

# On the Processing of Negative Polarity Constructions: When the Licensor makes the Difference

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Structure of the paper:

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- 2) Theoretical Background
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- 4) Experiment
- 5) Results of the ERP data
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## 1.) Introduction

This paper describes an ERP study (ERPs for Event-Related (Brain) Potentials) considering the processing of the German negative polarity item (NPI) *jemals* (ever) within two different licensing contexts.<sup>1</sup>

NPIs are lexical elements that have specific lexical properties, namely they need to be licensed. This restricts their occurrences to certain contexts. Such contexts are i.e. negation (negative quantifier or verbal negation), (wh-)questions, conditionals, restrictors of universal quantifiers as well as negative adversatives.

NPIs are not a German phenomenon only. NPIs occur in a wide range of languages and have broadly been described for many of them. NPIs have in common that they show sensitivity according to polarity contexts. NPIs may not occur in each context (see (1) and (2)).

(1) a) Kein Mann war *jemals* glücklich.

No man was ever happy.

b) Kein Mann war *gestern* glücklich.

No man was yesterday happy.

(2) a) \*Ein Mann war *jemals* glücklich.

\*A man was ever happy.

b) Ein Mann war *oft* glücklich.

A man was often happy.

(2) shows that NPIs behave different from “normal” adverbs. The contexts in which NPIs may occur must contain the appropriate semantic property (i.e. negation) that is syntactically accessible, namely by overt c-command (see pt. 2, Theoretical Background).

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<sup>1</sup> See also Drenhaus et al. (under review).

From the psycholinguistic view, NPIs are interesting since they inquire about if there are differences between semantic and syntactic processing. Due to ERP-results we tempt to increase indications for the specific features of NPIs. We want to know how NPI-features relate to specific contexts and which demands are made as to the language processor.

In this ERP study we investigated the language processing of the German NPI *jemals* (ever) occurring in two different licensing contexts, namely negation (3) and wh-question (4).

(3) **Kein** Lehrer hat den Schüler *jemals* geschlagen.

No teacher has the student ever beaten.

No teacher has ever beaten the student.

(4) **Welcher** Lehrer hat den Schüler *jemals* geschlagen?

Which teacher has the student ever beaten?

Which teacher has ever beaten the student?

We further investigated the differences in language processing of the German NPI *jemals* occurring in those contexts that fail to license the NPI, namely definite and indefinite determiner (5) and (6).<sup>2</sup>

(5) \* **Der** Lehrer hat den Schüler *jemals* geschlagen.

The teacher has the student ever beaten.

The teacher has ever beaten the student.

(6) \* **Ein** Lehrer hat den Schüler *jemals* geschlagen.

A teacher has the student ever beaten.

A teacher has ever beaten the student.

The study revealed ERP effects when the NPI was not licensed in comparison to the contexts (negation and wh-question) that approved to license the NPI. However, the results also showed different ERP effects for both contexts (negation and wh-question) showing that the NPI *jemals* is processed in a different way, respectively. Hence, the study showed differences in the processing of strong and weak NPI-licensing.

## 2) Theoretical Background

Finding a sufficient explanation for the licensing problem of NPIs has troubled linguist society for about a quarter of a century. The main interest points onto a homogeneous characterization of negative contexts in order to make predictions according to the licensing of an NPI. However, there is still disagreement since theoretical suggestions have been developed stretching from syntax (i.e. Klima, 1964; Haegeman, 1995; Progovac, 1994) throughout semantics (Ladusaw, 1979; Horn,

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<sup>2</sup> For the purpose of the paper I will not go into detail concerning the determiner contexts.

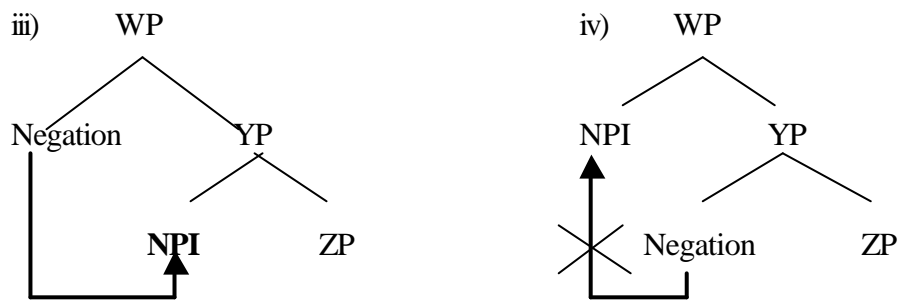
1985; Zwarts, 1993; van der Wouden, 1997) and pragmatics (Linebarger, 1980, 1987; Krifka, 1995) onto a combination of the three stated linguistic areas (Baker, 1970b).

The most appropriate explanation for the licensing problem of a NPI can be stated as follows: To accomplish the licensing of an NPI appropriately two conditions have to be met: First, there has to be a licensor → semantic condition (see i, ii).

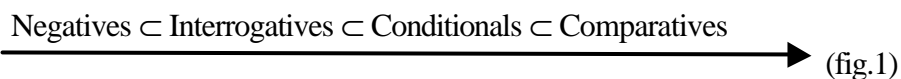
i) No man was *ever* happy. → Occurrence of the Negation approves the licensing of the NPI

ii) \*A man was *ever* happy. → Missing of a potential licensor (i.e. negation) results in a failure to license the NPI

Second, the licensor has to be structurally accessible which means that the NPI has to be overtly c-commanded by the licensor → syntactic condition (see iii, iv).



The two conditions just stated, seem to meet the demands of a NPI in to be licensed, no matter in which licensing context it occurs. However, it seems that NPI licensing contexts differ in their licensing potential. For the pupose of this paper I will shortly present a theoretical account on the different strength of NPI licensors. There are contexts that seem to be more negative than others.<sup>3</sup> Van der Wouden (1997) – following a.o. Edmondson (1981) - has offered a hierarchy of so-called affective contexts, stating negations as the strongest licensing context (see fig.1).<sup>4</sup>



- (7) Negatives: **No** man was *ever* happy.  
 Interrogatives: **Which** man was *ever* happy?  
 Conditions: **If** you *ever* go to China, visit Beijing.  
 Comparatives: **Less than** four men *ever* went to China.

The current study is concerned with negation and interrogatives as being both potential NPI licensing contexts, differing in their licensing strength. Following the account of van der Wouden (1997), here the suggestion is made that the different licensing strength of the two contexts of interest should also be revealed psycholinguistically by language processing reflexes.

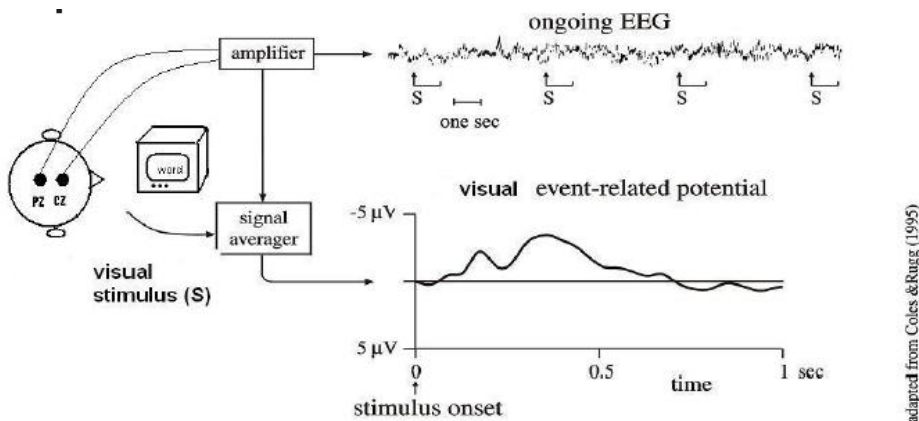
<sup>3</sup> I have already pointed out that negation is a possible licensor of NPIs.

<sup>4</sup> For a different account i.e. Giannakidou (1998, 2002) see Drenhaus et al. (under review).

### 3) ERP Method

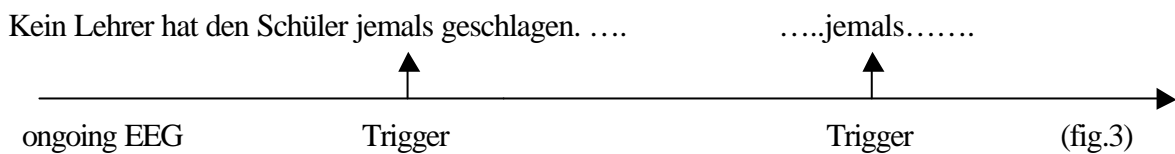
Ungrammaticality of sentences (compared to the analogous grammatical expressions) may lead to reactions and effects in the human brain. The question to be addressed must be if it is possible to apply such effects on language specific areas. In other words, is there a difference in the processing of i.e. syntactic or semantic anomalies? Former psycholinguistic research (i.e. Saddy et al., 2004; Drenhaus et al., 2004, 2005, 2006) showed that there is indeed a difference between syntactic and semantic processing.<sup>5</sup> This provides to systematically construct experiments following specific prospects of language phenomena like NPIs and their demands as to the language processor.

The ERP method has become a fruitful tool for psycholinguistic research. Based on EEG conduction, the ERP method enables to measure the processes of language processing online (see fig.2).



(fig.2)

Fig.2 illustrates an ongoing EEG where at certain points signals (so-called triggers) are sent to periodically (see fig.3).



The average of the triggers results in a visual ERP for the critical item *jemals* allowing analyzing its language processing. The visual ERP (see fig.2) – here for the critical item *jemals* - shows an ongoing wave that can be subdivided into components. Such components are analyzed for quantitative and qualitative parameters. The quantitative component is latency. The three qualitative components are polarity, topography and sensitivity. Such components are important in order to describe possible ERP effects resulting from language processing reflexes.

According to this study two components of language processing are important, namely N400 and P600. N400 is a negativity peaking around 400 ms with a bilateral distribution. It is associated with semantic anomalies (Kutas & Hillyard, 1980; Kutas & van Petten, 1994). Such anomalies pertain to violations in i.e. verb-argument structures (i.e. Frisch, 2000), semantic incongruity (Kutas

<sup>5</sup> These studies revealed differences in semantic and syntactic processing on the basis of NPI licensing / a failure of NPI licensing.

& Hillyard, 1980) as well as NPI licensing failures (i.e. Saddy et al., 2004; Drenhaus 2004, 2005, 2006). The second important ERP component is the P600. It is about a positivity peaking between 600 and 900 ms. P600 is associated with syntactic reanalysis or repair (i.e. Friederici et al., 2002). It occurred in studies with complex syntactic expressions like ambiguities (i.e. Frisch et al., 2002), also in polarity constructions missing a licenser (i.e. Drenhaus et al., 2004, 2005; 2006).

Former ERP studies with the German NPI *jemals* (i.e. Drenhaus et al., 2004, 2005; 2006) revealed amongst others a N400-P600 pattern when there was a violation of licensing concerning the NPI. Licensing failures were due to the complete absence of a licensing element (ex. 8b) or when the licensing element was structurally not accessible (ex. 8c).

- (8) a) **Kein** Mann, der einen Bart hatte, war *jemals* glücklich.  
b) \*Ein Mann, der einen Bart hatte, war *jemals* glücklich  
c) \*Ein Mann, der **keinen** Bart hatte, war *jemals* glücklich.

Drenhaus et al. (2005) and the related studies investigated the failures of NPI licensing within the context of negation. The current study extended the licensing condition for the wh-operator context. The main interest was about the possible differences in the licensing potential of negation on the one hand, wh-operator on the other.

#### 4) Experiment

The current study investigated the processing of the NPI in two different licensing contexts (negation and wh-question (ex. 1 and 2)) as well as two contexts that failed to license the NPI (definite and indefinite determiner (ex. 3 and 4)). Regarding former studies concerning the NPI *jemals* (see above) the prediction is made that the data should show a biphasic N400-P600 pattern on the NPI for both ungrammatical conditions (ex.3-4) compared to the grammatical conditions (ex. 1-2), respectively. This prediction is due to the theoretical account that for the ungrammatical condition a potential licenser is missing. Further, it is likely to expect a lower licensing potential for the wh-operator that might be shown by effects illustrating a higher processing load for the wh-licenser. This prediction is based on the theoretical account of the context hierarchy by van der Wouden (1997), which states negation to be a stronger licenser than wh-question. We hypothesize that for the language processor it should be harder to integrate an NPI into a wh-context compared to that of negation.

*Subjects:* There were 16 German students (5 male) with an average age of 25 years. All subjects were monolingual and right-handed.

*Material:* The subjects were presented 36 sets of 4 NPI-conditions (2 grammatical, 2 non-grammatical), which makes a total of 144 sentences. In addition there were presented 144 related sentences, so that each subject had to read a total of 288 sentences. Since the study concentrates on the negative polarity, only the 144 NPI sentences were analyzed. The sentences were presented in a pseudo-randomized order.

**Kein** Jäger hat den Angler *jemals* gestört.  
 No hunter has the fisherman ever disturbed.  
 No hunter has ever disturbed the fisherman.

**Welcher** Jäger hat den Angler *jemals* gestört?  
 Which hunter has the fisherman ever disturbed?  
 Which hunter has ever disturbed the fisherman?

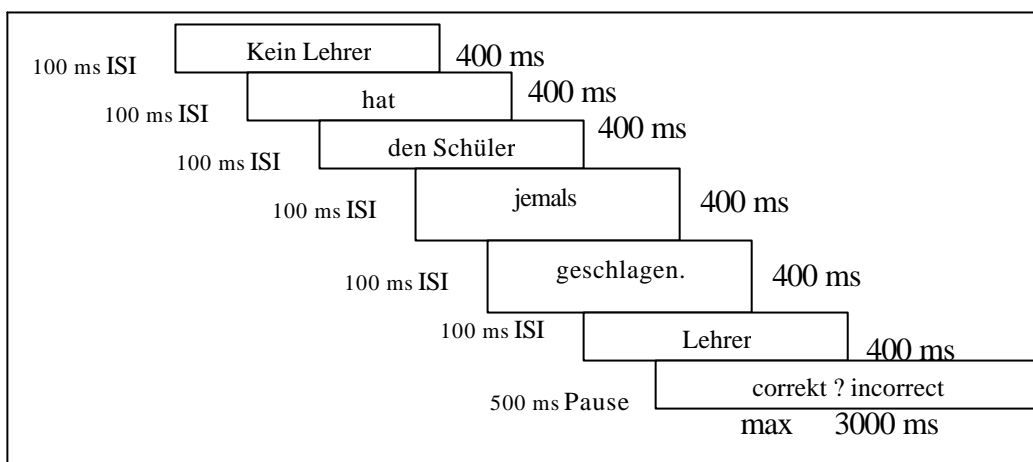
**\*Der** Jäger hat den Angler *jemals* gestört.  
 The hunter has the fisherman ever disturbed.  
 The hunter has ever disturbed the fisherman.

**\*Ein** Jäger hat den Angler *jemals* gestört.  
 A hunter has the fisherman ever disturbed.  
 A hunter has ever disturbed the fisherman.

The sentence structure was always the same: *NP AUX NP NPI V*

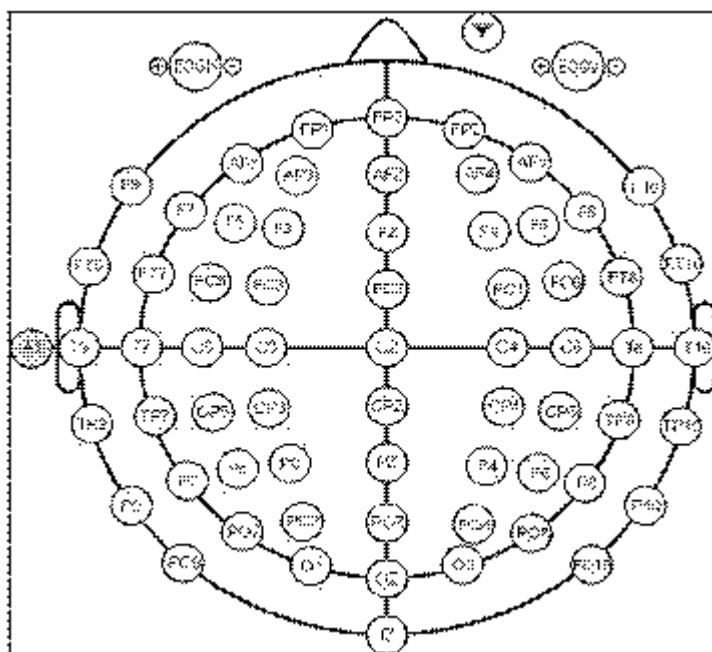
In order to avoid case ambiguities all NPs were male. The Verb was always transitive. Further, to assure that the subjects had really read the sentences there were presented a so-called probe. The task is called probe detection meaning that the subject had to decide if the target word (probe) occurred in the former sentence.

*Procedure:* First, the subjects were presented a set of 16 training sentences. Second, the total of 288 sentences were presented split up into four blocks. The blocks were interrupted by 3-5 minutes breaks. Such breaks were necessary in order to avoid possible tiredness or increasing unconscious eye movement of the subjects. The critical sentences were randomly presented in the center of the screen with 400 ms (plus 100ms interstimulus interval (ISI)) for the nominal phrases and the words in isolation. Immediately afterwards the subjects had to answer a probe task (probe = single male word) by pushing one out of two buttons within 3000 ms. The subjects had to decide whether the probe occurred in the former sentence or not. 1000 ms after the probe-response the next trial began (see fig.4).



(fig.4)

*EEG recording:* The EEG was recorded by way of 16 AgAgCl electrodes with a sampling rate of 250 Hz with impedances <5 kΩ. The electrodes were referenced to the left mastoid. The following electrode positions are based on the enhanced 10-20 system (Sharbrough et al., 1991): F7, F3, FZ, F4, F8, FC5, FC6, C3, C4, CP5, CP6, P7, P3, PZ, P4, P8 and (see fig.5).



(fig.5)

The EOG (electro oculogramm) was horizontally monitored with two electrodes placed at the outer cantus of each eye and vertically monitored with two electrodes above and below the right eye.

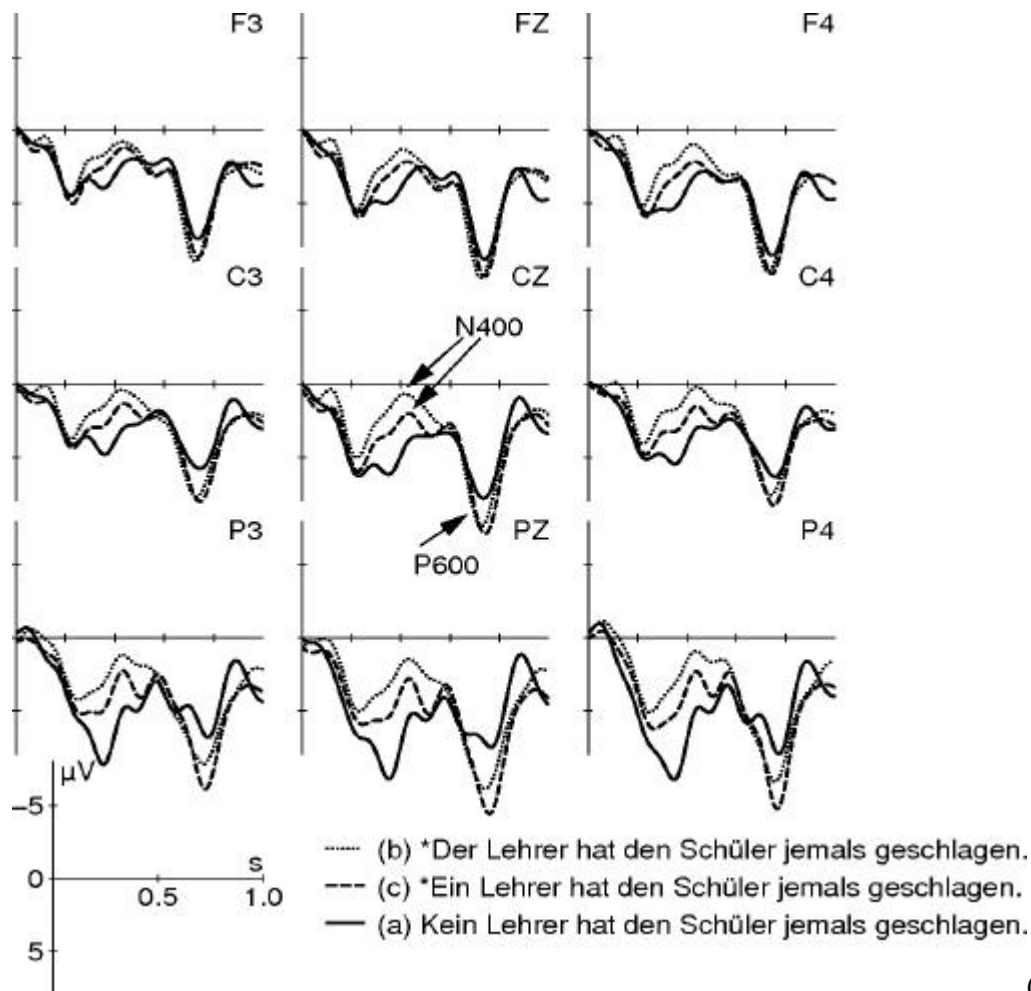
*Data Analysis:* The ERP data analysis included only those trials without artifacts and with correct answers in the judgment task. In order to compensate for possible disruptive elements or drifts a 0.2 Hz high pass filtered the data. The single subject averages and the grand average were computed in a time window of 1300 ms relative to the critical word (NPI) and aligned to a 200 ms pre-stimulus baseline.<sup>6</sup>

### **5) Results of the ERP Data**

Each of the following ERP patterns is visualized from the onset of the critical item (NPI) at 0 ms up to 1000 ms. The grammatical conditions negation and wh-operator are displayed in solid lines, respectively. The ungrammatical conditions on the one hand dashed lines (indefinite determiner) and on the other hand dotted lines (definite determiner.) For the ERP pattern showing the negation in comparison with the wh-operator, the latter is displayed by the dotted line. For the purpose of this paper I will only show the ERP results. In order to also account for the statistical results of judgments and reaction times and significance of effects see Drenhaus et al. (under review).

<sup>6</sup> For the statistical results and analysis see Drenhaus et al. (under review).

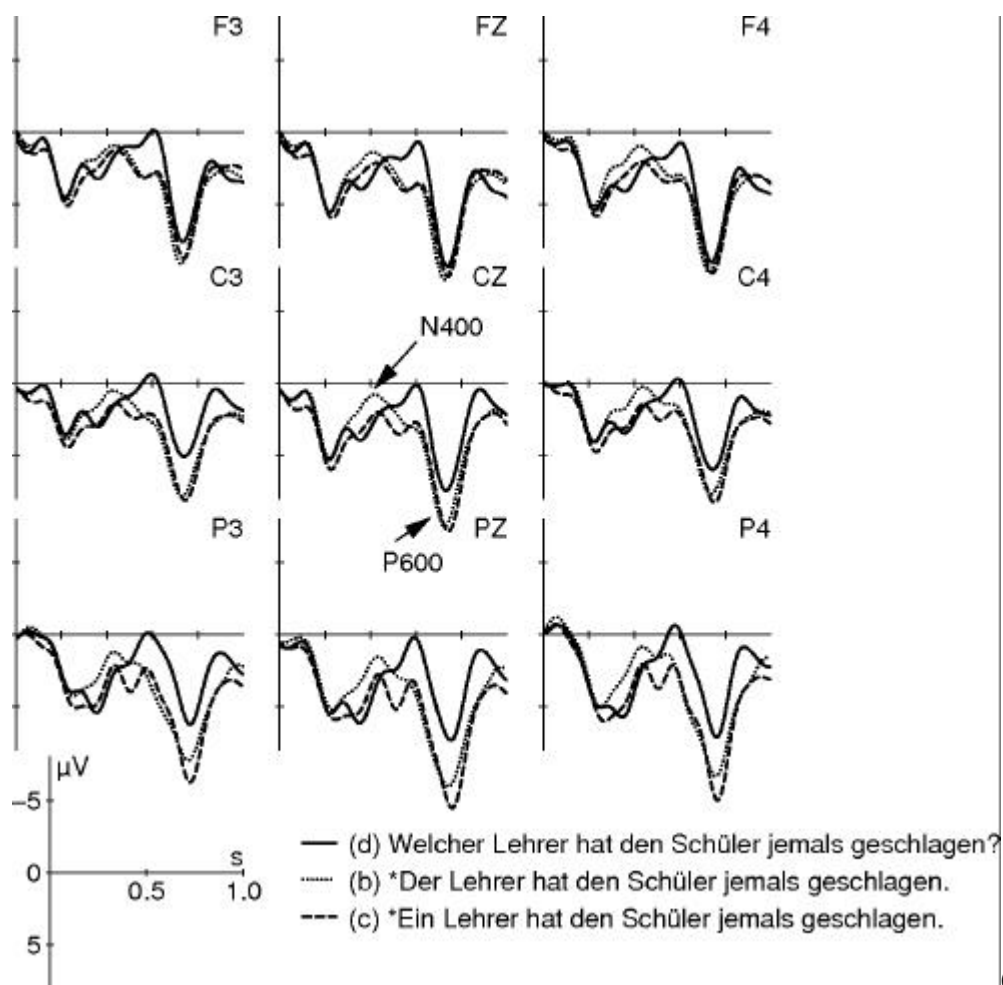
The results for the negation context in comparison with two ungrammatical conditions showed a biphasic N400-P600 pattern on the NPI in the two ungrammatical conditions. There was also found a modulation of the N400, showing that the violation of licensing is stronger for the definite condition. A difference for the P600 could not be found (see fig.6).



ERP effects on the negative polarity item *jemals* (ever) from the onset up to 1000ms there after at the electrodes. Negativity is plotted upwards. The solid line displays the grammatical negation-condition (b), the dotted line displays the incorrect definite condition (c) and the dashed line displays the incorrect indefinite condition (a).



For the two ungrammatical conditions in comparison with the wh-licensing context only the definite condition revealed a biphasic N400-P600 pattern. The indefinite condition only showed a P600; a N400 was not found (see fig.6).

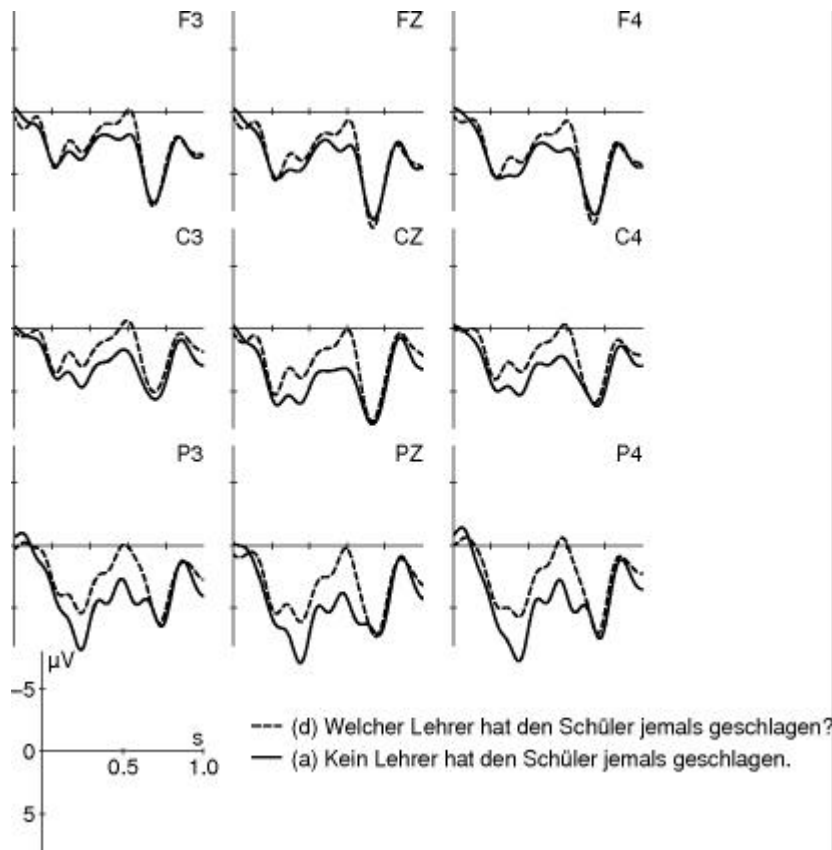


(fig.6)

ERP effects on the negative polarity item *jemals* (ever) from the onset up to 1000ms there after at the electrodes. Negativity is plotted upwards. The solid line displays the grammatical wh-condition (d), the dotted line displays the incorrect definite condition (b) and the dashed line displays the incorrect indefinite condition (c).

The data neither showed a difference for the P600 for both of the ungrammatical conditions.

The contrast between both of the grammatical conditions showed a negative run of the wh-curve throughout the entire time-window compared to negation (see fig. 9).



(fig.9)

ERP effects on the negative polarity item *jemals* (ever) from the onset up to 1000ms there after at the electrodes. Negativity is plotted upwards. The solid line displays the grammatical negation-condition (a), and the dashed line displays the correct wh-condition (c).

## 6.) Discussion

In the first line the results show that there are effects in the ERP when a context fails to license an NPI. Further, the results show that potential licensing contexts behave differently according to their licensing potential. This means that for the contexts in question the results revealed that there is a higher processing load for the wh-condition. As to the language processor it seems to be harder to integrate an NPI into a wh-licensing context, than into a negation context. The results suggest that there are differences in strength of the two licensing contexts.<sup>7</sup> Negation is claimed to be the strongest licensing context for a NPI. This is also revealed by the data since the wh-context seems to have a weaker licensing potential, which is reflected by the absence of the N400 in the indefinite condition. According to the strength hierarchy of van der Wouden (1997) negation indeed takes a higher position than interrogatives, which means that negation has a higher licensing potential/strength concerning NPIs (see also Zwarts, 1993).

<sup>7</sup> For theoretical discussions concerning NPI-licensing-strength, see i.e. Zwarts, 1993; van der Wouden, 1997 and Krifka, 1995.

To conclude, the results of this ERP-study confirm that there is indeed a psycholinguistic authenticity concerning the processing of negative polarity items. With regard to the theoretical assumptions of NPI licensing contexts concerning their difference in licensing strength the ERP results clearly reflect psycholinguistic evidence for strong and weak NPI-licensing contexts.

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