Psycholinguistic Evidence for Presuppositions: On-line and Off-line Data

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Abstract. This paper presents three self-paced reading studies on the processing of presuppositions. In these studies, we investigated the predictions a classical theory of presuppositions would make for the cognitive processing of presuppositions. This concerns mainly the triggering of presuppositions, their verification in a given context and their accommodation in cases where they are not supported by the context. Our studies revealed not only that presuppositions are evaluated on-line, but also that the classical theory of presuppositions makes solid predictions about their processing.

1   Motivation

For decades, presuppositions (PSPs) have been a vital topic in the semantic and pragmatic literature (see Beaver & Geurts (to appear) and the literature discussed therein). Up to the present, however, very basic issues surrounding the notion of PSP have not yet been resolved. They primarily concern the linguistic source of PSPs ("triggering problem") and their behaviour in compound sentences ("projection problem"). It seems fair to say that there is as yet no agreement on what the right theory of PSP is. In recent years, a venue of PSP theory has developed which involves empirical studies, using psycholinguistic methods. These efforts seek to understand PSPs via the way they are processed and evaluated by speakers (e.g. Schwarz 2007, Chemla 2009, Chemla & Bott 2010). Most of these studies deal with very elaborate questions concerning PSPs such as projection in quantified sentences or local versus global accommodation. The goal of our three studies is to go to the very core of PSP processing. This means that we first want to clarify basic questions such as whether it is possible to capture the processing of PSPs at all. Schwarz's (2007) findings suggest that the processing of PSPs can be made visible within a self-paced reading paradigm. We therefore set up our three experiments to be self-paced reading studies as well, albeit with more basic questions such as 'When are PSPs triggered?' (trigger study), 'When are PSPs validated within a context?' (verification study), and 'When does accommodation take place?' (accommodation study). In this paper, we present the predictions that a classical theory of PSPs makes about their

processing and report the results from three studies that were conducted to test these predictions.

2   Theoretical Background

In the following subsections, we will lay out what we call a classical theory of PSPs (cf. Heim 1990, Stalnaker 1973, Heim & Kratzer 1998), and the predictions this theory makes for sentence processing.

2.1   Classical Theory of Presuppositions

PSPs are restrictions on appropriate contexts. This means that (1) is only felicitous in a context that entails that Sue is a linguist.

(1)   Pete knows that Sue is a linguist.

It is generally assumed that the PSP is encoded in the lexical entry of the PSP trigger. Therefore the definition of the PSP trigger *know* in (2) entails that the truth value of a sentence containing the trigger may be undefined in a world.

(2) $[[know]] = \lambda w. \lambda p. \lambda x: p(w) = 1.$ x believes p in w

The compositional outcome of our example in (1) in the notation of Heim & Kratzer (1998) would then be:

(3) λw: Sue is a linguist in w. Pete believes that Sue is a linguist in w

This means that the PSP as definedness condition is inherited by the whole sentence. As mentioned before, (1) can only be uttered felicitously in a context which entails that Susan is a linguist. (4) states this restriction more precisely where c is Stalnaker's context set. This is the set which contains all "possible worlds where all the propositions that are the background assumptions of speakers are true" (Stalnaker 1973: 450).

(4) $c \subseteq \{w$: Susan is a linguist in $w\}$

A sentence S can only be added to c if c entails the PSP of S, more formally:

(5)   S is only felicitous in c if for all $w \in c$: $[[S]]$ (w) is defined

This explains how a PSP as undefinedness (the output of semantic computation) is mapped to appropriateness in a context. Von Fintel (2003) calls (5) Stalnaker's Bridge. For our example in (1) this means that it can be added to a context only if the context establishes the PSP (that Sue is a linguist). If so, it gets updated with the proposition that Pete believes that Sue is a linguist.

(6) λc: c ⊆{w: Sue is a linguist in w}.c∩{w':believe(w')(λw.Sue is a linguist in w)(Pete)}

2.2 Predictions

With the classical theory as a starting point, we can derive three predictions with respect to the processing of PSPs. In a sentence like (7) we identified three key areas where we expect semantic peculiarities which should be reflected in the processing.

(7) Pete *knows* that Sue is a **linguist**, <u>while Kim's job is unknown</u>.

The first area of interest is the trigger itself (here: *know*). Because the PSP that is semantically encoded in the trigger alerts the reader that she will have to look back at the preceding context, we would expect higher processing costs for a trigger in contrast to a word which does not trigger a PSP, e.g. *believe*. This should then be reflected in longer reading times on the trigger when compared with a non-trigger. We investigated this prediction in our trigger study.

The second area where the theory leads us to expect an effect is the critical word (here: *linguist*). This is the point at which it is known what the content of the PSP is. Thus, a verification process with the context should be started. Our hypothesis is that the explicit falsification of a PSP in the context causes higher processing costs at this point than the explicit verification. Therefore we expect longer reading times on the critical word in a context where the PSP of the sentence (that Sue is a linguist) is falsified than in a context where this PSP is verified. Our verification study aims at exploring this prediction.

The last interesting area is the sentence continuation (everything from the critical word onwards). This is so, because in the case when a PSP is neither falsified nor verified in the context, accommodation should kick in (Lewis 1979). In order to make sense of the sentence, the addressee will update the context with the information conveyed by the PSP. The expectation would thus be that this part of a presuppositional sentence should be harder to process when its PSP is neither verified nor falsified by the context (we will call this kind of context a *neutral context*). In our accommodation study, we investigate whether the continuation of a presuppositional sentence in a neutral context evokes longer reading times than in a falsifying or verifying context.

3   Studies

The following section reports three studies which test the predictions of the classical theory. Since we expected different triggers to behave differently (cf. Abusch 2009), we selected a range of different triggers from the literature (iterative: *wieder* (again), definite NP: *sein/e/s* (his), additive particle: *auch* (too), aspectual verb: *aufhören* (to stop), factive verb: *wissen* (to know)). These triggers were the same throughout all the experiments.

3.1   General Procedure

Participants were seated comfortably in a sound-attenuated room. The stimulus material was presented on a computer screen in white on a blue background. First, participants read a global context which introduced the acting people in the test material. Then the trials were presented. A trial began with the presentation of a warning signal followed by a context sentence, which was depicted as a complete sentence in the middle of the computer screen. After participants had read the context sentence, they pressed a button to request the test sentence. The test sentence was presented word-by-word in a self-paced manner, i.e., the participants demanded each word by a button press. Reading time was measured on-line. After reading the test sentence, participants rated the acceptability of the test sentence within the given context on a four-point scale. This scale ranged from very bad (1) to very good (4). Before each experimental session, participants worked on practice trials to get familiar with the experimental procedure. At the end of each session, they answered yes/no questions. These comprehension questions were included to ensure that participants processed the sentences attentively at a semantic level.

3.2   Trigger Study

3.2.1   Methods and Material

Thirty native speakers of German (24 women; mean age = 21.9; age range = 19-29) participated in this experiment. Most of them were students from the University of Tübingen. They had normal or corrected to normal vision. They were paid 20 Euros or got course credit for participation.

Sixty sets of experimental sentences were constructed. Each set consisted of a context sentence and three test sentences. The context sentence served as neutral context (8). The test sentences contained either a PSP trigger (9), a neutral word at the same position as the trigger which makes the sentence se-mantically acceptable (10), or a word at the same position that makes the sentence semantically unacceptable (11).

(8) Tina ist mit einer guten Freundin shoppen.
Tina is with a   good   friend   shopping.
'Tina is shopping with a good friend.'

(9) Sie kauft wieder rote Handschuhe.
She buys   again   red   gloves.
'She buys red gloves again.'

(10) Sie   kauft heute   rote Handschuhe.
She   buys today   red   gloves.
'She buys red gloves today.'

(11) *Sie kauft freundlich   rote Handschuhe.
 She buys friendly   red   gloves.
'She buys red gloves friendly.'

We created twelve experimental sentence sets for each of our 5 PSP triggers (resulsting in a total of 60 sets). The stimulus material was randomly divided into three parts. The three test sentences of one experimental sentence set were presented in different sessions on different days. The order of presentation was balanced according to a balanced latin square. This was done to make the design and conditions non-obvious to the participants. To avoid response strategies and to mask the purpose of the study, thirty filler sentence sets were constructed. The filler sentence sets were designed similarly to the experimental sentence set concerning their acceptability, but did not include PSP triggers. They were randomly intermixed in the experimental sessions. At the end of one session, twenty out of sixty yes/no comprehension questions (e.g. "Did Tina buy blue gloves?") were presented.

The design included the factors SENTENCE CONDITION (PSP, acceptable, unacceptable) and TYPE OF TRIGGER (*wieder, auch,* definite NP, *aufhören, wissen*). Besides the off-line measures of the acceptability, the reading time of the word before the trigger (trigger -1), the trigger itself, the word following the trigger (trigger + 1) and the final word of a sentences as well as the reading time of the whole sentence (total, mean of all words within a sentence) was measured as on-line data and calculated per letter as dependent variable. The statistical analyses were carried out by analyses of variance (ANOVA). To investigate specific differences between conditions, contrast analyses were performed.

3.2.2 Results

For the acceptability judgments we focused on the influences by the CONTEXT/ SENTENCE CONDITION and TYPE OF TRIGGER, as well as on the in-

teraction of the two factors. For the reading times we report only the influence of CONTEXT/ SENTENCE CONDITION.

Off-line Data
The statistical analysis revealed that the factor SENTENCE CONDITION influenced the acceptability judgements (F (2, 58) = 574.69, p < .01). The contrastive analysis showed that all context conditions differed from each other (p < .01) in the way that acceptable sentences were judged best, followed by the sentences with a PSP trigger, and the unacceptable sentences (see Figure 1 left side). TYPE OF TRIGGER additionally influenced acceptability judgments (F (4, 116) = 51.76, p < .01). There was also an interaction between SENTENCE CONDITION and TYPE OF TRIGGER (F (8, 232) = 23.86, p < .01).
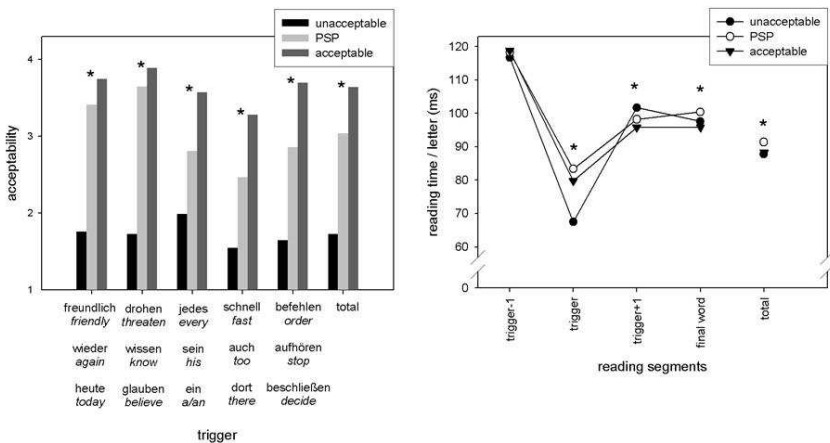

Figure 1.   Left side: Mean Acceptability values for target sentences. Right side: Reading times for the words of interest. The asterisk marks significant differences between sentence conditions.

On-line Data
Reading times for the words of interest are presented in Figure 1 (right side). There was no effect of SENTENCE CONDITION for the word before the trigger (F (2, 58) = 1.38, p > .25). Importantly, however, reading times differed depending on SENTENCE CONDITION for the PSP trigger (F (2, 58) = 179.62, p < .01). The longest reading times were needed for the PSP trigger, less long reading times for the word of the acceptable condition and the least long reading times for the word of the unacceptable condition (all ps < .01). SENTENCE CONDITION evoked a further effect on the word following the

trigger (F (2, 58) = 12.74, p < .01). The reading times were longest for the words of the unacceptable sentence condition, less long for the words of the sentences with a PSP and least long for the words of the acceptable sentence condition (all ps < .05). An effect of SENTENCE CONDITION was also observed on the final word (F (2, 58) = 3.82, p < .05). Longer reading times were needed for the words of the PSP condition compared to the words of the acceptable conditions (p < .05). The reading time of the unacceptable condition did not differ from the others (all ps > .09). The reading times for the whole sentence also differed depending on SENTENCE CONDITION (F (2, 58) = 21.52, p < .01). They were longer for sentences containing a PSP compared to the other conditions (p < .01), but the other two conditions did not differ (p > .33).

3.3 Verification Study

3.3.1 Methods and Material

Twenty-five native speakers of German (18 women; mean age = 24.68; age range = 19-67) participated in the second experiment. Most of them were students from the University of Tübingen. They had normal or corrected to normal vision. They were paid 16 Euros or got course credit for participation. The data of one participant had to be excluded from the analysis because he did not reach 75% correctness for the comprehension questions.

In this study we constructed two different context sentences. Each context sentence (12, 13) was paired with two test sentences (A, B) in such a way that the content of the test sentence's PSP was verified (12A, 13B) or falsified (12B, 13A) by the context. If the content of the PSP of a test sentence was verified by one context sentence, it was falsified by the other context sentence and vice versa. This design allows the comparison of the same test sentences under a verified and a falsified PSP. Altogether, sixty sets of experimental sentences (twelve sets for each trigger type) were created.

(12)   Susanne hat dieses Jahr bereits   rote Handschuhe gekauft.
       Susanne had this   year already red   gloves   bought.
       'Susanne had already bought red gloves this year.'

   A   Heute   hat Susanne wieder rote Handschuhe gekauft und
       Today   has Susanne again   red gloves   bought and
       sie   gleich   angezogen.
       them immediately   put on.
       'Today, Susanne bought red gloves again and put them on right away.'

   B   Heute   hat Susanne wieder keine roten Handschuhe gekauft
       Today   has Susanne again   no   red   gloves   bought

und ärgert sich.
and   is very upset
'Today, Susanne didn't buy red gloves again and is very upset.'

(13) Susanne hat bisher   nie   rote Handschuhe gekauft.
Susanne had until now   never red   gloves   bought
'Susanne had never bought red gloves until now.'

B Heute   hat Susanne wieder keine roten Handschuhe gekauft
Today has Susanne again   no   red   gloves   bought
und ärgert sich.
and is very upset
'Today, Susanne didn't buy red gloves again and is very upset.'

A Heute hat Susanne wieder rote Handschuhe gekauft und
Today has Susanne again   red   gloves   bought and
sie   gleich   angezogen.
them   right away   put on
'Today, Susanne bought red gloves again and put them on right away.'

To avoid repetitions of sentences of the same set, the stimulus material was divided into four sessions. Each possible pair of a context and a test sentence was presented in a different session. Participants completed each session on a different day.

The experiment included the factors CONTEXT CONDITION (PSP verifying context vs. PSP falsifying context) and TYPE OF TRIGGER. Acceptability judgments and reading times (per letter) of single words were collected analogous to Study 1. We expanded the analysis to one additional word, the so-called critical word. This is the word on which the content of a PSP is known to be verified or falsified by the context. In the above mentioned example it is the verb *bought*.

3.3.2 Results

Off-line Data

CONTEXT CONDITION influenced the acceptability judgments ($F_{(1, 23)} = 484.53$, $p < .01$) in that sentences in a PSP verifying context were judged better than sentences in a PSP falsifying context. The factor TYPE OF TRIGGER additionally influenced acceptability judgments ($F_{(4, 92)} = 213.40$, $p < .01$) and there was also an interaction between CONTEXT CONDITION and TYPE OF TRIGGER ($F_{(4, 92)} = 91.79$, $p < .01$). Acceptability judgments are presented in Figure 2 (left side).
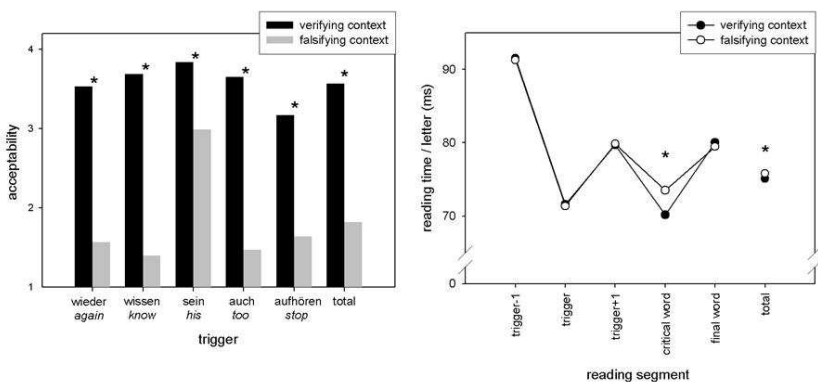
Figure 2. Left side: Mean Acceptability values for target sentences. Right side: Reading times for the words of interest. The asterisk marks significant differences between sentence conditions.

On-line Data

Reading times for the words of interest are presented in Figure 2 (right side). There were no effects of CONTEXT CONDITION on reading times for trigger –1, trigger, trigger + 1, and the final word (all *ps* > .59). Most importantly, however, reading times differed depending on CONTEXT CONDITION on the critical word (F (1, 23) = 12.66, $p < .01$). Longer reading times were needed for the falsifying context condition compared to the verifying context condition. This effect propagates to the whole sentence as longer reading times were needed for the falsifying context condition than for the verifying context condition (F (1, 23) = 4.87, $p < .05$).

3.4 Accommodation Study

3.4.1 Methods and Material

Thirty native speakers of German (21 women; mean age = 25.33; age range = 19-38) participated in the third experiment. Most of them were students from the University of Tübingen. They had normal or corrected to normal vision. They were paid 15 Euros or got course credit for participation.

Sixty sets of experimental sentences were created. One set consisted of three different context sentences (14, 15, and 16) and one test sentence (17) that contained a PSP. Each context sentence of a given set was presented with the test sentence. The context sentence verified the content of the PSP of the test sentence (14), falsified the PSP's content (15), or was neutral with respect to the PSP (16). Hence there were three different context conditions.

This design again allows the comparison of the same sentence in different experimental conditions. The stimulus material was presented in three sessions, where each context sentence of an experimental sentence set was presented in a different session. Participants worked on the sessions on different days and the order of sessions was balanced across participants.

(14) Susanne hat   bereits rote Handschuhe gekauft.
     Susanne had   already red   gloves   bought.
     'Susanne had bought red gloves before.'

(15) Susanne hat   bisher   nie   rote Handschuhe gekauft.
     Susanne had   until now never red   gloves   bought.
     'Susanne had never bought red gloves until now.'

(16) Inge hat bisher   nie   rote Handschuhe gekauft.
     Inge had until now never red   gloves   bought.
     'Inge had never bought red gloves until now.'

(17) Heute hat Susanne wieder rote Handschuhe gekauft und sie
     Today has Susanne again   red   gloves   bought and them
     gleich   angezogen.
     immediately   put on
     'Today, Susanne bought red gloves again and put them on right away.'

Analogous to Experiment 1 and Experiment 2, thirty filler sentence sets were designed in parallel to the experimental sentence sets but without a PSP. At the end of each session, twenty out of sixty yes/no comprehension questions were presented.

The experiment included the factors CONTEXT CONDITION (PSP verifying context, PSP falsifying context, PSP neutral context) and TYPE OF TRIGGER. The same words that were investigated in the second experiment were also investigated in the third experiment.

3.4.2 Results

Off-line Data

As in the previous Studies, the factor CONTEXT CONDITION influenced the acceptability judgements (F (2, 46) = 377.20, p < .01). The contrastive analysis showed that all context conditions differed from each other significantly (all ps < .01) in that sentences with a verifying context were judged best, followed by the sentences with a neutral context, and the sentences with a falsifying context (see Figure 3 left side). TYPE OF TRIGGER additionally influenced acceptability judgments (F (4, 92) = 35.30, p < .01).

An interaction between CONTEXT CONDITION and TYPE OF TRIGGER was observed (F (8, 184) = 61.41, p < .01).
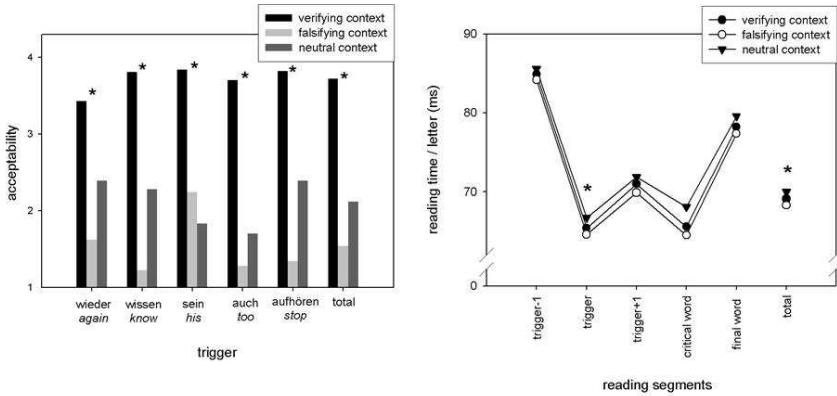

Figure 3.   Left side: Mean Acceptability values for target sentences. Right side: Reading times for the words of interest. The asterisk marks significant differences between sentence conditions.

On-line Data

Reading times for the words of interest are presented in Figure 3 (right side). There were no meaningful significant effects of CONTEXT CONDITION on reading times for trigger − 1, trigger + 1, the critical word, and the final word (all ps > .07). Reading times differed depending on CONTEXT CONDITION for the PSP trigger (F (2, 46) = 3.96, p < .01). Longer reading times were needed in the neutral context condition compared to the falsifying context condition (p < .01). The reading time of the verifying context condition did not differ from the others (all ps > .08). A similar pattern was present in reading times for the whole sentence (F (2, 46) = 3.68, p < .01). Reading times were longer in the neutral condition than in the falsifying condition (p < .01), but the reading times of the verifying context condition did not differ from the others (all ps > .15). A theoretical interesting trend of CONTEXT CONDITION on reading times on the critical word was observed (F (2, 46) = 2.83, p < .08).

4   Discussion

Off-line Data

The off-line data of the trigger study and the accommodation study provide further interesting results for the theory of PSP triggers. In both experiments, *auch* (too) and *sein* (his) got the lowest acceptability ratings in neutral con-

texts. The result for *auch* is not very surprising since the additive particle is commonly regarded as a "hard-core" trigger (Kadmon 2001: 207) whose PSP is very hard to accommodate. The appearance of *auch* is thus highly in-appropriate in a context which does not entail its PSP. It is however interesting that the definite NP patterns with *auch* in this respect. The definite article is commonly seen as a soft trigger which does not impose a lot of difficulties when uttered in a context which does not entail the PSP of the sentence. In fact, Spenander (2002) found in a corpus study that 58% of the definite determiners in spoken language are used in a context which does not provide a salient referent. Yet, the acceptability rates of the two experiments show us that the use of the definite determiner in a neutral context does not go through as smoothly as expected. A theoretical discussion of these results would go beyond the scope of this paper, but it becomes apparent that the class of PSP triggers is not as homogenous commonly assumed. This has already been discussed in Abusch (2009) and should receive further attention in future theoretical considerations.

Surprising are the relatively good acceptance rates for the definite determiner in supposedly falsifying contexts in the verification and the accommodation study. It has to be noted that in 50% of the falsifying contexts, we tried to explicitly falsify the uniqueness condition of the definite determiner (e.g. "Fritz has two dogs. Susanne fed his dog."). Bade (2010) concludes that these results suggest "that the uniqueness condition for singular definite descriptions is not a very strong one". They thus support Heim (1983) in denying Russell (1905) and claiming that definites "presuppose existence but not uniqueness" (Heim 1983: 233).

On-line Data

The hypotheses we started out with on the basis of the classical theory of PSPs are repeated below and on the next page.

I. **Trigger:**   Needs more attention because it alerts the reader that she will have to look back at the preceding context
⇒longer reading time of a trigger vs. a neutral word

II. **Critical Word:** It is known what the content of the PSP is. A verification process is started immediately.
⇒longer reading time when verification fails vs. succeeds

III. **Continuation:** Accommodation in case the PSP is neither verified nor falsified in the context

$\Rightarrow$ longer reading time in neutral contexts vs. verifying/falsifying contexts

The trigger study provides supporting evidence for prediction I. The results of this experiment revealed that words which trigger a PSP evoked significantly longer reading times than words which do not trigger a PSP. A cautionary remark: It is obvious that we have to deal with the fact that we are talking about three different words here. We tried to match them in frequency using the CELEX database (Baayen, Piepenbrock, & van Rijn 1993) and length, but this was not always possible. However, the effect we find on this word cannot be due to a frequency effect, which would predict that more frequent words are read faster, since the PSP trigger was always the most frequent word ($M = 1334.10$ in 6 million), the word in the acceptable condition was the second most frequent word ($M = 379.31$ in 6 million), and the word in the unacceptable condition the least frequent word ($M = 85.98$ in 6 million). A further interesting effect emerges after the word of interest. In the semantically unacceptable condition, reading times increase after the word of interest but decrease relatively quickly after that. In the PSP condition however, reading times are significantly longer compared to the control condition with the semantically acceptable word throughout. In other words, whilst the semantically unacceptable condition imposes processing difficulties for a rather short time span, the PSP condition is more difficult to process once the PSP trigger is known. This is also reflected in the reading times on the whole sentence where only the PSP condition differs significantly from the other two conditions. Since the sentences with a PSP were presented in a context which was neutral with respect to the content of the PSP, the processing difficulties can be assumed to reflect the cost that arises when the reader tries to incorporate the content of the PSP in the context. That is when the reader goes through the process of accommodation. This observation is supported by the results of the accommodation study.

In the verification study, we saw that a sentence carrying a PSP in a falsifying context needs longer to read on the critical word than in a verifying context. This study provides us thus with supporting evidence for the second prediction. Our hypothesis about this region of the sentence is that at this point, Stalnaker's Bridge applies and it becomes evident that a sentence is used inappropriately in the case where the PSP is explicitly falsified by the context. This conflict between the PSP of the sentence and the context is mirrored in the longer reading times on the critical word in the falsifying condition. The verification study reveals that PSP justification is checked as soon as the reader encounters the critical word.

The accommodation study shows that sentences carrying a PSP in a neutral context take longer to read on the critical word than the same sentence within a context which explicitly falsifies or verifies the content of the presupposition. This is to be expected from the theory, because at some point, the processor will start to search the context set for the relevant information. In the verifying context, the information is readily available. In the falsifying context, the PSP is established to be false. In the neutral context, however, the relevant information cannot be found in the context but it is also not explicitly not there. In order to make sense of the sentence, an accommodation process should be started. The fact that there is a trend on the critical word strongly suggests that this process happens immediately. Especially in the light of the trigger study, where a sentence carrying a PSP in a neutral context needed significantly longer to read than a sentence which did not trigger a PSP at all, we are very optimistic that further studies will provide us with more solid evidence for the third prediction.

5   Conclusion and Outlook

In accordance with Schwarz's (2007) findings, the results of the three conducted studies strongly suggest that the processing of PSPs can be captured in psycholinguistic experiments. We have seen that PSP processing happens on-line. As a next step, we plan to stabilize the results with follow-up studies. These will be further reading time experiments as well as ERP experiments. Once we get to the core of how PSPs are triggered (trigger study), validated within a context (verification study), and accommodated (accommodation study), we will eventually be able to tackle more controversial theoretical questions such as the projection problem or the differences between PSPs and implicatures.

References

Abusch, Dorit. 2002. Lexical alternatives as a source of pragmatic presupposition. In B. Jackson (ed.), *Proceedings of SALT XII*. CLC Publications: Ithaca NY.

Baayen, R. Harald, Richard Piepenbrock & Hedderik van Rijn. 1993. *The CELEX lexical database* [CD-ROM]. Philadelphia, PA: Linguistic Data Consortium, University of Pennsylvania [Distributor].

Bade, Nadine. 2010. *How are presuppositions triggered? Evidence from presupposition processing*. MA Thesis. Tübingen.

Beaver, David & Bart Geurts. 2011. Presupposition. In E. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*.

Chemla, Emmanuel. 2009. Presuppositions of quantified sentences: Experimental data. *Natural Language Semantics* 17. 299–340.

Chemla, Emmanuel & Lewis Bott. 2010. Processing presuppositions: Dynamic semantics vs. pragmatic enrichment. Ms. IJN, LSCP, Cardiff University.

von Fintel, Kai. 2003. *Pragmatics: Notes on presupposition.* MIT, MA.

Geurts, Bart & Rob van der Sandt. 1991. Presupposition, anaphora and lexical content. Text Understanding in LILOG, Integrating Computational Linguistics and Artificial Intelligence, Final Report on the IBM Germany LILOG-Project. 259–296.

Heim, Irene. 1983. On the projection problem for presuppositions. In D. Flickinger et al. (eds.), *Proceedings of the Second West Coast Conference on Formal Linguistics*. 114–125.

Heim, Irene. 1990. Presupposition projection. In R. van der Sandt (ed.), *Reader for the Nijmegen Workshop on Presupposition, Lexical Meaning, and Discourse Processes*. University of Nijmegen.

Heim, Irene & Angelika Kratzer. 1998. *Semantics in generative grammar.* Oxford University Press.

Kadmon, Nirit. 2001. *Formal pragmatics*. Blackwell: Oxford.

Karttunen, Lauri. 1974. Presupposition and linguistic context. *Theoretical Linguistics* 1. 181–194.

Lewis, David. 1979. Scorekeeping in a language game. In R. Bauerle, V. Egli, and A. von Stechow (eds.), *Semantics from Different Points of View*. Berlin: Springer Verlag.

Russell, Bertrand. 1905. On denoting. *Mind, New Series* 14. 479–493.

van der Sandt, Rob. 1992. Presupposition projection as anaphora resolution. *Journal of Semantics* 9. 333–377.

Schwarz, Florian. 2007. Processing presupposed content. *Journal of Semantics* 24. 373–416.

Stalnaker, Robert. 1973. Presuppositions. *Journal of Philosophical Logic* 2. 447–457.

Spenader, Jennifer. 2002. *Presuppositions in spoken discourse.* Doctoral Dissertation, Computational Linguistics, Stockholm University.