Janina Radó, Andreas Konietzko, and Wolfgang Sternefeld
Telescoping in relative clauses

Experimental evidence

1 Introduction

Sternefeld (this volume) observes that in sentences like (1) a bound reading of the pronoun *his* in (1a) and *him* in (1b) seems possible:

(1) a. The picture of himself$_i$ everybody$_i$ sent in annoyed his$_i$ mother. (Hulsey & Sauerland 2006, ex. 70)

   b. [[The picture of his$_i$ mother]$_j$ [that every soldier$_i$ kept t$_j$ wrapped in a sock] was not much use to him]. (Safir 1999, p. 613)

(2) Der Dozent,   der   jede Studentin   faszinierte, las   ihren Text
    the lecturer$_{nom}$ that$_{nom}$ every student$_{nom/acc}$ fascinated read her   text
    nochmal Korrektur.
    again   proof
    The lecturer that fascinated every student proofread her text again.

Hulsey & Sauerland (2006) discuss the possibility of binding of *his* by the quantifier but propose an E-type analysis. In (1b) there is no index on *him* in Safir's paper, but the bound reading is intuitively possible.

  In this paper we investigate whether German counterparts to (1) such as (2) allow a bound reading of the pronoun (*ihren* in (2)) and how syntactic and semantic factors influence the availability of the bound reading. This is of theoretical interest as the results bear on the debate concerning the correct analysis of telescoping and relative clauses in general (see Sternefeld this volume). We present two experiments on bound interpretations under telescoping. Experiment 1 establishes that telescoping out of the relative clause in sentences like (2) is possible. Experiment 2 compares various accounts of telescoping by testing the influence of syntactic and semantic factors on the availability of bound readings.

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2 Availability of bound variable interpretations

2.1 Experiment 1: Binding out of the relative clause

Experiment 1 was designed to test whether telescoping regularly takes place, that is, whether a quantifier embedded in a relative clause can scope out and bind a pronoun outside the relative clause without much additional effort. To assess that, we compared the preferred interpretations of sentences like (3), where telescoping is necessary for the bound reading with (4), where the quantifier is in the matrix clause and binding the pronoun should be easy.[1]

(3) Der Dozent, der fast jede Studentin faszinierte, las ihren
the lecturer$_{nom}$ that$_{nom}$ almost every student$_{nom/acc}$ fascinated read her
Text nochmal Korrektur.
text again proof
The lecturer that fascinated almost every student proofread her text again.

(4) Fast jede Studentin, die dieser Dozent faszinierte, las
almost every student$_{nom/acc}$ that$_{nom/acc}$ the lecturer$_{nom}$ fascinated read
ihren Text nochmal Korrektur.
her text again proof
Almost every student whom the lecturer fascinated proofread her text again.

The two conditions *telescoping* vs. *binding* (shown in (3) and (4), respectively)[2] were tested in an eye movement study including two further conditions that are not relevant for the present discussion. To check the availability of the bound reading, each sentence was followed by a comprehension question and two answer options, one compatible with the bound reading, the other with a unique referent for the

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1 The difference between *der Dozent* in (3) and *dieser Dozent* in (4) had to do with practical considerations: *dieser* is more similar in length to *fast jede* in the parallel condition. This was relevant for the analysis of reading times in region 2 (the relative clause, cf. Figure 1b), which was of crucial interest, but not for region 1, which we did not analyze. Thus in (3) we opted for the intuitively more natural *der*.

2 The corresponding LFs are:

(3-LF) $[_{CP} [_{DP} [_{DP} \text{der}_x \text{Dozent}_x]_x [_{CP} (\text{der}) [_{DP} \text{fast jede}_y [_{NP} \text{Studentin}_y]]_y [_{IP} t_x t_y \text{faszinierte}]]]$
$[_{C'} \text{las } \lambda z [_{IP} t_x \text{ihren}_y \text{Text nochmal Korrektur-}t_z]]]$

(4-LF) $[_{CP} [_{DP} \text{fast jede} [_{NP} [_{NP} \text{Studentin}][_{CP} (\text{die}) \lambda x [_{IP} \text{dieser Student } t_x \text{faszinierte}]]]]$
$\lambda x [_{C'} \text{las } \lambda z [_{IP} t_x \text{ihren}_x \text{Text nochmal Korrektur } t_z]]]$

pronoun of interest. For (3)/(4) the comprehension question was *How many texts were proofread?* (*one* / *several*).

48 native German speakers from the Tübingen University community read 20 sentences like those in (3) and (4) (plus two additional conditions) together with 138 other sentences (items from unrelated experiments and fillers) while their eye movements were being monitored. The answers to the comprehension questions showed no difference in the availability of bound readings in the two conditions. The bound answer (*several*) was chosen in 84.2% of the cases in the telescoping condition, and in 85% of the cases in the regular binding condition. For the analysis of reading times the sentences were divided into the following regions: first DP, relative clause, matrix verb, pronoun, rest of the sentence. We analyzed the time spent in an analysis region between first entering and first leaving it (first pass times) as well as the total time spent in the region, and regressions. First pass times at the pronoun region and total times across the sentence are displayed in Figure 1. Reading times revealed no additional difficulty in the telescoping condition compared to the binding condition, either on the pronoun itself or on the final region of the sentence (all t's < 1).

These data indicate that telescoping is relatively easy, at least when the interpretation resulting from the quantifier binding the pronoun is plausible. One might even wonder about the high proportion of bound answers in this experiment, especially in light of the fact that the possibility of this interpretation has largely gone unnoticed in the literature. Before we move on to examining factors that influence the availability of bound readings, let us thus briefly compare the present findings to other experimental studies on bound variable interpretations.

## 2.2 Bound variable interpretations in the experimental literature

Hirschberg & Ward (1991) tested strict and sloppy readings in VP ellipsis with c-commanding and non-c-commanding antecedents. A sample item is given below:

(5) a. Mary said she deserves the scholarship, and so did Cathy.

  b. People who study linguistics think it's critical to cognitive science, and so do people who study AI.

The stimuli were presented auditorily. After each item, participants had to choose between two written paraphrases: (a) *Cathy said Mary deserves the scholarship*, (b) *Cathy said Cathy deserves the scholarship*. The sloppy (bound) reading was chosen in 42.9% of the non-c-commanding contexts. In a written control study with the
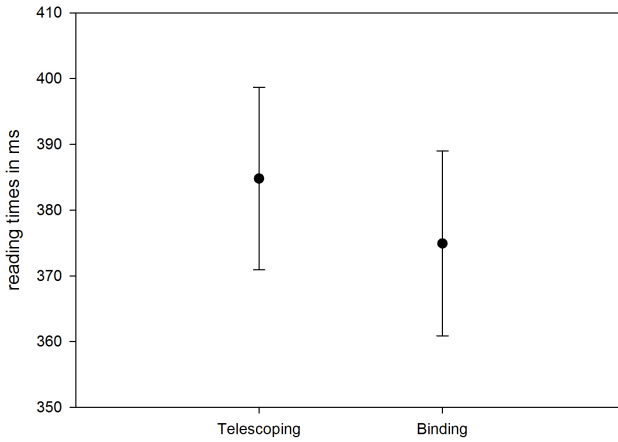
(a) First pass reading times at pronoun
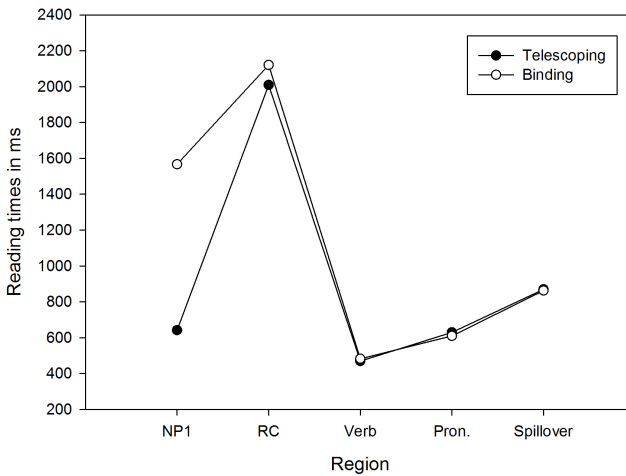
(b) Total reading times across all regions

Fig. 1: Mean reading times in the two conditions. Figure 1a shows the mean first pass times at the pronoun region. Figure 1b shows the mean total reading times across all regions of the sentence.

same items the sloppy reading was reported in 29.7% of the non-c-commanding contexts.

Frazier & Clifton (2000) investigated whether bound or coreferential readings are preferred in sentences such as

(6)   Mr. Stevenson helped his wife into the car, and his lawyer did too.

To assess which reading was preferred, participants had to answer a question such as *Who did the lawyer help into the car?*. In sentences like (6) that were not biased either towards a bound or towards a coreferential reading, 48% bound interpretations were reported, and even in the coreferential-biased condition a bound reading was chosen 29% of the time.

Koornneef (2008) used eye-tracking to investigate strict and sloppy readings of the pronoun *her* in Dutch stories given in (7) in their English translation:

(7)   a. Lisa and Anouk love the music channel MTV. They were very happy when they were selected for the show "Pimp My Room", in which their rooms were redecorated. Sadly, only Lisa thinks that her pimped room has a touch of class. Oh well, to each their own taste.

b. Lisa and Anouk love the music channel MTV. Lisa was very happy when she was selected for the show "Pimp My Room", in which her room was redecorated. Sadly, only Lisa thinks that her pimped room has a touch of class. Oh well, to each their own taste.

c. Lisa and Anouk love the music channel MTV. They were very happy when they were selected for the show "Pimp My Room", in which their rooms were redecorated. Sadly, Lisa thinks that her pimped room has a touch of class, but Anouk does not. Oh well, to each their own taste.

d. Lisa and Anouk love the music channel MTV. Lisa was very happy when she was selected for the show "Pimp My Room", in which her room was redecorated. Sadly, Lisa thinks that her pimped room has a touch of class, but Anouk does not. Oh well, to each their own taste.

Conditions (7a) and (7c) bias toward a sloppy (bound) reading, whereas in (7b) and (7d) the strict reading is much more plausible. There was a significant main effect (marginal by items) of shorter first fixations on the sloppy conditions at the region *pimped room* immediately after the pronoun. Planned comparisons showed that this effect was limited to the elliptical conditions (7c)–(7d). There was an advantage for sloppy readings in the ellipsis region *but Anouk does not* as well, most strongly in the regression path duration but also in the total fixation duration.

Reading times on the second sentence of the stories provide further support that strict readings are more difficult than sloppy ones. In the strict-biased conditions (7b) and (7d), the biasing sentence (*Lisa was very happy when she …*) was re-read significantly longer than the sloppy *They were very happy when they…*, both

in the ellipsis and in the *only*-structures. Thus Koornneef's results, just like Frazier & Clifton's (2000) findings in their self-paced reading experiments provide online evidence that readers prefer sloppy readings in ambiguous elliptical constructions.

Studies using quantifiers, on the other hand, present a mixed picture. Gordon & Hendrick (1998a) collected ratings for bound anaphora on a 5-point scale using the following sentences:

(8) a. Each girl decided what she could do.
    b. Each girl's parents decided what she could do.

Although sentences with a c-commanding quantifier were judged significantly better, sentences where the quantifier did not c-command the pronoun still received average ratings of 4.05.

Carminati, Frazier & Rayner (2002) recorded eye movements in a study using the following materials:

(9) a. Every British soldier aimed and then he killed an enemy soldier.
    b. Every British soldier thought that he killed an enemy soldier.
    c. The British soldier aimed and then he killed an enemy soldier.
    d. The British soldier thought that he killed an enemy soldier.

They report longer reading times in the region after the pronoun for sentences with a quantifier than for those that begin with a definite DP. Moreover, reading times were longer in sentences that contained complement clauses than in sentences with conjoined clauses. However, there was no significant interaction between the two factors, i.e. there was no processing benefit in cases where the pronoun in a complement clause was c-commanded by the quantifier.

In the studies by Carminati, Frazier & Rayner (2002) and Gordon & Hendrick (1998a) it is taken for granted that a bound interpretation was selected but in principle their experimental items were ambiguous between a bound reading and a deictic one where the pronoun picks up a discourse referent. A deictic reading was available in the present experiment as well.[3] However, if that reading was selected then we would expect the answer *one* to the question *How many texts were proofread?*, which was chosen less than 20% of the time. A possible problem may be that there is a pragmatic bias towards answering *several*, since instructors typically read more than one text. While this may be responsible for some of the "bound" answers, it is unlikely that it accounts for all or even the majority of

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3 Note that in our materials the definite DP *der Dozent* cannot be interpreted as coreferential with the (feminine) pronoun *ihren* as they do not match in gender.

them. Moreover, it is unlikely that the pragmatic bias had a stronger effect in the telescoping condition than under regular variable binding. The fact that there is no difference between the availability of bound readings in the condition where binding of the pronoun was unproblematic and in the one where telescoping was necessary for the bound interpretation is sufficient to show that telescoping is easily possible in the configuration under consideration here.

3 Experiment 2: Testing theoretical accounts

Having established that telescoping out of a relative clause is possible, we are ready to test some theoretical accounts. As mentioned in Sternefeld (this volume), syntactic approaches predict a subject-object asymmetry in telescoping: Under a syntactic reconstruction analysis, (10a) should not allow a bound reading of *seine Ärztin*, since the object quantifier cannot scope over the subject or its trace. By contrast, the bound reading should be possible in (10b), where the quantifier c-commands the trace in object position. Moreover, *ihm* should never receive a bound interpretation because the quantifier cannot take scope outside the relative clause.

(10)   a. Seine Ärztin,   die   jeden   Patienten seit   Langem
           his   doctor$_{nom/acc}$ who$_{nom/acc}$ every$_{acc}$ patient$_{acc}$ since long
           gekannt hat, hat ihm   ein teures   Medikament verschrieben
           known   has has for-him an expensive medication   prescribed
           His doctor who has known every patient for a long time prescribed him
           an expensive medication.

       b. Seine Ärztin,   die   jeder   Patient seit   Langem gekannt
           his   doctor$_{nom/acc}$ who$_{nom/acc}$ every$_{nom}$ patient since long   known
           hat, hat ihm   ein teures   Medikament verschrieben
           has has for-him an expensive medication   prescribed
           His doctor who every patient has known for a long time prescribed him
           an expensive medication.

If telescoping results from quantifier raising (QR), then the predictions are reversed: raising the object quantifier in (10a) at LF should be fine, whereas QR of *jeder Patient* into the matrix clause in (10b) should violate the ECP.[4]

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4 According to the ECP, all traces must be properly governed and subject traces can only be antecedent governed. The relative pronoun prevents antecedent government in this case as it acts as a barrier (Lasnik & Saito 1984).

On the other hand, a lack of subject/object asymmetry with respect to bound readings may be taken to support semantic theories of telescoping such as Sternefeld (this volume): in such theories both (10a) and (10b) are expected to be equally good.

Another issue briefly mentioned in Sternefeld (this volume) is whether there is a difference between the examples in (10) versus (11).

(11) a. Die Ärztin,   die   jeden   Patienten seit Langem gekannt
the doctor$_{nom/acc}$ who$_{nom/acc}$ every$_{acc}$ patient$_{acc}$ since long   known
hat, hat ihm   ein teures   Medikament verschrieben
has has for-him an expensive medication   prescribed
The doctor who has known every patient for a long time prescribed him an expensive medication.

b. Die Ärztin,   die   jeder   Patient seit Langem gekannt
the doctor$_{nom/acc}$ who$_{nom/acc}$ every$_{nom}$ patient since long   known
hat, hat ihm   ein teures   Medikament verschrieben
has has for-him an expensive medication   prescribed
The doctor who every patient has known for a long time prescribed him an expensive medication.

We might expect that the processing of forward anaphora is facilitated by cataphoric anaphora, i.e. that telescoping is easier in (10) than in (11).

3.1 Materials and procedures

To test these theoretical issues we conducted a self-paced reading study using the four conditions shown in (10)–(11) and repeated in (12). The sentences were presented phrase-by-phrase using the moving-window technique. The presentation regions are indicated by the slashes in (12).

(12) a. Seine Ärztin,/ die/ jeden Patienten/ seit Langem/ gekannt hat,/ hat/ ihm/ ein teures Medikament/ verschrieben.

b. Seine Ärztin,/ die/ jeder Patient/ seit Langem/ gekannt hat,/ hat/ ihm/ ein teures Medikament/ verschrieben.

c. Die Ärztin,/ die/ jeden Patienten/ seit Langem/ gekannt hat,/ hat/ ihm/ ein teures Medikament/ verschrieben.

d. Die Ärztin,/ die/ jeder Patient/ seit Langem/ gekannt hat,/ hat/ ihm/ ein teures Medikament/ verschrieben.

As the finite verb is in clause-final position in German relative clauses, the subject quantifier and object quantifier cases (12b,d) vs. (12a,c) only differ in the case

marking on the QP. To ensure unambiguous case marking and thus correct interpretation of the relative clause, the QP always contained a masculine noun. The matrix subject, by contrast, was feminine so it could not be construed as the antecedent of the masculine pronoun.

As in Experiment 1, the bound readings were assessed using comprehension questions. To avoid the pragmatic bias that may have affected the answers in the previous experiment, the question for the anaphoric reading of *ihm* was made more specific, e.g. for the item in (12) it was *Did each patient get a prescription for an expensive medication?*. The cataphoric reading of *seine* in (12a–b) was tested with the question *Did the sentence say that each patient has known his (own) doctor for a long time?*. Each item was followed by just one comprehension question, thus the anaphoric question appeared with half of the items. The other half of the items received the cataphoric question in conditions (a) and (b) and no question in the remaining two conditions.

24 items like (12) were constructed in four conditions. They were distributed across four presentation lists according to a latin square design. The items were mixed with 48 fillers of superficially similar structure, 16 of which were followed by a comprehension question. 42 native German speakers from the Tübingen University community participated in the experiment for a payment of 5 euros. Participants were tested individually. They were randomly assigned to one of the presentation lists and read the items and fillers in an individually randomized order. An experimental session lasted approximately 30 minutes.

3.2 Predictions

If telescoping is the result of QR into the matrix clause, then it should not be possible in (12b) and (12d) otherwise an ECP-violation will occur. Thus bound readings of *ihm* are only expected in (12a,c), since the object quantifier, but not the subject quantifier can QR out of the relative clause and end up high enough to bind the pronoun. By the same token, *seine* in (12b) should not have a bound reading. Assuming that the pronoun in the subject in (12a–b) acts as a trigger in inducing QR into the matrix clause, we may even expect a reading time difference: if raising of the subject quantifier into the matrix clause is attempted and then rejected because of the ECP, then longer reading times may be observed in the relative clause in (12b) than in (12a). Whether a reading time effect is expected at the pronoun *ihm* is not clear: As the bound interpretation is predicted not to be available in (12b,d) *ihm* will have to be interpreted deictically, which may or may not take longer than binding.

According to reconstruction theories of relative clause interpretation, the head of the relative clause (*die/seine Ärztin*) is interpreted in its "base" position inside the relative clause. This means that the cataphoric pronoun *seine* in (12b) appears within the scope of the quantifier during some stage of the interpretation, thus it can receive a bound reading. In (12a), however, reconstruction does not make a bound reading possible, since the position the DP is reconstructed into is still higher than the object quantifier. As LF-movement of the quantifier cannot yield new binding relations, *seine* in (12a) should only have a deictic interpretation. Moreover, a bound reading of *ihm* should not be possible in any of the conditions in (12) since the quantifier is presumably clause-bound. Thus the predictions this type of approach makes primarily concern the available readings. Given the discussion above, it is not clear whether any reading time differences are expected.

Semantic approaches such as Sternefeld (this volume) do not require any movement, thus no subject/object asymmetry is expected. The combination of continuation theory (Barker 2002) and delayed binding allows for a bound reading of *seine* both in (12a) and in (12b). Furthermore, Sternefeld conjectures that the bound interpretation of *ihm* may depend on that of *seine* (see Sternefeld this volume for details). If that is the case then we should find more bound readings in (12a–b) than in (12c–d). As with the previous approaches, there are no clear predictions concerning the reading times.

To sum up, the crucial test of the theories is the availability of bound readings of *ihm*: under reconstruction it should not be possible at all, under QR it should only occur with object quantifiers, whereas according to Sternefeld's proposal it should always be allowed. Concerning the bound reading of *seine*, the reconstruction approach predicts it to be available in the subject quantifier condition (12b), the QR approach in (12a), and the semantic approach in both cases.

There is an additional aspect of the materials which may affect reading times. As mentioned above, the DP inside the relative clause is unambiguously case-marked, which clearly indicates whether it is in subject or object position. However, the relative pronoun, which matches the feminine subject DP, is ambiguous: it may be interpreted as nominative or accusative. Its role as subject or object therefore only becomes clear when the full DP has been read. Numerous experiments have shown that readers prefer a subject-before-object order of constituents and take a case-ambiguous initial DP or pronoun to be nominative by default (cf. Bader & Bayer 2006, Bornkessel & Schlesewsky 2006). In case of an object relative clause this will result in a brief temporary misanalysis of the relative clause and reinterpretation when the (nominative-marked) DP has been encountered, which may result in longer reading times.

3.3 Results

The reading times per region, the readings participants reported, and the response times to the comprehension questions were subjected to repeated measures ANOVAs separately by participants and by items with the factors quantifier (subject vs. object quantifier) and determiner in matrix subject (*die* vs. *seine*). Figure 2 shows the proportion of bound readings of the (late) pronoun *ihm* in the four conditions, as well as the time participants took to read the comprehension question and indicate their interpretation of the pronoun, separately for bound and deictic answers.

Across all conditions the bound reading was reported on average on 28.8% of the trials. A repeated measures ANOVA with the factors quantifier (subject vs. object) and determiner in matrix subject (*die* vs. *seine*) revealed no main effects (all F's < 1); the interaction of the factors was marginal ($F_1(1,41) = 3.573$, p = .066, $F_2(1,11) = 3.609$, p = .084).[5] Planned comparisons showed that bound readings were equally frequent in conditions with a subject or object quantifier following an initial pronoun (*seine*) ($t_1(41) = -1.702$, p = .096, $t_2(11) = -1.467$, p = .170). There were marginally fewer bound answers when the object quantifier followed *seine* than when it followed an DP with *die* ($t_1(41) = -1.814$, p = .077, $t_2(11) = -2.836$, p = .016). With subject quantifiers, the numerical difference was reversed but it did not approach statistical significance (t's < 1). In the response times there was a marginally significant main effect of participants providing a bound interpretation faster in the conditions with *seine* than in those with *die* ($F_1(1,41) = 3.772$, p = .059, $F_2(1,11) = 4.817$, p = .051). There were no other significant effects or interactions (all F's < 1).

Figure 3 shows the proportion of bound readings of the initial pronoun *seine*, as well as the mean reaction times for answering the question that assessed the reading. The initial pronoun received a bound interpretation on average 32.9% of the time. The proportion of bound readings did not differ between the subject-quantifier and the object-quantifier conditions ((12b) and (12a), respectively), both t's < 1. However, with an object quantifier the bound answers were significantly slower than with a subject quantifier ($t_1(22) = 2.265$, p = .034, $t_2(11) = 2.146$, p = .055). The response times corresponding to the deictic interpretation of the pronoun did not differ from each other ($t_1(37) = 1.432$, p = .161, $t_2(11) = 1.928$, p = .086).

For the analysis of reading times, residual reading times were calculated for each participant. The mean residual reading times for each presentation region are shown in Figure 4.

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5 Note that the interpretation of *ihm* was tested after half of the items; the other half received questions about the interpretation of *seine*.
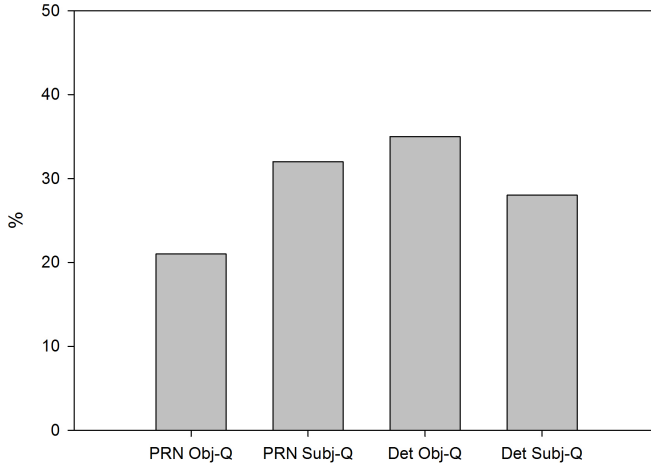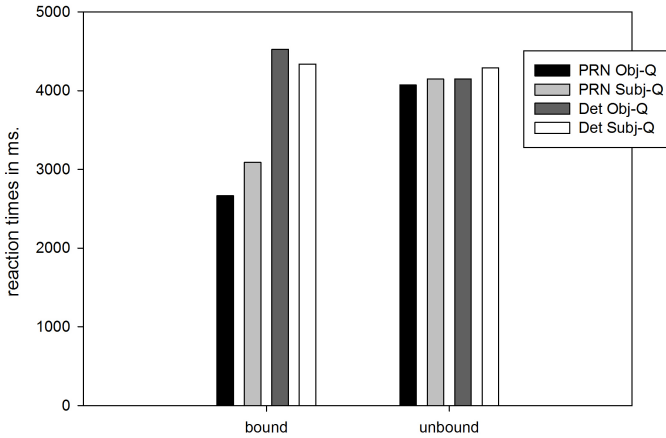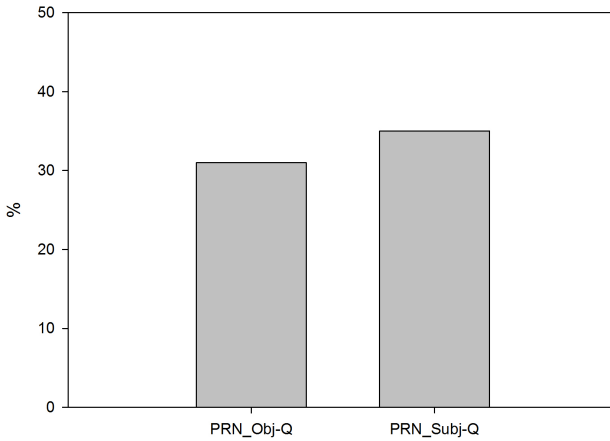
(a) Proportion of bound readings for *ihm*

(b) Response times for question about *ihm*

Fig. 2: Reported readings and response times to the question testing the reading of the anaphoric pronoun *ihm*. Figure 2a shows the proportion of bound readings for *ihm*. Figure 2b displays the mean response times per condition, separately for the bound and the deictic answers.

Reading times on the first two regions (subject DP and relative pronoun) are of no theoretical interest. At regions 3 (the quantifier phrase) and 4 (adverb) reading times did not differ from each other: all F's < 1. At region 5 (verb cluster at
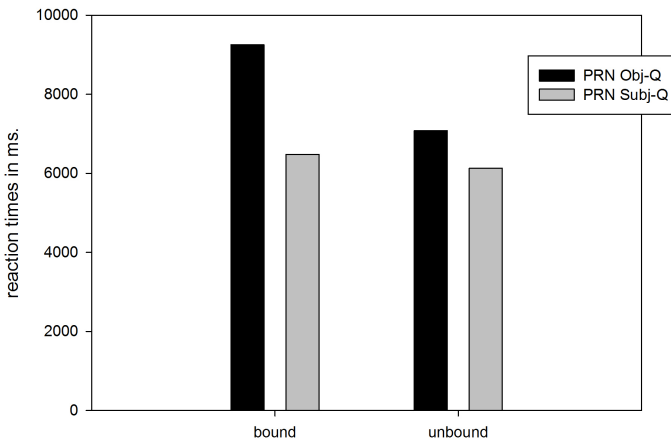
(a) Proportion of bound readings for *seine*

(b) Response times for question about *seine*

Fig. 3: Reported readings and response times to the question testing the reading of the cataphoric pronoun *seine*. Figure 3a shows the proportion of bound readings for *seine*. Figure 3b displays the mean response times per condition, separately for the bound and the deictic answers.

the end of the relative clause) both the main effect of quantifier ($F_1(1,41) = 11.239$, $p = .002$, $F_2(1,23) = 15.097$, $p = .001$), and of *die* vs. *seine* ($F_1(1,41) = 24.108$, $p < .001$, $F_2(1,23) = 16.009$, $p = .001$) were significant. In addition, there was a significant interaction ($F_1(1,41) = 5.275$, $p = .027$, $F_2(1,11) = 8.663$, $p = .007$). This was due to
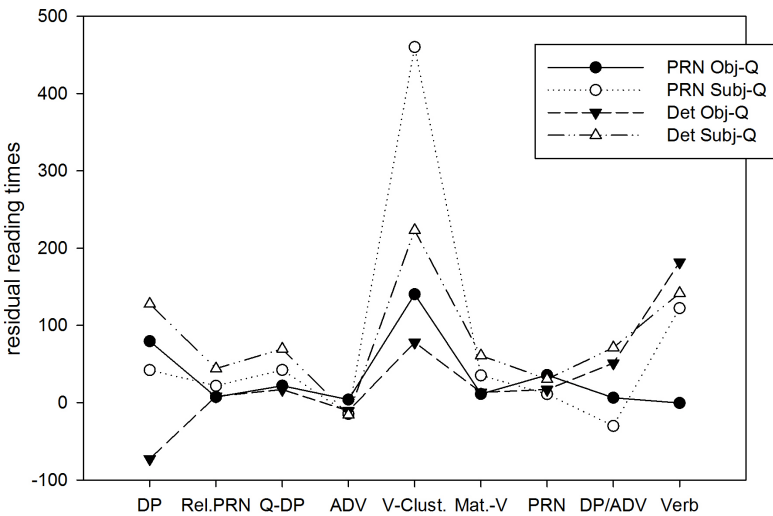
Fig. 4: Mean residual reading times across all regions

particularly long reading times in the subject quantifier condition with *seine* (12b): this condition was reliably slower than the corresponding subject quantifier condition with *die* ($t_1(41) = 3.384$, p = .002, $t_2(23) = 6.062$, p < .001), whereas there was no reliable difference between the two object-quantifier conditions ($t_1(41) = 1.404$, p = .168, $t_2(23) = 1.120$, p = .274).

At region 6 (the matrix auxiliary), there was a main effect of the object-quantifier conditions being read slower than the subject-quantifier ones ($F_1(1,41) = 7.932$, p < .007, $F_2(1,23) = 3.302$, p = .082). Neither the effect of the quantifier nor the interaction approached significance (F's < 1).

At the anaphoric pronoun (region 7, Figure 5 below) neither of the main effects turned out to be reliable (F's < 1) but the interaction was marginally significant ($F_1(1,41) = 3.311$, p = .076, $F_2(1,23) = 3.435$, p = .077). Pairwise comparisons revealed that reading times were slower when an initial DP with *seine* was followed by an object quantifier as opposed to a subject quantifier ($t_1(41) = 2.355$, p = .023, $t_2(23) = 2.132$, p = .044). In the corresponding conditions with *die* the numerical data showed the opposite pattern but the difference was not statistically significant ($t_1(41) = -1.866$, p = .069, $t_2 < 1$).

At region 8 (adverb), the conditions with *seine* were read significantly faster than those with *die* ($F_1(1,41) = 8.866$, p = .005, $F_2(1,23) = 18.306$, p = .001). There
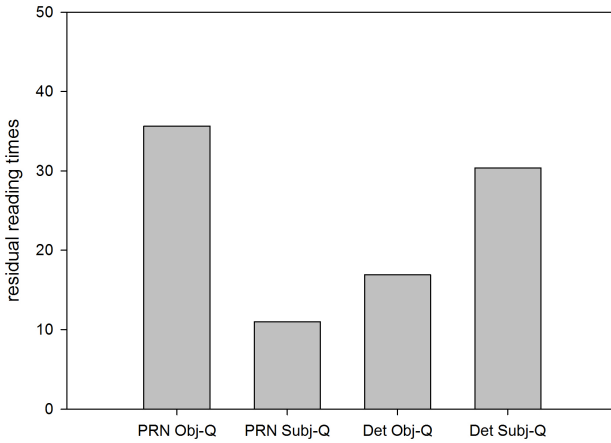
Fig. 5: Mean residual reading times at the pronoun *ihm* (Region 7)

were no other significant effects. The main effect of *seine* vs. *die* persisted on the final region as well ($F_1(1,41) = 4.520$, $p = .040$, $F_2(1,23) = 6.343$, $p = .019$), whereas the interaction did not reach significance.

The results discussed so far were based on all reading times, irrespective of the reading the participant reported. Recall that only about 33% of the answers provided at the end of the sentence reflected a bound reading of *seine*. Focusing on just those trials, the only region with a considerable reading time difference across conditions was region 5 (the end of the relative clause). As Figure 6 shows, at this region there was a massive slowdown in the subject quantifier condition, just like in the pattern with all observations.

Considering the bound reading of *ihm*, the earliest point in the sentence where we may be able to observe a difference based on the ultimate interpretation is the region of the second pronoun (region 7). At this region there were no significant differences across the four conditions. Crucially, at the next region the pattern is the same as the overall pattern of reading times, showing an advantage of the conditions with *seine* over those with *die*, cf. Figure 7.

Finally, looking at whether the interpretation of *seine* had any effect on the reading ultimately assigned to *ihm*, the only suggestive piece of evidence was relatively longer reading times at the relative pronoun in cases when the bound interpretation was reported, as shown in Figure 8.
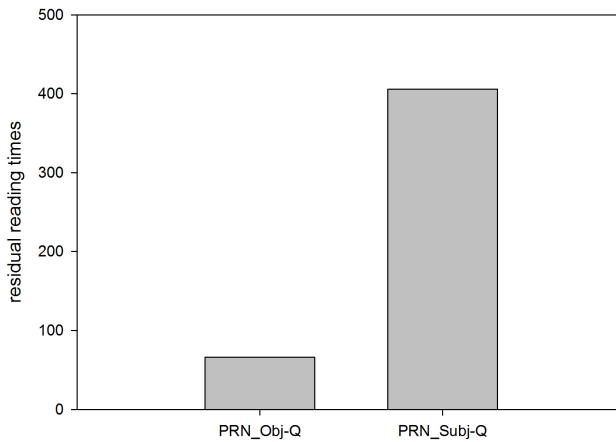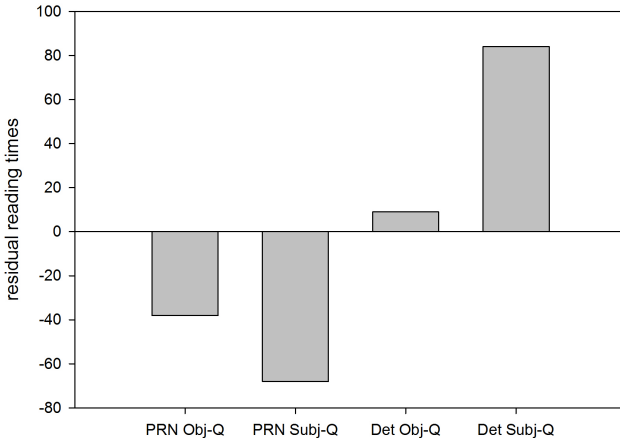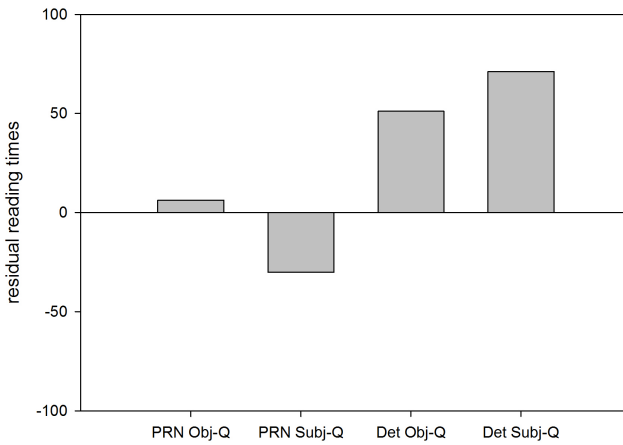
Fig. 6: Mean residual reading times for the bound readings of *seine* at the end of the relative clause (Region 5)

3.4 Discussion

The ca. 30% bound answers for both *seine* and *ihm* provide further evidence that bound readings are easily available. The discrepancy between the proportion of bound answers in Experiment 1 and Experiment 2 probably resulted from different presentation techniques and from the more specific questions used in Experiment 2. As discussed in section 2, in Experiment 1 there was a potential pragmatic bias to answer *several* even when no true bound reading was intended. In the present experiment care was taken to avoid this possibility, which naturally led to fewer bound readings. In addition, the previous experiment used eye-tracking, thus participants were able to go back and re-read earlier portions of the sentence when they encountered the pronoun. In Experiment 2 the moving-window technique made it impossible to reinspect earlier parts of the sentence. Participants thus had to rely on the representation they had constructed up to the point of encountering the pronoun, and that may have discouraged bound interpretations on some of the trials. Note that the proportion of bound readings in the present experiment is much more similar to the findings by other researchers reviewed in Section 2.

Participants' answers to the comprehension questions did not show any subject/object asymmetry with respect to the availability of bound readings. This fact constitutes evidence against both types of syntactic theories. Recall that the QR approach only allows telescoping with an object quantifier, since raising a subject

(a) Reading times for the bound interpretation of *ihm*

(b) Reading times across all trials

Fig. 7: Mean residual reading times at Region 8. Figure 7a shows the reading times on those trials where a bound reading of *ihm* was reported. Figure 7b displays the mean residual reading times on all trials.

quantifier high enough would result in an ECP-violaton. Under a reconstruction account, on the other hand, the pronoun in the matrix subject should only be able to receive a bound reading in an object relative clause, where it is reconstructed into
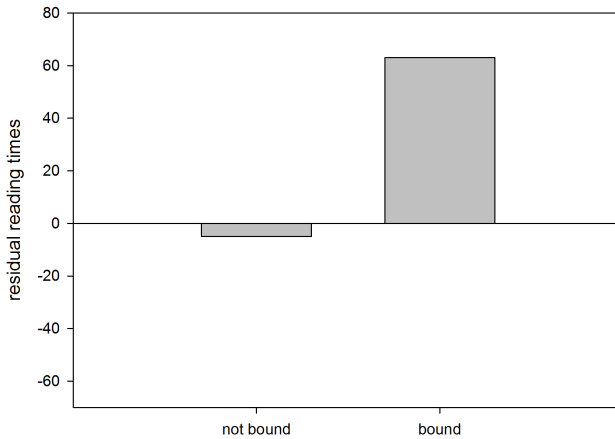
Fig. 8: Mean residual reading times for the bound and deictic readings of *seine* at the relative pronoun (Region 2)

the scope of the (subject) quantifier. Moreover, as the (late) pronoun *ihm* never has to reconstruct, it should only be interpreted deictically. In Experiment 2, however, both the initial and the late pronoun were interpreted as bound by the quantifier in more than 20% of the cases in all conditions.

The interpretations participants reported do not indicate a relationship between the availability of a bound reading of *ihm* and the choice of determiner in the initial DP. In fact, the pattern of bound answers with *die* vs. *seine* following an object quantifier, although not fully reliable, is the opposite of what would be expected if the anaphor benefitted from the presence of a sentence-initial cataphor. However, the reading and response times suggest that the presence of *seine* did facilitate the interpretation of the late pronoun *ihm*. First, the response times corresponding to a bound reading of *ihm* were faster in the conditions with *seine* than with *die*, whereas the choice of determiner in the initial DP did not affect the response times for a deictic interpretation. Furthermore, the significantly faster reading times in the conditions with *seine* at regions 8 and 9 also indicate that the initial pronoun makes the interpretation of the following anaphor easier.

Thus starting with region 8, the two conditions with *seine* are processed in a similar fashion and differently from *die*. However, the reading times on earlier parts of the sentence do not show a clear *seine* vs. *die* difference. Participants seem to encounter processing difficulty at region 5 in the case of *seine* and a subject quantifier, and at region 7 when *seine* is followed by an object quantifier. To explain

this difference it may be useful to consider what processing steps are likely to take place at each presentation region.

The interpretation of the initial DP in the conditions with *die* does not require any additional steps beyond lexical-semantic processing and setting up a discourse referent. *Seine*, however, cannot be fully interpreted since an appropriate antecedent is missing. At this point full interpretation may be delayed or an unidentified discourse antecedent may be postulated, resulting in a deictic reading. Gordon & Hendrick's (1998b) findings indicate that readers typically do not associate a later potential antecedent with a possessive pronoun in a sentence-initial subject DP. Instead they tend to assume the existence of an appropriate referent in context. This is consistent with the difference in the contingent reading times at region 2 (Figure 8): no bound reading resulted on those trials where participants quickly moved on to later parts of the sentence.

In line with the general subject-before-object preference documented for German (Bader & Bayer 2006, Bornkessel & Schlesewsky 2006), the case-ambiguous relative pronoun in region 2 is initially interpreted as nominative. This interpretation is disconfirmed in the subject-quantifier conditions (12b,d). The resulting reanalysis is presumably responsible for the significantly longer reading times in the subject-quantifier conditions at the end of the relative clause. Although this effect would be expected to appear right after the quantifier (at region 3 or 4), given the relatively short presentation regions in the present experiment it may have been delayed until region 5. The second main effect observed at this region, namely longer reading times for the conditions with *seine*, was due to the extreme slow-down in the condition with *seine* and a subject quantifier. A possible explanation, consistent with the pattern at later parts of the sentence, is that the extra processing that was needed to recover from the garden-path in the subject quantifier conditions also made the quantifier more salient, and as a consequence, at least on a proportion of the trials it was considered as a potential antecedent for the initial pronoun. This did not necessarily lead to actual binding, but it was sufficient to slow down processing in order to check the viability of a representation where binding could be established. When the second pronoun was encountered two short regions later, the relevant representation was already available, resulting in particularly fast reading in the subject quantifier condition with *seine*. By contrast, the object quantifier could be integrated into the unfolding representation of the sentence without any difficulty. As no additional processing effort was needed, object quantifiers remained less salient during the interpretation of the relative clause and presumably no binding was attempted between the quantifier and the initial pronoun. The kind of representation that would allow a bound interpretation (of both pronouns) was thus only considered when *ihm* was encountered in region 7, leading to considerably slower reading times at this region.

4 Conclusions

Our results indicate that binding out of a relative clause is not particularly difficult. In addition, the observed lack of a subject/object asymmetry with respect to the availability of bound readings constitutes evidence against syntactic theories of telescoping. Moreover, the data suggest that the presence of an initial pronoun may facilitate the binding of a later one within the same sentence. The present evidence is only indirect, based on reading and response times. Follow-up experiments should assess the reading of both pronouns within a sentence to establish a clear connection between the two. If our results are confirmed, they will be difficult to account for in syntactic terms; however, they are compatible with Sternefeld's (this volume) semantic approach to telescoping.

The work reported here focused on the universal quantifier *jede(r)* "every". In order to fully understand telescoping it is necessary to examine other quantifiers as well; we are currently conducting an experiment investigating the availability of bound readings with the negative quantifier *keine* "no". Another possible extension would be to consider the effect of clausal relations on bound interpretations: Intuitively, in the sentence *The poison that every dog ate killed him.* the deictic reading is not available at all. Testing this intuition is left to future research.

References

Bader, Markus & Joseph Bayer. 2006. *Case and linking in language comprehension: Evidence from German*. Heidelberg: Springer.

Barker, Chris. 2002. Continuations and the nature of quantification. *Natural Language Semantics* 10. 211–242.

Bornkessel, Ina & Matthias Schlesewsky. 2006. The extended argument dependency model: A neurocognitive approach to sentence comprehension across languages. *Psychological Review* 113(4). 787–821.

Carminati, Maria Nella, Lyn Frazier & Keith Rayner. 2002. Bound variables and c-command. *Journal of Semantics* 19. 1–34.

Frazier, Lyn & Charles Clifton Jr. 2000. On bound variable interpretations: The LF-only hypothesis. *Journal of Psycholinguistic Research* 29(2). 125–139.

Gordon, Peter C. & Randall Hendrick. 1998a. Dimensions of grammatical coreference. In Morton Ann Gernsbacher & Sharon J. Derry (eds.), *Proceedings of the Twentieth Annual Conference of the Cognitive Science Society*, 424–429. Mahwah, NJ: Lawrence Erlbaum Associates.

Gordon, Peter C. & Randall Hendrick. 1998b. The representation and processing of coreference in discourse. *Cognitive Science* 22. 389–424.

Hirschberg, Julia & Gregory Ward. 1991. Accent and bound anaphora. *Cognitive Linguistics* 2(2). 101–121.

Hulsey, Sarah & Uli Sauerland. 2006. Sorting out relative clauses. *Natural Language Semantics* 14. 111–137.

Koornneef, Arnout Willem. 2008. *Eye-catching anaphora*. Utrecht University PhD thesis.

Lasnik, Howard & Mamoru Saito. 1984. On the nature of proper government. *Linguistic Inquiry* 15. 235–289.

Safir, Ken. 1999. Vehicle change and reconstruction in A'-chains. *Linguistic Inquiry* 30. 587–620.