

Presupposition Processing and Accommodation: An Experiment on *wieder* ('again') and Consequences for Other Triggers

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Abstract This paper investigates the processing and accommodation of the presuppositions triggered by *wieder* ('again'). We conducted a word by word self-paced reading experiment where we presented sentences containing *wieder* in a context which furnished the relevant presupposition and one which did not. We then additionally asked questions to determine whether people accommodate the presupposition of *wieder* when it is not explicitly given in the context. The results show that effects due to a missing presupposition arise very early during reading and that there is no accommodation of the presupposition introduced by *wieder*. On the basis of this, we introduce the interpretation principle *minimize accommodation* and discuss what implications this brings about for other presupposition triggers. Another interesting result is a late increase in reading times in the condition which verifies the presupposition. We argue that this is due to the referential nature of *wieder*.

Keywords Presuppositions · Psycholinguistics · Presupposition processing · Accommodation · Self-paced reading

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1 Introduction

According to a theory which analyzes presuppositions as restrictions on appropriate contexts, the context set has to entail all the presuppositions of a sentence in order for the sentence to get a truth value. The context set is the set which contains all “possible worlds where all the propositions that are the background assumptions of speakers are true” (Stalnaker 1973, p. 450). What that means for a sentence like (1-a) is that the context set has to consist only of those worlds in which Susanne went skiing some time before last weekend. A semi-formal representation is given in (1-b) which states that the context set c has to be a set of worlds in which Susan went skiing at prior to last weekend.

- (1) a. Last weekend, Susan went skiing again.
 b. $c \Rightarrow \lambda w. \exists t[t < \text{last weekend} \ \& \ \text{skiing}(\text{Susanne})(w)(t)]$

If the context is not such that it provides the relevant presupposition, there are only two ways out: Either, the hearer of a sentence like (1-a) accommodates the relevant presupposition, i.e., s/he adjusts the context set in such a way that it only contains the worlds in which the presupposition is true, or s/he decides that the relevant piece of background information is missing and thus the whole sentence cannot receive a well defined interpretation. However, in the case of *wieder*, the matter is even more complicated than that. It has been argued by Soames (1982), Heim (1990), and Kamp and Rossdeutscher (1994) among others that the temporal variable in the presupposition of *wieder* is not existentially bound but receives its value from the context. Consequently, (1-b) has to look like (2) where t is not existentially bound, but remains free.

- (2) $c \Rightarrow \lambda w. t < \text{last weekend} \ \& \ \text{skiing}(\text{Susanne})(w)(t)$

So from a theoretical perspective, there are two issues that have to be looked at when it comes to the processing of *wieder*: 1. How and when is the presupposition of *wieder* checked in a given context, and 2. How is the free time variable processed. The first question relates to the processing of presuppositions in general. The second question, however, is interesting from a wider perspective of sentence interpretation. For decades, psycholinguists have been concerned with how bound and free variables are processed. Recent research (e.g. Frazier and Clifton (2000), Koornneef (2008)) has shown that there is a processing advantage for bound over free variables. The issue at hand is even more interesting since previous research on the processing of variables has almost exclusively focused on individual variables. To date there is only very little work on the processing of temporal variables. In fact, Dickey (2000) seems to be the only one who makes a serious effort to combine semantic theories of tense and processing hypotheses. Moreover, to our knowledge, there is no one out there who has looked at the processing of variables which are introduced at the level of presupposition.

The experiment presented in this chapter will look at the two issues of presupposition verification and variable assignment. Concerning the former, the focus is

on what happens when the presupposition of *wieder* is given versus not given in a certain context. When is the missing presupposition recognized by the processor? What happens when it is recognized? Does accommodation of the missing presupposition apply or does the processor give up on the sentence completely? Are there alternative routes? As it will turn out, the answers to these questions are intimately connected to the second issue of assigning a value to the free time variable. Does variable assignment interfere with presupposition verification? When does the free variable receive its value during online processing?

This paper is organized as follows: First, we will lay out the possible processing predictions on the matter of the missing presupposition that we can deduct from previous experiments on presuppositions. Second, we will present a self-paced reading study which is designed to investigate the issues laid out above. Finally, the results and their implication for the semantic theory will be discussed in the last section.

2 What happens When a Presupposition is Not Entailed by the Context?

There is already an abundant amount of work on the processing of definite NPs in the psycholinguistic literature, but a lot less on other presupposition triggers. But what can these results tell us about the processing of presuppositions in general? In the following, we will try to excerpt common underlying mechanisms uncovered by these studies and what they can tell us about the processing of presuppositions.

In one of the first experiments which are relevant to the issue of presupposition processing, Altmann and Steedman (1988) investigated in a self-paced reading fashion how sentences with a definite determiner are processed when the uniqueness presupposition is not met. Even though their actual goal was to test Frazier (1978)'s *Minimal Attachment Hypothesis*, their results turn out to be very relevant for a theory of presupposition processing. In their experiment, they had subjects read sentences along the lines of either (4-a) or (4-b).¹ They presented these test sentences in two different contexts. One which introduced two safes (3-a), and another one in which only one relevant safe was mentioned (3-b). By having the PP modifying *the safe* in (4-a), the uniqueness presupposition is met even when the sentence is presented in a context like (3-a), whereas this is not the case for a sentence like (4-b).

- (3) a. A burglar broke into a bank carrying some dynamite. He planned to blow open a safe. Once inside he saw that there was a safe with a new lock and a safe with an old lock.
 b. A burglar broke into a bank carrying some dynamite. He planned to blow open a safe. Once inside he saw that there was a safe with a new lock and a strongbox with an old lock.

¹ Slashes indicate the strings of words that were presented together at the same time.

- (4) a. The burglar/blew open/the safe/with the new lock/and made off/with the loot.
 b. The burglar/blew open/the safe/with the dynamite/and made off/with the loot.

The results reveal that reading times came apart on the disambiguating region (i.e. the PP *with the new lock* or *with the dynamite*). Test sentence (4-b) was read more slowly in the context which introduced two safes than all the other conditions. Moreover there was no difference in reading times for (4-a) in either (3-a) or (3-b). There was, however, a difference between (4-a) and (4-b) when presented in a context like (3-a) with (4-b) being read more slowly. This shows that when the uniqueness presupposition of the definite determiner is not met, people experience processing difficulties quite early, i.e., before the end of the sentence. However, the results of this experiment also suggest that comprehenders do not detect an unmet presupposition immediately (on the NP). It seems that the processor rather delays the evaluation of the presupposition until later. In this experiment, such a strategy turned out to be especially useful since the constituent following the NP made it obvious whether the presupposition was met or not. If comprehenders were to check the presupposition right away, one would expect an increase in reading times on the NP already. Moreover, one would expect these inflated reading times for both test sentences when presented in a context such as (3-a). Since there were no effects of that sort, it seems that the processor delayed the decision of whether the presupposition of the definite article is met or not met to a later, disambiguating region of the sentence.

In relation to this, the studies in van Berkum et al. (1999) and van Berkum et al. (2003) are relevant. In an experiment with spoken sentences, van Berkum et al. (2003) replicated the findings obtained from a written language experiment in van Berkum et al. (1999) that definite NPs evoke early ERP effects when the uniqueness presupposition is not met. Their material comprised of discourses like (5) and (6). In (5), the uniqueness of the NP **the girl** in the last sentence is verified because there is only one girl salient in the context. In (6) on the other hand, there are two girls introduced in the context which are both equally salient and hence the uniqueness presupposition of the definite determiner is violated.

- (5) David had told the boy and the girl to clean up their room before lunchtime. But the boy had stayed in bed all morning and the girl had been on the phone all the time. David told **the girl** that had been on the phone to hang up.
- (6) David had told the two girls to clean up their room before lunchtime. But one of the girls had stayed in bed all morning and the other girl had been on the phone all the time. David told **the girl** that had been on the phone to hang up.

The ERP results reveal that there is an early negative deflection on the critical noun (*girl*) in (6) when compared to (5). This deflection occurs about 300–400 ms after the acoustic onset of the noun. Van Berkum et al. (2003) take this to suggest that “referential ambiguity” is detected very early during sentence comprehension. This can also be interpreted as saying that the unmet presupposition of the definite determiner leads to early effects in ERPs. What is crucial here is that even though the test items were such that there was a disambiguating relative clause after the NP, initial processing of the presupposition was not delayed until this part of the sentence had been

heard/read. In other words, interpreters checked the presupposition in the context as early as hearing/reading the noun and encountered a problem when it was not given even though they knew that the succeeding discourse could in principle still save the sentence from presupposition failure. This is an interesting result because it contrasts with the result found in Altmann and Steedman (1988) in the way that the ERP data suggest that the presupposition of *the* is checked as soon as possible regardless of what might follow afterwards. Without knowing how exactly the filler items in the three experiments looked like, it is hard to say how these different effects come about. It may well be that in the study of Altmann and Steedman (1988), subjects developed a processing strategy in which they always waited for the disambiguating PP before caring about the presupposition. The same could hold for the material in van Berkum et al. (1999) and van Berkum et al. (2003), but since these were physiological rather than behavioral studies, they can give us an even deeper understanding of what happens cognitively during sentence processing. Whatever the exact reasons for this difference in timing are, at this point it is sufficient to acknowledge that the electrophysiological experiment clearly shows that people realize the unmet presupposition of a definite NP at the earliest point possible, even though it might still be amended later on in the sentence.

Another ERP study which gives interesting insights in the processing of the presupposition of the definite determiner, is found in Burkhardt (2006). This paper reports an experiment in which a target sentence with a definite NP like (8) was presented in three different contexts. The *given* context in (7-a) explicitly introduces the individual which the definite NP refers to. The other two contexts do not explicitly verify the existence presupposition of the definite, but it can be inferred in the *bridged* condition (7-b), whereas this is not possible in the *new* condition in (7-c).

- (7) a. Tobias visited a conductor in Berlin.
 b. Tobias visited a concert in Berlin.
 c. Tobias talked to Nina.
- (8) He said that the conductor was very impressive.

The results show an early negative deflection 400 ms after the noun onset in the new condition (N400). This effect was less pronounced in the bridged condition. This shows that when the existence presupposition of the definite determiner is not given, an N400 emerges, parallel to what van Berkum et al. (2003) found for sentences where the uniqueness presupposition was violated. This effect is not as strong when the relevant individual can be easily inferred from the context. Most importantly however, Burkhardt (2006) found a late positive effect (P600) in the new and in the bridged condition when compared to the given condition. The author concludes that this “suggests that the respective discourse units are fully integrated at this point, indicating that an independent discourse referent is identified to be stored and maintained in discourse representation” (Burkhardt 2006, p. 166). In the words of a presupposition theory, the late positive deflection might be taken to signify accommodation.

Other presupposition triggers which have been studied by the means of online methods are German *auch* ('too'), English *also* and factives such as *to know*.

In a reading experiment using self-paced reading, Schwarz (2007) investigated the processing of German *auch* ('too') and English *also*. Since the results are roughly the same for both languages, we will only discuss the experiment conducted in English here for ease of presentation. In this experiment, subjects were asked to read sentence along the lines of (9).

- (9) 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.

The sentences were constructed in such a way that the presupposition of *also* (that there is another $x \neq$ the mayor, such that the congressman wrote to x) is given in (9-a), but not in (9-c). The sentences in (9-b) and (9-d) do not trigger the relevant presupposition and were thus used as controls. The results show that a sentence like (9-a) was read faster than a sentence like (9-c) on the region containing *also*. This can again be seen as evidence for an early presupposition processing since the mode of presentation in this experiment was such that the string of words that *also* was presented with already made the presupposition evident. However, it fails to pinpoint the exact point in time at which presupposition processing takes place.

A similar point applies to Inhoff (1985)'s eye-tracking study. The author had subjects read a text in which some of the sentences were such that a non-factive (a)/factive (b) verb embedded a false (according to world knowledge) clause. An example is given below.

- (10) ... Today was an arithmetic test. The teacher asked little Tom. He {(a) said/(b) knew} that two and two equalled three. ...

On the false complement, there was a significant difference in first gaze durations where the complement was read more slowly when presented after a factive verb than after a non-factive verb. Inhoff (1985) concludes that "the finding that lexical presuppositions affected the interpretation of the false complement suggests that reader's sentence interpretation was based not only on their empirical and analytical knowledge but also on their linguistic knowledge". The interesting finding is here that people did not experience processing difficulties on the false complement per se, but only when it was embedded under a verb which presupposes its complement to be true. This is just one more experiment which shows that presuppositions play an important role in sentence understanding. However, again the critical region looked at was so large (the whole complement), that we cannot determine precisely at which point the presupposition started to have an effect on people's reading times.

These experiments tell us a lot about the processing of presuppositions and the definite determiner in particular. First, that effects connected to presuppositions do arise with a wide variety of modalities (behavioral and physiological). Second, early deflections in ERPs indicate that presuppositions (at least the one of the definite determiner) are computed as soon as possible.

However, it would be premature to conclude from these experiments that all presupposition triggers are processed in the same way. We have already discussed that there are substantial semantic differences between a trigger like *again* on the one hand and the definite determiner on the other hand. Another issue which is not really answered by the experiments presented here is when the presupposition of a trigger other than the definite is processed. Those studies that investigated other triggers were set up in such a way that it is not possible to track the exact time course of presupposition processing, simply because the regions analyzed were too large. Additionally, it is not clear what happens when a presupposition is not given in the context. While Schwarz (2007) concludes that his results show that the presupposition of *also* is not accommodated, Burkhardt (2006) seems to suggest that the effects obtained in her experiment signify accommodation. The experiment in this paper is designed to provide answers to these questions.

3 Experiment: *wieder* in Supporting and Neutral Contexts

The experiment presented in this section aims to address the questions laid out above. The two central questions are: 1. How is the presupposition of *wieder* processed?, and 2. What is the exact time course of this process? An additional issue which will be looked at in this experiment is the notion of accommodation. Most theories of presuppositions assume that in case of presupposition failure, a sentence will either be undefined or the relevant presupposition will be accommodated. Since it has been argued for triggers like *again* and *too* (cf. Kripke (2009), Beaver and Zeevat (2008)) that their respective presuppositions are especially hard to accommodate, it is especially interesting to test experimentally how people deal with sentences containing *again* in a context which does not support its presupposition.

To this end, we set up an experiment using self-paced reading (SPR) with questions which targeted the presupposition of *again*. As we have seen in Schwarz (2007)'s experiments on *auch* and *also*, SPR is sensitive enough to capture presupposition related effects. The present study extends on Schwarz (2007)'s experiments in that it presents target sentences in a word by word fashion. This ensures that effects due to the presupposition will emerge as soon as they arise during sentence processing.

3.1 Method and Materials

The basic idea was to present a target sentence with one of two context sentences which differed as minimally as possible. In order to do this, we created 40 items along the lines presented below, where the presupposition of (12)-a is given in (11-b) (supporting context), but not in (11-a) (neutral context), and the presupposition of (12)-b is given in (11-a) (supporting context), but not in (11-b) (neutral context). In order to prevent anticipation, we additionally constructed target sentences where the subject of the target sentence was not the beneficiary but the agent.

- (11) a. Letzte Woche hat Linda Judith eine rosa Lampe für ein Zimmer
last week has Linda Judith a pink lamp for a room
gekauft.
bought
Last week, Linda Judith a pink lamp for a room.
- b. Letzte Woche hat Judith Linda eine rosa Lampe für ein Zimmer
last week has Judith Linda a pink lamp for a room
gekauft.
bought
Last week, Judith bought Linda a pink lamp for a room.
- (12) Vor zwei Tagen hat {(a) Linda /(b) Judith} wieder eine rosa Lampe
ago two days has {(a) Linda /(b) Judith} again a pink lamp
erhalten, als sie mit einer Freundin unterwegs war.
received, when she with a friend out was
Two days ago, {(a) Linda /(b) Judith} received a pink lamp again, when
she was out with a friend.

Apart from the 40 experimental items, we created 40 filler items in order to mask the purpose of the experiment. The filler items were constructed in a parallel fashion to the experimental items. Crucially, they did not contain the presupposition trigger *wieder*. After each (experimental and filler) sentence we asked multiple-choice comprehension questions with three possible answers to choose from. For one third of the experimental items, the question targeted the content of the presupposition directly. An example of such a question is (13-a) with the possible answers in (13-b).

- (13) a. How many pink lamps did {Linda/Judith} receive?
b. Cannot be answered/one/at least two

In those cases where the question did not target the presuppositional content of the sentence, they addressed information introduced either by the context sentence or the test sentence, like the one in (14).

- (14) a. Who was {Linda/Judith} out with?
b. Cannot be answered/a friend/her father

We included the option *cannot be answered* to explore the possibility that an unaccommodated presupposition leads to the uninterpretability of the sentence it occurs in. In order not to make it a viable answer only in the questions concerning the presupposition, *cannot be answered* was always one of the three possible answers

displayed. Therefore, we also included questions that really could not be answered on the basis of the information given in the context and the target sentence.

The experiment was programmed using the ERTS language. The experiment was divided in eight randomized lists. All participants came in two times. Each time they were given four of the eight randomized lists. The order of the eight lists was counterbalanced across participants. A global context was provided in the beginning of the experiment in order to introduce the relevant characters. Responses were collected via an external keyboard consisting of six separate keys.

A trial began with the presentation of a warning signal that consisted of five stars. Then the context sentence was presented. A self-paced reading paradigm was used for the critical target sentence that followed. Participants were presented the sentence word by word. Reading times were collected by having the reader press a response key after each word. Thus, reading times were measured on-line. The end of a sentence was signaled by a full stop. After that, participants had to rate the acceptability of the test sentence with respect to the context sentence on a four item rating scale (1 = very bad 2 = rather bad 3 = rather good 4 = very good). Participants were given an even number of points on the scale to choose between in order to guarantee that they had to express a tendency towards acceptability or unacceptability. They delivered their judgment by pressing a corresponding button. After the end of each trial, the comprehension question was asked.

Sixteen subjects participated in the experiment. Most of them were students of the University of Tübingen (13 women; mean age = 24,38; age range = 18–37). They were native speakers of German and had normal or corrected to normal vision.

3.2 Results

The analyses were carried out using the R programming language (R Development Core Team) as linear mixed models, using the program *lmer* (Bates 2005). The fixed factor was context (neutral/supporting). The random factors were subjects and items. Additionally, models with random slopes for both subjects and items were calculated. When an ANOVA revealed a significant difference between the models, we included the more complex model in our analysis. For each of the analyzed words, trials were deleted if they deviated by 3 SD or more from the mean reading time of the respective word.

3.2.1 Questions

All participants answered more than 75 % of the comprehension questions which did not target the presupposition correctly, suggesting that the participants paid ample attention. The Average accuracy was 91 %. The mean accuracy was not influenced by the context (supporting or neutral) the target sentence appeared in; in both contexts, mean accuracy of the answers was 91 %. Regarding the questions which targeted the presupposition, there were differences with respect to the two different contexts. In

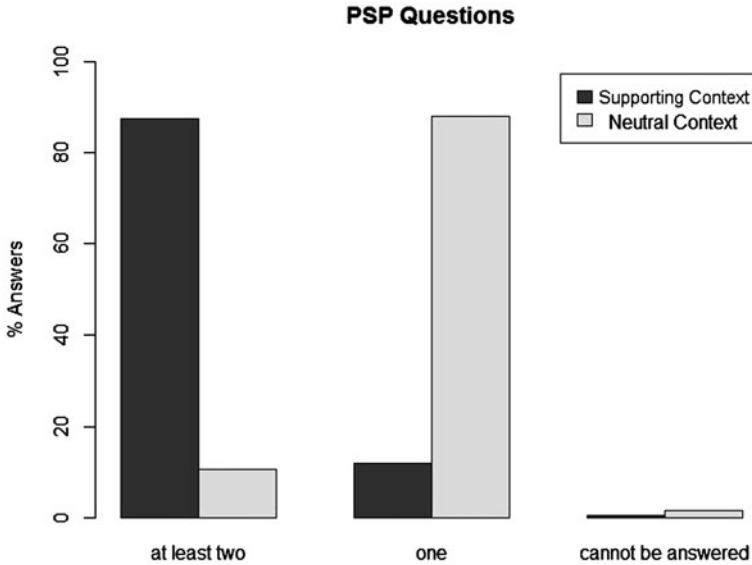


Fig. 1 Answers for questions targeting the presupposition content—mean answers

a supporting context, people answered the presupposition question with *at least two* 87.5 % of the time, with *one* 12 %, and with *cannot be answered* 0.5 % of the time. When the target sentence was presented in a neutral context, 10.5 % of the answers were *at least two*, 88 % were *one*, and 1.5 % of the time subjects chose *cannot be answered* (see Fig. 1).

3.2.2 Acceptability Judgments

Regarding the acceptability judgments elicited, sentences in a neutral context averaged around 1.9, whereas sentences in a supporting context received a mean rating of 3.6. This difference was significant ($|t| = 8.24$, $p < .001$).

3.2.3 Reading Times

The reading times for each word are listed in Table 1. On the critical word, i.e., the word at which the content of the presupposition of *wieder* was evident (*erhalten* in (12), repeated in (15)), reading times in the neutral context condition were significantly longer than in the supporting context condition ($|t| = 2.927$, $p < 0.05$). This effect was still marginally significant in the spillover region ($|t| = 2.262$, $p = 0.058$), and subsided after that on spillover +1 ($|t| = 0.609$, $p > 0.1$). On word 14 and 15 (*einer Freundin* in (15)), the sentence in the neutral context condition was read significantly faster than in the supporting context condition ($|t| = 2.51$, $p < 0.05$, and $|t| = 2.812$, $p < 0.05$ respectively) (Fig. 2).

Experimental Perspectives on Presuppositions

Schwarz, F. (Ed.)

2015, VIII, 262 p. 58 illus., Hardcover

ISBN: 978-3-319-07979-0