The Processing of German Modal Particles and their Counterparts

Laura Dörre, Anna Czypionka, Andreas Trotzke and Josef Bayer

Department of Linguistics, University of Konstanz

Corresponding Author:

Laura Dörre

Department of Linguistics

University of Konstanz

Universitätsstraße 10

78462 Konstanz

Germany

Tel: +49 7531 88-4751

Abstract

Modal particles (MPs) like German *bloß* form a heterogeneous word class. MPs do not contribute to the propositional meaning (the At-Issue meaning) of a sentence, but rather display a Non-At-Issue meaning. All of these words are ambiguous between the Non-At-Issue (NAI) meaning of the MP and an At-Issue (AI) meaning of a counterpart. Unlike MPs, the counterpart typically affects truth conditions, like *bloß* as a focus particle with the translation 'only'. So far, there has been little psycholinguistic research on the processing of MPs, the counterparts and their differing contributions to sentence meaning. We present the results of a self-paced reading experiment on the processing of both meaning types. In our experiment, we varied MP and counterpart readings, position of the disambiguiating region, and the relative frequencies of both MP and counterpart readings (i.e., whether a specific word occurs more often as a MP or a counterpart). The results point to processing differences between the NAI and the AI meaning of German MPs and their counterparts. They also show a marked influence of the relative frequency of both readings.

Keywords: modal particles, NAI meaning, processing, self-paced reading

German Modal Particles and their Counterparts

Introduction

1.1 Modal particles and counterparts

German is rich in modal particles (MPs) like *bloß*, *doch*, *eben*, and *schon*. They belong to the inventory of expressives (cf. Potts 2005) by contributing an expressive meaning (Kratzer 1999, Gutzmann 2013). This meaning modifies the speech act and depends on the illocutionary force of the sentence (e.g., Coniglio 2011, Zimmermann 2011). Furthermore, the meaning contribution of an MP is assumed to be speaker-oriented (Thurmair 1989).

By using the MP *bloß* in a *wh*-interrogative sentence (*Wer hat das bloß gemacht?* 'Who BLOSS did that?'), the speaker expresses that he has (desperately) tried to find a value for the *wh*-variable and did not succeed (basically corresponding to '*wh-on-earth*' cases in English or 'Can't-Find-the-Value-of-*x* Questions', in Obenauer's 2004 terms; Bayer & Obenauer 2011, for more details, cf. also Bayer & Trotzke 2015). Furthermore, *bloß* has the expressive meaning that the speaker's interest is targeted at the question and that the subjective interest of the speaker is strengthened (Thurmair 1989). By means of the MP *doch* in a declarative sentence (*Hans hat* doch *einen neuen Job*. 'Hans has DOCH a new job.') the speaker refers to knowledge that is shared by the speaker and the hearer but might not be present to the hearer at the time of utterance (Grosz 2010, Rojas-Esponda 2014). By means of the MP *eben* in a declarative sentence (*Hans ist* eben *nicht der Schlauste.* 'Hans is EBEN not the most intelligent person.'), the speaker expresses that the proposition is evidently true (Autenrieth 2005). The MP *schon* in a declarative sentence (*Du hast mit der einen Sache* schon *recht, aber…* . 'You are SCHON right about the one thing, but … .') contributes that only parts of the preceding utterance are strengthened, while other parts of the utterance are rejected.

Furthermore, *schon* indicates that the speaker restricts the validity of the opposite standpoint of the hearer, so that the speaker can prevent possible objections, leading to a strengthening of his own opinion (*Du solltest* schon *etwas Besonderes anziehen*. 'You should SCHON wear something special') (Thurmair 1989, Meibauer 1994, Egg 2013).

Every MP has a homonymous counterpart, from which they where historically derived (Thurmair 1989, Helbig 1990, Abraham 1991, Meibauer 1994, Coniglio 2011, Hentschel 1986). In their counterpart reading, *bloß* is a focus particle ('only'), *doch* is a modal adverb ('nevertheless') or a conjunction ('but'), *eben* is a temporal adverb ('just'), a truncated form of *soeben*, or an adjective ('flat'), and *schon* is a temporal adverb ('already'). All counterparts have a propositional meaning. In contrast, the corresponding MPs do not have a propositional, but an expressive meaning. The meaning of the MPs is usually not the main meaning contribution of the sentence (Büring 2012). The two different meaning contributions of the counterpart and of the MP can be captured by a two-dimensional semantics (Potts 2005, 2007, Gutzmann 2013). We will refer to the two dimensions as the At-Issue (AI) meaning, which represents the propositional meaning dimension of the counterpart, and the Non-At-Issue (NAI) meaning, which represents the expressive meaning dimension of the MP. According to Potts (2005), the semantic contribution of the NAI content has only limited interaction with the AI content. This account is challenged, for example, by work on anaphoric references, which shows that AI and NAI content interact (Anderbois et al. 2011), and supported, for instance, by work on parentheticals, which are treated by the parser as if they were a separate speech act and processed semi-independently (Dillon et al. 2014).

In German, there are ambiguous sentences containing an MP/counterpart. The following minimal pairs exemplify the respective readings. The sentences in (1a) and (1b) are examples for two contexts, whereby (1a) triggers the AI meaning and (1b) the NAI meaning of the ambiguous utterance.

(1) Wer hat *bloß* den Flur gewischt?

`Who wiped only/BLOSS the corridor?'

(a – *bloß* – counterpart – AI meaning) Die anderen Zimmer sind ebenfalls schmutzig!

`The other rooms are also dirty!'

(b – *bloß* – MP – NAI meaning) Hier ist noch Schneematsch von draußen!

`Here is still mud from outside!'

If the particle in (1) is interpreted as a focus particle (= the AI meaning), there is a possible set of at least three rooms, given the context in (a). All rooms might have been dirty, or all rooms should have been cleaned. The speaker expresses the fact that the floor in the corridor has been wiped, and that the other rooms have not been wiped (e.g., Horn 1996, Ippolito 2007). This meaning contribution, which is triggered by the focus sensitive particle *only*, is analyzed as a weak presupposition in the literature (cf. Glanzberg 2003, 2005). If for instance the floor in the kitchen has been wiped as well, the sentence in (1) with the AI meaning turns out to be false, indicating that *bloß* as a counterpart affects the truth conditions of a sentence (cf. Bader 1996).

If *bloß* is dropped as in (2), which would be the prejacent of (1) with the meaning of *bloß* as the focus sensitive particle (Horn 1996), the set of rooms changes: There can be one room, the corridor, but also an open number of other rooms, since the number is not restricted. Thus, *bloß* as a counterpart does not only change the truth conditions, but also restricts the elements of a set / affects the set of alternatives (e.g., Rooth 1992).

(2) Wer hat den Flur gewischt?

`Who wiped the corridor?'

If *bloß* in (1) is interpreted as an MP, the truth condition of the sentence is not affected. By means of *bloß* as an MP, the speaker expresses that he has tried to find a value for the *wh*-variable and did not succeed, or/and that he is upset about the fact that the corridor is – contrary to his expectations – still dirty. In contrast to the counterpart meaning, *bloß* as an MP makes no claim about the number of possible rooms; it does not trigger the presupposition that there is a non-trivial set of rooms.

The minimal pair in (1) and the two different contexts in (1a) and (1b) demonstrate that the interpretation of the NAI/AI meaning is strongly context dependent (cf. Doherty 1985, Hartmann 1986, Harris & Potts 2009).

According to Kratzer (1999), MPs and other kinds of expressives are ignored in the computation of the descriptive meaning, as shown in (3) and (4). Relevant for the computation of the descriptive meaning of (3) is only (4), without the MPs.

(3) Sie kann ja nicht kommen, weil sie ja doch ihre Zwillinge versorgen muss.
`She JA cannot come, because she JA DOCH must take care of her twins.'

(4) Sie kann nicht kommen, weil sie ihre Zwillinge versorgen muss.
`She cannot come, because she must take care of her twins.'

According to Kratzer (2004), the expressive meaning comes into being via appropriateness conditions, rather than via truth conditions, and they are used differently in the semantic composition process. The semantic/pragmatic interpretation system treats the expressive meaning as if it was on a different tier. The descriptive (AI) and expressive (NAI) content must be separated, essentially suggesting a multi-tiered semantics.

1.2 Previous psycholinguistic studies on the processing of MPs and counterparts

To our best knowledge, there is only one study on the processing of MPs, the counterparts and their differing contributions to sentence meaning, conducted by Bayer (1991). Bayer used the visual-half field technique in order to find out, which hemishere in the brain is involved in the processing of the different meaning types[2]. The material used by Bayer (1991) consisted of short texts that served as contexts for a following sentence (target sentence). The target sentences were minimal pairs and thus ambiguous between an MP and a counterpart meaning. Whether the target sentence was interpreted as an MP or a counterpart depended on (a) the preceding context (either triggering the MP or the counterpart meanings) and (b) the intonation of the target sentence (the target sentence *Spielt nur im Garten!* containing *nur* (`only') as an MP with the translation ‘Just go ahead and do play in the garden!’ has the intonation *SPIELT nur im Garten!*; the same sentence with *nur* as a counterpart with the translation ‘Play only in the garden!’ has the intonation *Spielt nur im GARTEN!*; words in capital letters indicate sentence stress). The appropriate particle was deleted in the target sentence and the missing part was filled with a hum. The sentences were presented auditorily. After the sentence presentation, the respective particle (target), which was missing in the target sentence, was presented tachistoscopically either to the the RVF or to the LVF of the participants. Besides the targets, Bayer (1991) used distractor items, which did not complete the target sentences in a meaningful way. The participants had to decide as fast as possible, whether the presented target/distractor matched the previous target sentence or not. The analyses of the errors showed that among the MPs, target items attracted significantly fewer errors than the distractor items. No such difference was encountered for the counterparts.

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[2] By means of this technique, stimulus material can be presented in a way that only one visual field is stimulated. The left hemisphere (LH) receives direct sensory input from the right visual field (RVF), while the right hemisphere (RH) receives direct sensory input from the left visual field (LVF).

Bayer (1991) took this result as an argument for the existence of two different knowledge/processing systems for semantics and pragmatics. The analyses of reading times (RTs) showed that both hemispheres were about equally fast in reacting correctly on targets of both types and equally slow in reacting correctly on modal distractors. However, there was a clear LH superiority with respect to semantic distractors. These results are in accordance with the assumption that the language processor is located in the LH, while pragmatic processing is a matter that is not lateralized (or modularized) in a comparable way.
This study gives interesting insides into the neurological processing of these meaning types. However, it makes no claim about the exact time course of the processing.

Schwarz (2007) conducted a self-paced reading study on the processing of the German presupposition trigger *auch* and the english equivalent *also.* He found processing costs related to subtle semantic differences in the field of presuppositions and presupposition failures. Participants were able to detect presupposition failures very early, as soon as the region[3] containing *auch/also* was encountered. Interestingly, the German lexeme *auch*, which functioned in the study of Schwarz (2007) as a focus particle ('also'), is also an MP. However, this ambiguity is not mentioned in the study of Schwarz.

1.3 Factors that influence the processing of ambiguities

There are two common factors that influence the processing of ambiguous words, phrases and sentences. The first factor is the disambiguating region (e.g., Altman 1998, Recanati 2010). According to Recanati (2010), the meaning of an expression may depend upon the meaning of the complex in which it occurs (top-down influence) or upon the meaning of other words that

[3] The sentences were presented part by part, not word by word. The following sentence exemplifies the devision into parts, whereby the slashes indicate the breaks between the parts.

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

occur in the same complex (lateral influence). A top-down influence can be a context-driven interpretation. A lateral influence can be illustrated by means of the different meanings of the word *cut* in combination with *the grass* versus *the hair*, or by means of the different meanings of *like* in *He likes my sister* versus *He likes roasted pork* (Searle 1980). In our study we focused on the influence of a context. There are a lot of studies indicating that context plays a crucial role in the processing of sentences in general and of ambiguities particularly (e.g., Schumacher 2012, 2014, Meibauer 2012). However, existing studies show contradicting results according to the exact influence of context. While some speak in favor of a strong influence of context, which only leads to the activation of the meaning that was contextually triggered (e.g., the context-dependent view, Kellas et al. 1991), others show that there are several meanings activated initially (e.g., the context-independent view, Fodor 1983, Seidenberg at al. 1982) and that the influence of context unfolds rather late during sentence processing (e.g., Swinney 1979).

The second factor is the frequency of the different meanings of homonymous words (cf. Rayner & Frazier 1989, Rayner & Duffy 1986, Hogaboam & Perfetti 1975, Seidenberg et al. 1982, Leinenger & Rayner 2013). The meaning frequency provides information about the frequency of one meaning over the other meaning. The studies showed that the more frequent meaning (primary meaning) has a processing advantage over the less frequent meaning (secondary meaning). This agrees with Giora (1997), where the salient meaning of a word/phrase is the primary meaning and is processed first. According to Giora, the term *salient meaning* refers for instance to the conventional, frequent, familiar meaning, or to a meaning that is enhanced by prior context.

Taken together, researchers in theoretical linguistics generally assume that the counterpart with its AI meaning triggers the primary meaning. This definition of primary meaning is in line with the historical development of counterparts and MPs, with counterparts occurring earlier and being the origin of MPs. In psycholinguistics, however, the primary meaning is defined differently: Here, the most frequent meaning is taken to be the primary or dominant meaning that is accessed first during language processing. Therefore, individual counterpart/MP pairs can have either the counterpart or the MP reading as the most frequent and dominant reading. To investigate the differences between counterpart and MP processing, it is crucial to assess the relative frequencies of the two readings.

The experiments described in this article are based on two research questions: The first research question is whether the two readings of the MP and the counterpart differ in their relative frequencies. The second research question is whether the two-dimensionality of the NAI/AI meaning (cf. Potts 2005) of MPs and their counterparts is reflected in sentence processing. Furthermore, how is the ambiguity between MP and counterpart readings resolved upon encountering the MP/counterpart candidate? We are especially interested in a) the role of relative frequencies of both readings, and b) the role of the disambiguating context in this ambiguity resolution.

We make the following assumptions:

I If the ambiguous lexemes have a primary meaning, then one meaning should occur more frequently than the other meaning/s.

II If the AI meaning of the counterpart is the primary meaning, then this meaning should occur more frequently than the NAI meaning of the MP.

III If the AI meaning is the primary meaning in general (as assumed by theoretical linguists, see above), then the AI meaning of all included lexemes should occur more frequently than the NAI meaning.

IV If there is no primary meaning, then all meanings should occur with equal frequency.

V If the NAI and the AI meanings are processed differently, processing times for the two meaning types should differ between conditions where a context triggers the NAI meaning and the AI meaning.

VI If the AI meaning of the counterpart is the primary meaning, processing times should be shorter if a context triggers the AI meaning than if it triggers the NAI meaning.

VII If the NAI meaning of the MP is the primary meaning, processing times should be shorter if a context triggers the NAI meaning than if it triggers the AI meaning.

VIII If both meanings activate each other/ if no meaning activates the other, processing times should be equally short if a context triggers the NAI and the AI meaning.

IX If a disambiguating context is crucial in this ambiguity resolution, a preceding context that triggers a special meaning should lead to an activation of the respective meaning. A context that follows the ambiguity should lead to longer processing times of the ambiguous region.

X If a disambiguating context is not crucial in this ambiguity resolution, we expect equal processing times for the ambiguous region, independent of whether the context precedes or follows the ambiguous region.

XI If the frequency of the different meanings is crucial for the processing, processing times for lexemes with a frequent NAI meaning should be shorter if a preceding context triggers the NAI meaning. Processing times for lexemes with a frequent AI meaning should be shorter if a preceding context triggers the AI meaning.

XII If the frequency of the different meanings is not crucial for the processing, we expect equal processing times for lexemes with a frequent NAI and AI meaning.

To test these hypotheses, we conducted a corpus study followed by a self-paced reading time study.

Corpus Study on Meaning Frequencies

Apart from the overall frequency of lexical items, the meaning frequency of different meanings of ambiguous lexical items is known to influence the activation of single meanings. However, meaning frequency data are not available for German MPs and their counterparts, since corpora do not distinguish between homonymous words. As a first step, we therefore conducted a corpus study (adopting methodological insights by Potts & Schwarz 2008) to collect meaning frequency data of twelve homonymous lexemes with an MP (NAI) and a counterpart (AI) meaning. The goal of the corpus study was to find out whether the NAI meaning of the MP or the AI meaning of the counterpart is more frequent and therefore represents the primary meaning.

Method

For the corpus study we used the DWDS special corpus on spoken language (Klein & Geyken 2010). Altogether, we examined 13.100 sentences, which contained twelve different homonymous lexemes with an NAI and an AI meaning. The twelve lexemes (translations of the AI meaning in brackets) were *auch* (‘also’), *bloß* (‘only’), *doch* (‘nevertheless’, ‘but’), *eben* (‘just’, ‘flat’), *einfach* (‘easy’, ‘simple’), *erst* (‘first’), *gleich* (‘immediately’, ‘same’), *nur* (‘only’), *ruhig* (‘quiet’), *schon* (‘already’), *vielleicht* (‘probably’, ‘perhaps’), and *wohl* (‘possibly’, ‘well’). The counterparts with AI meanings were adverbs (ADV), adjectives (ADJ), conjunctions (CONJ), response particles (RP), focus particles (FP), and prepositions (P)[4].

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[4] Some examples for the different word classes; the relevant words are written in italic:
ADV: Mir ist nicht *wohl*. (I don’t feel *well*.)
ADJ: Die Aufgabe ist sehr *einfach*. (The task is quite *easy*.)
CONJ: Er ist arm, *aber* gut gekleidet. (He is poor, *but* well dressed.)
RP: A: Thomas kommt nicht zur Party. B: *Doch*. (A: Thomas won’t show up at the party. B: *Yes*, he will.)
FP: Ich möchte *nur* ein kleines Stück haben. (I’d *only* like to hava a small piece.)

Results

By means of the Chi-Square test, we analyzed for each lexeme whether the different meanings of that lexeme differed significantly in their frequencies of occurrence. The differences were significant for all twelve lexemes. For reasons of space, we will report the results of the statistical analyses only for the lexeme *auch*. The distribution of the three main word classes for *auch* differed significantly (X^2 (2, N = 994) = 721.2, p <.001). In particular, *auch* as a FP occured in 70.3% of the cases, as a CONJ in 1.3%, and as an MP in 28.4% of the cases.

We determined the biased meaning of each lexeme as follows: If one meaning occurred in over 60% of the cases, the lexeme had a biased meaning. If no single meaning of the lexeme occurred in over 60% of the cases, the lexeme had a balanced meaning. Nine of the twelve lexemes had a biased meaning. Of these nine lexemes, four had a biased MP meaning (*doch, eben, einfach, wohl*) and five had a biased counterpart meaning (*auch, bloß, erst, nur, vielleicht*). Three of the twelve lexemes had a balanced meaning (*gleich, ruhig, schon*). Figure 1 illustrates the distribution of the different word classes for the lexemes with a biased MP meaning, Figure 2 for the lexemes with a biased counterpart meaning and Figure 3 for the lexemes with a balanced meaning. The MP meaning is always indicated by the red color.

P: *Gleich* einem Tiger streift er durch das Gebüsch. (*Like* a tiger he ranges through the bushes.)

Figure 1.

Results for lexemes with a biased MP meaning

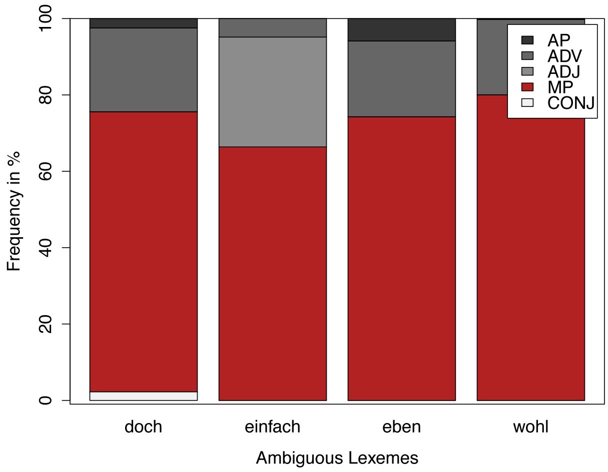


Figure 2.

Results for lexemes with a biased counterpart meaning

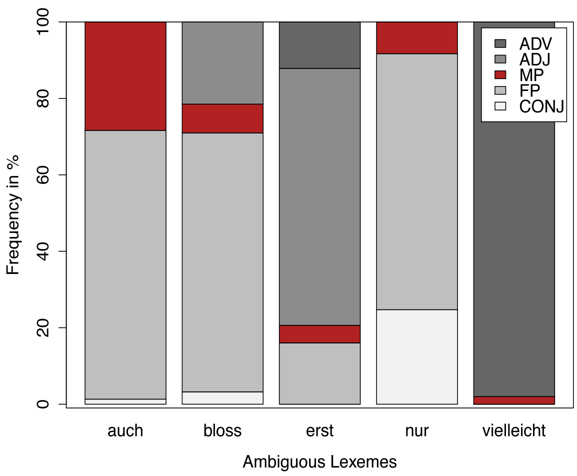
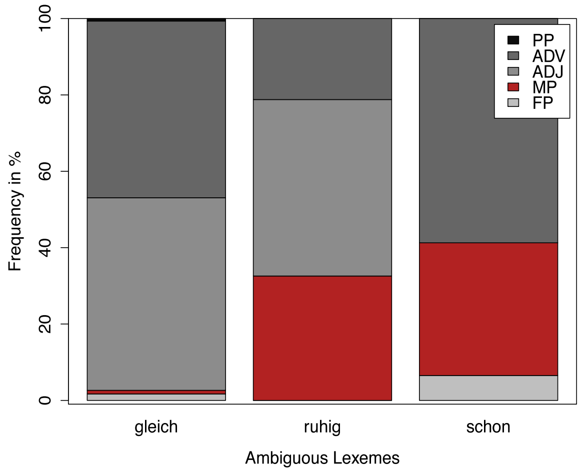


Figure 3.

Results for words with a balanced meaning



Discussion

Hypothesis I is corroborated: In the corpus study, some meanings occured significantly more often than other meanings, suggesting that there are primary meanings. Hypothesis II is partly corroborated: The AI meaning of the counterparts was more frequent than the NAI meaning of the MP. However, this was not true for all twelve lexemes: For some lexemes, the NAI meaning of the MP was more frequent. That is the reason why hypothesis III must be rejected. Hypothesis IV is partly corroborated as well: For some lexemes there was no difference in frequency between the NAI and AI meaning.

The twelve lexemes can be divided into three meaning frequency groups, namely one group with a biased MP meaning, one group with a biased counterpart meaning and one group with a balanced meaning. This means that although the AI meaning of the counterparts is the historical origin, it is not always the most frequent meaning. We conclude that for psycholinguistic investigations, it is crucial to adopt the psycholinguistic definition of primary meaning, based on actual frequencies of occurrence.

The results of this corpus study are the basis for the different conditions in our next study, the self-paced reading experiment.

Self-Paced Reading Experiment

For convenience, we repeat the research questions related to the self-paced reading experiment: Is the two-dimensionality of the NAI/AI meaning (cf. Potts 2005) reflected in sentence processing? How is the ambiguity between MP and counterpart readings resolved upon encountering the MP/counterpart candidate? We are especially interested in a) the role of relative frequencies of both readings, and b) the role of the disambiguating context in this ambiguity resolution.

Material and Methods

Language material. The first factor in our experimental design was the biased meaning (MP, counterpart, or balanced) of the lexem. Ten target words were chosen from the twelve targets of the corpus study, namely *auch, bloß, doch, eben, einfach, gleich, nur, ruhig, schon,* and *vielleicht*. We calculated a meaning frequency ratio, which comprised the meaning frequency bias towards the NAI meaning of the MP. *Auch*, for example, had a value of 0.284 (NAI meaning occurred in 28.4% of the cases), while *eben* had a higher value of 0.743 (NAI meaning occurred in 74.3% of the cases). Table 1 summarizes the data for the targets. The lemma frequency data refer to the absolute lemma frequency, taken from the dlex.db database (Heister et al. 2011).

Table 1

Data for the targets.

	Meaning Frequency ratio	Biased Word Class	Letters	Syllables	Lemma Frequency
auch	0.284	FP	4	1	723524
bloß	0.075	FP	4	1	21402
doch	0.733	MP	4	1	143842
eben	0.743	MP	4	2	31008
einfach	0.664	MP	7	2	30525
gleich	0.009	ADJ/ADV	6	1	65484
nur	0.083	FP	3	1	311989
ruhig	0.326	MP/ADJ/ADV	5	2	12403
schon	0.347	ADV/ADJ	5	1	143725
vielleicht	0.020	ADV	10	2	43560

The second factor was the position of the disambiguating region (preceding the ambiguous words, or following the ambiguous words). The language material consisted of a sequence of two clauses. One clause provided the target sentence (*Wer hat bloß den Flur gewischt?*) containing the target word (*bloß*). The other clause provided the context that disambiguated between the NAI/AI meaning of the MP and counterpart. The context, which either preceded or followed the ambiguous target sentence, triggered either the NAI (5) or the AI meaning (6). This leads to four conditions, as summarized in Table 2.

(5) Hier ist noch Schneematsch von draußen, wer hat bloß den Flur gewischt?

‘Here is still mud from outside, who on earth wiped the corridor?’

(6) Die anderen Zimmer sind ebenfalls schmutzig, wer hat bloß den Flur gewischt?

‘The other rooms are also dirty, who wiped only the corridor?’

The mean length of the contexts was 7.57 words (range 6-10 words). The contexts that triggered the NAI meaning had a mean length of 7.55 words (range 6-10 words) and the contexts that triggered the AI meaning had a mean length of 7.59 words (range 6-10 words). The contexts were kept short in order to keep them as uniform as possible.

Table 2

Experimental conditions.

	Context	**Target Sentence**	**Context**
	NAI: *‘Hier ist noch Schneematsch von draußen’*/ AI: ‘*Die anderen Zimmer sind ebenfalls schmutzig’*	*‘Wer hat bloß den Flur gewischt?’*	NAI: *‘Hier ist noch Schneematsch von draußen’*/ AI: ‘*Die anderen Zimmer sind ebenfalls schmutzig’*
Condition 1	NAI meaning	ambiguous	-
Condition 2	AI meaning	ambiguous	-
Condition 3	-	ambiguous	NAI meaning
Condition 4	-	ambiguous	AI meaning

For each target, five ambiguous target sentences were created. An exception was the target *vielleicht*, for which we created ten target sentences: Five as a declarative sentence and five as an interrogative sentence[5]. The target sentences had a mean length of 6.13 words (range 5-8 words).

The final set of experimental sentences comprised fifty-five sentence quartets, leading to 220 sentences. 220 sentences were added from an unrelated experiment. The 440 sentences were allocated to four lists by a Latin square design, yielding fifty-five experimental sentences and fifty-five sentences from the unrelated experiment on each list. To each list, sixty-five filler sentences were added, leading to a total of 175 sentences on each of the four experimental lists. One fifth of all sentences were combined with a yes/no question in order to control for the participants' sustained attention. The questions were equally distributed over the experimental conditions and over the sentence types (experimental sentences versus filler sentences).

Participants. Sixty students of the University of Konstanz participated in the experiment for the payment of eight Euros. All were monolingual native speakers of German who had not been exposed to another language before the age of six (17 male, 41 female, mean age 22.9 years). They were not dyslexic, and had normal or corrected-to-normal vision.

Procedure. Stimuli were presented on a 17" cathode ray tube monitor (Sony Trinitron Multiscan G400), connected to a Fujitsu personal computer. Response latencies were recorded via a keypress on a Razor Deathstalker essential gaming keyboard with a 1000 Hz ultrapolling rate. Stimuli were presented and reaction times were measured using Linger

[5] In the corpus study, *vielleicht* as an adverb occured more often in declarative sentences and *vielleicht* as an MP occured more often in interrogative sentenes. To control for these differences we decided to include two different sentence types for the target *vielleicht*.

(Version 2.94, Doug Rohde, 2001-2003). Participants were randomly assigned to one of the four lists. Each list was further subdivided into five blocks of thirty-five trials each. The ordering of the sentences was randomized for each participant. Participants were tested individually in the University of Konstanz Psycholinguistics Lab, with a viewing distance of about 60 cm from the screen. There were four practice trials, resembling the sentences containing the MPs and the sentences of the unrelated experiment. Each trial started with black underscores in central horizontal alignment on a white screen, whereby each underscore corresponded to a word of the sentence. After pressing the spacebar, the first underscore turned into the first word of the sentence. After pressing the spacebar again, the first word turned back into the underscore and the second underscore turned into the second word of the sentence. This procedure continued until the last word of the sentence was reached. As soon as the last word turned back into an underscore, either the next sentence, again represented by underscores, appeared, or participants had to answer a question related to the last sentence they had read. The question was answered by pressing the key ‘y’ for yes or the key ‘n’ for no. Participants were given feedback whether they answered the questions correctly or incorrectly. All sentences were presented in Sans Serif letters. Participants were asked to read the sentences and to answer the questions as fast and as correct as possible. The experiment lasted about 25 minutes. Breaks between the blocks were self-paced by the participants.

Results

Log-normalized reading times in milliseconds were analyzed for four critical regions, namely for the target (*bloß*) and the three following words (+1: *den*, +2: *Flur*, +3 *gewischt*). All reported means correspond to the raw data. The data of two participants had to be excluded, because one participant grew up bilingually (German-French) and one participant had very short RTs. Data points beyond 2 SD of the mean were removed. Linear mixed-effects regression models, following the procedure described in Baayen (2008), were used with *meaning* (NAI vs. AI meaning), *context* (preceding vs. following) and *meaning frequency* as fixed factors. *Participants* and *sentence number* were included as random factors and *meaning* and *context* as random slopes. Interactions were included if they contributed to model fit, using the anova() function in R.

Target word. There were no significant differences between the conditions on the target word. If the preceding context triggered the NAI meaning, RTs for the target word were as fast as if it triggered the AI meaning (343.9 ms vs. 341.1 ms). If the following context triggered the NAI meaning, RTs for the target word were as fast as if it triggered the AI meaning (346.5 ms vs. 345.0 ms).

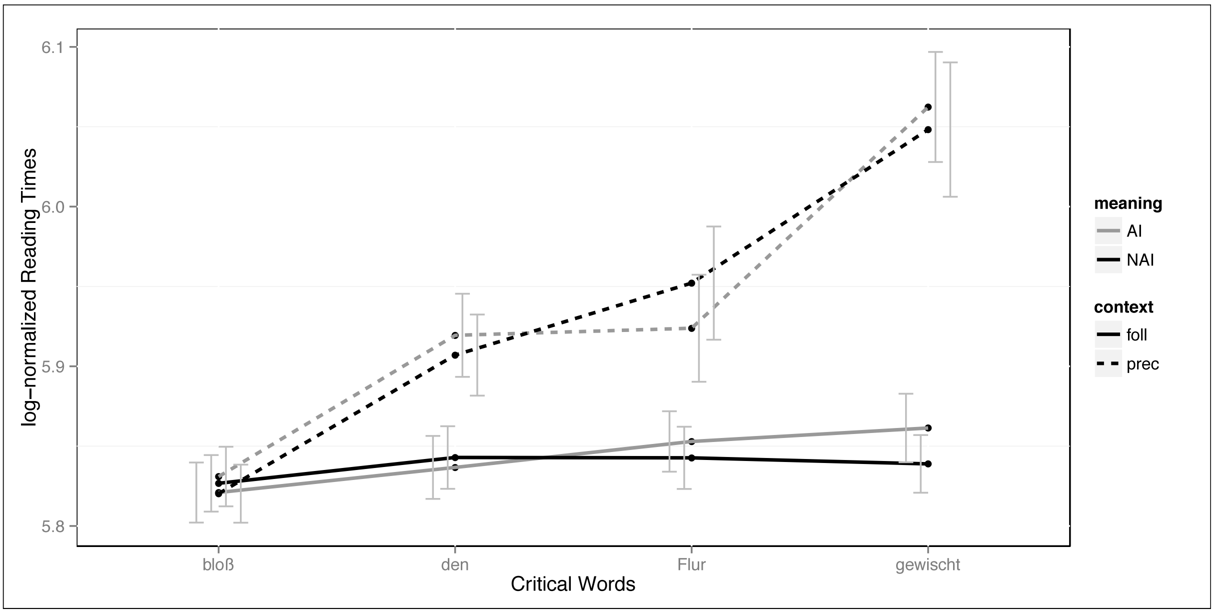
+1 region. The results showed a significant main effect of *context* (β = 0.04, SE = 0.01, t = 3.4, p < .001). If the context preceded the target sentence, RTs were longer (374.5 ms) than if the context followed the target sentence (349.0 ms). Furthermore, there was an interaction of *meaning frequency* × *context* (β = 0.11, SE = 0.03, t = 3.2, p < .01). If the context preceded the target sentence, RTs were longer with increasing frequency bias towards the NAI meaning of the target word. That is, the higher the frequency bias towards the NAI meaning of the MP, the longer the RTs. This difference did not show up once the context followed the target sentence.

+2 region. The results showed a significant main effect of *context* (ß = 0.08, SE = 0.03, t = 3.3, p = .001). If the context preceded the target sentence, RTs were longer (388.1 ms) than if the context followed the target sentence (354.6 ms). Furthermore, there was an interaction of *meaning* × *context* (β = 0.04, SE = 0.02, t = 2.06, p < .05). If the context preceded the target sentence, RTs were longer if the context triggered the NAI meaning (396.3 ms) than if it triggered the AI meaning (380 ms). If the context followed the target sentence, RTs were shorter if the context triggered the NAI meaning (351.7 ms) than if it triggered the AI meaning (357.6 ms).

+3 region. The results showed again a significant main effect of *context* (β = 0.22, SE = 0.02, t = 9.0, p < .001). If the context preceded the target sentence, RTs were longer (456.9 ms) than if the context followed the target sentence (354 ms). There was a significant main effect of *meaning* (β = -0.04, SE = 0.02, t = -2.25, p < .05). RTs were shorter for the NAI meaning (382.6 ms) than for the AI meaning (386 ms). Furthermore, there was a significant main effect of *meaning frequency* (β = -0.07, SE = 0.03, t = -2.4, p < .05). RTs were shorter with increasing frequency bias towards the NAI meaning of the target word. Finally, the interaction of *meaning frequency* × *meaning* was significant (β = 0.08, SE = 0.04, t = 2.0, p = .04). While RTs are generally shorter with increasing frequency bias toward the NAI meaning, RTs are longer when the NAI meaning is triggered than if the AI meaning is triggered. Figure 4 illustrates the results for all four regions, including the factors *context* and *meaning.*

Figure 4.

Results for all four critical regions, including the factors context *and* meaning *(foll = context followed target; prec = context preceded target)*



Discussion

Hypothesis V is corroborated for the +2 region, the second word following the ambiguous target word. We found differences between RTs for the condition in which the NAI meaning of the MP and the AI meaning of the counterpart was triggered by a context: The AI meaning has a processing advantage over the NAI meaning, if a preceding context triggers the AI meaning. However, in the +3 region, the NAI meaning of the MP has a processing advantage over the AI meaning of the counterpart, independent of a disambiguating context.

Hypothesis VI is corroborated for the +2 region: RTs were shorter if a preceding context triggered the AI meaning than if it triggered the NAI meaning.

Hypothesis VII can be corroborated for the +3 region: RTs were shorter for the NAI meaning than for the AI meaning. However, this processing advantage is independent of a disambiguating context.

Hypothesis VIII is disproved, since the AI meaning of the counterpart shows a processing advantage over the NAI meaning in the +2 region, and vice versa in the +3 region.

Hypothesis IX is partly corroborated. A preceding context lead to differences in reading times between the NAI and AI meaning. We conclude that the respective meanings were activated by the contextual trigger. When the context followed the ambiguous target sentence, there were no differences between the meanings that were triggered by the two different contexts, suggesting that a preceding context is crucial in the ambiguity resolution. However, we expected longer processing times for the ambiguous region if the context follows this ambiguity, which was not true in our reading experiment: RTs were even shorter in this condition, suggesting a shallow parsing of the ambiguous sentence until enough information is available in order to resolve the ambiguity (cf. Bayer & Marslen-Wilson 1992, Townsend & Bever 2001).

Hypothesis X is rejected, since we found differences in processing between the conditions were the context preceded or followed the ambiguous target sentence.

Hypothesis XI is partly corroborated. The meaning frequency of the target words influenced the processing, since there was a *meaning frequency* × *context* interaction in the +1 region and a *meaning frequency* × *meaning* interaction in the +3 region. However, the effect observed in the +3 region is against our expectation. We hypothesized that RTs for words with a biased meaning should be shorter if the context triggers this meaning. The results show, however, that the processing advantage of the NAI meaning disappears for words with a biased NAI meaning. We take this result as evidence for higher processing costs related to the NAI meaning.

Hypothesis XII is rejected, since we found processing differences between words with a frequent NAI meaning and a non-frequent NAI meaning.

Longer RTs for the NAI meaning in the +2 region. The late significant *meaning* × *context* interaction in the +2 region speaks in favor of a higher processing cost related to the NAI meaning of the MPs. This can be seen as supporting evidence for a two-dimensional meaning representation of the NAI and AI content, as assumed in the theoretical literature. Adopting this account, the AI meaning of the counterpart would be the primary meaning, comprising its function in the composition of propositional meaning. The NAI meaning is the secondary meaning, comprising emotional and expressive meaning components that do not affect propositional meaning, and that are activated in a second step, after the primary meaning is encountered.

The interaction of *meaning* × *context* shows up late in the +2 region. This is in common with the study of Swinney (1979), in which he measured the activation of multiple meanings of ambiguous words in a sentence. The activation was measured immediately after encountering the ambiguous target word and three syllables following the ambiguous target word. The results showed different activation patterns in the two regions of interest: While multiple meanings were activated immediately after the ambiguous target word, only the meaning that was triggered by the context was still activated three syllables after the ambiguous target word. The results indicate that the influence of context unfolds quite late during sentence processing, which can be an explanation for the late *meaning* × *context* interaction in our study.

In the condition, in which there was no disambiguating context given, the ambiguous sentence was parsed very quick and shallowly. That some structurally ambiguous sentences are parsed faster than unambiguous ones was also observed by other researchers (e.g., Townsend & Bever 2001, Bayer & Marslen-Wilson 1992, Traxler et al. 1998, van Gompel et al. 2001, Swets et al. 2008, Ferreira et al. 2002, Sanford 2002). For instance, Swets et al. (2008), Ferreira et al. (2002), and Sanford (2002) represent an underspecification approach to language comprehension, according to which readers do not commit to a particular meaning when they are not provided with clearly disambiguating information. This allows the comprehension system to sometimes compute interpretations that are shallow and incomplete. Sentence comprehension draws on a limited pool of resources, including working memory, attention, and time. Hence people often prefer to leave ambiguities unresolved when resources are in short supply, when motivation to undertake all the necessary processing steps is low, or when there is a lack of disambiguating context.

Longer RTs for the AI meaning in the +3 region. We observed a different picture on the third word following the target word. Here, the NAI meaning had a processing advantage over the AI meaning. This can be explained by the fact that the AI meaning operates at the propositional dimension of meaning and influences the propositional meaning (often the truth value) of a sentence. As explained in the introduction, if *bloß* is interpreted as a counterpart, in this case the focus particle ‘only’, processing steps emerge that do not emerge if the NAI meaning of the MP is activated. For example, *bloß* as a focus particle excludes alternatives to the focal constituent (Rooth 1992). Therefore, preceding information which invites the existence of such alternatives has to be recalled, hampering processing. Altough the AI and the NAI meaning have an anaphoric relation to preceding information, a recall of a particular set need not to be performed for the NAI meaning. For the NAI meaning it is rather necessary to recall information of the common ground. It could be possible that the particular recall that is necessary for the AI meaning explains why the AI meaning exhibits higher processing costs if a context precedes the ambiguous target sentence. However, *meaning* did not interact with *context* in the +3 region, indicating that the AI meaning leads to higher processing costs if there was no preceding information as well. This can be explained by the fact that *bloß* does not only activate a set of alternatives that is provided by contextual information (Rooth 1992), or a set of alternatives that is not contextually enumerated (e.g., Braun & Tagliapietra 2010, Gotzner et al. in revision), but also a set of alternatives that is not contextually enumerated and that is unrelated to the target word. Gotzner et al (in revision) conclude that listeners activate a broad set of alternatives that goes beyond the set of particular elements enumerated contextually. They found evidence for this in a lexical decision experiment. In a first step, they found activation of unmentioned alternatives, belonging to the same semantic taxonomy as the target. Unrelated items of another semantic taxonomy were not activated. In a second step, Gotzner (2014) divided these unrelated items into two classes: One class, in which the unrelated items could be possible alternatives, and one class, in which the unrelated items could not be possible alternatives. Gotzner (2014) found that the unrelated items that could be possible alternatives show the same activation as the items that share a semantic taxonomy with the target words. Hence, the activation of alternatives is context-independent and the set of alternatives is quiet broad.

Taken these data into account, it is possible that a broad set of alternatives is activated as soon as *bloß* was encountered in our study, independently of any context. The higher processing costs for the AI meaning only emerge in the late +3 region. This can be due to the fact that in order to construct alternatives, it is not only sufficient to encounter the focus particle *bloß*, but also the focused constituents [[$_{FOC}$ den Flur] gewischt] or [$_{FOC}$ den Flur gewischt] ('the corridor wiped'). These consituents can then activate an alternative set of elements, such as *die Küche gewischt* ('the kitchen wiped'), *das Wohnzimmer gewischt* ('the living room wiped'). Furthermore, they also can alternative sets that were not enumerated contextually, such as *die Küche geputzt* ('the kitchen cleaned up'), *den Rasen geharkt* ('the lawn raked'), or *die Wäsche gewaschen* ('the clothes washed'). Thus, higher processing costs for the AI meaning arose late in the +3 region and not earlier.

It should be further noted that *meaning* interacted with *meaning frequency* in a way that the processing advantage of the NAI meaning disappears with increasing frequency bias toward the NAI meaning. This effect is against our prediction. We expected shorter RTs for the NAI meaning if there was a strong frequency bias toward the NAI meaning. We interpret the direction of the interaction found in our study as a reflection of the higher processing costs related to the NAI meaning.

Generally speaking, the processing differences between the NAI and the AI meaning, independent of which meaning lead to higher processing costs, speaks in favor of differences in meaning representation of the NAI and AI content. It can be assumed that there is a limited interactivity between the NAI and the AI content (cf. Dillon et al. 2014), whereby both meanings do not unfold in parallel but rather serially.

Meaning frequency. The results of the self-paced reading experiment show that the meaning frequency influenced the processing of the NAI and AI meaning of MPs and their counterparts. In the +1 region, *meaning frequency* interacted with *context* in a way that there were higher RTs for words with a biased NAI meaning, but only if there was a preceding context given. This indicates that if there is not enough information given by the ambiguous target sentence, the meaning frequency unfolds its effect only if there is a preceding context that enriches the meaning of the incomplete target sentence. However, in the +3 region we found an interaction of *meaning frequency* × *meaning*, independent of the position of context. This shows that if the parser has more information in order to interpret the target sentence, the effect of *meaning frequency* occurs independent of a preceding context. The influence of meaning frequency lead to longer RTs for words with a biased NAI meaning, reflecting the higher processing costs related to the NAI meaning of MPs.

Context dependency. The meaning activation of the NAI and AI meaning is strongly context dependent, since *meaning* interacted with *context* in the +2 region: The AI meaning was processed faster than the NAI meaning, but only when the context preceded the target sentence, assuming that context had a top-down influence on the processing of the respective meaning (Recanati 2010). There is no context dependency of the NAI/AI meaning in the +3 region, since the AI meaning shows longer RTs irrespective of the position of the context. It is possible that this effect of meaning in the +3 region reflects the pecularities and the necessary processing steps of the AI meaning, es explained in the former paragraph.

Possible shortcomings of the experimental material. Using minimal pairs enabled us to compare identical words in different conditions. This is a huge advantage, since the critical words are perfectly matched. However, since the minimal pair sentences are ambiguous, both meanings are always possible. This means that we cannot be absolutely sure that participants interpreted the sentences in the way we wanted them to. In fact, only prosody would disambiguate the utterance reliably. There are prosodic differences between the NAI and the AI meaning of the ambiguous sentences (cf. Bayer 1991). For instance, the intonation of the sentence with the NAI meaning would be *Wer HAT bloß den Flur gewischt?*, whereas the intonation of the sentence with the AI meaning would be *Wer hat bloß den FLUR gewischt?*. We are currently preparing a study that takes this factor into account.

General Discussion and Conclusion

We presented a corpus study of the meaning frequencies of twelve German MPs and their counterparts, and we found out that these lexemes differed strongly in their biased meanings. We conducted a reading experiment, which probed into the processing of the NAI and AI meaning of German MPs and their counterparts. The meaning frequency data of the corpus study were included and the position of the disambiguating context was manipulated. The results showed a processing advantage of the AI meaning over the NAI meaning on the second word following the ambiguous target word. We thus conclude that the NAI meaning results in higher processing costs in this region. We took this result as a confirmation of a two-dimensionality of the NAI and AI meaning of MPs and their counterparts. On the third word following the target word, we found a processing advantage of the NAI meaning over the AI meaning, which is due to the special processing steps related to the AI meaning. The differences of the NAI/AI meaning in processing can be seen as evidence for a division between the NAI and the AI meaning. These meanings seem to belong to two different dimensions that hardly interact. Their respective meanings seem to unfold in a serial manner. The meaning frequency and the position of a disambiguating context influenced the processing of the NAI/AI meaning. However, more studies on the processing of German MPs and their counterparts are necessary before one can make more subtle claims about the processing differences between AI and NAI meaning components.

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