Processing Presupposed Content

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Abstract

This paper presents three experimental studies investigating the processing of presupposed content. The first two experiments employ the German additive particle *auch* (*too*), and the third uses English *also*. In experiment 1, participants were given a questionnaire containing bi-clausal, ambiguous sentences with *auch* in the second clause. The presupposition introduced by *auch* was only satisfied on one of the two readings of the sentence, and this reading corresponded to a syntactically dispreferred parse of the sentence. The prospect of having the *auch*-presupposition satisfied made participants choose this syntactically dispreferred reading more frequently than in a control condition. Experiment 2 used the self-paced-reading paradigm and compared the reading times on clauses containing *auch*, which differed in whether the presupposition of *auch* was satisfied or not. Participants read the clause more slowly when the presupposition was not satisfied. Experiment 3 followed up a number of issues that arose from experiment 2 and confirmed the results found there. Furthermore, it made an attempt at determining the level of representation relevant for the processes under investigation. It is argued that these studies show that presuppositions play an important role in online sentence comprehension and affect the choice of syntactic analysis. Some theoretical implications of these findings for semantic theory and dynamic accounts of presuppositions as well as for theories of semantic processing are discussed.

1 Introduction

Presuppositions have been an important topic in both the philosophy of language and in linguistic semantics and pragmatics, but only more recently have they been investigated with psycholinguistic methods. However, a lot can be gained from such investigations, both with respect to theoretical issues in presupposition theory and with respect to our understanding of semantic processing. In the following, I present three experimental studies, two of which focus on the German additive particle *auch* (*too*), while the last one uses English *also*. I argue that the results from these studies indicate that presuppositions play an important role early on in sentence comprehension. This, together with seeing other relevant studies in the processing literature from the viewpoint of semantic theory, opens up the possibility of testing theoretical claims with psycholinguistic methods. Assuming that the parser makes use of the interpretative system supplied by the grammar, the results presented here suggest that something like contextual update (in the sense of update semantics) is carried out below the sentence level in actual processing, namely, at the level of noun phrases. This, in turn, requires that our theory of semantic interpretation in context allows for updates at such a lower level. In addition to these theoretical conclusions about semantics, some questions arising for a theory of semantic processing are also discussed.

The paper is organized as follows. In the following section, I provide some background on the main issues relevant to the experiments, including my theoretical assumptions about presuppositions and a few remarks about existing work on semantic processing. Section 3 presents the three exper-

imental studies that were carried out. Section 4 discusses implications of the experimental results for presupposition theory and some perspectives on future research, and also some implications for semantic processing. Section 5 concludes the paper.

2 Background

One might start out the enterprise of investigating presuppositions in processing by wondering about how we can capture their effects in online sentence comprehension studies at all. After all, they are most commonly thought of as crucially relating to the context, and in the experimental settings typically used in psycholinguistic work, there is no realistic context. So it is at least possible that participants in experiments more or less ignore such context-related information. This would be especially likely if presuppositions are dealt with in very late pragmatic processes that are more like conscious reasoning. If, on the other hand, the processor automatically makes use of presupposed content, we would expect participants to be unable to ignore it. The question then becomes in what ways presuppositions affect the parsing of incoming strings of linguistic expressions, and how quickly their content is accessible to the parser. Furthermore, we would want to know whether presuppositions interact with other factors known to be relevant in parsing, and if so in what ways.

From a theoretical viewpoint, we are, of course, especially interested in what implications experimental results might have for semantic and pragmatic theory. In connection with this it is interesting to note that most of the

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theoretical frameworks for the analysis of presuppositions share a procedural view of some sort which determines how presupposed content is integrated with contextual information (although typically they don't make any explicit claims about actual processing). For concreteness, I will frame the discussion in this paper in terms of Heimian update semantics (Heim 1982, Heim 1983a, Heim 1983b).

In what is often called the Stalnaker-Karttunen-Heim tradition of presupposition theory, presuppositions are assumed to have two crucial properties. First, they are something that is taken for granted by the discourse participants. Secondly, they behave differently from asserted content in most embedded contexts. This is at the heart of the *projection problem* (for an overview, see Beaver 1997, von Fintel 2004). In update semantics, which can be viewed as a formal implementation of the accounts for presuppositional phenomena by Stalnaker and Karttunen (Stalnaker 1973, Stalnaker 1974, Karttunen 1973, Karttunen 1974), being taken for granted is modeled by the *common ground*, which is the set of worlds in which all of the beliefs that the discourse participants knowingly share are true. A sentence can only be felicitously uttered when the presuppositions that come with uttering the sentence are entailed by the common ground. The behavior of presuppositions in embedded contexts is accounted for by the way that the common ground is updated when a new utterance is made in the discourse. Under certain circumstances, presupposition failure can be remedied by a process of accommodation (Lewis 1979), in which the common ground is adjusted in such a way that it does entail the presupposition at issue prior to the update.

Update semantics represents the meanings of sentences as context change

potentials. More concretely, sentence meanings are understood as functions from contexts to contexts (where contexts are modeled either as sets of worlds or sets of pairs of worlds and assignment functions). One of the crucial issues in this type of theory is where or when context updates take place, and this is where the procedural viewpoint becomes relevant: the issue of when the adjustments to the context are made is determined by the procedural steps that the theory assumes. Quite frequently the discussion in the literature focuses on the sentence or clause level as the locus of updates, which seems intuitively plausible. However, in the full version of Heim's system, which includes assignment functions, updates also take place at the level of noun phrases (which are viewed as denoting atomic propositions). Furthermore, in order to account for certain facts concerning the behavior of presuppositions in embedded contexts, Heim (1983a) introduces the notions of local and global accommodation. As I will discuss in some more detail below, the issue of where updates take place is crucial for semantic processing viewed from the perspective of update semantics: if the processor is to make use of compositional semantic information, the way in which it can be used depends on the time at which it has access to it.

I should note that there is an obvious alternative choice of theoretical framework. The results presented here could just as well be framed in another popular semantic theory in which detailed issues of presupposition theory have been explored, Discourse Representation Theory (DRT) (Kamp 1981, Kamp and Reyle 1993, van der Sandt 1992, Geurts 1999) (and possibly in other theories as well). DRT shares most of the features relevant for our purposes here with update semantics. One crucial difference between

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the two concerns the role of semantic representations: DRT explicitly talks about a level of Discourse Representation Structures (DRS's), whereas update semantics is more neutral in that it does not formulate its generalizations in terms of any specific representation, but rather at the level of content.[1] One important project for experimental research on presuppositions is to investigate whether there are processes that can only be understood as taking place at the representational level. A first attempt (though fairly inconclusive) at addressing this is made in experiment 3.[2] In any case, it should be kept in mind in the following that the theoretical characterizations have more or less straightforward equivalents in DRT.

Before turning to the discussion of the experiments, let me briefly review some existing work on presuppositions in processing. Most related work focuses on the presupposition of the definite article and follows the basic approach taken in the seminal study of Crain and Steedman (1985).[3] Looking at locally ambiguous sentences like the one in (1), they show that varying the discourse context (as in (2)) affects the way that the sentence is parsed.

(1)   The psychologist told the wife that he was having trouble with. . .

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[1] This does not rule out the existence of representations, though it doesn't require them.

[2] An anonymous reviewer suggested that a representational theory like DRT is needed to characterize mental processes, which are representational, and that update semantics, which states is generalizations over content (usually understood in terms of possible world semantics), seems less adequate for this purpose. However, it seems clear to me that there are semantic phenomena (other than the ones at issue here) that have to be characterized in terms of content. And, of course, Discourse Representation Structures (DRS's) have to be interpreted in some truth-conditional way as well. I cannot address the much bigger question of how the descriptions of such content relate to psychological reality here, but do believe that we have to model our semantic knowledge in some way at the end of the day.

[3] But recent work is becoming more diverse in terms of the presupposition triggers covered. See, for example, Chambers and Juan (2005) on *again* and for new work on pragmatic processing more generally the volume edited by Noveck and Sperber (2004).

a. . . . her husband.

b. . . . to leave her husband.

(2) a. *Complement Inducing Context*

A psychologist was counseling a married couple. One member of the pair was fighting with him but the other one was nice to him.

b. *Relative Inducing Context*

A psychologist was counseling two married couples. One of the couples was fighting with him but the other one was nice to him.

In (1a) the *that*-clause is interpreted as the complement of *told*, while in (1b), it is a relative clause modifying *wife*. The latter reading is much harder to see due to a typical garden-path effect (especially out of context). The preceding contexts were varied in introducing either one or two couples, the idea being that if two couples are introduced, the definite description consisting of the noun only (*the wife*) cannot refer successfully, while the complex description consisting of the noun and the following *that*-clause analyzed as a relative clause does have a unique referent. The sentences were judged to be ungrammatical about 50 percent of the time in a grammaticality judgment task when the context and the sentence did not match, but they were judged to be grammatical around 75 to 90 percent of the time when the context matched. Crucially, even the garden-path in (1b) was ameliorated by putting it in a matching context. This finding motivated Crain and Steedman to propose a principle of parsimony, which guides the selection between different syntactic parses in their parallel parsing architecture, so that the reading carrying the fewest unsatisfied presuppositions will be the

preferred one. Similar designs are used in more recent work by van Berkum and colleagues (van Berkum, Brown and Hagoort 1999, van Berkum, Brown, Hagoort and Zwitserlood 2003), which shows that there are ERP-effects related to whether the definite description can refer successfully or not. These studies all focus on definite descriptions and show effects of presuppositions in connection with structural parsing issues in particular parsing architectures. The studies presented here aim to broaden the range of triggers being studied and to look at effects of presuppositions in a more direct way. The experimental techniques used here contribute a new type of evidence to presupposition theory, where many hotly debated issues involve subtle intuitions. Furthermore, an attempt is made to integrate the experimental results into the theoretical discussion, in order to contribute to a theory of semantic processing informed by linguistic semantics.

3   Experimental Studies on *auch* and *also*

How should we go about testing the potential effects of presuppositions in sentence processing? One of the standard techniques in psycholinguistics is to compare a normal or unproblematic form to a somehow deviant (or temporarily deviant seeming) form. This basic idea is applied to presuppositions in the studies below in two ways: first, participants were shown ambiguous sentences containing *auch*, where one reading of the sentence satisfied the presupposition introduced by *auch*, whereas the other did not. The task, then, was to choose a paraphrase corresponding to the participants' understanding of the sentence. The second approach was to show unambiguous

sentences with *auch* (experiment 2) and *also* (experiment 3) that varied in whether the presupposition was satisfied or not. These studies employed the self-paced-reading method, and participants simply had to read the sentences region by region. In experiment 2, they also had to answer simple questions about the sentences.

A few remarks are in order with respect to the particular choice of presupposition trigger made here. As mentioned above, the presuppositions introduced by many triggers can easily be accommodated. It certainly is a possibility to be considered that in an experimental setting participants are willing to accommodate just about any content, since the situation they are in is obviously artificial. Just compare this situation to reading an example sentence in a linguistics article. It might very well contain, say, a definite description. As a reader, there certainly is nothing odd about reading such a sentence, even if it is completely unclear and left open whether the relevant presuppositions are satisfied or not. The danger for an experimental inquiry into presuppositions in processing might be that their effects can't be measured at all, at least to the extent to which they can be accommodated without a problem.[4] There are, however, a few presupposition triggers that are well-known to either strongly resist accommodation or to be unaccommodable altogether (cf. Beaver and Zeevat to appear). One case in point is additive particles like *too* and *also*, which associate with the focus of the sentence and, roughly speaking, presupposes that there is another salient entity (or property, or whatever type the focus has) of the same type that has

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[4]A related question of great interest is to what extent accommodation has measurable effects. Although this is just as important, I won't pursue this question here.

the property of the background of the sentence. If there is no such discourse entity, the utterance of the sentence will be infelicitous. This is illustrated by Kripke's famous example in (3a) (from Kripke 1991).

(3)   a.   JOHN$_F$ is having dinner in New York tonight too.

        b.   Did you know that Bill is having dinner in New York tonight?

In an out of the blue context, the sentence in (3a) is very odd, since there is no salient individual about whom it is already known in the discourse that they are having dinner in New York tonight. And even though it is completely uncontroversial that there are many people having dinner in New York every night, this presupposition failure cannot be remedied by accommodation. The utterance of (3a) is only felicitous when there is some individual salient in the discourse that has the relevant property, e.g., in the context of (3b). Even though it is more or less uncontroversial that *too* has this property (see, for example, the discussion in Beaver and Zeevat to appear), it is worth noting recent work by Spenader (2002), who provides solid empirical evidence that the presupposition of *too* is hardly ever accommodated. In a corpus study of the London-Lund corpus, she finds that *too* lacks an antecedent only four percent of the time, whereas many other presupposition triggers (e.g., definite descriptions and factives) lack an antecedent much more often (40 and 80 percent of the time, respectively) and are apparently easily accommodated in such situations. For our concerns, then, *too* (as well as its German counterpart *auch*) lends itself to experimental investigation, as we have more control over whether presupposition failure takes place or not, without having to worry about the possibility of accommodation.

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3.1 Questionnaire Study on *auch*

3.1.1 Methods and Materials

The basic strategy for the experimental items for the first study was to construct bi-clausal, ambiguous sentences consisting of a relative clause and a main clause. One of the readings was preferred based on well-known syntactic parsing preferences. The other reading was the one that satisfied the presupposition of *auch*, which appeared in the second clause. An example is given in (4).

(4) Die Frau,   die   das Mädchen sah, hatte auch der Mann
     The woman$_{N/A}$ who$_{N/A}$ the girl$_{N/A}$ saw had   also the man$_N$
     gesehen.
     seen

     'The woman that (saw the girl/ the girl saw) had also been seen by
     the man.'[5]

The relative clause is syntactically ambiguous due to the ambiguity in the case-marking. In German, there is a strong and extremely well-studied parsing preference for interpreting such clauses as having a subject-initial, i.e., as having subject-object order (Hemforth 1993, Bader and Meng 1999, Schlesewsky, Fanselow, Kliegl and Krems 2000, beim Graben, Saddy, Schlesewsky and Kurths 2000, Schlesewsky and Friederici 2003). In the main clause, the unambiguously nominative marked subject appears in final position and is preceded by *auch*. Assuming that *auch* is understood as being unstressed (a plausible assumption for function words), it associates with an expres-

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[5]N and A stand for nominative and accusative respectively. Here and below, the passive is only used in the English paraphrase to keep the word order similar to the German one. Note that the sentences given here are only used for illustration purposes and were not used in the actual studies. The complete experimental materials are provided in the appendix.

sion that follows it (for a discussion of stressed versus unstressed *auch*, see Krifka 1999), here most naturally the subject (*der Mann*), which yields the presupposition that someone else had seen the woman. This presupposition is not satisfied on the syntactically preferred subject-initial interpretation of the relative clause. However, the syntactically dispreferred object-initial interpretation of the relative clause (that the girl saw the woman) *does* satisfy this presupposition.

The task for the participants then was to choose a paraphrase that best matched their understanding of the sentence. The paraphrases for (4) would have been *The man and the girl saw the woman* and *The woman saw the girl and the man saw the woman*. This choice between paraphrases amounted to a choice between the syntactically preferred interpretation and the interpretation on which the presupposition of *auch* was satisfied. As a control condition, the same sentence was used except that *auch* was replaced by *vorher* (here best translated as *earlier*), which does not introduce any presupposition whose satisfaction depends on the interpretation of the relative clause. Two further conditions followed the same basic idea, but had the order of the clauses reversed, with *auch* appearing in the relative clause. An example is given in (5).

(5) Die Frau   sah das Mädchen, das   auch den Mann gesehen
    The woman$_{N/A}$ saw the girl$_{N/A}$ who$_{N/A}$ also the man$_A$ seen
    hatte.
    had

    'The woman saw the girl that had also seen the man.' or

    'The woman was seen by the girl that had also seen the man.'

In this case, the matrix clause is ambiguous, and the relative clause contains *auch*. Note that this time the noun phrase *den Mann* (*the man*) in the relative clause is unambiguously marked accusative, so that the clause can only mean that the girl saw the man. As above, the ambiguous clause had a syntactic parsing preference for a subject-initial interpretation, whereas the dispreferred object-initial interpretation satisfied the presupposition introduced by *auch* (that the girl saw someone else apart from the man). A control condition was again constructed by replacing *auch* by *vorher*.

Finally, a fifth condition was included, which was identical to the previous one, except that all noun phrases were ambiguously case marked:

(6) Die Frau   sah das Mädchen, das   auch die Lehrerin
     The woman$_{N/A}$ saw the girl$_{N/A}$ who$_{N/A}$ also the teacher$_{N/A}$
     gesehen hatte .
     seen   had

   (i) 'The woman saw the girl that had also seen the teacher.'

   (ii) 'The woman was seen by the girl that had also seen the teacher.'

   (iii) 'The woman saw the girl that had also been seen by the teacher.'

As a result, the sentence was three-way ambiguous.[6] Two of the readings satisfied the presupposition of *auch* (namely (ii) and (iii)), but differed in whether the matrix clause or the relative clause was interpreted as being object-initial. Therefore, the results for this condition provide a further perspective on the differences between the first two pairs of conditions.

The setup resulted in a 2 × 2 design (plus the fifth condition, which was treated separately), with the presence or absence of *auch* as the first factor

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[6]In principle, there even is a fourth reading on which both clauses are interpreted as being object-initial. But since that reading does not satisfy the *auch*-presupposition, it is unlikely that this reading will come to mind.

and clause order as the second factor. For the questionnaire, 30 sentences were constructed with versions for each of the five conditions above. Five versions of the questionnaire were created, varying sentences across conditions, so that each list contained 6 sentences per condition, resulting in a counterbalanced design. The questionnaire was created in HTML and made available online. The sentences were followed by disambiguated paraphrases and participants were asked to choose the paraphrase that matched their initial understanding of the sentence or their preferred interpretation of the sentence if more than one reading was possible. In addition to the experimental items, there were 3 items similar to the experimental ones, but preceded by a short text. Also, there were 20 unrelated filler items. Altogether, 90 native speakers of German completed the questionnaire.

3.1.2 Results

The results were analyzed with the percentage of the type of paraphrase chosen as the dependent variable, where the paraphrases corresponded to either the subject-initial interpretation or the object-initial interpretation. The mean percentage of how often the object-initial paraphrase was chosen is shown in Figure 1 for each condition.

The object-initial interpretation was chosen more frequently in the *auch*-conditions (A and C) than in the corresponding control conditions with *vorher* (B and D). It was also chosen more frequently in general for the relative clause-first order than for the matrix clause-first order. A 2 × 2 ANOVA (*auch* vs. *vorher* and relative-first vs. matrix-first) was performed. There was a main effect of *auch* ($F_1(1, 89) = 112.3$, $p = .001$, $F_2(1, 29) =$

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Figure 1: Percentage of object-initial paraphrases per condition
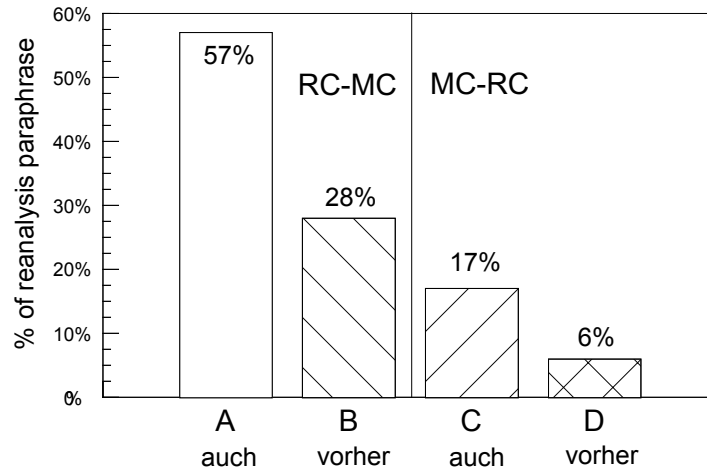
277.2, $p = .001$) and a main effect of clause type ($F_1(1, 89) = 183.3$, $p = .001$, $F_2(1, 29) = 92.1$, $p = .001$). There also was an interaction between the two factors ($F_1(1, 89) = 30.7$, $p = .001$, $F_2(1, 29) = 37.2$, $p = .001$). Two-tailed t-tests were carried out to test for simple effects of *auch* for the two types of clause orders. Both effects were significant (condition A vs. B: $t_1(89) = 10.3$, $p = .001$, $t_2(29) = 13.2$, $p = .001$, condition C vs. D: $t_1(89) = 5.4$, $p = .001$, $t_2(29) = 7.3$, $p = .001$). This shows that the differences between the *auch* and *vorher* conditions are significant for each of the clause orders. In the three-way ambiguous fifth condition, the paraphrase corresponding to the object-initial interpretation of the relative clause was chosen 43 percent of the time and the paraphrase corresponding to the object-initial interpretation of the matrix clause was chosen 8 percent of the time. The syntactically preferred subject-initial interpretation of both clauses was

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chosen 49 percent of the time.

During the initial inspection of the data, the percentage of object-initial interpretations seemed to be higher in the later parts of the questionnaire. To test whether there was a significant increase, post hoc regression analyses with order position as a factor were carried out. Since the two clause orders varied substantially in how often the object-initial paraphrase was chosen, this was done separately for the two *auch* conditions. There was no significant correlation between order position and the percentage of b-readings for the relative clause condition ($r = .065$, $B = .1\%$, $p = .73$). For the matrix clause condition, on the other hand, there was a significant correlation between order position and percentage of b-readings ($r = .544$, $B = .6\%$, $p < .01$). The control conditions without the presupposition patterned with the relative clause presupposition condition and did not display any significant correlation between order position and percentage of b-readings. To test whether there actually was an interaction between the relative clause and matrix clause *auch* conditions with respect to order position, the percentages for the b-readings were converted into z-scores to control for differences in variability found in the two conditions. Regressing the z-scores of the percentage of b-readings on order, sentence type, and order position × sentence type yielded a marginally significant interaction coefficient (B = .054, p = .057). We can thus conclude with fairly high certainty that the relative clause and matrix clause conditions do differ in the way order position affects the percentage of b-readings chosen, which indicates that the two differ in the presence of practice effects.

3.1.3 Discussion

The results from the questionnaire study clearly show that participants'
choice of paraphrase is influenced by the presupposition introduced by *auch*.
When it is present, as in conditions A and C, the otherwise dispreferred
object-initial paraphrase is chosen more frequently than when it is not, pre-
sumably because this order yields the *auch*-presupposition satisfied. This
effect is present and significant for both clause orders, but stronger in the
relative clause-first order. Altogether, the object-initial paraphrase is chosen
more frequently in the relative-first order. This, together with the inter-
action, suggests that the effect of the presupposition interacts with other
parsing factors.

One way of describing the process that readers might go through in read-
ing these sentences is that they first commit themselves to a subject-initial
interpretation of the ambiguous clause and then reanalyze that clause once
they see that this renders the presupposition of *auch* satisfied.[7] While this
reanalysis is fairly unproblematic in the case of the ambiguous relative clause,
it is most likely harder and involves at least one additional confounding fac-
tor in the the matrix clause: interpreting the sentence-initial noun phrase
as the object requires a special interpretation (e.g., as a topic), which is not
supported by anything in the context. Therefore, it is altogether harder and
less likely that participants will end up with the object-initial interpretation
for the matrix-first order, and the effect of the presupposition is smaller in
the condition with this order of clauses. An interesting further result in the

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[7]This description assumes a non-parallel parsing architecture. I briefly discuss the
relevance of the present studies to this issue of parsing architectures in section 4.2

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statistical analysis is that there was a practice effect reflected in a significant correlation between the percentage of object-initial paraphrases chosen for the matrix-first order and the order position of the sentence within the questionnaire. For the relative-first order, there was only a small numerical increase throughout the questionnaire that was not significant. This supports the conclusion made above that it is harder to get the object-initial interpretation in the matrix-first order. Apparently, participants become more likely to choose the object-initial interpretation after having been exposed to a number of these constructions and paraphrases for the matrix-first order, whereas they start out at a fairly high level for the other clause order.

The results from the three-way ambiguous fifth condition are also important in a number of ways. First they support the point made at the end of the last paragraph, since they show that what is behind the object-initial paraphrases being chosen less often in the matrix clause-first condition really is that the matrix clause has to be reanalyzed. In the three-way ambiguous condition, either clause could have been given the object-initial interpretation in order to satisfy the *auch*-presupposition. But again, we find a strong asymmetry between the relative clause and the matrix clause, with 43 % object-initial paraphrases chosen for the relative clause and only 8 % object-initial paraphrases for the matrix clause. This asymmetry shows that the differences between the matrix-first and the relative clause-first conditions are not due to parallelism, as one might be tempted to hypothesize, since the object-initial interpretation of the relative-first conditions results in both clauses having the same order, whereas the matrix-first conditions have non-parallel orders on that interpretation. Furthermore, the asymmetry helps

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to fend off another alternative hypothesis, namely, that the higher percentage in object-initial interpretations for the relative-first order is due to the obligatory object-initial interpretation of the matrix clause. But since the object-initial paraphrase of the relative clause was chosen so frequently in the three-way ambiguous condition, where no such obligatory object-initial interpretation was present, this explanation does not seem promising.

In sum, then, we have found that both the presupposition of *auch* and the type of clause that is ambiguous have a great impact on the choice of paraphrase. The interaction seen between the effect of the presupposition and other parsing factors related to the differences between relative clauses and matrix clauses can be taken as a first indication that issues of presupposition satisfaction are present in online processing, although we need to be cautious in drawing any firm conclusions in this regard from an off-line questionnaire study. The experiment reported in the next section attempts to address this issue in a more direct way.

3.2   Self-Paced-Reading Study on *auch*

3.2.1   Methods and Materials

The second experiment used the self-paced-reading method to investigate the effect of presuppositions on the time people spend reading the relevant parts of the experimental sentences. For this study, the basic strategy was to present morpho-syntactically unambiguous versions of the materials in the first experiment, which varied in whether the presupposition of *auch* was satisfied or not. To disambiguate the sentences, masculine, rather than

feminine or neuter noun phrases were used in the critical positions, so that the case marking on the definite article was unambiguously nominative (*der*) or accusative (*den*). Since the effect in the questionnaire was larger for the relative-first order, sentences using this order were used for the online study. An example illustrating the setup of the experimental items is given in (7).[8]

(7)   a.   Die Frau,/   die   der Junge sah,/ hatte auch der Mann
           The woman$_{N/A}$ who$_{N/A}$ the boy$_N$ saw   had   also   the man$_N$
           gesehen.
           seen

           'The woman that the boy saw had also been seen by the man.'

   b.   Die Frau,/   die   den Jungen sah,/ hatte auch der Mann
           The woman$_{N/A}$ who$_{N/A}$ the boy$_A$ saw   had   also   the man$_N$
           gesehen.
           seen

           'The woman that saw the boy had also been seen by the man.'

In the sentence in (7a), the noun phrase in the relative clause (*der Junge, the boy*) is unambiguously marked nominative, which results in the clause being object-initial and meaning that the boy saw the woman. The main clause contains *auch*, which (again assuming that it associates with *der Mann* (*the man*)) introduces the presupposition that someone else saw the woman. Given the meaning of the relative clause, this presupposition is satisfied. In (7b), on the other hand, the noun phrase *den Jungen* (*the boy*) is unambiguously marked accusative, so that the relative clause is subject-initial and can only be understood as the woman seeing the boy. The presupposition of the main clause is as in (7a), and is therefore not satisfied by the relative clause.

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[8]As before, this example is only used for illustrative purposes. See the appendix for the actual materials used in the experiment. The character '/' indicates the frame breaks between the parts of the sentence that were displayed at one time in the moving-windows display (this is described in more detail below).

If we found any reading time effects related to whether or not the presupposition is satisfied (and which didn't show up in the controls), this would tell us that information about presupposition satisfaction has to be available to the processor at that time, and hence that any semantic processes necessary to determine presupposition satisfaction must have already taken place.

As in experiment 1, control conditions were constructed by replacing *auch* with *vorher*. As before, this resulted in a 2×2 design, with the presence or absence of *auch* as the first factor and subject-initial vs. object-initial structures as the second factor. The experiment included 24 sentences with versions in each of the four conditions. The sentences were counter-balanced across conditions in four lists. Participants only saw each sentence in one condition. The experiment was programmed using E-Prime software. The presentation order of the items was randomized. Sentences were presented using the moving-window technique. On the first screen, all characters were replaced by underscores. Participants had to press the space bar to see the first part of the sentence. When they pressed the space bar again, the first part was replaced by underscores, and the next part of the sentence was displayed. Reading times were recorded for each displayed phrase.

After each sentence, a yes-no question about that sentence was presented, and participants had to push 's' to answer 'yes' and 'k' to answer 'no'. Half of the questions asked about the relation in the relative clause ('Did the boy see the woman?'[9]) and the other half about the relation in the matrix clause ('Did the man see the boy?'). Overall, half of the questions had 'yes' as a correct answer and half of them 'no'. For the relative clause questions, the

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[9]For the actual questions, see the materials in the appendix.

correct answer varied across conditions, since the relation depended on the experimental manipulation of subject vs. object relative clauses. Both the responses and the response times were recorded.

Apart from the experimental items, there were 72 items from unrelated experiments and 12 from a related experiment. Furthermore, there were 12 filler items. Subjects were instructed that they were going to read sentences on the screen and that they had to answer short questions about them, which did not necessarily have right or wrong answers. They also were told to answer questions with 'yes' only if this followed directly from the sentence in question and that they had to press the 's' key for 'yes' and the 'k' key for 'no'. On average it took about 30 minutes to complete the experiment. 20 native speakers of German participated in the experiment.

3.2.2   Results

The measure of most interest was the reading times on the clause containing *auch* (or *vorher*). Their means are shown for each condition in Figure 2.

When *auch* was present, the reading time in the object-initial condition A (where the presupposition of *auch* was satisfied) was almost two seconds faster than in the subject-initial condition C (where the presupposition was not satisfied). When *auch* was replaced by *vorher*, the subject-initial condition (D) had a small advantage over the object-initial condition (B). Interestingly, the *auch*-phrase was read almost 1.5 seconds faster than the *vorher* phrase in the object-initial condition (A vs. B), but roughly one second slower in the subject-initial condition (C vs. D).

A 2×2 ANOVA revealed an interaction between the two factors ($F_1(1, 19) =$

Figure 2: Reading time on final clause in ms
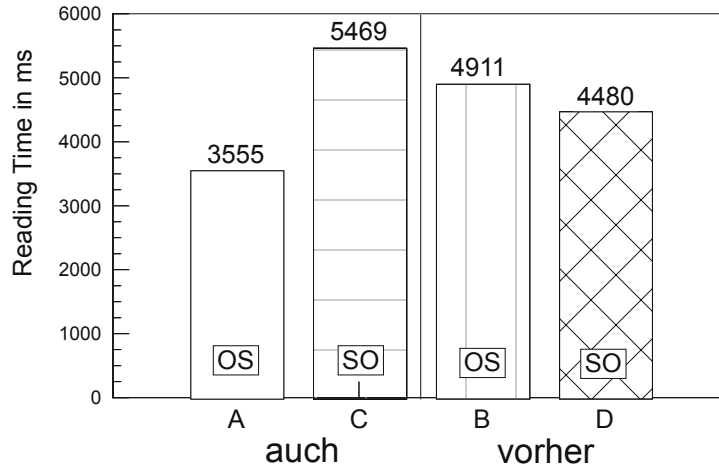
26.00, $p < .001$, $F_2(1, 23) = 17.81$, $p < .001$). In addition, there was a main effect of order (subject-initial vs. object-initial) ($F_1(1, 19) = 11.58$, $p < .01$, $F_2(1, 23) = 7.88$, $p = .01$), which was dominated by the interaction. A number of t-tests were also carried out to test for simple effects of *auch* vs. *vorher* and object-initial vs. subject-initial relative clauses separately. The difference between conditions A and C was significant ($t_1(19) = -6.49$, $p < .001$, $t_2(23) = -4.58$, $p < .001$), which shows that there was a simple effect of subject-initial vs. object-initial structures in the *auch*-conditions. There also was a significant difference between A and B ($t_1(19) = -4.72$, $p < .001$, $t_2(23) = -5.03$, $p < .001$), i.e., a simple effect of *auch* in the object-initial conditions. The difference between C and D was significant by subject and near significant by items ($t_1(19) = 3.07$, $p < .01$, $t_2(23) = 1.96$, $p = .06$), but the difference between B and D was not significant

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$(t_1(19) = -1.28,\ p = .22,\ t_2(23) = 1.25,\ p = .23)$. In terms of the statistical analysis, then, the main results are the interaction between the two factors and the simple effect of the order of subject and object in the relative clause. The simple effect of *auch* in the object-initial conditions is of interest as well, but its interpretation is less clear as it could in principle be due to a lexical effect involving *auch* and *vorher*.[10]

Taken together, these results show that the reading times in the *auch* conditions were strongly influenced by subject-initial vs. object-initial order (corresponding to whether the presupposition of *auch* is satisfied or not), while the reading times in the *vorher* conditions were only slightly influenced by this factor, and in the opposite direction.

The data for the relative clause region were analyzed as well to provide a comparison with the effects in the *auch* region. The reading times by condition were as follows:[11] condition A: 3615ms, condition B: 3776ms, condition C: 3648ms, condition D: 3429ms. A 2×2 ANOVA did not find any significant effects.

As additional measures, the response times and the accuracy rates for the yes-no questions following the display of the sentence were also analyzed. In the response times, there was a main effect of order, with the

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[10]In light of the fairly low accuracy rates, an anonymous reviewer suggested to also analyze the data by only looking at data points from sentences to which the subjects had responded correctly. The overall pattern of the data looked very similar: condition A: 3582ms, B: 4916ms, C: 5079ms, D: 4648ms. The interaction was significant ($F_1(1, 19) = 9.85,\ p < .01,\ F_2(1, 23) = 10.80,\ p < .01$). The main effect of order was only marginally significant by subjects, but significant by items ($F_1(1, 19) = 3.73,\ p = .07,\ F_2(1, 23) = 6.24,\ p < .05$). The simple effect comparing conditions A and C was still present, ($t_1(19) = -3.34,\ p < .01,\ t_2(23) = -3.90,\ p = .001$), as was the simple effect comparing A and B ($t_1(19) = -3.78,\ p = .001,\ t_2(23) = -4.59,\ p < .001$).

[11]After removal of eight outliers that were over three standard deviations from the mean of each condition (RT's over 10s).

object-initial conditions having roughly an advantage of one second over the subject-initial conditions (object-initial: 3885ms, subject-initial: 4960ms, $F_1(1, 19) = 16.4$, $p = .001$, $F_2(1, 23) = 16.41$, $p < .001$).[12] There was no significant interaction and no other significant main effect. Response times were faster when the correct response was 'yes' (3955 ms) than when it was 'no' (4996 ms) $(t_1(19) = 2.54$, $p < .05)$[13] and correct answers (4134 ms) were faster than incorrect answers (5878 ms) $(t_1(1, 19) = 4.08$, $p = .001$, $t_2(1, 23) = 3.80$, $p = .001)$.

The overall mean accuracy rate was 81.25%.[14] There was a main effect of order $(F_1(1, 19) = 7.69$, $p < .05$, $F_2(1, 23) = 5.11$, $p < .05)$, with means of 86.25% for the object-relative clause conditions and 76.17% for the subject-initial ones. There was no significant interaction and no other significant main effect. Accuracy in the object-relative clause condition with *auch* (85%) was higher than in the subject-initial one (73%) $(t_1(19) = 2.67$, $p < .05$, $t_2(23) = 1.94$, $p = .07)$, which indicates a simple effect of presupposition satisfiction, with higher accuracy rates when the presupposition was satisfied. There was a numerical difference between questions that asked about the relative clause (78%) and those that asked about the matrix clause (85%), which could simply be due to recency of the phrase asked about. Accuracy was the lowest when both of these last two factors

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[12]The effect of order on response times was also significant when including only the data for correct responses (object-initial: 3633 ms, subject-initial: 4754 ms; $F_1(1, 19) = 18.45$, $p < .001$, $F_2(1, 23) = 12.81$, $p < .01$).

[13]Analyses involving this factor as well as the question type factor below were only done by subjects, since the levels of these factors were not varied systematically within items.

[14]The numbers and results for the accuracy rates reported here differ from those previously reported in (Schwarz 2006), because a small error was discovered during a re-examination of the data.

were considered in combination, namely in the subject-relative clause condition with *auch* when the question was about the relative clause (67%). It was highest, on the other hand, in the object-relative clause conditions when the question was about the matrix clause (91.5%), in which case the presupposition is satisfied and the question is about the most recently seen part of the sentence. Looking at order, *auch*, and question-type together in a 3-way ANOVA, there was a marginally significant 3-way interaction ($F(1, 19) = 4.04$, $p = .06$). This suggests that some of the questions were particularly hard in certain conditions and that the relatively low overall accuracy rates were predominantly due to these combinations of questions and conditions. Whether the correct response was 'yes' or 'no' did not alter accuracy rates significantly ('yes': 82%, 'no': 80%). In summary, the question response times and accuracy rates did not display the *auch* × order interaction, but were predominantly affected by order. This might well be due to the fact that it was easier to keep the relations in the relative clause and the matrix clause straight when they were parallel (The woman was seen by the boy and the man) than when they were not (The boy was seen by the woman and the woman was seen by the man). In terms of simple effects, both recency of the phrase asked about and the satisfaction of the *auch*-presupposition affected accuracy.

3.2.3 Discussion

The results from the self-paced-reading study clearly show that the reading time on the final clause containing *auch* was substantially affected by whether the presupposition of *auch* was satisfied or not. This is not merely

an effect of parallel order in the two clauses, as the effect was reversed in the *vorher* conditions, in which no relevant presupposition interfered. Interestingly, this effect was not reflected in the accuracy rates or the question response times, which only exhibited main effects but no interaction of *auch* and order. Nonetheless, a simple effect effect of presupposition satisfaction showed up in the accuracy rates.

The effect of the presupposition is rather large, at almost two seconds difference between conditions A and C. It is very likely that this is due to the relatively demanding task, especially in certain conditions, of answering the yes-no questions that followed the display of the sentence. Almost all subjects reported that it was often quite difficult to keep in mind who did what to whom amongst the three people talked about in each sentence. When the presupposition did not match the content of the relative clause, it must have been even harder to keep this information straight, and this may have caused rather substantial delays when reading the final part of the sentence. The simple effect of presupposition-satisfaction on the accuracy rates supports this as well. In connection with this, one particularly telling comment made by a participant after the experiment was that she thought there were some spelling mistakes in the sentences, especially with respect to the case marking on noun phrases (e.g., *der Mann* rather than *den Mann*). Apparently, the expectation raised by the presupposition of *auch* was so strong that the mismatch was perceived as a mistake. One thing that is remarkable about this is that when sentences like those in the unsatisfied *auch*-condition are seen out of context and without the question, they don't stand out much at all (the reader can make their own judgment about the corresponding English

examples in experiment 3). It thus seems like the presence and nature of the questions contributed substantially to the slow reading times and large effect sizes.

The strong effect on the reading time suggests that the presupposed content is evaluated online, which lends further support to the speculative conclusion above that the results from the questionnaire study are based on online effects of presuppositions. This finding is consistent with previous studies on the presuppositions of definite descriptions that were mentioned above (e.g., Crain and Steedman 1985, van Berkum et al. 2003). An additional point of interest here is that the reading times for the clause containing *auch*, preceded by the relative clause that satisfied the *auch*-presupposition (A), were faster than the reading times for the same clause with *vorher* preceded by the same relative clause (B). However, it is possible that this is simply a lexical effect of *auch* compared to *vorher*. If this difference turned out to be real, it could be taken to tell us something interesting about the role of presupposed content in natural language. The advantage of the *auch* condition might be that the presupposed content facilitates the integration of new content into the contextual representation by connecting new and old information. Since this effect was not replicated in experiment 3 discussed below, we should be careful not to over-interpret the effect at this point.

While the results in general reinforce the conclusion that there are online effects of presuppositions, a number of questions remain open that might undermine the interpretation of these results to some extent. First, the critical region was the final region, which makes it impossible to distinguish between online effects during the actual reading and potential sentence final

wrap-up effects. Secondly, the rather slow reading times and the large effect size, together with the rather low accuracy rates in some conditions, give rise to the possibility that the effects found are due to the task demands of answering the questions. Another worry in this direction is that the well-documented subject relative clause advantage did not show up significantly in the relative clause reading times.[15] Finally, the possibility of the *auch* vs. *vorher* advantage being a lexical effect keeps us from drawing any strong conclusions in this respect.

3.3   Self-Paced-Reading Study on *also*

3.3.1   Methods and Materials

In order to address the issues with the German self-paced-reading study raised above, a follow-up study was undertaken in English. The additive particle chosen for this study was *also*, rather than *too*, in order to allow for a similar paradigm where other adverbials could replace *also* in the control conditions. The main new features introduced in this study were that the critical region was non-final, that no questions were asked (although there were filler items and items from other studies for which questions had to be answered), and that a range of different adverbs was used for the control conditions (e.g., *just, once, almost, recently, now*). An example from the materials[16] is provided below.

(8)   a. The congressman/ who **wrote to John**/ had **also** written to the

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[15]Part of the reason for this may be that a large number of object-initial structures was presented throughout the various experiments included in the self-paced-reading study.

[16]See the appendix for the full set of materials.

mayor/ to schedule a meeting/ for the fundraiser.

b. The congressman/ who **wrote to John**/ had **just** written to the mayor/ to schedule a meeting/ for the fundraiser.

c. The congressman/ who **John wrote to**/ had **also** written to the mayor/ to schedule a meeting/ for the fundraiser.

d. The congressman/ who **John wrote to**/ had **just** written to the mayor/ to schedule a meeting/ for the fundraiser.

In the English setup, unlike in the German setup, the matrix clause is subject-initial, which means that it is now the subject-initial relative clause (a) that satisfies the presupposition of *also*.

One additional manipulation was introduced in this experiment: whereas half of the items had the same verb in the relative clause and in the matrix clause, the other half had two different verbs in the two clauses. These two verbs were more or less synonymous and were all chosen in such a way that the verb in the relative clause implied the verb in the matrix clause (at least in the specific usage in the sentence). An example is given in (9).

(9) a. The lawyer/ who contacted Allison/ will also get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

b. The lawyer/ who contacted Allison/ will later get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

c. The lawyer/ who Allison contacted/ will also get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

d. The lawyer/ who Allison contacted/ will later get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

Apart from making the materials more diverse and more natural, this served as a first attempt to shed light on an important question about the level of semantic representation at which the processes studied here take place. In particular, the contrast between Discourse Representation theory and theories such as update semantics, which don't explicitly talk about any additional levels of representation, introduces the question whether we find any effects supporting the existence of the level of discourse representation in the former. Varying whether or not the verb is the same in the two clauses gets at this question, because when the verbs are the same, the satisfaction of the *also*-presupposition can be read off the representation without accessing any truth-conditional or model-theoretic interpretation. In the case of lexically distinct verbs that are very close in meaning, on the other hand, the satisfaction of the *also*-presupposition can only be determined after considering the truth-conditional interpretation of the sentence.

Taking the perspective of DRT, and assuming that presupposition resolution takes place (or at least can take place) at the level of discourse representation, it seems plausible that the effect of the *also*-presupposition would be stronger in the same-verb condition than in the different-verb condition. This is because only in the former it is possible to resolve the presupposition at the purely representational level, which presumably precedes the level of truth-conditional interpretation in processing.[17] If we found a 3-way interaction between the presence of *also*, order in the relative clause, and verb-sameness, this would be straightforward evidence for discourse representations playing

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[17]If one assumed that processes of presupposition resolution *only* operate on uninterpreted DRS's, the prediction would be even stronger, namely that the effect should only appear in the same verb condition.

Table 1: Reading times on *also* region

condition	A	B	C	D
RT's in ms	1601	1633	1821	1692

a role in online processing.

The procedures for this experiment were the same as in experiment 2, except that no questions were asked after the experimental items. The study included 60 items from 3 unrelated experiments as well as 40 filler items. Most of these other items were followed by a question. 48 undergraduates from the University of Massachusetts Amherst participated in the experiment.

3.3.2 Results

As in experiment 2, the main interest was in the reading times on the region containing *also*. The means are shown by condition in Table 1.[18]

A 2×2 ANOVA was performed on the data. There was a significant interaction ($F_1(1, 47) = 4.55$, $p < .05$, $F_2(1, 23) = 5.57$, $p < .05$) and a main effect of order ($F_1(1, 47) = 15.61$, $p < .001$, $F_2(1, 23) = 12.19$, $p < .05$). Finally, there was a main effect of *also* that was significant by items ($F_1(1, 47) = 2.33$, $p = .134$, $F_2(1, 23) = 4.92$, $p < .05$). Turning to simple effects, the subject-relative clause condition with *also* was faster than the object-initial one ($t_1(47) = 4.16$, $p < .001$, $t_2(23) = 3.97$, $p = .001$). The only other significant simple effect was comparing the object-relative clause

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[18]Outliers that were over 3 standard deviations from the mean of their condition were excluded from the analyses. This removed 2.2% of the data points.

condition with *also* to the one with another adverb ($t_1(47) = 2.31$, $p <$ .05, $t_2(23) = 3.39$, $p < .05$). In summary, we find the same interaction as in experiment 2, as well as main effects that are dominated by the interaction.

The reading times for the same and different verb conditions are presented in Table 2. In numerical terms, the interaction seems to be present in both conditions, with the advantage of condition A over C being bigger than the advantage of B over D. Including the factor of verb-sameness in the analysis by running a 3-way ANOVA (order $\times$ *also* $\times$ verb) did not yield a significant interaction ($F_1(1, 46) = .34$, $p = .56$, $F_2(1, 22) = .37$, $p = .55$). Reading times were slightly higher in the different verb conditions, which was reflected in a main effect of verb-sameness that was significant by items and marginally significant by subjects ($F_1(1, 46) = 3.44$, $p = .07$, $F_2(1, 22) = 4.47$, $p <$ .05). The main effect of order and the order $\times$ *also* interaction were also significant. There were no other significant effects.

In terms of the hypothesized stronger effect in the same verb condition, the numerical results go in the opposite direction of what we would expect if the representations would facilitate the process of checking whether the presupposition is satisfied. While the difference between the two *also* conditions is slightly bigger in the same verb conditions than in the different verb conditions (227 vs. 196 ms), the difference in the corresponding control conditions patterns the other way (128 vs. 64 ms), so that the advantage of the satisfied *also* presupposition is actually bigger in the different verb condition when viewed relative to the control conditions.

Turning to the relative clause region, the subject relative clauses (1382 ms) were read significantly faster than the object relative clauses (1667

Table 2: Reading times on *also* region

condition	A	B	C	D
same verb: RT's in ms	1540	1554	1767	1682
different verb: RT's in ms	1635	1674	1829	1693

Table 3: Reading times on region after the *also* region

condition	A	B	C	D
RT's in ms	890	904	969	931

ms), which was reflected in a main effect of order ($F_1(1, 47) = 15.97$, $p < .001$, $F_2(1, 23) = 19.18$, $p < .001$). No other effects were significant. This effect illustrates the well-known advantage of subject relative clauses over object relative clauses.

Finally, since there were two additional regions following the *also* region, we should also look at the reading times for the region immediately following the one with *also*. The mean reading times are shown in Table 3.[19] A 2 × 2 ANOVA did not find a significant interaction. There was a main effect of order ($F_1(1, 47) = 3.76$, $p = .06$, $F_2(1, 23) = 5.58$, $p < .05$). The only significant simple effect was between the subject-initial and the object-initial *also* conditions ($t_1(47) = 2.12$, $p < .05$, $t_2(23) = 2.08$, $p < .05$). Thus, although there seems to be some spill-over from the *also* region yielding this simple effect, the bulk of the effect we are looking at is confined to the region containing *also*.

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[19]Again, outliers over 3 standard deviations from the condition means were excluded from the analyses.

3.3.3 Discussion

Experiment 3 avoided some of the shortcomings of experiment 2, discussed above. Although no specific task other than reading the sentences was performed, we found the same interaction effect as before. The reading times in experiment 3 were much shorter than in experiment 2, and the effect between the subject relative clause and the object relative clause *also* conditions is on the order of 200 ms. This is about the same size as the subject relative clause advantage found in the relative clause region, which was around 250 ms. Furthermore, the effect in its full form showed up only on the region containing the *also*, with minimal spill-over to the following region. This excludes the possibility that we are only dealing with sentence-final wrap-up processes. Finally, the difference between the subject relative clause *also* and adverb conditions (corresponding to the object-relative clause conditions with *auch* and *vorher*) was not replicated in experiment 3, which suggests that in experiment 2 this difference reflected a lexical effect or that it was task specific in that it was helpful in answering the questions asked after each sentence.

With respect to the newly introduced factor in experiment 3, which varied between having identical and different verbs in the relative and matrix clauses, no relevant interaction effect of verb sameness could be determined. Assuming that DRS's are utilized by the processor in the process of presupposition resolution, we would expect that the possibility of the processor checking the presupposition in the uninterpreted DRS would lead to a stronger effect in the same verb conditions. Not only did we not find a signifi-

cant interaction, but numerically the reading times patterned in the opposite way, with a larger advantage of the satisfied *also* condition in the different verb conditions (relative to the control conditions). That said, we still are dealing with a null effect that can't be interpreted in any strong way. In particular, these results do not constitute any evidence against the role of representations, but merely fail to provide evidence for it. Thus, we can only note that we were unable to find the effect expected based on the sketched role of representations in DRT presupposition resolution.

A number of theoretical issues arise in connection with the results of the experimental studies reported here, which in turn have the promise of providing new approaches for empirical research on presuppositions. I turn to these points in the next section.

4 Theoretical Implications

Ideally, results from psycholinguistic studies can contribute to theory in two directions, which correspond to the following two questions: What do the results tell us about (the relevant part of) linguistic theory, and what can we learn from them with respect to processing theories? I will focus on the implications for semantic theory, which I turn to in the next subsection. A few brief remarks about related processing issues are made in the final part of this section.

4.1 Implications for Semantic Theory

Let us briefly consider the general question of how we can draw theoretical conclusions from experimental results such as the present ones. I take it to be the null-hypothesis that the processor makes use of the grammar when parsing linguistic input. It may have additional principles that help to rule out many of the grammatical analyses of the structure that might in principle be possible, but it certainly should make use of the grammatical system to exclude ungrammatical analyses. If we can conclude from experimental results that the processor has access to certain information for a given structure, then we can conclude that the grammatical system must function in a way that allows it to provide this information to the parser at that point and on the basis of the information available at the time. This is the general form of the line of argument taken below. To anticipate, I will argue that the processor evaluates the *auch*-clauses from the self-paced-reading materials with respect to the preceding noun phrase (including the relative clause), which means that the semantic component of the grammar must have already integrated the content of that noun phrase into the context when it encounters the *auch*-clause.

Now we are ready to take a closer look at the example sentences in order to understand what is going on in the processing study in slightly more refined semantic terms. I will focus on the English examples from experiment 3 for ease of exposition, but the same points of course apply to the German studies. The example sentence for condition A, where the presupposition of *also* is satisfied by the relative clause, is repeated in (10).

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(10)   a. The congressman/ who wrote to John/ had also written to the mayor/…

      b. Presupposition of *also* in general (Heim 1992)[20]

Φ *also*$_i$ $[\alpha]_F$ presupposes $x_i \neq \alpha$ & $\Phi(x_i)$

      c. Presupposition of *also* in (a) (with focus on *the mayor*)

$\lambda x.\ write(congressman, x)$ *also* $[the\ mayor]_F$ presupposes

$x_i \neq the\ mayor$ & $write(congressman, x_i)$

As the results from the self-paced-reading studies show (and as is also intuitively clear), the relative clause satisfies the presupposition characterized in (10c). As far as the processing perspective is concerned, the process of determining this seems to take place online, since the effect shows up in the reading time on the clause that contains the presupposition trigger. This suggests that as one is reading the part of the sentence containing *auch*, one is aware of the content of the relative clause (of course, that also matches our intuitive sense of what happens when we read). When we look at processing in terms of update semantics, this is rather interesting: to evaluate the presupposition of *also* is to check whether the context entails it (and in the case of *also*, it also involves something like checking whether there is an appropriate discourse entity having the relevant property). Since the sentence is not at all problematic in any way (neither intuitively nor in terms of the reading time results), it seems to be the case that the content of the relative clause is already part of the context by the time the part of the sentence containing

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[20]This formulation of the presupposition of *also* and *too* (as well as *auch*) is not without its problems, either, of course. For a more recent proposal within DRT, see van der Sandt and Geurts (2001)

also is semantically processed. In other words, it looks as if the context has been updated with the sentence-initial noun phrase, including the relative clause, by the time the next part of the matrix clause is interpreted and integrated into the context.

As discussed above, it is plausible to assume that the processor makes use of the grammatical system, which allows us to draw conclusions about the latter based on findings about the former. If we think of context updates as only taking place at the level of a sentence or a full clause, we cannot explain how the initial noun phrase can satisfy the presupposition: If we tried to apply the context change potential of the entire sentence to the neutral context, the update would fail, since the presupposition of *auch* is not satisfied in the initial context (and no repair would work, since the presupposition of *auch* cannot be accommodated). However, as I already mentioned in section 2, in the full version of update semantics of Heim (1983b), contexts consist of sets of pairs of worlds and assignment functions, and noun phrases denote atomic propositions (and hence have complete context change potentials of their own). The meaning of definite and indefinite noun phrases is as in (11), with the difference between definite and indefinite ones being captured with the Novelty Condition in (11b)[21].

(11)   a. Let c be a context (here a set of assignment functions)

and let p be an atomic formula, then, if defined :

$c + p = \{g : DOM(g) = \bigcup Dom(f) \ s.t. \ f \in c \cup \{i : x_i \text{ occurs in } p\}$

$\& \ g$ is an extension of one of the functions in $c \ \& \ g$ verifies $p\}$

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[21]For simplicity, I restrict the formal representation of contexts to sets of assignment functions

b. The Novelty/Familiarity Condition

$c + p$ is only defined if for every NP_i that p contains,

if NP_i is definite, then $x_i \in Dom(c)$, and

if NP_i is indefinite, then $x_i \notin Dom(c)$.

With denotations such as these, the progression of updates for the sentences of condition A can proceed without a problem. First, the initial noun phrase is interpreted and its presupposition is evaluated with respect to the input context. It is not satisfied, but it can be accommodated without a problem. Next, the rest of the matrix clause is interpreted, and the presupposition of *auch* is evaluated with respect to the local context. In this context it is satisfied, and the update can proceed smoothly. These steps are sketched in semi-formal terms in (12).

(12) $p :$ The congressman x that wrote to John

   $q : x$ also wrote to the mayor

   a. $c + p$ defined only if

   there is a unique congressman that wrote to John

   b. after accommodation :

   $c + p = \{g : g$ verifies $congressman(x)$ & $write(x)(john)\} = c'$

   c. $c' + q$ defined only if there is a $z \neq$ *the mayor in c' &* $write(x)(z)$

   defined, since the congressman wrote to John, hence

   $c' + q = \{g : g$ verifies $congressman(x)$ & $write(x)(john)$ &

   $mayor(z)$ & $write(x)(z)\}$

This contrasts with condition C, where the order in the relative clause has been switched around, so that even after the initial noun phrase has become

part of the context by the time the rest of the matrix clause is interpreted, the presupposition of *also* is not satisfied, and there is no chance to accommodate it, since the presupposition of *also* resists accommodation. The contrast in presupposition satisfaction between conditions A and C is the only relevant difference that isn't also present in the control contrast between B and D. We can thus conclude that the reading time effects we have found between A and C (but not between B and D) are due to this difference in presupposition satisfaction. This, in turn, requires that the semantic analyses necessary for recognizing this contrast have been carried out by the time the *also*-phrase is being read and interpreted. More specifically, the initial noun phrase, including its relative clause, must have been syntactically parsed and compositionally interpreted - the relation in the relative clause must have been fully understood by the time the presupposition of *also* is evaluated. In addition to these purely semantic steps of analysis, the noun phrase as a whole, being definite, needs to be accommodated prior to the evaluation of the *also* presupposition.

The results from these studies thus provide insight into the timing of compositional semantic processing, including the evaluation and accommodation of presupposed content. It is worth comparing this aspect of the present studies with previous work on definite descriptions and their presuppositions. Recall the Crain and Steedman type of experimental design discussed in section 2. The effect found there concerned the evaluation of a definite description with respect to a context, consisting of the preceding sentence, where the uniqueness presupposition of the definite article was or was not satisfied. While this allows conclusions about the timing of the eval-

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uation of the uniqueness presupposition, it does not reveal anything about the sentence-internal dynamics of interpretation. The studies presented here therefore present a further step towards bringing together our understanding of semantic interpretation in theory and processing.

The more general picture that is evolving from this discussion is that in processing, the context is updated as soon as possible. Since noun phrases have context change potentials of their own, the processor can update the context as soon as it has been given a noun phrase. Further support for updates at this level comes from examples such as the following, where the presupposition of *too* is satisfied by a noun phrase which doesn't have any phrasal sub-part as in the relative clause cases considered above.[22]

(13)   a. My teacher works as a DJ too.

        b. Critics of science use it, too.

Apparently, the noun *teacher* suffices to satisfy the presupposition that the relevant individual works as something else than a DJ. And the (admittedly slightly playful) example in (13b) can be understood with focus on *critics*, which introduces the presupposition that other people use science. The occurrence of *science* seems to make it salient enough that there are scientists who do science, so that the presupposition is satisfied. In addition to the level of the noun phrase, updates can, of course, also occur at the level of the full clause (or any propositional level, for that matter).[23]

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[22]The example in (13b) was a headline in the Valley Advocate on December 1st, 2005. Kai von Fintel (p.c.) suggests that this is to be understood with focus on *use*, with *critics* as the antecedent for *too*. While agreeing that that is a possible reading, I and several other people I have consulted find the reading discussed in the text at least as plausible.

[23]Quick updates that take place whenever a propositional unit has been parsed might be

As an anonymous reviewer pointed out, there is, in principle, another perspective one could take on the experimental results presented here. Rather than concluding that the grammar itself must function incrementally, one could suppose that it is at the level of the processor that incremental interpretation takes place.[24] As far as I can tell, this requires giving up on the assumption that I have made above: that the processor should make use of the grammar in carrying out functions that we would attribute to the grammar from a theoretical perspective. Giving up on this would force us to come up with processing mechanisms that more or less mirror the grammar, but are in some sense independent from it. Consider what all would need to be accomplished here: the relative clause on the initial noun phrase in the experimental materials has to be compositionally interpreted and the content of the noun phrase as a whole needs to be computed in some way in order to be able to determine the satisfaction of the *also* presupposition. Note that as far as we can tell from the different verb condition in experiment 3, it is necessary to access interpretations to do this, not just representational structures such as DRS's. It is more parsimonious, then, to assume that the parser makes use of the grammar (whether or not the grammar includes the specific structures posited by DRT). I thus conclude that the results of the experiments presented here contribute a new kind of evidence to the theoretical

part of the explanation for the surprising findings in Christianson, Hollingworth, Halliwell and Ferreira (2001), where subjects are reported to answer 'yes' 60 percent of the time to the question 'Did Anna dress the baby' after reading the sentence 'While Anna dressed the baby baby spit up on the bed.' This finding suggests that even though subjects revise their syntactic analysis of the garden-path structure, they hold on to the incorrect interpretation (that Anna dressed the baby) corresponding to the initial syntactic analysis of the first part of the sentence.

[24]A similar line of argument has also been pursued by Geurts (1999: Chapter 4).

discussion. They show that the processor goes about interpreting a sentence in steps very much like those assumed by dynamic semantic theories. If we continue to assume that the processor does this by using the system supplied by the grammar, working out the details of a theory of semantic processing based on something like update semantics will make further experimentally testable predictions, which can help us to broaden the empirical foundation of semantic analyses of presuppositions.

In addition to these considerations about the online studies, we should also note the relevance of the findings of the questionnaire study in this respect. Assuming a model of the syntactic parser that only pursues one structural analysis at the time, and given that there is independent evidence supporting a syntactic parsing preference for subject-initial clauses, we find a remarkable amount of effort put into reanalysis of the first clause in the questionnaire items. If that clause has initially been parsed as subject-initial, it must be revised in order to satisfy the presupposition. The fact that this revision is even considered indicates that the meaning of the first clause is accessible to the parser at the time it evaluates the presupposition. With respect to this point, there might be an advantage to having access to representations such as DRS's. When the parser considers the revision of the analysis of the relative clause, it must somehow see that the reversal of the syntactic roles of the subject and the object yields an interpretation that will just be of the right kind to satisfy the presupposition of *too*. This is easily imaginable if the parser has access to representations such as $see(x, y)$, but possibly problematic if all the parser can see is syntactic structure and (simple, i.e., unstructured) propositions. Since there is no obvious connection or

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relation between the set of worlds in which x sees y and the set of worlds in which y sees x, having access to only the propositional meaning does not seem to be enough to trigger reanalysis. But access to and the ability to compare pairs of structures and their interpretations might suffice to do the job. It's just that more needs to be said to account for this option. In connection with this, it is worthwhile to note that it seems to be fairly easy in general for the processor to invert relations when there is enough evidence, as was shown in recent work by Kim and Osterhout (2005).

Needless to say, a lot of work needs to be done to relate more complex theoretical issues to processing results. One interesting question is what happens when a presupposition trigger like *auch* appears early on in a sentence, with the part that satisfies it following later on, as in the following sentence:[25]

(14) Auch der Mann sah die   Frau,   die   das   Kind gesehen
      Also the$_N$ man   saw the$_{N/A}$ woman who$_{N/A}$ the$_{N/A}$ child seen
      hatte.
      had

‘Also the man saw the woman that the child had seen.’ or

‘Also the man saw the woman that had seen the child.’

While it is unclear to me what exactly to expect in connection with this in terms of processing results, it is intuitively clear that there is a certain element of suspense in sentences like this, with a high expectation that the presupposition of *auch* will be satisfied by something that is coming later on in the sentence.

Future work will hopefully be able to address questions related to cur-

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[25]Thanks to Francesca Panzeri and Hans Kamp for independently bringing my attention to this question.

rent issues in the presupposition literature more directly, for example the ever pressing issue of local and global accommodation (see Heim's work and for a recent critical position on local accommodation, van Rooy 1999). If the general approach pursued in this paper is on the right track, local accommodation becomes a very plausible mechanism from the viewpoint of processing. Another important issue, partly related to this, is the question of whether presuppositions are at heart semantic or pragmatic (Stalnaker 1974, Simons 2001, Abusch 2005, Beaver and Krahmer 2001). One might take the apparent automatic nature of presupposition processing to support a semantic view (at least for the presupposition of *auch*), but that, of course, depends on how we deal with pragmatic phenomena in processing in general. Without being able to go into the details of these issues, I hope that the present findings will inspire further exploration of these topics from a processing perspective.

4.2   Implications for Processing Theories

Let us now turn to some considerations about what the results reported here mean for a theory of semantic processing. At this point, we aren't anywhere close to having a realistic idea of how compositional semantic processing takes place online. One central question, of course, is at what point the processor actually goes through steps of semantic composition and at what point the content of the currently processed linguistic unit is integrated with the information present in the context (which crucially should involve the evaluation of presuppositions with respect to that context). A viable hypothesis can

be constructed from what has been said here: Apart from the level of full clauses, where we obviously are dealing with propositional units, updates also take place at the level of noun phrases. This amounts to a straightforward extension of update semantics to the theory of processing. Whether or not this can be upheld, it is the simplest assumption that the processor makes use of the system supplied by the grammar, and it has the advantage of making predictions that should, at least in principle, be experimentally testable. Hopefully, this will also enable us to investigate further theoretical issues in presupposition theory in new ways.

Apart from these issues related immediately to semantic processing, the studies might also contribute to more general architectural questions in processing theory. Let me just mention one particularly interesting point, namely, that the results from the questionnaire study are most likely problematic for a simple version of a parallel parsing architecture along the lines of the one proposed by Crain and Steedman (1985). The idea in this work is that when the processor deals with an ambiguous structure, it considers all possible structures at the same time, with some structures being filtered out by certain principles. One central principle that they assume to account for the data mentioned above in (1) is the principle of parsimony, which only keeps those interpretations that have the fewest presuppositions violated. One of the more intriguing aspects of the questionnaire study discussed here was the interaction of how often subjects would choose the syntactically dispreferred structure (to have the presupposition of *auch* satisfied) with the order the clauses appeared in (which affected whether the matrix clause or the relative clause was ambiguous). If people were always considering both interpreta-

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tions of the ambiguous clauses at the same time, and then choosing one of them based on which one had the fewest presupposition violations, we would expect that they would choose the reading on which the *auch*-presupposition is satisfied more often than they actually did (in the matrix-first condition with *auch*, they chose it only 17 percent of the time, and even in the relative-first condition, they chose it only 57 percent of the time). Furthermore, we would not expect that the two clause orders would differ so drastically in this respect. Of course we need to be cautious in drawing conclusions about online processing from the results of an offline study. Nonetheless, it is worth considering possible predictions that online accounts make for tasks in offline studies. And unless other factors can be identified that account for the differences between the relative and matrix-first conditions as well as the overall fairly low percentages for the readings where the *auch* presupposition is satisfied, these effects are unexpected from the perspective of the framework assumed by Crain and Steedman (1985). Thus, the questionnaire results introduce an interesting question to be considered in this debate between different parsing architectures.

5 Conclusion

I have argued that the results from the studies reported here suggest that the processor has access to and makes use of presupposed content in online processing and employs something like context updates at the level of noun phrases. In a sense, this means taking the 'dynamic' aspect of dynamic semantics quite literally by claiming that the linguistic processor employs

dynamic updates in the process of interpreting a sentence compositionally. Bringing our theoretical frameworks and processing theories closer together in this way has the advantage of being temptingly simple. Hopefully, this will lead to interesting new predictions that we can test in further work, and open up the possibility of extending the empirical foundation for work in theoretical semantics and of addressing central issues in presupposition theory that often involve disputes about the intuitive status of presupposed content. Investigating these issues in a more direct empirical way will make an important contribution to the theoretical discussion. With a better understanding of what kind of effects related to presuppositions there are in processing, we can hope to address more sophisticated questions in presupposition theory (e.g., the issue of local and global accommodation) by employing a whole new range of empirical evidence.

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Acknowledgments

A   Materials

A.1   *auch*-questionnaire materials

1. a. Das   Marketingteam, das   die   Abteilungsleiterin beraten hat, hatte
   $\text{The}_{N/A}$ marketing-team $\text{RP}_{N/A}$ $\text{the}_{N/A}$ department-head advised has, had
   auch der   Geschftsführer beraten.
   also the_N CEO   advised.

   'The marketing-team that the department head advised, had also been advised by the CEO.' or
   'The marketing-team that advised the department-head had also been advised by the CEO.'

   b. Das   Marketingteam, das   die   Abteilungsleiterin beraten hat, hatte
   $\text{The}_{N/A}$ marketing-team $\text{RP}_{N/A}$ $\text{the}_{N/A}$ department-head advised has, had

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vorher der   Geschäftsführer beraten.
before the$_N$ CEO   advised.

Paraphrases to choose from for (a) and (b):

  i. Die Abteilungsleiterin wurde von dem Marketingteam beraten, und das
     the department-head was   by the$_D$ marketing-team advised and the
     Marketingteam von dem Geschäftsführer.
     marketing-team by   the$_D$ CEO

     'The department-head was advised by the marketing-team and the marketing-team by the CEO.'

  ii. Das Marketingteam wurde von der   Abteilungsleiterin und vom
     the marketing-team was   by the$_D$ department-head and by-the
     Geschäftsführer beraten.
     CEO   advised

     'The marketing-team was advised by the department-head and by the CEO.'

c. Das   Marketingteam beriet   die   Abteilungsleiterin, die   auch den
   The$_{N/A}$ marketing-team advised the$_{N/A}$ department-head   RP$_{N/A}$ also, the$_A$
   Geschäftsführer beraten hatte.
   CEO   advised had.

   'The marketing-team advised the department-head that also had advised the CEO.'
   or
   'The marketing-team was advised by the department-head that also had advised the CEO.'

d. Das   Marketingteam beriet   die   Abteilungsleiterin, die   vorher den
   The$_{N/A}$ marketing-team advised the$_{N/A}$ department-head   RP$_{N/A}$ before, the$_A$
   Geschäftsführer beraten hatte.
   CEO   advised had.

   Paraphrases to choose from for (c) and (d):

  i. Die Abteilungsleiterin wurde von dem Marketingteam beraten und der
     the department-head was   by the$_D$ marketing-team advised and the
     Geschäftsführer von der   Abteilungsleiterin.
     CEO   by   the$_D$ department-head

     'The department-head was advised by the marketing-team and the CEO by the department-head'

  ii. Das Marketingteam und der   Geschäftsführer wurden von der
     the marketing-team and the$_N$ CEO   were   by the$_D$
     Abteilungsleiterin beraten.
     department-head advised

     'The marketing-team and the CEO were advised by the department-head'

e. Das   Marketingteam beriet   die   Abteilungsleiterin, die   auch die
   The$_{N/A}$ marketing-team advised the$_{N/A}$ department-head   RP$_{N/A}$ also, the$_{N/A}$
   Geschäftsführerin beraten hatte.
   CEO   advised had.

   Paraphrases to choose from for (e):

  i. Die Abteilungsleiterin wurde von dem Marketingteam beraten, und die
     the department-head was   by the$_D$ marketing-team advised and the

Geschäfsführerin von der Abteilungsleiterin.
CEO by the$_D$ department-head

'The department-head was advised by the marketing-team and the CEO by the department-head.'

ii. Die Abteilungsleiterin wurde von dem Marketingteam und von der
the department-head was by the$_D$ marketing-team und by the$_D$
Geschäftsführerin beraten.
CEO advised

'The department-head was advised by the marketing-team and by the CEO.'

iii. Das Marketingteam und die Geschäftsführerin wurden von der
the marketing-team and the CEO were by the$_D$
Abteilungsleiterin beraten.
department-head advised

'The marketing-team and the CEO were advised by the department-head.'

2. a. Die Mitarbeiterin, die die Sekretärin auswählte, hatte auch der Direktor
The employee RP the secretary chose had also the director
ausgewählt.
chosen

b. Die Mitarbeiterin, die die Sekretärin auswählte, hatte vorher der Direktor ausgewählt.

c. Die Mitarbeiterin wählte die Sekretärin aus, die auch den Direktor ausgewählt hatte.

d. Die Mitarbeiterin wählte die Sekretärin aus, die vorher den Direktor ausgewählt hatte.

e. Die Mitarbeiterin wählte die Sekretärin aus, die auch die Direktorin ausgewählt hatte.

3. a. Die Spionin, die die Kommissarin verfolgt hat, hatte auch der KGB Mann
The spy RP the superintendent chased has had also the KGB man
verfolgt.
chased.

b. Die Spionin, die die Kommissarin verfolgt hat, hatte vorher der KGB Mann verfolgt.

c. Die Spionin verfolgte die Kommissarin, die auch den KGB Mann verfolgt hatte.

d. Die Spionin verfolgte die Kommissarin, die vorher den KGB Mann verfolgt hatte.

e. Die Spionin verfolgte die Kommissarin, die auch die KGBF rau verfolgt hatte.

4. a. Die Grenzbeamtin, die die Polizistin kontrollierte, hatte auch der
The border-officer RP the police-officer examined had also the
Staatsanwalt kontrolliert.
prosecutor examined.

b. Die Grenzbeamtin, die die Polizistin kontrolliert hat, hatte vorher der Staatsanwalt kontrolliert.

c. Die Grenzbeamtin kontrollierte die Polizistin, die auch den Staatsanwalt kontrolliert hatte.

d. Die Grenzbeamtin kontrollierte die Polizistin, die vorher den Staatsanwalt kontrolliert hatte.

e. Die Grenzbeamtin kontrollierte die Polizistin, die auch die Staatsanwältin kontrolliert hatte.

5. a. Die Professorengruppe, die das Expertenteam begutachtete, hatte auch der
   The group-of-professors RP the expert-team reviewed had also the
   Universitätspräsident begutachtet.
   university-president reviewed.

   b. Die Professorengruppe, die das Expertenteam begutachtete, hatte vorher der Universitätspräsident begutachtet.

   c. Die Professorengruppe begutachtete das Expertenteam, das auch den Universitätspräsidenten begutachtet hatte.

   d. Die Professorengruppe begutachtete das Expertenteam, das vorher den Universitätspräsidenten begutachtet hatte.

   e. Die Professorengruppe begutachtete das Expertenteam, das auch die Universitätspräsidentin begutachtet hatte.

6. a. Die Redakteurin, die das Projektmitglied begleitete, hatte auch der
   The editor RP the project-member accompanied had also the
   Computertechniker begleitet.
   computer-technician accompanied

   b. Die Redakteurin, die das Projektmitglied begleitete, hatte vorher der Computertechniker begleitet.

   c. Die Redakteurin begleitete das Projektmitglied, das auch den Computertechniker begleitet hatte.

   d. Die Redakteurin begleitete das Projektmitglied, das vorher den Computertechniker begleitet hatte.

   e. Die Redakteurin begleitete das Projektmitglied, das auch die Computertechnikerin begleitet hatte.

7. a. Das norwegische Team, das die finnische Mannschaft besiegte, hatte auch der
   The Norwegian team RP the Finish team defeated had also the
   Jemen besiegt.
   Yemen defeated

   b. Das norwegische Team, das die finnische Mannschaft besiegte, hatte vorher der Jemen besiegt.

   c. Das norwegische Team besiegte die finnische Mannschaft, die auch den Jemen besiegt hatte.

   d. Das norwegische Team besiegte die finnische Mannschaft, die vorher den Jemen besiegt hatte.

   e. Das norwegische Team besiegte die finnische Mannschaft, die auch die Türkei besiegt hatte.

8. a. Die Lehrerin, die die Mutter begrüsste, hatte auch der Schulrat
   the teacher RP the mother welcomed had also the super-intendent
   begrüsst.
   welcomed.

   b. Die Lehrerin, die die Mutter begrüsste, hatte vorher der Schulrat begrüsst.

   c. Die Lehrerin begrüsste die Mutter, die auch den Schulrat begrüsst hatte.

d. Die Lehrerin begrüsste die Mutter, die vorher den Schulrat begrüsst hatte.

e. Die Lehrerin begrüsste die Mutter, die auch die Schulrätin begrüsst hatte.

9. a. Das Anwaltsbüro, das die Ärztin konsultierte, hatte auch der Professor
   the law-firm   RP the doctor consulted   had   also the professor
   konsultiert.
   consulted

   b. Das Anwaltsbüro, das die Ärztin konsultierte, hatte vorher der Professor konsultiert.

   c. Das Anwaltsbüro konsultierte die Ärztin, die auch den Professor konsultiert hatte.

   d. Das Anwaltsbüro konsultierte die Ärztin, die vorher den Professor konsultiert hatte.

   e. Das Anwaltsbüro konsultierte die Ärztin, die auch die Professorin konsultiert hatte.

10. a. Die Italienerin, die die Studentin unterrichtete, hatte auch der Musiklehrer
    the Italian   RP the student   taught   had   also the music-teacher
    unterrichtet.
    taught

    b. Die Italienerin, die die Studentin unterrichtete, hatte vorher der Musiklehrer unterrichtet.

    c. Die Studentin unterrichtete die Italienerin, die auch den Musiklehrer unterrichtet hatte.

    d. Die Studentin unterrichtete die Italienerin, die vorher den Musiklehrer unterrichtet hatte.

    e. Die Studentin unterrichtete die Italienerin, die auch die Musiklehrerin unterrichtet hatte.

11. a. Die Putzfrau, die die alte Dame suchte,   hatte auch der kleine Junge
    the cleaner   RP the old lady looked-for had   also the small boy
    gesucht.
    looked-for

    b. Die Putzfrau, die die alte Dame suchte, hatte vorher der kleine Junge gesucht.

    c. Die Putzfrau suchte die alte Dame, die auch den kleinen Jungen gesucht hatte.

    d. Die Putzfrau suchte die alte Dame, die vorher den kleinen Jungen gesucht hatte.

    e. Die Putzfrau suchte die alte Dame, die auch das kleine Mädchen gesucht hatte.

12. a. Das Computergenie, das die Schachspielerin beobachtete, hatte auch der
    the computer-genius RP the actress   watched   had   also the
    Programmierer beobachtet.
    programmer   watched

    b. Das Computergenie, das die Schachspielerin beobachtete, hatte vorher der Programmierer beobachtet.

    c. Das Computergenie beobachtete die Schachspielerin, die auch den Programmierer beobachtet hatte.

    d. Das Computergenie beobachtete die Schachspielerin, die vorher den Programmierer beobachtet hatte.

    e. Das Computergenie beobachtete die Schachspielerin, die auch die Programmiererin beobachtet hatte.

13. a. Die Krankenschwester, die die Pflegerin überwachte, hatte auch der
       the nurse   RP the caregiver supervised   had   also   the
       Stationsleiter überwacht.
       station-chief supervised
    b. Die Krankenschwester, die die Pflegerin überwachte, hatte vorher der Stationsleiter
       überwacht.
    c. Die Krankenschwester überwachte die Pflegerin, die auch den Stationsleiter überwacht
       hatte.
    d. Die Krankenschwester überwachte die Pflegerin, die vorher den Stationsleiter überwacht
       hatte.
    e. Die Krankenschwester überwachte die Pflegerin, die auch die Stationsleiterin überwacht
       hatte.

14. a. Die Sängerin, die die Galeristin   einlud, hatte auch der Kurator eingeladen.
       the singer   RP the gallery-owner invited had   also the curator invited
    b. Die Sängerin, die die Galeristin einlud, hatte vorher der Kurator eingeladen.
    c. Die Sängerin lud die Galeristin ein, die auch den Kurator eingeladen hatte.
    d. Die Sängerin lud die Galeristin ein, die vorher den Kurator eingeladen hatte.
    e. Die Sängerin lud die Galeristin ein, die auch die Kuratorin eingeladen hatte.

15. a. Die Lektorin, die die Schriftstellerin lobte, hatte auch der Verleger gelobt.
       the editor   RP the author   praised had   also the publisher praised
    b. Die Lektorin, die die Schriftstellerin lobte, hatte vorher der Verleger gelobt.
    c. Die Lektorin lobte die Schriftstellerin, die auch den Verleger gelobt hatte.
    d. Die Lektorin lobte die Schriftstellerin, die vorher den Verleger gelobt hatte.
    e. Die Lektorin lobte die Schriftstellerin, die auch die Verlegerin gelobt hatte.

16. a. Die Goldschmiedin, die die Schneiderin beauftragte, hatte auch der Gärtner
       the gold-smith   RP the seamstress commissioned had   also the gardener
       beauftragt.
       commissioned
    b. Die Goldschmiedin, die die Schneiderin beauftragte, hatte vorher der Gärtner
       beauftragt.
    c. Die Goldschmiedin beauftragte die Schneiderin, die auch den Gärtner beauftragt
       hatte.
    d. Die Goldschmiedin beauftragte die Schneiderin, die vorher den Gärtner beauftragt
       hatte.
    e. Die Goldschmiedin beauftragte die Schneiderin, die auch die Gärtnerin beauftragt
       hatte.

17. a. Die Cellistin, die die Komponistin bewunderte, hatte auch der Dirigent
       the cellist   RP the composer   admired   had   also the director
       bewundert.
       admired
    b. Die Cellistin, die die Komponistin bewunderte, hatte früher der Dirigent bewun-
       dert.
    c. Die Cellistin bewunderte die Komponistin, die auch den Dirigenten bewunderte.
    d. Die Cellistin bewunderte die Komponistin, die vorher den Dirigenten bewunderte.

e. Die Cellistin bewunderte die Komponistin, die auch die Dirigentin bewundert hatte.

18. a. Die Apothekerin, die die Optikerin benachrichtigte, hatte auch der Pfarrer
    the pharmacist   RP the optician   notified   had   also the pastor
    benachrichtigt.
    notified

    b. Die Apothekerin, die die Optikerin benachrichtigte, hatte vorher der Pfarrer benachrichtigt.

    c. Die Apothekerin benachrichtigte die Optikerin, die auch den Pfarrer benachrichtigt hatte.

    d. Die Apothekerin benachrichtigte die Optikerin, die vorher den Pfarrer benachrichtigt hatte.

    e. Die Apothekerin benachrichtigte die Optikerin, die auch die Pfarrerin benachrichtigt hatte.

19. a. Die Vereinigung, die das Projekt unterstützte, hatte auch der Bürgermeister
    the association   RP the project supported   had also the mayor
    unterstützt.
    supported

    b. Die Vereinigung, die das Projekt unterstützte, hatte vorher der Bürgermeister unterstützt.

    c. Die Vereinigung unterstützte das Projekt, das auch den Bürgermeister unterstützt hatte.

    d. Die Vereinigung unterstützte das Projekt, das vorher den Bürgermeister unterstützt hatte.

    e. Die Vereinigung unterstützte das Projekt, das auch die Bürgermeisterin unterstützt hatte.

20. a. Das Model, das die Fotografin   kontaktierte, hatte auch der Designer
    the model RP the photographer contacted   had   also the designer
    kontaktiert.
    contacted

    b. Das Model, das die Fotografin kontaktierte, hatte vorher der Designer kontaktiert.

    c. Das Model kontaktierte die Fotografin, die auch den Designer kontaktiert hatte.

    d. Das Model kontaktierte die Fotografin, die vorher den Designer kontaktiert hatte.

    e. Das Model kontaktierte die Fotografin, die auch die Designerin kontaktiert hatte.

21. a. Die Klassenlehrerin, die das Wunderkind verabschiedete, hatte auch der
    the teacher   RP the child-prodigy saw-off   had   also the
    Rektor   verabschiedet.
    principal seen-off

    b. Die Klassenlehrerin, die das Wunderkind verabschiedete, hatte vorher der Rektor verabschiedet.

    c. Das Wunderkind verabschiedete die Direktorin, die auch den Klassenlehrer verabschiedet hatte.

    d. Das Wunderkind verabschiedete die Direktorin, die vorher den Klassenlehrer verabschiedet hatte.

e. Das Wunderkind verabschiedete die Direktorin, die auch die Klassenlehrerin verabschiedet hatte.

22. a. Die Kindergärtnerin, die das kleine Mädchen getroffen hat, hatte auch der
the nursery-teacher RP the little girl met has had also the
Elternvereinsvorsitzende getroffen.
parent-representative met

b. Die Kindergärtnerin, die das kleine Mädchen getroffen hat, hatte vorher der Elternvereinsvorsitzende getroffen.

c. Die Kindergärtnerin traf das kleine Mädchen, das auch den Elternvereinsvorsitzenden getroffen hatte.

d. Die Kindergärtnerin traf das kleine Mädchen, das vorher den Elternvereinsvorsitzenden getroffen hatte.

e. Die Kindergärtnerin traf das kleine Mädchen, das auch die Elternvereinsvorsitzende getroffen hatte.

23. a. Die Pianistin, die die Malerin besuchte, hatte auch der Cellist besucht.
the pianist RP the painter visited had also the cellist visited

b. Die Pianistin, die die Malerin besuchte, hatte vorher der Cellist besucht.

c. Die Pianistin besuchte die Malerin, die auch den Cellisten besucht hatte.

d. Die Pianistin besuchte die Malerin, die vorher den Cellisten besucht hatte.

e. Die Pianistin besuchte die Malerin, die auch die Cellistin besucht hatte.

24. a. Die Schönheitskönigin, die das Gewinnerpaar beglückwünschte,
the beauty-queen RP the winner-couple congratulated
beglückwünschte auch der Showmaster.
congratulated also the host

b. Die Schönheitskönigin, die das Gewinnerpaar beglückwünschte, hatte vorher der Showmaster beglückwünscht.

c. Die Schönheitskönigin beglückwünschte das Gewinnerpaar, das auch den Showmaster beglückwünscht hatte.

d. Die Schönheitskönigin beglückwünschte das Gewinnerpaar, das vorher den Showmaster beglückwünscht hatte.

e. Die Schönheitskönigin beglückwünschte das Gewinnerpaar, das auch die Showmasterin beglückwünscht hatte.

25. a. Die Klientin, die die Maklerin überredete, hatte auch der Hausmeister
the client RP the real-estate-agent convinced had also the janitor
überredet.
convinced

b. Die Klientin, die die Maklerin überredete, hatte vorher der Hausmeister überredet.

c. Die Klientin überredete die Maklerin, die auch den Hausmeister überredet hatte.

d. Die Klientin überredete die Maklerin, die vorher den Hausmeister überredet hatte.

e. Die Klientin überredete die Maklerin, die auch die Hausmeisterin überredet hatte.

26. a. Das Aufsichtsratsmitglied, das die Grafikerin überzeugte, hatte auch der
the board-member RP the designer convinced had also the
Kreativdirektor überzeugt.
art-director convinced

b. Das Aufsichtsratsmitglied, das die Grafikerin überzeugte, hatte vorher der Kreativdirektor überzeugt.

c. Das Aufsichtsratsmitglied überzeugte die Grafikerin, die auch den Kreativdirektor überzeugt hatte.

d. Das Aufsichtsratsmitglied überzeugte die Grafikerin, die vorher den Kreativdirektor überzeugt hatte.

e. Das Aufsichtsratsmitglied überzeugte die Grafikerin, die auch die Kreativdirektorin überzeugt hatte.

27. a. Die Gastmoderatorin, die die Sopranistin ankündigte, hatte auch der
    the guest-host   RP the soprano   announced   had   also the
    Programmdirektor angekündigt.
    head   of   programming announced

b. Die Gastmoderatorin, die die Sopranistin ankündigte, hatte vorher der Programmdirektor angekündigt.

c. Die Gastmoderatorin kündigte die Sopranistin an, die auch den Programmdirektor angekündigt hatte.

d. Die Gastmoderatorin kündigte die Sopranistin an, die vorher den Programmdirektor angekündigt hatte.

e. Die Gastmoderatorin kündigte die Sopranistin an, die auch die Programmdirektorin angekündigt hatte.

28. a. Das Touristenehepaar, das die Künstlerin fotografierte, hatte auch der
    the tourist-couple   RP the artist   photographed had   also the
    Journalist fotografiert.
    journalist photographed

b. Das Touristenehepaar, das die Künstlerin fotografierte, hatte vorher der Journalist fotografiert.

c. Das Touristenehepaar fotografierte die Künstlerin, die auch den Journalisten fotografiert hatte.

d. Das Touristenehepaar fotografierte die Künstlerin, die vorher den Journalisten fotografiert hatte.

e. Das Touristenehepaar fotografierte die Künstlerin, die auch die Journalistin fotografiert hatte.

29. a. Die Besucherin, die die Dichterin erkannte, hatte auch der Gastgeber
    the visitor   RP the poet   recognised had   also the host
    erkannt.
    recognised

b. Die Besucherin, die die Dichterin erkannte, hatte vorher der Gastgeber erkannt.

c. Die Besucherin erkannte die Dichterin, die auch den Gastgeber erkannt hatte.

d. Die Besucherin erkannte die Dichterin, die vorher den Gastgeber erkannt hatte.

e. Die Besucherin erkannte die Dichterin, die auch die Gastgeberin erkannt hatte.

30. a. Die Staatsanwältin, die die Kommission beurteilte, hatte auch der Richter
    the prosecutor   RP the commission assessed   had   also the judge
    beurteilt.
    assessed

    b. Die Staatsanwältin, die die Kommission beurteilte, hatte vorher der Richter beurteilt.

    c. Die Staatsanwältin beurteilte die Kommission, die auch den Richter beurteilt hatte.

    d. Die Staatsanwältin beurteilte die Kommission, die vorher den Richter beurteilt hatte.

    e. Die Staatsanwältin beurteilte die Kommission, die auch die Richterin beurteilt hatte.

A.2 *auch*-self-paced-reading materials

1. a. Das Marketingteam, das der Manager beraten hat, hatte auch der
The$_{N/A}$ marketing-team RP$_{N/A}$ the$_N$ manager advised has, had also the$_N$
Geschftsführer beraten.
CEO advised.

   'The marketing-team that the manager advised had also been advised by the CEO.'

   b. Das Marketingteam,/ das der Manager beraten hat,/ hatte vorher der
the marketing-team RP$_{N/A}$ the$_N$ manager advised has had before the$_N$
Geschäftsführer beraten.
CEO advised

   'The marketing-team that the manager advised had previously been advised by the CEO.'

   c. Das Marketingteam, das den Manager beraten hat, hatte auch der
The$_{N/A}$ marketing-team RP$_{N/A}$ the$_A$ manager advised has, had also the$_N$
Geschäftsführer beraten.
CEO advised.

   'The marketing-team that advised the manager had also been advised by the CEO.'

   d. Das Marketingteam, das den Manager beraten hat, hatte vorher der
The$_{N/A}$ marketing-team RP$_{N/A}$ the$_A$ manager advised has, had before the$_N$
Geschäftsführer beraten.
CEO advised.

   'The marketing-team that advised the manager had previously been advised by the CEO.'

   Question for all conditions:

   Hatte das Marketingteam den Manager beraten?

   Had the marketing-team advised the manager?

2. a. Die Spionin,/ die der Kommissar verfolgte,/+ hatte auch der KGB-Mann
the spy RP the super-intendent chased had also the KGB-man
verfolgt.
chased

   b. Die Spionin,/ die der Kommissar verfolgte,/+ hatte vorher der KGB-Mann verfolgt.

   c. Die Spionin,/ die den Kommissar verfolgte,/+ hatte auch der KGB-Mann verfolgt.

   d. Die Spionin,/ die den Kommissar verfolgte,/+ hatte vorher der KGB-Mann verfolgt.

   Question for all conditions:

Wurde der Kommissar von der Spionin verfolgt?

Was the super-intendent chased by the spy?

3. a. Die Grenzbeamtin,/ die der Polizist   kontrollierte,/+ hatte auch der
        the border-officer   RP the police-officer examined   had   also   the
        Staatsanwalt kontrolliert.
        prosecutro   examined

    b. Die Grenzbeamtin,/ die der Polizist kontrollierte,/+ hatte vorher der Staatsanwalt
        kontrolliert.

    c. Die Grenzbeamtin,/ die den Polizisten kontrollierte,/+ hatte auch der Staatsanwalt
        kontrolliert.

    d. Die Grenzbeamtin,/ die den Polizisten kontrollierte,/+ hatte vorher der Staatsan-
        walt kontrolliert.

    Question for all conditions:

    Hatte die Grenzbeamtin den Staatsanwalt kontrolliert?

    Had the border officer examined the prosecutor?

4. a. Die Cellistin,/ die der Komponist bewunderte,/+ hatte auch der Dirigent
        the cellist   RP the composer   admired   had   also the director
        bewundert.
        admired

    b. Die Cellistin,/ die der Komponist bewunderte,/+ hatte zuvor der Dirigent bewun-
        dert.

    c. Die Cellistin,/ die den Komponisten bewunderte,/+ hatte auch der Dirigent be-
        wundert.

    d. Die Cellistin,/ die den Komponisten bewunderte,/+ hatte zuvor der Dirigent be-
        wundert.

    Question for all conditions:

    Wurde der Dirigent von der Cellistin bewundert?

    Was the director admired by the cellist?

5. a. Die Gruppe,/ die der Naturschutzverein   unterstützte,/+ hatte
        the group   RP the nature-conversancy-orangisation supported   had
        auch der Bürgermeister unterstützt.
        also the mayor   supported

    b. Die Gruppe,/ die der Naturschutzverein unterstützte,/+ hatte vorher der Bürgermeister
        unterstützt.

    c. Die Gruppe,/ die den Naturschutzverein unterstützte,/+ hatte auch der Bürgermeister
        unterstützt.

    d. Die Gruppe,/ die den Naturschutzverein unterstützte,/+ hatte vorher der Bürgermeister
        unterstützt.

    Question for all conditions:

    Hatte die Gruppe den Naturschutzverein unterstützt?

    Had the group supported the nature conservancy organisation?

6. a. Die Norwegerin,/   die der Finne besiegte,/+ hatte auch der Schwede besiegt.
        the NorwegianFEM RP the Fin   defeated   had   also the Swede   defeated

b. Die Norwegerin,/ die der Finne besiegte,/+ hatte vorher der Schwede besiegt.

c. Die Norwegerin,/ die den Finnen besiegte,/+ hatte auch der Schwede besiegt.

d. Die Norwegerin,/ die den Finnen besiegte,/+ hatte vorher der Schwede besiegt.

Question for all conditions:

Wurde der Finne von der Norwegerin besiegt?

Was the Fin defeated by the Norwegian?

7. a. Das kleine Mädchen,/ das der Erzieher ermutigte,/ hatte auch der
   the little girl   RP the educator encouraged had   also the
   Elternsprecher   ermutigt.
   parent-representative encouraged

   b. Das kleine Mädchen,/ der Erzieher ermutigte,/ hatte zuvor der Elternsprecher ermutigt.

   c. Das kleine Mädchen,/ das den Erzieher ermutigte,/ hatte auch der Elternsprecher ermutigt.

   d. Das kleine Mädchen,/ das den Erzieher ermutigte,/ hatte zuvor der Elternsprecher ermutigt.

Question for all conditions:

Hatte der Elternsprecher das kleine Mädchen ermutigt?

Had the parent-representative encouraged the little girl?

8. a. Die Künstlerin,/ die der Tourist fotografierte,/ hatte auch der Journalist
   the artist   RP the tourist photographed had   also the journalist
   fotografiert.
   photographed

   b. Die Künstlerin,/ die der Tourist fotografierte,/ hatte vorher der Journalist fotografiert.

   c. Die Künstlerin,/ die den Touristen fotografierte,/ hatte auch der Journalist fotografiert.

   d. Die Künstlerin,/ die den Touristen fotografierte,/ hatte vorher der Journalist fotografiert.

Question for all conditions:

Wurde die Künstlerin vom Journalisten fotografiert?

Was the artist photographed by the journalist?

9. a. Die Italienerin,/ die der Student unterrichtete,/+ hatte auch der Musiklehrer
   the Italian   RP the student taught   had   also the music-teacher
   unterrichtet.
   taught

   b. Die Italienerin,/ die der Student unterrichtete,/+ hatte zuvor der Musiklehrer unterrichtet.

   c. Die Italienerin,/ die den Studenten unterrichtete,/+ hatte auch der Musiklehrer unterrichtet.

   d. Die Italienerin,/ die den Studenten unterrichtete,/+ hatte zuvor der Musiklehrer unterrichtet.

Question for all conditions:

Hatte der Student die Italienerin unterrichtet?

Had the student taught the Italian?

10. a. Die Putzfrau,/ die der alte Herr suchte,/+ hatte auch der kleine Junge
the cleaner   RP the old man looked-for had   also the little boy
gesucht.
looked-for

   b. Die Putzfrau,/ die der alte Herr suchte,/+ hatte vorher der kleine Junge gesucht.

   c. Die Putzfrau,/ die den alten Herrn suchte,/+ hatte auch der kleine Junge gesucht.

   d. Die Putzfrau,/ die den alten Herrn suchte,/+ hatte vorher der kleine Junge gesucht.

Question for all conditions:

Wurde der alte Herr von der Putzfrau gesucht?

Was the old man looked for by the cleaner?

11. a. Das Computergenie,/ das der Schachspieler beobachtete,/+ hatte auch der
the computer-genius RP the chess-player   watched   had   also the
Programmierer beobachtet.
programmer   watched

   b. Das Computergenie,/ das der Schachspieler beobachtete,/+ hatte vorher der Programmierer beobachtet.

   c. Das Computergenie,/ das den Schachspieler beobachtete,/+ hatte auch der Programmierer beobachtet.

   d. Das Computergenie,/ das den Schachspieler beobachtete,/+ hatte vorher der Programmierer beobachtet.

Question for all conditions:

Hatte das Computergenie den Programmierer beobachtet?

Had the chess player watched the programmer?

12. a. Die Politikerin,/ die der Dichter erkannte,/+ hatte auch der Gastgeber
the politician   RP the poet   recognised had   also the host
erkannt.
recognised

   b. Die Politikerin,/ die der Dichter erkannte,/+ hatte zuvor der Gastgeber erkannt.

   c. Die Politikerin,/ die den Dichter erkannte,/+ hatte auch der Gastgeber erkannt.

   d. Die Politikerin,/ die den Dichter erkannte,/+ hatte zuvor der Gastgeber erkannt.

Question for all conditions:

Wurde der Gastgeber von der Politikerin erkannt?

Was the host recognised by the politician?

13. a. Die Tennisspielerin,/ die der Trainer nominierte,/ hatte auch der
the tennis-player   RP the trainer nominated   had   also the
DTB-Vorsitzende nominiert.
DTB-chairman   nominated

   b. Die Tennisspielerin,/ die der Trainer nominierte,/ hatte vorher der DTB-Vorsitzende nominiert.

   c. Die Tennisspielerin,/ die den Trainer nominierte,/ hatte auch der DTB-Vorsitzende nominiert.

d. Die Tennisspielerin,/ die den Trainer nominierte,/ hatte vorher der DTB-Vorsitzende nominiert.

Question for all conditions:

Hatte der Trainer die Tennisspielerin nominiert?

Had the trainer nominated the tennis player?

14. a. Die Regisseurin,/ die der Schauspieler um Rat   fragte,/+ hatte auch der
       the director   RP the actor   for advice asked   had   also   the
    Intendant   um Rat   gefragt.
    head-of-programming for advice asked

    b. Die Regisseurin,/ die der Schauspieler um Rat fragte,/+ hatte vorher der Intendant um Rat gefragt.

    c. Die Regisseurin,/ die den Schauspieler um Rat fragte,/+ hatte auch der Intendant um Rat gefragt.

    d. Die Regisseurin,/ die den Schauspieler um Rat fragte,/+ hatte vorher der Intendant um Rat gefragt.

Question for all conditions:

Wurde die Regisseurin vom Schauspieler um Rat gefragt?

Was the director asked for advice by the actor?

15. a. Die Sportreporterin,/ die der Athlet anrief,/+ hatte auch der Sponsor
       the sports-reporter   RP the athlete called   had   also the sponsor
    angerufen.
    called

    b. Die Sportreporterin,/ die der Athlet anrief,/+ hatte vorher der Sponsor angerufen.

    c. Die Sportreporterin,/ die den Athleten anrief,/+ hatte auch der Sponsor angerufen.

    d. Die Sportreporterin,/ die den Athleten anrief,/+ hatte vorher der Sponsor angerufen.

Question for all conditions:

Hatte der Sponsor die Sportreporterin angerufen?

Had the sponsor called the sports reporter?

16. a. Die Anwältin,/ die der Sekretär befragte,/+ hatte auch der Referendar
       the lawyer   RP the secretary interrogated had   also the clerk
    befragt.
    interrogated

    b. Die Anwältin,/ die der Sekretär befragte,/+ hatte vorher der Referendar befragt.

    c. Die Anwältin,/ die den Sekretär befragte,/+ hatte auch der Referendar befragt.

    d. Die Anwältin,/ die den Sekretär befragte,/+ hatte vorher der Referendar befragt.

Question for all conditions:

Wurde der Referendar von der Anwältin befragt?

Was the clerk interrogated by the lawyer?

17. a. Das Model,/ das der Fotograf   kontaktierte,/+ hatte auch der Designer
       the model   RP the photographer contacted   had   also the designer
    kontaktiert.
    contacted

b. Das Model,/ das der Fotograf kontaktierte,/+ hatte vorher der Designer kontaktiert.

c. Das Model,/ das den Fotografen kontaktierte,/+ hatte auch der Designer kontaktiert.

d. Das Model,/ das den Fotografen kontaktierte,/+ hatte vorher der Designer kontaktiert.

Question for all conditions:

Hatte das Model den Fotografen kontaktiert?

Had the model contacted the photographer?

18. a. Die Barmixerin,/ die der Koch anstellte,/+ hatte auch der Jazz-Club
the bartender   RP the cook hired   had   also   the jazz-club
angestellt.
hired

b. Die Barmixerin,/ die der Koch anstellte,/+ hatte vorher der Jazz-Club angestellt.

c. Die Barmixerin,/ die den Koch anstellte,/+ hatte auch der Jazz-Club angestellt.

d. Die Barmixerin,/ die den Koch anstellte,/+ hatte vorher der Jazz-Club angestellt.

Question for all conditions:

Wurde der Koch von der Barmixerin angestellt?

Was the cook hired by the bartender?

19. a. Die Sängerin,/ die der Bühnenbildner empfahl,/+   hatte auch der
the singer   RP the stage-designer recommended had   also the
Musikdirektor empfohlen.
music-director recommended

b. Die Sängerin,/ die der Bühnenbildner empfahl,/+ hatte vorher der Musikdirektor empfohlen.

c. Die Sängerin,/ die den Bühnenbildner empfahl,/+ hatte auch der Musikdirektor empfohlen.

d. Die Sängerin,/ die den Bühnenbildner empfahl,/+ hatte vorher der Musikdirektor empfohlen.

Question for all conditions:

Hatte der Musikdirektor die Sängerin empfohlen?

Had the music director recommended the singer?

20. a. Die Schönheitskönigin,/ die der Quizgewinner beglückwünschte,/+ hatte auch
the beauty-queen   RP the quiz-winner congratulated   had   also
der Showmaster beglückwünscht.
the host   congratulated

b. Die Schönheitskönigin,/ die der Quizgewinner beglückwünschte,/+ hatte vorher der Showmaster beglückwünscht.

c. Die Schönheitskönigin,/ die den Quizgewinner beglückwünschte,/hatte auch der Showmaster beglückwünscht.

d. Die Schönheitskönigin,/ die den Quizgewinner beglückwünschte,/+ hatte vorher der Showmaster beglückwünscht.

Question for all conditions:

Wurde die Schönheitskönigin vom Showmaster beglückwünscht?

Was the beauty queen congratulated by the host?

21. a. Die Klientin,/ die der Makler   überredete,/+ hatte auch der
        the client   RP the real-estate-agent convinced   had   also   the
        Hausmeister überredet.
        janitor   convinced

     b. Die Klientin,/ die der Makler überredete,/+ hatte vorher der Hausmeister überredet.

     c. Die Klientin,/ die den Makler überredete,/+ hatte auch der Hausmeister überredet.

     d. Die Klientin,/ die den Makler überredete,/+ hatte vorher der Hausmeister überredet.
     Question for all conditions:

Hatte der Makler die Klientin überredet?

Had the real estate agent convinced the client?

22. a. Das Aufsichtsratsmitglied,/ das der Grafiker überzeugte,/+ hatte   auch der
        the board-member   RP the graphic designer   convinced had   also
        Kreativdirektor überzeugt.
        the   art   director convinced

     b. Das Aufsichtsratsmitglied,/ das der Grafiker überzeugte,/+ hatte vorher der Kreativdi-
        rektor überzeugt.

     c. Das Aufsichtsratsmitglied,/ das den Grafiker überzeugte,/+ hatte auch der Kreativdi-
        rektor überzeugt.

     d. Das Aufsichtsratsmitglied,/ das den Grafiker überzeugte,/+ hatte vorher der Kreativdi-
        rektor überzeugt.
     Question for all conditions:

Wurde das Aufsichtsratmitglied vom Grafiker überzeugt?

Was the boardmember convinced by the graphic designer?

23. a. Die Gastmoderatorin,/ die der Tenor ankündigte,/ hatte auch der
        the guest-host   RP the tenor announced   had   also   the
        Programmdirektor   angekündigt.
        head-of-programming announced

     b. Die Gastmoderatorin,/ die der Tenor ankündigte,/ hatte zuvor der Programmdi-
        rektor angekündigt.

     c. Die Gastmoderatorin,/ die den Tenor ankündigte,/ hatte auch der Programmdi-
        rektor angekündigt.

     d. Die Gastmoderatorin,/ die den Tenor ankündigte,/ hatte zuvor der Programmdi-
        rektor angekündigt.
     Question for all conditions:

Hatte die Gastmoderatorin den Programmdirektor angekündigt?

Had the guest host announced the head of programming?

24. a. Die Kommission,/ die der Staatsanwalt beurteilte,/ hatte auch der Richter
        the commission   RP the prosecutor   assessed   had   also   the judge
        beurteilt.
        assessed

     b. Die Kommission,/ die der Staatsanwalt beurteilte,/ hatte zuvor der Richter beurteilt.

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c. Die Kommission,/ die den Staatsanwalt beurteilte,/ hatte auch der Richter beurteilt.

d. Die Kommission,/ die den Staatsanwalt beurteilte,/ hatte zuvor der Richter beurteilt.

Question for all conditions:

Wurde die Kommission von dem Richter beurteilt?

Was the commission assessed by the judge?

A.3 *Also*-self-paced-reading materials

1. a. The congressman/ who wrote to John/ had also written to the mayor/ to schedule a meeting/ for the fundraiser.

    b. The congressman/ who wrote to John/ had just written to the mayor/ to schedule a meeting/ for the fundraiser.

    c. The congressman/ who John wrote to/ had also written to the mayor/ to schedule a meeting/ for the fundraiser.

    d. The congressman/ who John wrote to/ had just written to the mayor/ to schedule a meeting/ for the fundraiser.

2. a. The electrician/ that helps Justin/ also helped the old lawyer/ in setting up/ his new computer.

    b. The electrician/ that helps Justin/ once helped the old lawyer/ in setting up/ his new computer.

    c. The electrician/ that Justin helps / also helped the old lawyer/ in setting up/ his new computer.

    d. The electrician/ that Justin helps / once helped the old lawyer/ in setting up/ his new computer.

3. a. The singer/ who met Josh/ had also met Kurt Cobain/ at a benefit concert/ in Boston.

    b. The singer/ who met Josh/ had once met Kurt Cobain/ at a benefit concert/ in Boston.

    c. The singer/ who Josh met/ had also met Kurt Cobain/ at a benefit concert/ in Boston.

    d. The singer/ who Josh met/ had once met Kurt Cobain/ at a benefit concert/ in Boston.

4. a. The coach/ that chose Sam/ had also chosen a Canadian player/ after the Canadian team/ did so well at the Olympics.

    b. The coach/ that chose Sam/ had almost chosen a Canadian player/ after the Canadian team/ did so well at the Olympics.

    c. The coach/ that Sam chose / had also chosen a Canadian player/ after the Canadian team/ did so well at the Olympics.

    d. The coach/ that Sam chose / had almost chosen a Canadian player/ after the Canadian team/ did so well at the Olympics.

5. a. The police officer/ who noticed the burglar/ had also noticed a suspicious car/ in front of the building/ on the corner.

    b. The police officer/ who noticed the burglar/ had once noticed a suspicious car/ in front of the building/ on the corner.

   c. The police officer/ who the burglar noticed/ had also noticed a suspicious car/ in front of the building/ on the corner.

   d. The police officer/ who the burglar noticed/ had once noticed a suspicious car/ in front of the building/ on the corner.

6. a. The model/ that spoke with the producer/ had also spoken with Calvin Klein/ at the show/ in Paris last month.

   b. The model/ that spoke with the producer/ had recently spoken with Calvin Klein/ at the show/ in Paris last month.

   c. The model/ that the producer spoke with/ had also spoken with Calvin Klein/ at the show/ in Paris last month.

   d. The model/ that the producer spoke with/ had recently spoken with Calvin Klein/ at the show/ in Paris last month.

7. a. The organizer/ who hired Jeremy/ will also hire a secretary/ to do the paper work/ for the project.

   b. The organizer/ who hired Jeremy/ will now hire a secretary/ to do the paper work/ for the project.

   c. The organizer/ who Jeremy hired/ will also hire a secretary/ to do the paper work/ for the project.

   d. The organizer/ who Jeremy hired/ will now hire a secretary/ to do the paper work/ for the project.

8. a. The radio show host/ that talked to Melissa/ will also talk to Chomsky/ to hear his views/ about the Middle East.

   b. The radio show host/ that talked to Melissa/ will probably talk to Chomsky/ to hear his views/ about the Middle East.

   c. The radio show host/ that Melissa talked to/ will also talk to Chomsky/ to hear his views/ about the Middle East.

   d. The radio show host/ that Melissa talked to/ will probably talk to Chomsky/ to hear his views/ about the Middle East.

9. a. The artist/ who visited Mrs. Walters/ will also visit the Dean of Fine Arts/ when he is in town/ for the conference.

   b. The artist/ who had visited Mrs. Walters/ will now visit the Dean of Fine Arts/ while he is in town/ for the conference.

   c. The artist/ who Mrs. Walters visited / will also visit the Dean of Fine Arts/ when he is in town/ for the conference.

   d. The artist/ who Mrs. Walters had visited / will now visit the Dean of Fine Arts/ while he is in town/ for the conference.

10. a. The research assistant/ that had taken Kyle to the airport/ will also take Dr. Jackson/ to the train station/ on the way to New York.

   b. The research assistant/ that had taken Kyle to the airport/ will now take Dr. Jackson/ to the train station/ on the way to New York.

   c. The research assistant/ that Kyle had taken to the airport/ will also take Dr. Jackson/ to the train station/ on the way to New York.

   d. The research assistant/ that Kyle had taken to the airport/ will now take Dr. Jackson/ to the train station/ on the way to New York.

11. a. The author/ who discussed Dan Rather/ will also discuss Oprah/ the next time/ he is visiting campus.

   b. The author/ who discussed Dan Rather/ will probably discuss Oprah/ the next time/ he is visiting campus.

   c. The author/ who Dan Rather discussed/ will also discuss Oprah/ the next time/ he is visiting campus.

   d. The author/ who Dan Rather discussed/ will probably discuss Oprah/ the next time/ he is visiting campus.

12. a. The executive/ that impressed the marketing director/ will also impress the board members/ at the meeting/ next week.

   b. The executive/ that impressed the marketing director/ will probably impress the board members/ at the meeting/ next week.

   c. The executive/ that the marketing director impressed/ will also impress the board members/ at the meeting/ next week.

   d. The executive/ that the marketing director impressed/ will probably impress the board members/ at the meeting/ next week.

13. a. The soccer team/ who defeated Courtney's school/ also beat the state champion/ in the tournament/ last year in Boston.

   b. The soccer team/ who defeated Courtney's school/ recently beat the state champion/ in the tournament/ last year in Boston.

   c. The soccer team/ who Courtney's school defeated/ also beat the state champion/ in the tournament/ last year in Boston.

   d. The soccer team/ who Courtney's school defeated/ recently beat the state champion/ in the tournament/ last year in Boston.

14. a. The actor/ that irritated Shannon at the party/ had also annoyed Shannon's Dad/ at the dinner/ the night before.

   b. The actor/ that irritated Shannon at the party/ had once annoyed Shannon's Dad/ at the dinner/ the night before.

   c. The actor/ that Shannon irritated at the party/ had also annoyed Shannon's Dad/ at the dinner/ the night before.

   d. The actor/ that Shannon irritated at the party/ had once annoyed Shannon's Dad/ at the dinner/ the night before.

15. a. The law professor/ who advised the committee/ also counseled the governor/ about the education program/ for underprivileged youth.

   b. The law professor/ who advised the committee/ often counseled the governor/ about the education program/ for underprivileged youth.

   c. The law professor/ who the committee advised/ also counseled the governor/ about the education program/ for underprivileged youth.

   d. The law professor/ who the committee advised/ often counseled the governor/ about the education program/ for underprivileged youth.

16. a. The sports reporter/ that commended the sponsor/ also praised the tennis player/ for showing up/ despite his injury.

   b. The sports reporter/ that commended the sponsor/ once praised the tennis player/ for showing up/ despite a serious injury.

c. The sports reporter/ that the sponsor commended/ also praised the tennis player/ for showing up/ despite his injury.

d. The sports reporter/ that the sponsor commended/ once praised the tennis player/ for showing up/ despite a serious injury.

17. a. The poet/ who admired the cellist/ also looked up to Harvey Keitel/ for his performance/ in Blue in the Face.

b. The poet/ who admired the cellist/ still looked up to Harvey Keitel/ for his performance/ in Blue in the Face.

c. The poet/ who the cellist admired/ also looked up to Harvey Keitel/ for his performance/ in Blue in the Face.

d. The poet/ who the cellist admired/ still looked up to Harvey Keitel/ for his performance/ in Blue in the Face.

18. a. The agent/ that was watching the Iranian/ also kept an eye on the shop-owner/ who was suspected of/ dealing with illegal weapons.

b. The agent/ that was watching the Iranian/ still kept an eye on the shop-owner/ who was suspected of/ dealing with illegal weapons.

c. The agent/ that the Iranian was watching/ also kept an eye on the shop-owner/ who was suspected of/ dealing with illegal weapons.

d. The agent/ that the Iranian was watching/ still kept an eye on the shop-owner/ who was suspected of/ dealing with illegal weapons..

19. a. The lawyer/ who contacted Allison/ will also get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

b. The lawyer/ who contacted Allison/ will later get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

c. The lawyer/ who Allison contacted/ will also get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

d. The lawyer/ who Allison contacted/ will later get in touch with her neighbors/ to discuss the problems/ with the new zoning law.

20. a. The Italian visitor/ that had instructed the opera singer/ will also teach Daniel/ in order to prepare him/ for his visit to Florence.

b. The Italian visitor/ that had instructed the opera singer/ will now teach Daniel/ in order to prepare him/ for his visit to Florence.

c. The Italian visitor/ that the opera singer had instructed/ will also teach Daniel/ in order to prepare him/ for his visit to Florence.

d. The Italian visitor/ that the opera singer had instructed/ will now teach Daniel/ in order to prepare him/ for his visit to Florence.

21. a. The customer representative/ who criticized the programmer/ will also reproach the manager/ for not responding/ to his email-requests.

b. The customer representative/ who criticized the programmer/ will probably reproach the manager/ for not responding/ to his email-requests.

c. The customer representative/ who the programmer criticized/ will also reproach the manager/ for not responding/ to his email-requests.

d. The customer representative/ who the programmer criticized/ will probably reproach the manager/ for not responding/ to his email-requests.

22.   a. The beauty queen/ that introduced the Nobel Prize winner/ will also present the famous conductor/ to the audience/ at Madison Square Garden.

     b. The beauty queen/ that introduced the Nobel Prize winner/ will now present the famous conductor/ to the audience/ at Madison Square Garden.

     c. The beauty queen/ that the Nobel Prize winner introduced/ will also present the famous conductor/ to the audience/ at Madison Square Garden.

     d. The beauty queen/ that the Nobel Prize winner introduced/ will now present the famous conductor/ to the audience/ at Madison Square Garden.

23.   a. The investor/ who endorsed the former businessman/ will also support Judge Smith/ in his campaign/ for reelection.

     b. The investor/ who endorsed the former businessman/ will now support Judge Smith/ in his campaign/ for reelection.

     c. The investor/ who the former businessman endorsed/ will also support Judge Smith/ in his campaign/ for reelection.

     d. The investor/ who the former businessman endorsed/ will now support Judge Smith/ in his campaign/ for reelection.

24.   a. The personnel committee/ that supervises the director of Human Resources/ will also oversee several departments/ related to employment/ and pay issues.

     b. The personnel committee/ that supervises the director of Human Resources/ will probably oversee several departments/ related to employment/ and pay issues.

     c. The personnel committee/ that the director of Human Resources supervises/ will also oversee several departments/ related to employment/ and pay issues.

     d. The personnel committee/ that the director of Human Resources supervises/ will probably oversee several departments/ related to employment/ and pay issues.

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