency where upon encountering the filler (the overt *wh*-phrase), the parser is instructed to look for a gap (the originating position). In doubly quantified sentences, on the other hand, there is no overt cue within the sentence for a long-distance dependency until the second QP is reached. Thus, in contrast to overt *wh*-movement, QR involves a retrospective search in parsing, which could be seen to be responsible for the higher processing cost for covert movement. Possible support for this direction could come from sentences such as *A different member tested every recipe*, which received almost exclusively the 'several' answer to the comprehension question in Anderson (2004)'s experiments (see Table 1). Since in such cases there is an early clause-internal cue for the costly interpretation—the modifier *different*, the costs of QR, although still existent and observable as increased reading times (see section 3.1), become tolerable and do not affect the acceptability of inverse scope. The prediction would be that in such cases, the processing costs of *wh*-movement and QR are comparable.<sup>20</sup>

Let us finally turn to QR from adjuncts. The focus of the current paper is QR in clausal complementation configurations, but for completeness, I provide a preliminary suggestion for how one may approach QR from adjuncts here. This should only be seen as a first approximation with many data points still in need to be determined. As shown in Table 5, I assume that not all adjuncts cause a syntactic locality violation for A'-dependencies spanning across them. Specifically, weak islands of the kind discussed in Tanaka (2015b) could be assumed to allow successive cyclic movement across them (cf. the acceptability rates of 3/5 or higher in Figure 3), and the decrease in acceptability could arise as a processing issue (see also Kluender & Kutas 1993 for a similar claim regarding *wh*-islands). Recall from Figure 4 that QR from *during* PPs is less acceptable than long QR (e.g. across finite clauses), however, the difference has not reached significance. Based on that, an option similar to Tanaka (2015b)'s cost calculation is to assume that crossing a non-island adjunct (i.e., an island that in contrast to absolute islands allows successive cyclic

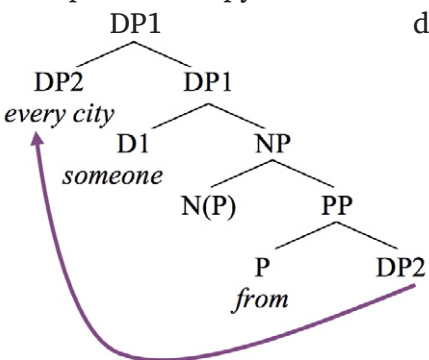
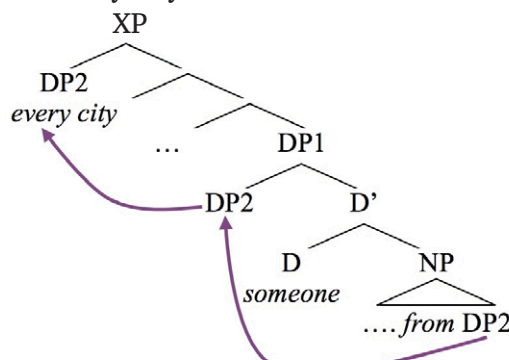
<sup>20</sup> For the specific algorithm of calculating the processing costs, there are two options: either overt and (non-cue) covert movement incur different costs (e.g., covert movement receives a double penalty per movement step, perhaps related to the additional LF-PF mismatch arising in the highest copy which is deleted at PF but fully interpreted at LF; see also fn. 25) or the costs accumulated are the same in overt and covert dependencies, but factors such as an early cue reduce these costs. Until a concrete quantitative comparison between overt and covert dependencies is available it seems premature to choose between these general options.

**Table 5:** Syntactic complexity and QR.

absolute island	after gerund adjunct	during PP adjunct	attitude/speech complement	future complement	tenseless complement	simple predicate
			indicative	subjunctive		
movement impossible; syntactic locality violation	✓QR in syntax					
	adjunct, 4 steps: $\emptyset\emptyset \emptyset\emptyset\emptyset\emptyset$	adjunct, 2? steps: $\emptyset\emptyset \emptyset\emptyset$	3 domains, 4 steps: $\emptyset\emptyset\emptyset\emptyset$	2 domains, 3 steps: $\emptyset\emptyset\emptyset$	1 domain, 2 steps: $\emptyset\emptyset$	within 1 domain, 1 step: $\emptyset$
	worst ←					→ best

movement across it) imposes a stronger processing burden—a double penalty—compared to QR along the clausal spine. This cost applies to overt and covert movement alike, since, as Tanaka (2015b)’s experiments show, *wh*-movement and QR show similar effects of decreased acceptability in weak islands (compare the acceptability rates in Figure 3 and Figure 4). Furthermore, *after* gerunds and *during* PPs need to be assumed to differ in structure, with the former involving a full clausal structure (*vP*, *TP*, and *CP/PP*), whereas the latter are simple PPs or have a reduced clausal structure.<sup>21</sup> Since it is not clear at this point whether *during* PPs are stronger boundaries for QR than finite clauses, I leave details of the structure of these PPs open until further experimental evidence is available which could then shed light on the syntactic composition of these PPs.

Before concluding this section, a final comment on the claim that QR obeys the same locality constraints as overt A’-movement is in order. A construction which potentially involves a difference in mobility between overt and covert contexts is Inverse Linking as in (30a,b). To derive wide scope of DP2 (*every city*), two movement derivations are conceivable: movement to the edge of DP1 as in (30c), or movement through the edge of DP1 to a higher position in the structure as in (30d).

- (30) a. May (1977; 1985: (26))  
 Someone from every city despises it.  
 b. Larson (1985: 5, (12);  $2 \gg \forall \gg \exists$ ;  $\forall \gg \exists \gg 2$ ;  $*\forall \gg 2 \gg \exists$ )  
 Two politicians spy on someone from every city.  
 c.   
 d. 

Both derivations have been proposed and motivated. The derivation in (30c), or some variation thereof, goes back to May 1977; 1985) (see also May & Bale 2006), and is compatible with DP1 being an island since DP2 never (fully) leaves DP1 (thus, (30c) can be the structure for (30a), given that subjects are typically islands for extraction). This

<sup>21</sup> To achieve the result in Table 5, movement out of *during* PPs must be cyclic with a stop-over at the edge of PP. This would mean that (at least certain) PPs are domains/phases for movement. An alternative (if PPs are not phases as in Bruening 2009; 2014) may be to assume a tense domain within *during* PPs and require movement to go through the edge of that domain.

derivation can also account for the bound variable interpretation in (30a) if a DP specifier or adjunct is assumed to c-command out of the hosting DP (see Kayne 1994). Furthermore, the scope restriction noted in (30b) can be derived since DP2 and DP1 act as a “unit” (see May & Bale 2006 for details and a specific implementation). The derivation in (30d), on the other hand, derives bound variable interpretations under any definition of c-command and predicts that scope splitting should be possible. This has been argued to be the case in Sauerland (2005) when scope between quantifiers and intensional verbs is considered as in (31a), which, according to Sauerland, can have the interpretation in (31b). The impossibility of scope splitting in contexts such as (30b) then requires a different account (e.g., a superiority approach, following Bruening 2001, as in Sauerland 2005).

- (31) a. Sauerland (2005: 306, (8a))  
 Mary wanted to marry someone from these two countries.  
 b. Sauerland 2005: 306, (8d); *these two* » *want* » *someone*  
 ‘For these two countries, Mary had the desire to marry someone from that country.’

The approach to QR taken in the current paper is compatible with both derivations in (30c) and (30d), however, the latter should only be possible if DP1 is not an island—i.e., if it does not block overt movement in the same context. Cases such as (31a), which provide the strongest argument for a structure such as (30c), readily allow *wh*-extraction of the *from* complement, as shown in (32a). The same is the case for the ACD example in (32b), in which the ACD VP can take a narrow (embedded) or wide (matrix) antecedent. Crucially, under the wide antecedent interpretation, scope splitting is still possible: the example can be interpreted with the *every* DP2 taking scope over *want* and the *someone* DP1 taking scope under *want* (i.e., ‘For every city such that John has the desire to meet someone from it, Mary also has the desire to meet someone from it.’ Sauerland 2005: 307, (13b)). As shown by the grammatical paraphrase of wide Ellipsis in (32c), overt long-distance extraction of the *from* complement is also possible, thus the current account correctly predicts that QR is possible in this context, exactly as required to resolve ACD in (32b) and to derive the interpretation where DP1 and DP2 take separate scope. Lastly, to derive the wide scope of both quantifiers over *want* in (32b), the derivation is as in (30c).

- (32) a. Which countries did Mary want to marry someone from?  
 b. Sauerland (2005: 307, (12))  
 John wanted to meet someone from every city Mary did.  
 i. did = met  
 ii. did = wanted to meet  $\forall \gg \exists \gg \text{want}; \forall \gg \text{want} \gg \exists$   
 c. John wanted to meet someone from every city Mary wanted to meet someone from.

Although, so far, the derivations in (30c,d) are compatible with the claim that overt and covert movement are subject to the same locality constraints, a problem could arise if scope splitting from subjects is also possible in Inverse Linking contexts. If this is the case, the current approach would need to resort to a different account of scope splitting (e.g., a non-scopal account of *de re* interpretations).<sup>22,23</sup>

<sup>22</sup> M. Križ, p.c., points out that the interpretation in (31b) for cases such as (31a) can also arise without scope splitting (i.e., without QR of *these two country* above *want*) under a *de re* construal of *these two countries* and a structure such as (30c) with DP1 in situ (since wide and narrow scope of a distributive operator over an intensional verb with universal force, such as *want*, are equivalent).

<sup>23</sup> As a reviewer notes it would be interesting to see how scope of indefinites (which is often assumed to not be derived by QR) compares to scope of universal QPs in terms of processing. The island-insensitivity of

### 4.3 The cost of QR

Recall the summary of the findings from the experimental results in (27), repeated in (33). In the previous section, I addressed the point in (33f). In this section, I provide a possible direction for further implementing the other observations.

- (33)
- a. QR is costly, even in simple clauses.
  - b. The cost of QR is observable as increased reading times of sentences with inverse scope (even when the inverse scope interpretation is the only interpretation available) and, for ambiguous sentences, a (possibly significantly) higher rate of surface scope than inverse scope.
  - c. ACD with a non-local Ellipsis resolution is costly (in contrast to non-local VPE without QR).
  - d. Additional factors (e.g., lack of parallelism in Ellipsis, islands) increase the processing burden, which may lead to unacceptability of an inverse scope interpretation.
  - e. Scope biasing contexts and ACD facilitate the acceptability of inverse scope. In both cases, acceptability rates increase, however, the cost may still be detectable through reading times.
  - f. QR across clause/predicate-boundaries increases the processing burden along the syntactic complexity scale; the more steps of QR inverse scope requires, the less acceptable it is (up to possible unacceptability of an inverse scope interpretation).

The first step is to separate the question of the specifics of the cost of QR from the effects of the cost. In section 4.3.1, I summarize and present further data which show that the acceptability of inverse scope is only a reliable diagnostics for the cost of QR in sentences that are ambiguous (where there is a choice between a costly and a less costly interpretation). In cases where only the more costly interpretation is available (for whatever reason), the lack of choice makes inverse scope more or fully acceptable, while nevertheless remaining costly, which will confirm the hypothesis that every step of QR incurs a cost. Finally, in section 4.3.2, I formulate a possible algorithm for how to compute that cost.

#### 4.3.1 Cost and acceptability

As we have seen in section 3, the cost of QR is typically reflected as decreased accessibility of an inverse scope interpretation. There are two exceptions, however—sentences that only involve an inverse scope interpretation, and, as I will suggest here, certain ACD contexts. Anderson (2004) showed that unambiguous quantified test sentences such as (11c), repeated as (36), received almost exclusively the ‘several’ response to the comprehension question (see Table 1). In other words, the acceptability of inverse scope is close to ceiling in cases where the inverse scope interpretation is the only interpretation the test sentence has. While the cost of QR cannot be deduced from the acceptability rate of inverse scope in these cases, the increased reading times these examples received nevertheless indicate that QR incurs a cost.

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indefinite QPs is usually taken as an indication of the lack of movement of these quantifiers. However, since not all islands are blocking domains for syntactic movement and acceptability of an inverse scope interpretation does not necessarily show that there is no processing burden (see also the next section), a re-evaluation and consideration of processing properties could shed new light on the scope of indefinites.

- (34) a. Anderson (2004: 272, Item 2-1)  
*Inverse scope bias; unambiguous inverse scope test sentence*  
 The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. Members who nominated recipes were required to test the recipes to make sure that the instructions were correct. **A different member tested every recipe.**  
 One.                      Several.

The same pattern is found in ACD contexts, although, unfortunately, no information comparable to Anderson's reading times is available to this point. As pointed out in section 1, even speakers who generally do not accept inverse scope of a QP across a finite clause or a Non-Restructuring infinitive as in (35a) allow matrix ACD resolution and accompanying wide scope as in (35b). Note, however, that this interpretation, in particular the matrix Ellipsis resolution, is the only interpretation this sentence can have. For (35b) to be well-formed, only the matrix VP can function as the antecedent of the elided VP since the auxiliary *did* would not be compatible with the embedded VP—if a narrow antecedent were intended, the auxiliary would have to be *was* as in (35c). ACD examples such as (35b) are thus similar to unambiguous sentences like (34), in that there would, in principle, be a less costly QR derivation, however, that derivation is blocked independently (in case of ACD by the incompatibility of the stranded auxiliary with embedded Ellipsis resolution). Although long QR is costly in both (35a) and (35b), the effects of this cost are different. In (35a), the high cost (non-clausebound) interpretation competes with a less costly interpretation, and the availability of the latter makes it harder, possibly impossible, to access the more costly interpretation (or to use the garden path analogy from the last section, the easy access to the “wrong” path derivation makes it harder for the speaker to find the “correct” path derivation). In (35b), on the other hand, there is no choice and only the high cost derivation is available (there is only one path), and therefore speakers find inverse scope (more) acceptable. The prediction this approach makes, to be confirmed by further testing, is that even though (35b) is acceptable, it should still be costly in terms of processing, which could be detectable, for instance, via reading times.

- (35) a. Cecchetto (2004: 388, (92); \* $\forall$ » $\exists$ )  
 A middle school teacher claimed to be about to catch each problem student.  
 b. Cecchetto (2004: 388, (93); ? $\forall$ » $\exists$ )  
 A middle school teacher claimed to be about to catch each problem student  
 John did [~~claim to be about to catch~~].  
 c. \*Low ACD resolution:  
 A middle school teacher claimed to be about to catch each problem student  
 John \**did*/3*was* [~~about to catch~~]

While no reading time data are available yet, the relevance of choice has been shown to play an essential role in acceptability rates for ACD. While the ACD cases in Syrett & Lidz (2011)'s experiments involved ambiguous conditions (cf. (20)), a study by Sugawara et al. (2013) tested unambiguous ACD configurations such as (36) (only non-finite contexts were tested). Interestingly, the accuracy rates for adults, which were 50% for non-finite ACD in Syrett & Lidz (2011), were 95% for both short and long QR in Sugawara et al. (2013: 9). This confirms again that only when there is a choice between a matrix or embedded Ellipsis antecedent, speakers have a clear and strong preference for the less

costly options (cf. Table 3). When there is no choice, the costs of QR are tolerable, which is reflected in the high acceptability rate of such sentences.

- (36) Sugawara et al. (2013: 5, (10a,b))
- a. Cookie Monster wanted to be the same thing that Dora is.
  - b. Cookie Monster wanted to be the same thing that Dora did.

The final set of data illustrating the connection between choice and acceptability comes from Italian. Cecchetto (2004) shows that in Italian, matrix ACD resolution is possible in Restructuring contexts such as (37a), but impossible in Non-Restructuring contexts such as (37b), which only allow the embedded VP to function as an Ellipsis antecedent. There is one exception, however, namely cases such as (37c) where due to a tense mismatch embedded Ellipsis resolution becomes unavailable. In exactly (and only) those cases, matrix ACD resolution is possible.

- (37) *Italian*
- a. Cecchetto (2004: 379, (77); Restructuring)  
Sono andato a svegliare ogni ragazzo che mi aveva chiesto di farlo.  
'I have gone to wake up every boy who had asked me to do it.'  
lo = [<sub>VP-matrix</sub> go to wake up t]
  - b. Cecchetto (2004: 380, (78); Non-Restructuring)  
Ho promesso di interrogare ogni ragazzo che mi aveva chiesto di farlo.  
'I have promised COMP examine every boy who had asked me to do it'  
\*lo = [<sub>VP-matrix</sub> promise to examine t]  
lo = [<sub>VP-embedded</sub> examine t]
  - c. Cecchetto (2004: 380, (79); Non-Restructuring)  
Ammetterò di aver licenziato (senza giusta causa) ogni lavoratore che mi costringerà a farlo.  
'I will admit to have fired (with no good reason) every employee who will force me to do that.'  
lo = [<sub>VP-matrix</sub> admit to have fired t]  
\*lo = [<sub>VP-embedded</sub> fired t]

Recall that in Cecchetto's account, QR from the embedded vP to the matrix VP is licensed in high ACD resolution contexts since syntactic Scope Economy can be satisfied by the need to resolve ACD. It is, however, not clear in this account why high ACD resolution is then not available in (37b), since no constraint would be violated if QR took place as in (37c). Cecchetto (2004: 380, fn. 33) states that "A legitimate question is why, if the matrix reading is possible in principle, it only emerges when the embedded reading is excluded. This seems to be a typical fact that should be accounted for by a theory of processing (the matrix reading requires a much more complicated computation than the embedded one)." As is clear from the analysis in this paper, I agree with this point. However, once we make this move, the question is whether we then still need syntactic Scope Economy, or whether, following Anderson (2004), the other facts attributed to syntactic Scope Economy can also be seen as issues arising at the level of processing.<sup>24</sup>

<sup>24</sup> Another empirical domain for which syntactic Scope Economy has been employed but which I cannot discuss in this paper is scope in comparative QPs (see Mayr & Spector 2010 and Syrett et al. 2016 for an experimental study).

### 4.3.2 Calculating costs

In the analysis presented so far, I have adopted and further specified the processing approach in Anderson (2004), with the additional part highlighted in (38).

- (38) *Processing Scope Economy* (based on Anderson 2004: 48, (46))  
 The human sentence processing mechanism prefers to compute a scope configuration with the simplest syntactic representation (or derivation).  
 Computing a more complex configuration is possible but incurs a processing cost **of one penalty for each step of QR.**

Within a cyclic movement approach, the further the distance between two quantifiers is, the more steps are necessary to derive inverse scope. Each step increases the processing burden up to a point where the inverse scope derivation becomes impossible to parse. The final question is whether there is more to these costs than just counting steps. In this section, I suggest a possible direction for how to formalize the cost computation in a copy theory approach to QR. It is not my aim to convey that this is the only approach to QR—I simply try to provide a possible way to further understand the reason for Processing Economy.

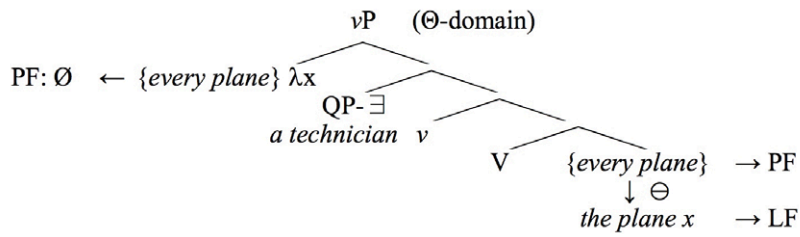
I follow a copy approach to movement where QR applies cyclically (not counter-cyclically at LF) and involves the PF pronunciation of the lowest copy. To derive inverse scope of the object over the subject, I assume that the subject can be interpreted in its base position within the  $\nu$ P (but more complex derivations are possible, too). To resolve copy choice at LF and to create the proper LF representation of quantificational phrases from multiple QP-copies, I adopt the process of *Trace Conversion* in (39).

- (39) *Trace Conversion* (Fox 2003: 111, (50))
- a. Variable Insertion: (Det) Pred  $\Rightarrow$  (Det) [Pred  $\lambda y(y = \text{him}_n)$ ]  
 [n is the index of the moved QNP]
  - b. Determiner Replacement: (Det) [Pred  $\lambda y(y = \text{him}_n)$ ]  $\Rightarrow$  the [Pred  $\lambda y(y = \text{him}_n)$ ]

The scope-relevant derivation for a sentence such as (40a) is given in (40b). The object undergoes movement to the edge of  $\nu$ P above the base position of the subject. When the  $\nu$ P is complete, there are thus two copies of the object in the  $\Theta$ -domain. The lower copy is transferred to and spelled out at PF and the higher copy is deleted for PF purposes. As part of transfer to LF, the lower copy undergoes trace conversion. As indicated in (40b), I propose that it is the operation of trace conversion that adds a cost ( $\Theta$ ) for processing. Although the subject QP undergoes further movement to TP, I follow approaches which regard the  $\nu$ P-internal subject position as the position relevant for LF. Thus the configuration in (40b) is what is sent to LF (either at the stage in (40b) or at a later stage after reconstruction).<sup>25</sup>

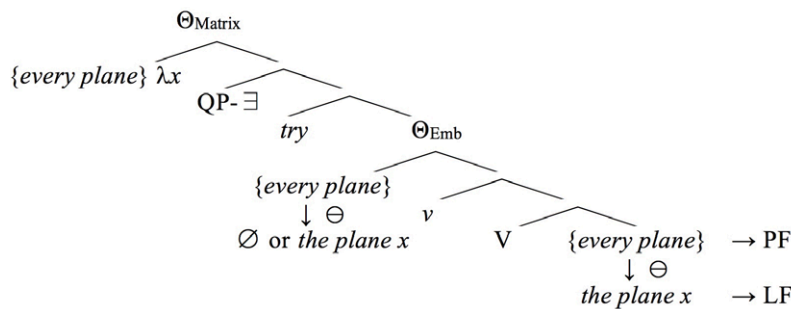
<sup>25</sup> A reviewer raises an important question regarding the derivation of sentences with surface scope. It is difficult to provide firm answers, since there is no comparison of QR and reconstruction in complex sentences available. In simple sentences, it is clear that the surface scope interpretation is less costly than the inverse scope interpretation (see the results in section 3.1). To derive this, one could assume that in the surface scope interpretation at least the object quantifier is interpreted in their base-position (this would be incompatible with approaches that require QR of object quantifiers for type reasons). Alternatively, as suggested in fn. 20, the cost computation of movement could involve an additional penalty for interpretations in which PF and LF mismatch (perhaps along the lines suggested in Bobaljik & Wurmbrand 2012). The latter would also predict that reconstruction in complex clauses incurs a processing burden, which, as stated by the same reviewer, is impressionistically the case (for simple clauses it depends on where the subject quantifier is interpreted—Spec,TP or Spec, $\nu$ P, which is still an open question). In general, many interesting issues arise for the processing of reconstruction, which have to be set aside here.

- (40) a. A technician tried to inspect every plane.  $\forall \gg \exists$   
 b.



Turning to Restructuring infinitives such as (41a), we have seen in section 4.1 that even the smallest complements involve at least an independent thematic domain. I propose that movement exiting a domain must proceed successive cyclically through the edge of each cyclic domain as depicted in (41b).<sup>26</sup> In a phasal approach, this would correspond to the Restructuring complement counting as a phase, either because it is a *vP* (see Wurmbrand 2015a; Wurmbrand & Shimamura 2017) or because it is the top extended projection of the embedded *V* (see Wurmbrand 2013; 2014a; 2015a; Bošković 2014). The first cycle in (41b) is identical to the derivation in (40b)—the lowest copy undergoes trace conversion at LF, incurring a processing cost, and is spelled out at PF (whether actual LF spell-out occurs at this point or, as in Cecchetto 2004, only at the end of the entire derivation is not relevant for our purposes, as long as LF spell-out occurs after trace conversion). After completion of the first cycle, PF and LF go separate ways (the moved QP is not visible for PF anymore, but it is still active in syntax). The QP-copy of the object undergoes a second step of movement and adjoins to the matrix *vP*, above the matrix subject. At the end of this cycle, copy choice occurs again since there are again two copies of the QP (minus the PF part). This can be achieved either via another application of trace conversion of the lower (now intermediate) copy or via deletion of the intermediate copy which is not interpreted in any way and hence is superfluous (as pointed out to me by B. Spector, p.c., since a trace converted definite description in this position would be vacuous, deletion may not be necessary). Either operation, I assume, is costly and hence the structure ends up with two  $\Theta$  which make inverse scope less available in (41) than in (40).<sup>27</sup>

- (41) a. A technician tried to inspect every plane.  $\forall \gg \exists$ : less available than (40)  
 b.



Lastly, the (simplified) derivation for inverse scope spanning a *decide*-type infinitive is given in (42). Since infinitives combining with verbs like *decide* involve a future interpretation, they project a tense/modal ( $\Phi$ ) domain (see Wurmbrand 2014c for motivation of a syntactic future element in infinitives). For an embedded object to take scope over a matrix quantifier, a QP originating in embedded object position has to cross two domains to reach a position above the matrix subject. As illustrated in (42b), this leads to two stop-overs

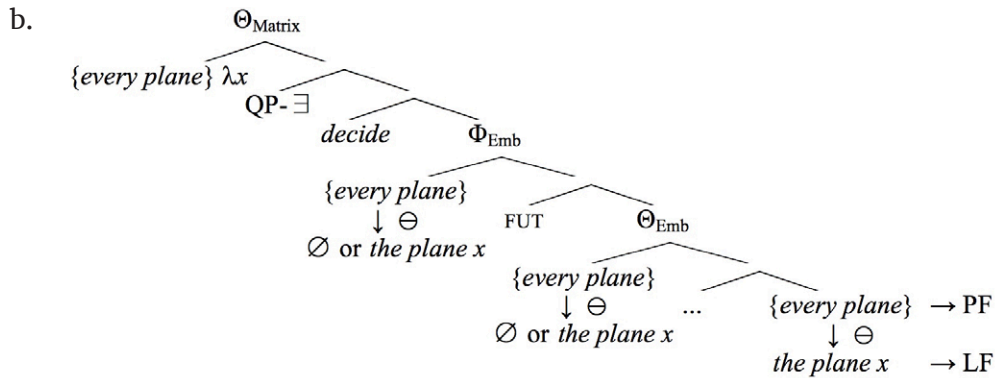
<sup>26</sup> Technically, this is not compatible with Grohmann’s suggestion of antilocality. I leave this issue open here.

<sup>27</sup> A prediction of this account which is yet to be tested is that QR from multiple Restructuring infinitives should incur a higher cost since more domains are crossed.



and three applications of trace conversion, thus a processing cost of three  $\Theta$ , which makes inverse scope more difficult than in *try*-type infinitives and simple predicates.

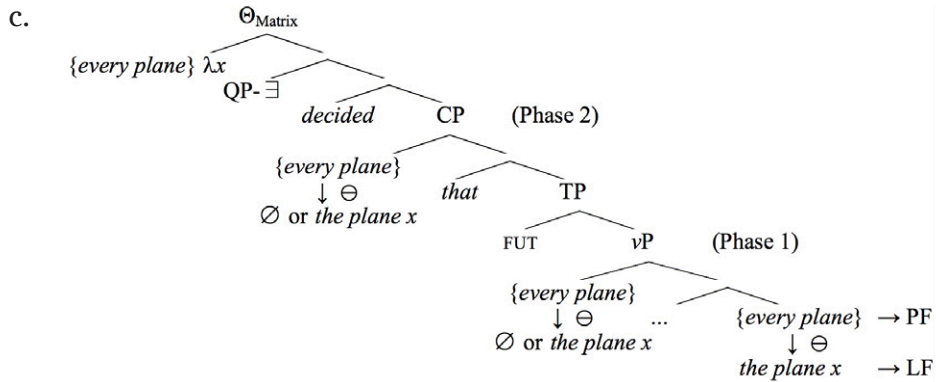
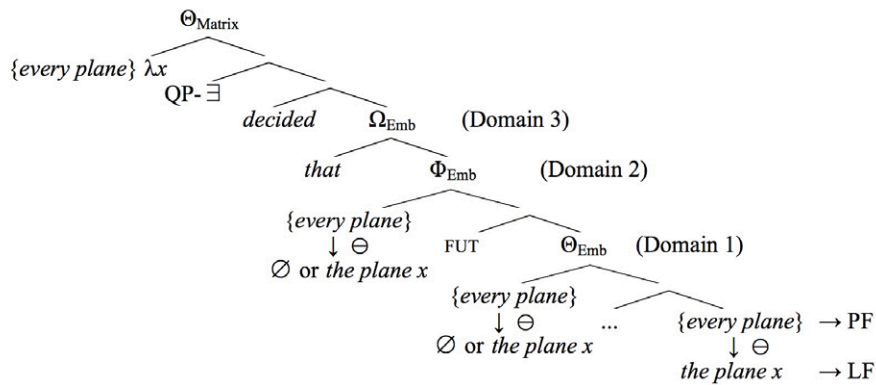
(42) a. A technician decided to inspect every plane. % $\forall$  $\exists$



To ensure that movement proceeds as in (42b) in future infinitives, the embedded clause (e.g., TP or ModP) must count as a cyclic domain, which is the case under a contextual phase approach or a Grohmannian domain approach, but not under a phase approach in which only  $\nu$ P and CP are phases (Chomsky 2000; 2001). This finally brings us to QR from finite clauses. Interestingly, a phase approach and a domain approach make different predictions regarding the difficulty of QR from a finite clause compared to a future infinitive. The difference between phases and domains is the TP/ $\Phi$  domain in contexts where that domain is not the top projection/domain of a clause. As shown in (43), an embedded finite clause involves three domains, (43b), but only two phases, (43c). A phase approach thus predicts that QR from finite clauses should be similar in difficulty to QR from future infinitives, whereas a domain approach predicts that QR from finite clauses should be harder than QR from future infinitives. To date, none of the experimental approaches has compared QR from finite complements and QR from future infinitives. Further psycholinguistic data will thus not only allow us to settle this data point but also contribute to the theoretical debate(s) of how to define cyclic domains.<sup>28</sup>

<sup>28</sup> Another relevant contrast that has not been explored yet is the difference between propositional infinitives and future infinitives. In Wurmbrand (2014c) and Todorović and Wurmbrand (To appear) it is argued that propositional infinitives obligatorily involve an  $\Omega$  domain. If this view is correct, propositional infinitives should pattern with finite clauses. The difficulty for English is that propositional control infinitives are very rare, basically only *claim* can naturally combine with a control infinitive (other propositional contexts require ECM), which restricts the options for testing this construction.

- (43) a. A technician decided that he would inspect every plane. % $\forall$  $\gg$  $\exists$   
 b.



### 5 Conclusion

The main proposal of this paper is that QR is not subject to QR-specific locality or domain restrictions but that differences observed between overt and covert movement are the result of an increased processing burden associated with multiple steps of covert movement and the lack of a cue for the parser to initiate a search for a covert dependency. One of the main observations was that QR from different types of clausal complements is gradient and speakers' acceptance of non-local QR tracks syntactic complexity defined over clausal domains. The account developed provided a preliminary algorithm for computing processing costs, which included costs for trace conversion, movement from islands, and lack of parallelism. Although these costs are hypothesized to always arise when QR applies, they are not always reflected in an acceptability decrease for inverse scope. In particular, if an inverse scope interpretation is the only option available, it is easier for speakers to access that interpretation than in ambiguous contexts where (costly) inverse scope competes with (less costly) surface scope. The sum of the findings summarized and discussed in the paper is given in (44).

- (44) a. QR is costly, even in simple clauses.  
 b. The cost of QR is observable as increased reading times of sentences with inverse scope (even when the inverse scope interpretation is the only interpretation available) and, for ambiguous sentences, a (possibly significantly) higher rate of surface scope than inverse scope.  
 c. ACD with a non-local Ellipsis resolution is costly (in contrast to non-local VPE without QR).  
 d. Additional factors (e.g., lack of parallelism in Ellipsis, islands) increase the processing burden, which may lead to unacceptability of an inverse scope interpretation.

- e. Scope biasing contexts and ACD facilitate the acceptability of inverse scope. In both cases, acceptability rates increase, however, the cost may still be detectable through reading times.
- f. QR across clause/predicate-boundaries increases the processing burden along the syntactic complexity scale; the more steps of QR inverse scope requires, the less acceptable it is (up to possible unacceptability of an inverse scope interpretation).

Many points raised still await experimental confirmation, but the paper has outlined what several of the predictions are and what to test further. If the conclusions can be maintained, attributing the distribution of QR across different clausal domains to processing difficulties rather than “hard” syntactic constraints captures the availability of QR as diagnosed by ACD, the variability in judgments, the gradient difficulty of QR in different syntactic contexts, and allows a uniform approach to the locality of A'-movement including QR.

### Abbreviations

ACD = antecedent contained deletion, Exp = experiment, FUT = future, INF = infinitive, QR = quantifier raising, VPE = VP Ellipsis.

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### Competing Interests

The author has no competing interests to declare.

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