

## The Processing of German Modal Particles and their Counterparts

### Abstract

Modal particles (MPs) like German *bloß* form a heterogeneous lexical category. One common property is that they do not contribute to the propositional meaning of a sentence, but rather display a Not-At-Issue (NAI) meaning. All of these words are ambiguous between the NAI meaning of the MP and an At-Issue (AI) meaning of a counterpart (e.g., focus particles, adverbs, and conjunctions). 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 corpus study where we measured the relative frequencies of both MP and counterpart readings (i.e., whether a specific word occurs more often as an MP or a counterpart) and a self-paced reading experiment on the processing of both meaning types. In our experiment, we varied MP and counterpart readings, and the position of the disambiguating region. We also examined the influence of the relative frequencies of both meaning types on the processing. The results point to processing differences between the NAI and the AI meaning of German MPs and their counterparts, suggesting that the two meanings are represented in different dimensions of meaning.

*Keywords:* modal particles, Not-At-Issue meaning, processing, self-paced reading, context

## German Modal Particles and their Counterparts

### 1 Introduction

#### 1.1 Modal particles and counterparts

German is rich in modal particles (MPs) like *ja*, *doch*, and *wohl*. As MPs, these small words are hard to translate word-by-word, since they do not contribute a descriptive meaning to the sentence which hosts the MP. More specifically, MPs are an entire part of speech that does not affect the truth-conditional meaning of utterances and rather organizes the discourse by conveying the epistemic states of both the speaker and the hearer. Consider the following examples by Zimmermann (2011: 2013):

- (1) a. Max ist ja auf See.  
 Max is PART at sea  
 ‘(As I and you assume) Max is at sea.’
- b. Max ist doch auf See.  
 Max is PART at sea  
 ‘(As you must know) Max is at sea.’
- c. Max ist wohl auf See.  
 Max is PART at sea  
 ‘Max is at sea (speaker is uncertain concerning the truth of the proposition).’

Roughly, *ja* conveys that both the speaker and the hearer may already know the proposition, *doch* expresses that the hearer should update his knowledge concerning the proposition, and *wohl* articulates that the speaker is to some degree uncertain concerning the truth of the propositional content.

Like other non-descriptive elements of language (e.g., expressive adjectives or

epithets), MPs are optional in the sense that leaving them out does not affect the truth conditions of a sentence. As pointed out by Gutzmann (2013: 11), all variants in examples like (1) are true iff, in our case, Max is at sea. The meaning conveyed by the different MPs has no bearing on this semantic dimension of the different versions in (1). Although all variants are true if Max is at sea, the different cases in (1) are not felicitous in the same contexts. Gutzmann (2013: 12) gives the following example, showing that for instance *ja* (like all other MPs) is ‘use-conditional’ in the sense that it cannot be used in a context like (2):

(2) [Context: A happy father rushes out of the delivery room]

a. # Es ist ja ein Mädchen!

it is PART a girl

‘It’s a girl!’

b. Es ist ein Mädchen!

it is a girl

‘It’s a girl!’

Here, *ja* is not felicitous since the truth of the propositional content of the utterance is not known to be shared by the addressee (cf. Zimmermann 2011).

In the literature, it is claimed that the two different meaning contributions of the propositional part of a sentence and of the MP (the truth-conditional and the use-conditional contribution) can be captured by a two-dimensional semantics (Potts 2005, 2007, Gutzmann 2013; but see Grosz 2016 for alternative proposals). In accordance with this account, we will refer to the two dimensions as the At-Issue (AI) meaning, which represents the propositional meaning dimension, and the Not-At-Issue (NAI) meaning, which represents the meaning dimension of the MP. According to Potts (2005), the semantic contribution of the NAI content features only limited interaction with the AI content. This claim that both meaning

dimension are, for the most part, independent semantic levels receives empirical support by experimental work on parentheticals, which are one of Pott's prominent examples of NAI content (see Potts' 2005: 89-152 discussion of supplemental expressions). Parentheticals are treated by the parser as if they were a separate speech act and processed semi-independently (Dillon, Clifton & Frazier 2014). On the other hand, this account of treating AI and NAI as independent meaning dimensions has been challenged, for example, by work on anaphoric references, which shows that AI and NAI content interact (Anderbois, Brasoveanu & Henderson 2015).

In this article, we will adopt a processing perspective and make use of a distributional feature of the German language that allows us to investigate both the differences and the similarities of AI and NAI content in a straightforward way: One property that all MPs have in common is that every MP has a counterpart, from which it is historically derived (Hentschel 1986, Thurmair 1989, Helbig 1990, Abraham 1991, Meibauer 1994, Coniglio 2011). As a consequence, there are also ambiguous sentences where the relevant lexeme can either be interpreted as an MP or receives the reading of the counterpart. The following minimal pair exemplifies the respective readings for the particle *bloß*. The sentences in (3a) and (3b) are examples for two different contexts, whereby (3a) triggers the meaning of the counterpart, which is a focus particle in the case of *bloß*, and (3b) yields the NAI meaning of the MP.

(3) Wer hat *bloß* den Flur gewischt?

Who has PART the corridor wiped?

'Who wiped only/ PART the corridor?'

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

'The other rooms are also dirty!'

(b – *bloß* – MP – NAI meaning/BLOSS) Hier ist noch Schneematsch von draußen!  
 ‘Here is still mud from outside!’

If the particle *bloß* in (3) is interpreted as a focus particle, 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. *Bloß*, which corresponds to the eliminative focus particle *only*, presupposes the corresponding sentence without the focus particle (cf. König 1991, Horn 1996), that is, that the corridor has been wiped. Furthermore, *bloß* quantifies over the set of alternatives {kitchen, bath room, ...} to the value of the focused expression (the corridor) and excludes these alternatives as possible values for the open sentence in its scope (cf. König 1991), thereby expressing that no room other than the corridor has been wiped. If for instance the floor in the kitchen has been wiped as well, the sentence in (3) with its AI meaning turns out to be false, indicating that *bloß* in the focus-particle reading affects the truth conditions of a sentence (e.g., Jacobs 1983, König 1991: 34, Bader 1996: 203). If *bloß* is dropped as in (4), 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).

(4) Wer hat den Flur gewischt?  
 ‘Who wiped the corridor?’

However, if *bloß* in (3) is interpreted as an MP, the truth conditions of the sentence are not affected. Rather, 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 (see corresponding ‘*wh-on-earth*’ cases in English or ‘Can’t-Find-

the-Value-of-*x* Questions’ in Obenauer’s 2004 analysis; cf. also Bayer & Obenauer 2011, Bayer & Trotzke 2015 for more details on the MP *bloß* in *wh*-questions). Crucially, in contrast to the counterpart meaning, *bloß* as an MP makes no claim about the number of possible rooms.<sup>1</sup> The minimal pair in (3) with its two different contexts in (3a) and (3b) demonstrates that the interpretation of the NAI/AI meaning is strongly context dependent (cf. Doherty 1985, Hartmann 1986, Harris & Potts 2009). In our study, we thus examine the impact of varying contexts on the processing of both meaning types and, in addition, we ask whether the relative frequencies of both the MP (NAI) readings and the counterpart (AI) readings influence processing as well. We hope that this experimental investigation can shed light not only on the processing differences of MPs and their counterparts, but also on similarities and differences of NAI and AI content in natural language processing in general.

### 1.2 Previous psycholinguistic studies on the processing of MPs and their 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 hemisphere in the brain is involved in the processing of the different meaning types<sup>2</sup>. The material used by Bayer (1991) consisted of short texts that served as contexts for a following sentence (target sentence). The

---

<sup>1</sup> Note, however, that there is of course an abstract similarity between the AI and the NAI meaning of *bloß* in *wh*-questions, due to their common diachronic source (this also holds for *nur*, which is likewise ambiguous between a focus-particle and an MP-reading). As pointed out by Bayer & Obenauer (2011: 469), the MPs *bloß/nur*: “[...] function as eliminative operators as in their function as focus particles. As a focus particle with the semantic impact of *only*, *nur/bloß* (p) denies the truth of proposition p, p = [ ... FOC ... ], with respect to alternatives of FOC. As a discourse particle, *nur/bloß* seems to express the speaker’s elimination of the values that he or she has been able to consider for the *wh*-variable while in principle assuming that such a value does exist.”

<sup>2</sup> By means of this technique, stimulus material can be presented at short latencies in such 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).

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 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. 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 insights into the neuropsychological processing of these meaning types. However, it makes no claim about the exact time course of the processing.

There are studies on the processing of presuppositions that might be interesting for our

purpose. For instance, 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<sup>3</sup> containing *auch/also* was encountered. Importantly, the German lexeme *auch*, which functioned as a focus particle ('also') in the study of Schwarz (2007), is also an MP<sup>4</sup>. This ambiguity is not mentioned in the study of Schwarz, indicating that the presence of an MP interpretation is often neglected in experimental studies on particles. However, we can conclude that the self-paced reading paradigm is likely to be suitable for detecting processing costs related to subtle semantic differences in sentence processing (cf. also Schwarz & Tiemann 2016, Tiemann et al. 2011).

### *1.3 Factors that influence the processing of ambiguities*

In the present study, we are dealing with ambiguous words that can function as MPs or their counterparts and with minimal pair sentences that can have an overall MP or counterpart interpretation. 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 occur in the same complex (lateral influence). A top-down influence can be a context-driven interpretation. A lateral influence can be illustrated by

---

<sup>3</sup> The sentences were presented in chunks. The following sentence exemplifies the division into chunks, whereby the slashes indicate the breaks between them.

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

<sup>4</sup> The meaning of the MP seems not to be as prominent as the meaning of the focus particle. It gets more obvious by inserting the MP *ja* before *auch*.

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 former, namely 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 contradictory results according to the exact influence of context. 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, Paul & Martin 1991). Others show that there are several meanings activated initially (e.g., the context-independent view, Fodor 1983, Seidenberg et al. 1982), or that there is always the literal meaning activated initially before a contextually appropriate meaning is computed (literal-meaning hypothesis, cf. Searle 1979, Gibbs 1984), assuming that the influence of context unfolds rather late during sentence processing (e.g., Swinney 1979, Till, Mross & Kintsch 1988). Swinney (1979) suggests that after initially activating several meanings, the later role of discourse context is to suppress the inappropriate one. However, studies that compare the processing of sentences in isolation (local semantic processing) and of sentences embedded in a discourse context (global semantic processing) show that incoming words are rapidly related to the semantics of the wider discourse, without a delay, and that sentence processing is incremental all the way up to the discourse level (van Berkum, Hagoort & Brown 1999).

The second factor is the frequency of the different meanings of homonymous words (cf. Hogaboam & Perfetti 1975, Seidenberg et al. 1982, Rayner & Duffy 1986, Rayner & Frazier 1989, Leininger & Rayner 2013). The meaning frequency provides information about the frequency of one meaning over the other meaning. The cited studies show 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. Here we have to keep attention with respect to the terms ‘primary’ and ‘secondary’ meaning. In the previous section, we described the counterparts as having descriptive, or truth-conditional meanings, therefore *primarily* affecting the propositional content of an utterance. MPs, on the contrary, do not have descriptive but use-conditional meanings, therefore conveying a *secondary* meaning in addition to the propositional content of the utterance. However, regarding the meaning frequency of ambiguous words, the term ‘primary’ refers to the most frequent, biased meaning, while the term ‘secondary’ refers to the less frequent, non-biased meaning.<sup>5</sup> We call this the psycholinguistic definition of primary and secondary meaning. This distinction has important consequences, since it is assumed that the primary, more frequent meaning is accessed first during language processing. To investigate the differences between the processing of the AI meaning of the counterpart and the NAI meaning of the MP, it is crucial to know which meaning is more frequent, and therefore is the primary meaning in psycholinguistic terms. However, there are no meaning frequency information available for German MPs and their counterparts.

Our first research question is whether the two readings of the MP and the counterpart differ in their relative frequencies. We predict that if the ambiguous lexemes have a primary meaning in psycholinguistic terms, then this meaning should occur more frequently than the other meaning/s. That is, 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, and vice versa for the NAI meaning of the MP. To test these hypotheses, we conducted a corpus study.

---

<sup>5</sup> Another way of defining ‘primary’ and ‘secondary’ is in terms of language evolution, in that the historical origin, which would be the counterpart, is the primary meaning, and the derived meaning, which would be the MP, is the secondary meaning.

## 2 Corpus Study on Meaning Frequencies

As described, the frequency of different meanings of ambiguous lexical items is known to influence the activation of single meanings in language processing. However, meaning frequency data are not available for German MPs and their counterparts. As a first step, we therefore conducted a corpus study (adopting methodological insights by Potts & Schwarz 2008) to collect meaning frequency data of twelve ambiguous lexemes with an MP and a counterpart 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 in psycholinguistic terms.

### 2.1 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 lexemes with an NAI and AI meaning. The twelve lexemes (translations of the AI meaning in brackets) were *auch* ('also'), *bloß* ('only'), *doch*<sup>6</sup> ('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)<sup>7</sup>.

---

<sup>6</sup> We are aware of the fact that the status of accented *doch* is controversial (cf. Grosz 2010, Karagjosova 2006, 2009, 2012, Egg & Zimmermann 2012, Rojas-Esponda 2014). For the purpose of this study, we classify accented *doch* as adverbial and therefore as a counterpart.

<sup>7</sup> Some examples for the different word classes; the relevant words are written in italics:

ADV: Mir ist nicht *wohl*. (I don't feel *well*.)

ADJ: Die Aufgabe ist sehr *einfach*. (The task is quite *easy*.)

CONJ: Ich mag Kuchen, *bloß* bin ich nicht hungrig. (Actually, I like cake, *but* I am not hungry at the moment.)

RP: A: Thomas kommt nicht zur Party. B: *Doch*. (A: Thomas won't show up at the party. B: *Yes*, he will.)

## 2.2 Results

By means of the Chi-Square test, we determined for each lexeme whether the different meanings of that lexeme differed significantly in their frequency of occurrence. All twelve lexemes showed significant differences between the frequencies of their different meanings. The raw data for each lexeme, that is, how often each lexeme occurred as MP or as the specific counterpart, the overall number of occurrence of each lexeme (N) and the results of the statistical analyses ( $X^2$ - and p-value) are shown in table 1.

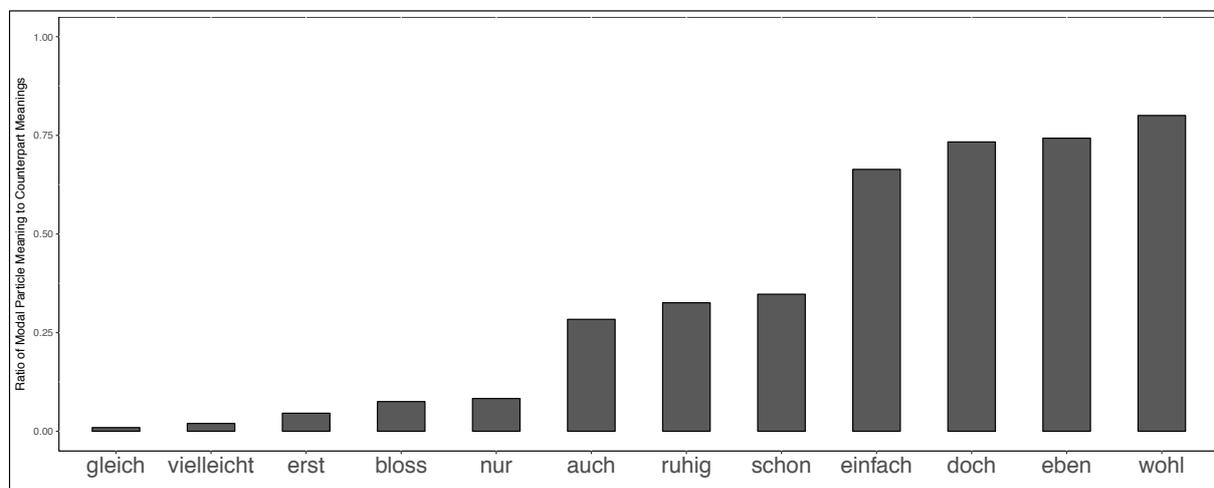
There are several ways how to deal with the data of the corpus study. One possibility is to divide the lexemes into different frequency groups, that is, into words with a biased MP meaning, a biased counterpart meaning, and a balanced meaning. The first question that arises here is where to draw the line between a biased and a balanced meaning. One possibility is to draw the line at 60%, an arbitrary value over 50% that is appropriate to cover most of the lexemes of our study: If one meaning occurred in over 60% of the cases, the lexeme has a biased meaning; otherwise, it has a balanced meaning. According to this classification, *eben* would have a biased MP meaning (occurred in 74% of the cases as MP), *vielleicht* a biased counterpart meaning (occurred in 98% as adverb) and *ruhig* a balanced meaning (occurred in 32,6% as MP, in 46,2% as adjective and in 21,2% as adverb). However, as pointed out by an anonymous reviewer, the lexemes differ in their number of word classes. While *vielleicht* can function as MP and adverb, *bloß* can function as MP, as focus particle, as adjective and as conjunction. That is, a 60% criterion (or another value near the threshold of 50%) would be suitable for *vielleicht*, which only has two functions, but not for *bloß*, which has four functions, and where the threshold should lie at 25%. Another disadvantage of categorizing the lexemes is that the resulting frequency groups differ in their number of representatives.

---

FP: Ich möchte *nur* ein kleines Stück haben. (I'd *only* like to have a small piece.)

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

This might be problematic when it comes to the integration of meaning frequency information into statistical models for psycholinguistic experiments. To bypass this classification and in order to integrate the factor meaning frequency as a continuous variable, we calculated a meaning frequency ratio for each lexeme, that is, the ratio of the MP meaning to the counterpart meanings. Figure 1 depicts the data of all 12 lexemes with increasing frequency of the MP meaning and shows that there is a fairly even distribution of values. Table 1 contains the frequency ratios for each lexeme.



**Figure 1.** Distribution of lexemes with increasing frequency of the MP meaning

	Word Classes								Statistical Data			
	MP	FP	ADV	ADJ	CONJ	AP	P	Most Frequent Meaning	N	$\chi^2$	p	Ratio MP Meaning
auch	282	699	-	-	13	-	-	FP	994	721.2	< .001	0.2837
bloß	7	63	-	20	3	-	-	FP	93	97.4	< .001	0.0752
doch	685	-	205	-	21	23	-	MP	934	1259.7	< .001	0.7334
eben	922	-	246	-	-	73	-	MP	1241	973.2	< .001	0.7429
einfach	766	-	56	332	-	-	-	MP	1154	666.1	< .001	0.6638
erst	134	469	355	1965	-	-	-	ADJ	2923	2859.0	< .001	0.0458
gleich	11	20	545	594	-	-	8	ADJ	1178	1582.8	< .001	0.0093
nur	80	645	-	-	238	-	-	FP	963	529.4	< .001	0.0830
ruhig	43	-	28	61	-	-	-	ADJ	132	12.4	< .01	0.3258
schon	346	65	585	-	-	-	-	ADV	996	408.1	< .001	0.3474
vielleicht	31	-	1531	-	-	-	-	ADV	1562	1440.5	< .001	0.0198
wohl	742	-	183	-	-	2	-	MP	927	963.2	< .001	0.8004

**Table 1.** Raw data for all twelve lexemes: number of occurrences as modal particle (MP), focus particle (FP), adverb (ADV), adjective (ADJ), conjunction (CONJ), answer particle (AP) and Preposition (P); statistical data for all twelve lexemes: overall number of occurrences (N),  $\chi^2$ -value, p-value and frequency ratio of the MP meaning (number of occurrence as modal particle divided by the number of overall occurrences of the lexeme)

### 2.3 Discussion

By means of a corpus study, we found that some meanings occurred significantly more often than other meanings, indicating that there are primary meanings in psycholinguistic terms. Sometimes, the primary meaning is the AI meaning of the counterpart, as it is the case for the adverbial meaning of *vielleicht*. Sometimes, the primary meaning is the NAI meaning of the MP, as it is the case for *eben*. However, it is not trivial to divide the lexemes into different frequency groups. The lexemes differ in their number of word classes, what poses the question of where to draw the line between biased and balanced meanings. Instead of dividing the lexemes into frequency groups with biased and balanced meanings, we calculated ratios for the frequency of the MP meaning. That enables us to include meaning frequency information as a continuous variable into further psycholinguistic investigations. By means of these data we can control for the fact that some meanings occur more often and therefore could be processed faster than others.

### 3 Self-Paced Reading Experiment

The lexemes that we investigated can function as MPs with an NAI meaning, and as counterparts with an AI meaning. They differ with regard to the most frequent meaning: While for some lexemes, the AI meaning of the counterpart is the most frequent meaning, for others it is the NAI meaning of the MP that occurs more often. The open question is whether the distinction between the NAI and AI meaning of MPs and their counterparts is reflected in sentence processing. Specifically, we ask whether the NAI meaning of the MP leads to higher processing costs, since it conveys a meaning dimension that must be seen as added to the AI-meaning. Furthermore, we investigate how the ambiguity between the NAI and the AI meaning of MPs and their counterparts is resolved upon encountering the ambiguous particle. We are especially interested in a) the role of the disambiguating context in this ambiguity resolution, and b) the role of relative frequencies of both meanings. Based on studies outlined

in the introduction, we assume that a disambiguating context is crucial in ambiguity resolution. In the light of this, we predict that 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. Specifically, if the AI meaning of the counterpart primarily affects the propositional meaning of a sentence, and if the NAI meaning of the MP is conveyed in an additional step with respect to the propositional meaning of the sentence which hosts the MP, processing times should be shorter if a context triggers the AI meaning than if it triggers the NAI meaning. Furthermore, if the frequency of the different meanings is crucial for the processing, we expect to find a meaning frequency effect in that 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. To test these hypothesis, we conducted a self-paced reading experiment.

### 3.1 Method

*Language material.* 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*. The lexemes *erst* and *wohl* had to be excluded because it was not possible to build suitable minimal pairs and disambiguating discourse contexts. All ten lexemes differed in their frequency ratio of the MP meaning (mean 0.33, range 0.01-0.74), their length (mean 5 letters, range 3-10), the number of syllables (mean 1.4, range 1-2) and the overall lemma frequency (mean 152746, range 12403-723524) (see table 2). The lemma frequency data refer to the absolute lemma frequency, taken from the *dlex.db* database (Heister et al. 2011). We have to condone that the lexemes differ in these criteria, since modal particles as a word class is a closed class and therefore is limited in its size. However, as described later on, since we compare the processing of the NAI and the AI meaning of the same words, the differences

hold for both experimental conditions.

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

**Table 2.** Characteristics of the target words

We manipulated the position of the disambiguating context (preceding the ambiguity, or following the ambiguity). 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 the counterpart. The context, which either preceded or followed the ambiguous target sentence, triggered either the NAI (5) or the AI meaning (6) (contexts in italic letters). This leads to four conditions, as summarized in Table 3.

- (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.

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

**Table 3.** Experimental conditions

For each target, five ambiguous target sentences were created. An exception was the target *vielleicht*, for which we created ten target sentences: Five as declarative sentences and five as

interrogative sentences<sup>8</sup>. Another exception was the target *bloß*, for which we created five imperative target sentences and five interrogative target sentences<sup>9</sup>, leading to sixty target sentences. In a web-based pretest, we tested whether the context and target sentences were natural and whether they licensed the respective target words. This is important because MPs can only occur in specific environments and their meaning contributions are very subtle. We tested all sixty target sentences, preceded by two possible disambiguating contexts (triggering the NAI or the AI meaning). The resulting 120 complex sentences were divided into four lists. Forty-two German native speakers read the complex sentences without the target word. A pop-up field with the ten target words, presented in alphabetical order, replaced the respective target word and participants had to choose an appropriate word. An answer was correct if the participants choose the expected target word. We counted the correct answers for each sentence. If in at least 50% of the cases the target word was correctly chosen, we concluded that the context was appropriate in order to trigger the respective meaning and that the sentence was natural. We included the sentence in the self-paced reading experiment. 50% of correct answers is not high, but considering that the meaning contributions of MPs are very subtle, that facets of meanings of different MPs even overlap, and that participants had to choose out of a high number of different MPs, the 50% criterion is realistic. Thirty sentences had to be revised, because the correct target word was not chosen in at least 50% of the cases. These sentences were tested in a second pre-test. Forty-eight German native speakers participated in the second pre-test. The procedure was the same as in pre-test 1. Again, we counted the correct answers for each sentence. For sixteen of the thirty revised sentences the target word was chosen in at least 50% of the cases. After the pre-test, we removed a whole

---

<sup>8</sup> In the corpus study, *vielleicht* as an adverb occurred more often in declarative sentences and *vielleicht* as an MP occurred more often in interrogative sentences. To control for these differences, we included both sentence types

<sup>9</sup> In the corpus study, *bloß* as an MP occurred in 43% of the cases in imperative sentences and in 43% of the cases in interrogative sentences. In order to have representative sentences in our reading experiment, we tried to include both sentence types.

target word, if at least five of the ten complex sentences failed the pre-tests. This was the case for *bloß* in imperative sentences. After this exclusion, fifty-five of the initial sixty target sentences were left. Based on the pre-tests, we assume that these target sentences together with the context sentences are natural and that they license the occurrence of the target word.<sup>10</sup> 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 (see Appendix A for all fifty-five German target sentences with the two contexts triggering the AI and the NAI meaning, respectively). 220 sentences were added from an unrelated experiment. The 440 sentences were allocated to four lists by a Latin square design<sup>11</sup>, 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

---

<sup>10</sup> Interestingly, a further analyses of the remaining fifty-five target sentences showed that target words with a strong bias towards the NAI or AI meaning were chosen significantly more reliably than target words with no bias towards one meaning, suggesting that meaning frequency plays a crucial role in the general interpretation of ambiguous sentences.

<sup>11</sup> We initially created sixty sentence quartets, which is more suitable for the Latin square design than fifty-five sentence quartets. However, as already described, five sentence quartets had to be excluded after the pre-tests.

recorded via a key press on a Razor Deathstalker essential gaming keyboard with a 1000 Hz ultra polling rate. Stimuli were presented and reaction times were measured using Linger (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.

### 3.2 Results

Log-normalized reading times in milliseconds were analyzed for four critical regions, namely for the target (e.g., *bloß*) and the three following words (e.g., +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 (344 ms vs. 341 ms). If the following context triggered the NAI meaning, RTs for the target word were as fast as if it triggered the AI meaning (347 ms vs. 345 ms).

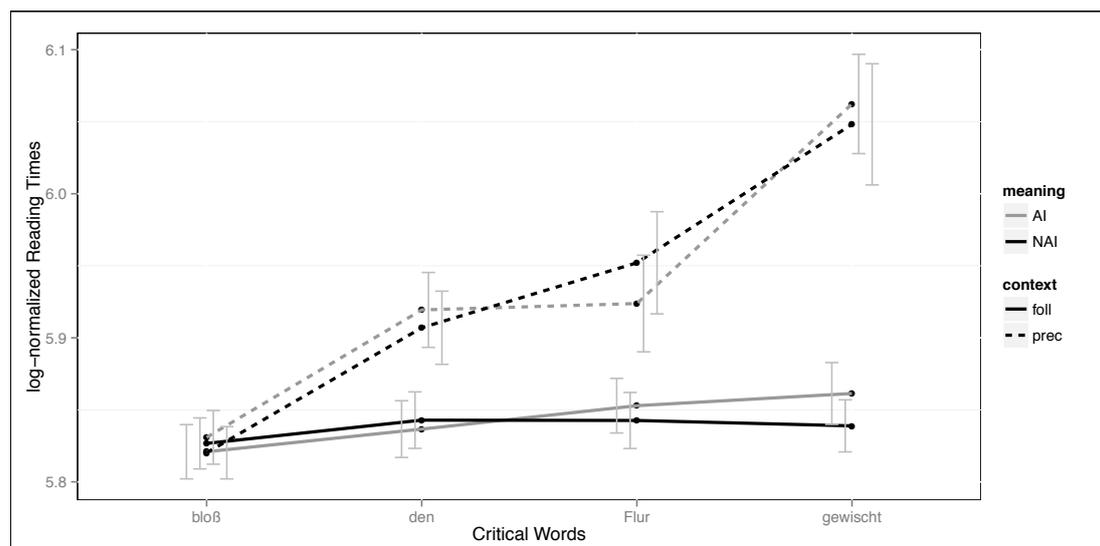
*+1 region.* The results showed a significant main effect of *context* ( $\beta = 0.04$ ,  $SE = 0.01$ ,  $t = 3.4$ ,  $p < .001$ ). If the context preceded the target sentence, RTs were longer (375 ms) than if the context followed the target sentence (349 ms). Furthermore, there was an interaction of *meaning frequency*  $\times$  *context* ( $\beta = 0.11$ ,  $SE = 0.03$ ,  $t = 3.2$ ,  $p < .01$ ). 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* ( $\beta = 0.08$ ,  $SE = 0.03$ ,  $t = 3.3$ ,  $p = .001$ ). If the context preceded the target sentence, RTs were longer (388 ms) than if the context followed the target sentence (355 ms). Furthermore, there was an interaction of *meaning*  $\times$  *context* ( $\beta = 0.04$ ,  $SE = 0.02$ ,  $t = 2.06$ ,  $p < .05$ ). If the context preceded the target sentence, RTs were longer if the context triggered the NAI meaning (396 ms) than if it triggered the AI meaning (380 ms).

*+3 region.* The results showed again a significant main effect of *context* ( $\beta = 0.22$ ,  $SE$

= 0.02,  $t = 9.0$ ,  $p < .001$ ). If the context preceded the target sentence, RTs were longer (457 ms) than if the context followed the target sentence (354 ms). There was a significant main effect of *meaning* ( $\beta = -0.04$ ,  $SE = 0.02$ ,  $t = -2.25$ ,  $p < .05$ ). RTs were shorter for the NAI meaning (383 ms) than for the AI meaning (386 ms). Furthermore, there was a significant main effect of *meaning frequency* ( $\beta = -0.07$ ,  $SE = 0.03$ ,  $t = -2.4$ ,  $p < .05$ ). RTs were shorter with increasing frequency bias towards the NAI meaning of the target word. Finally, the interaction of *meaning frequency*  $\times$  *meaning* was significant ( $\beta = 0.08$ ,  $SE = 0.04$ ,  $t = 2.0$ ,  $p = .04$ ). 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*.

Additionally, we analyzed that data by including the general frequency of each lexeme and the number of meanings per lexeme as fixed factors. However, it turned out that these factors did not influence processing.



**Figure 4.** Results for all four critical regions, including the factors *context* and *meaning* (foll = context follows target sentence; prec = context precedes target sentence)

### *3.3 Discussion*

We asked whether the two-dimensionality of the NAI/AI meaning of MPs and their counterparts is reflected in sentence processing. We predicted that processing differences between the NAI/AI meaning suggest differences in their meaning representation in that higher processing times for the NAI meaning indicate the conveyance of an additional secondary meaning. Indeed, a difference between the processing of the NAI and AI meaning was found in the +2 region, the second word following the ambiguous target word. As predicted, the AI meaning had a processing advantage over the NAI meaning and this difference depended on the presence of a preceding context. However, in the +3 region, which is the third word following the ambiguous target word, the NAI meaning of the MP had a processing advantage over the AI meaning of the counterpart, and this time independent of the presence of a disambiguating context.

We assumed that a disambiguating context is crucial in this ambiguity resolution. This is confirmed by our results, in that 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, the target sentences were processed equally fast in both conditions. However, against intuitions, processing times for the ambiguous target sentences were shorter, compared to the condition where the context preceded the target sentence. This suggests 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, Ferreira, Bailey & Ferraro 2002, Sanford & Sturt 2002, Sanford 2002, Ferreira 2003, Christianson et al. 2001, 2006, Ferreira & Patson 2007, Kuperberg 2007, Swets et al. 2008) and shows that preceding contextual information is necessary in order to initiate an in-depth parsing of an ambiguous sentence. Another possibility is that since the meaning differences are subtle, participants were not aware of the ambiguity in this condition, leading to faster processing of the sentence

than if the interpretation would have been guided into a specific direction by a preceding context. However, in this case, one meaning, probably the most frequent meaning, should have been processed as fast as if it had been preceded by the respective context. Clearly, this was not the case, since the conditions where the context followed was up to 100 milliseconds faster than the conditions where the context preceded the target sentence and triggered either the AI or the NAI meaning. We conclude that shallow parsing is the more plausible explanation for our results.

In the corpus study, we measured the meaning frequency bias of the lexemes towards the NAI meaning and found that the investigated lexemes differ strongly in their meaning frequency bias. For the reading experiment, we predicted that if the frequency of the different meanings is crucial for the processing of the ambiguous lexemes and the ambiguous sentences, 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. The results of the reading experiment show that the meaning frequency of the target words influenced the processing, since there was a *meaning frequency*  $\times$  *context* interaction in the +1 region and a *meaning frequency*  $\times$  *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.

*Longer RTs for the NAI meaning in the +2 region.* The significant *meaning*  $\times$  *context* interaction in the +2 region speaks in favor of higher processing costs related to the NAI meaning of 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 use-conditional meaning components that usually do not affect the propositional meaning, and that are activated in a second step, after the meaning of the sentence which hosts the MP is encountered.

The interaction of *meaning*  $\times$  *context* shows up in the +2 region. This is in line with the study of Swinney (1979), in which the activation of multiple meanings of ambiguous words in a sentence were measured; either immediately after encountering the ambiguous target word, or three syllables following the ambiguous target word. The results of the study of Swinney (1979) 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 although the influence of context does not unfold immediately after the target word, it guides the interpretation process incrementally during sentence processing. In the light of these data, higher processing costs in the +2 region found in our experiment might indicate that the meaning of the ambiguous target sentence was disambiguated in this region. If a preceding context triggered the NAI meaning, the AI meaning of the counterpart, which was initially activated together with the NAI meaning, was suppressed and the NAI meaning of the MP was the only available meaning. The higher processing costs thus can have two sources: Either the suppression of the AI meaning is especially costly, or the conveyance of the secondary, NAI meaning related to the MP is especially costly. However, the results are also in line with studies showing a direct influence of context (e.g., van Berkum et al. 1999), according to which only the NAI meaning was immediately available, and no suppression of the AI meaning took place. In that case, the presence of the NAI meaning would be the only source for the higher processing costs in this region. At present, our study cannot distinguish between these two possibilities, but we

suggest that the conveyance of the secondary, NAI meaning related to the MP lead to higher processing costs, since this would be compatible with both possibilities.

In the condition, in which there was no disambiguating context provided, the ambiguous sentence was parsed very quick and shallowly. That some structurally ambiguous sentences are parsed faster than unambiguous ones is observed frequently, as previously described (e.g., Bayer & Marslen-Wilson 1992, Traxler, Pickering & Clifton 1998, Townsend & Bever 2001, van Gompel, Pickering & Traxler 2001, Ferreira et al. 2002, Sanford 2002, Swets et al. 2008). For instance, Ferreira et al. (2002), Sanford & Sturt (2002), and Sanford (2002), Ferreira (2003), Christianson et al. (2001, 2006), Ferreira & Patson (2007), Kuperberg (2007), and Swets et al. (2008), argue for an underspecification, or good-enough approach to language comprehension according to which readers do not commit themselves 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.

The results of our study indicate that the presence of a context is crucial in the ambiguity resolution and that the influence of contextual information, if present in form of a preceding context, is reflected two words following the ambiguous target word. Finally, that the higher processing costs for the NAI meaning only arise in the presence of a preceding *discourse* context is not surprising in the light of their status as *discourse* particles.

*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 is unexpected, but can be explained if we look at processing steps related to the AI meaning of the counterparts in more detail. As mentioned throughout the

paper, the AI meaning influences the propositional meaning (often the truth value) of a sentence. Studies with time-sensitive measures on the processing of truth-conditional information show that truth-values of a sentence are processed incrementally as the sentence meaning unfolds. They offer evidence that people effortlessly map incoming utterances onto what they think is a mental model that renders the input true and relevant and that both word meaning and world knowledge are recruited and integrated very rapidly, within 400 milliseconds during online sentence comprehension (e.g., Nieuwland 2013, Hagoort et al. 2004, Nieuwland & Kuperberg 2008, Nieuwland & Martin 2012). In the following we argue that in the case of the lexemes used in our study, processing steps emerge rather at the end of the sentence when enough information is available to the comprehension system. Note that this effect can be seen as incremental, since it still occurs in the time course of sentence processing (cf. Cozijn, Noordman & Vonk 2011).

Since the counterparts are very diverse, it is not possible to make generalizations for all counterparts used in this study. Therefore, in the following, we will take the lexeme *bloß* as one representative and explain why the processing of this focus particle might have led to higher processing costs at the end of the sentence. We would like to stress that these processing steps do not necessarily arise for all other counterparts in the same way, but since we only had five sentence quartets per target word, it is not valid to make a claim about the exact processing of each single counterpart, but only of all counterparts as one class. Although the diversity of the counterparts might blur the distinction between NAI and AI meanings, we think that if one includes a set of counterparts that is large enough, like ours, it is valid to make a general claim about this set.

As explained in the introduction, if *bloß* is interpreted as a focus particle, processing steps emerge that do not emerge if the NAI meaning of the MP is activated. For example, *bloß* as a focus particle associates with a focus in a sentence (cf. Jackendoff 1972, König 1991) and excludes alternatives to this focal constituent (Rooth 1992). Therefore, preceding

information which suggests the existence of such alternatives has to be recalled, hampering processing. Although 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 incurs 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, Wartenburger & Spalek 2016), but also a set of alternatives that is not contextually enumerated and that is unrelated to the target word. Gotzner et al. (2016) 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 rather broad.

Taken these data into account, it is possible that a broad set of alternatives was activated as soon as *bloß* was encountered in our study, independently of the presence of a preceding context. The higher processing costs for the AI meaning only emerge in the +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 to identify the focus, that is, the focused constituents [[<sub>FOC</sub> den Flur] gewischt] or the whole VP [<sub>FOC</sub> den Flur gewischt] (‘the corridor wiped’). The focused constituents can activate an alternative set of elements, such as *die Küche* (‘the kitchen’), or *das Wohnzimmer* (‘the living room’). The VP activates even broader alternative sets, 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 in the +3 region and not earlier. These focus ambiguities (e.g., Jackendoff 1972) do not arise in the case of the NAI meaning of MPs. It seems that as soon as the NAI meaning is activated, no further processing steps emerge.

A further processing step is that focus particles may induce a ranking into the set of alternatives (cf. König 1991). *Bloß*, for instance, can open a scale where alternatives are ranked regarding the size of the set (*the corridor*, *the corridor + the kitchen*, *the corridor + the kitchen + the living room*, and so forth). *Bloß* can also open a “pragmatic” scale where it invites an evaluative interpretation (cf. Bayer 1996: 62) (*Hans ist bloß Bauarbeiter*, ‘Hans is only a builder’), with alternatives ordered on a scale regarding the reputation of the work (e.g., *builder < teacher < lawyer*). These scales differ qualitatively and as soon as *bloß* and its focused constituent are encountered, the hearer has to figure out which kind of scale is involved. According to Jacobs (1983: 171), whether alternatives invite evaluative or non-evaluative interpretations is often vague, leading to two possible interpretations of the same sentence (cf. also König 1991: 100). Furthermore, Loureda et al. (2015) showed that processing a closed class of alternatives, ordered on a pragmatic, or evaluative scale, is less costly than processing an open class of alternatives, ordered on a pragmatic, or evaluative scale, and that the role of the focus particle differs with respect to the two different classes.

Importantly, although the counterparts investigated in the present study differ, there are similarities regarding the involvement of scales and the relation to the elements of a set.

*Schon*, for instance, has in its core meaning a temporal interpretation. As pointed out by Bayer & Obenauer (2011: 469 f.), it requires a scale on which *already* (p) denotes a state p right after  $\neg$  p. The temporal scale can be transposed to other scales, like a local scale (*We are already in Paris*) or a prestige scale (*John is already associate professor*). The latter case illustrates the strong resemblance to the evaluative interpretation of the alternatives activated by *bloß*. Another resemblance can be found between *bloß* and the focus particle *auch*, with *bloß* discarding all the other elements of a set and *auch* indicating that the information conveyed by the sentence is valid for all elements of the set (cf. Loureda et al. 2015). The processing steps for the different counterparts are not fundamentally different. This may explain the higher processing costs found at the end of the sentence in our reading experiment for the AI meaning of the counterparts as one class.

High processing costs located at the end of the sentence are also found in a study by Cozijn et al. (2011) on propositional integration and world knowledge inference in sentences containing the conjunction *because*. The authors found evidence for two different processes during the comprehension of *because*-sentences, in that the presence of the conjunction speeds up the processing of the words immediately following the conjunction, and slows down the processing of the final word (in comparison to the absence of the conjunction). Cozijn et al. (2011) argue that the higher processing costs at the end of the sentence are due to inferential processes related to the world knowledge inference induced by *because* (cf. Till et al. 1988 for inference processes being part of the sentence wrap-up process, but see Hagoort et al. 2004 for an immediate integration of world knowledge, without assuming a two-step integration procedure). Note that we also dealt with bi-clausal sentences in our experiment, which were sometimes combined with a conjunction. If in our study the presence of the conjunction lead to higher processing costs related to the AI meaning at the end of the sentence, one would expect to find conjunctions mostly in the AI conditions. However, this is not the case, since the complex sentences for three of the investigated ten target words (*schon*,

*vielleicht*, and *auch*) did include conjunctions in both the AI and NAI conditions, the complex sentences for two target words (*bloß*, and *nur*) did not include conjunctions in any condition, the complex sentences for two target words (*eben*, and *einfach*) did only include conjunctions in the NAI condition, and the complex sentences for three target words (*ruhig*, *doch*, and *gleich*) did only include conjunctions in the AI condition. This small difference between the AI and NAI condition cannot explain the higher processing costs at the end of the sentence related to the AI meaning.

Following the argumentation of Cozijn et al. (2011), the processing costs observed for the NAI and AI meaning in our experiment seems to exhibit a chronological order. This does not necessarily mean that the processing of the AI meaning is delayed, but that the processing of the AI meaning occurs when the information required is available. We also illustrated how the calculation of the propositional meaning of the sentence can change (e.g., in terms of focus ambiguities) as the sentence unfolds. That processing costs related to both meanings are reflected during sentence processing shows that the processing of both propositional and secondary, additional information is immediate and incremental.

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. While the processing costs for the AI meaning rise continuously as the sentence meaning unfolds in a way that more information leads to more possible interpretations (e.g., in terms of focus ambiguities), the processing costs for the NAI meaning rise fast, but as soon as this meaning is activated, no further processing steps emerge.

*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 intended way. The fact that the difference between the NAI and AI meaning only occurred if a context preceded the target sentence indicates that our contexts reliably triggered the respective meaning. However, another cue to disambiguate the utterance reliably is prosody. 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.

#### *4 Conclusion*

We presented a corpus study of the meaning frequencies of twelve German MPs and their counterparts, and showed that these lexemes differ strongly in their frequency bias towards the NAI meaning of the MPs. 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 as we argue is due to processing steps related to the AI meaning, like the resolution of focus ambiguities and the activation of alternatives. 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 whose processing involves different steps. The meaning frequency and the presence 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 sophisticated claims about the processing differences between AI and NAI meaning components.

## References

- Abraham, Werner (1991): The grammaticalization of the German modal particles. In: Elizabeth. C. Traugott & Bernd Heine (eds.), *Approaches to grammaticalization* (pp. 331-380). Amsterdam: Benjamins.
- Altmann, Gerry. T. M. (1998): Ambiguity in sentence processing. In: *Trends in Cognitive Sciences*, 2, 146-152.
- Anderbois, Scott, Adrian Brasoveanu & Robert Henderson (2015): At-issue proposals and appositive impositions in discourse. In: *Journal of Semantics*, 32, 93-138.
- Baayen, R. Harald (2008): *Analyzing linguistic data. A practical introduction to statistics using R*. Cambridge: Cambridge University Press.
- Bader, Markus (1996): *Sprachverstehen - Syntax und Prosodie beim Lesen*. Opladen: Westdeutscher Verlag.
- Bayer, Josef (1991): German particles in a modular grammar: Neurolinguistic evidence. In: Werner Abraham (ed.), *Discourse particles: Descriptive and theoretical investigations on the logical, syntactic and pragmatic properties of discourse particles in German* (pp. 253-302). Amsterdam: Benjamins.
- (1996): *Directionality and logical form: On the scope of focusing particles and wh-in-situ*. Dordrecht: Kluwer Acad.
- Bayer, Josef & William Marslen-Wilson (1992): *Configurationality in the light of language comprehension: The order of arguments in German*.
- Bayer, Josef & Hans-Georg Obenauer (2011): Discourse particles, clause structure, and question types. In: *Linguistic Review*, 28, 449-491.
- Bayer, Josef & Andreas Trotzke (2015): The derivation and interpretation of left peripheral particles. In: Josef Bayer, Roland Hinterhölzl & Andreas Trotzke (eds.), *Discourse-oriented Syntax*. Amsterdam, Philadelphia: Benjamins.

- Braun, Bettina & Lara Tagliapietra (2010): The Role of contrastive intonation contours in the retrieval of contextual alternatives. In: *Language and Cognitive Processes*, 25, 1024-1043.
- Christianson, Kiel, Andrew Hollingworth, John F. Halliwell & Fernanda Ferreira (2001): Thematic roles assigned along the garden path linger. In: *Cognitive Psychology*, 42, 368-407.
- Christianson, Kiel, Carrick C. Williams, Rose T. Zacks & Fernanda Ferreira (2006): Younger and older adults "good-enough" interpretations of garden-path sentences. In: *Discourse Processes*, 42, 205-238.
- Coniglio, Marco (2011): *Die Syntax der deutschen Modalpartikeln: Ihre Distribution und Lizenzierung in Haupt- und Nebensätzen*. Berlin: Akademie-Verlag.
- Cozijn, Reinier, Leo G. M. Noordman & Wietske Vonk (2011): Propositional integration and world-knowledge inference: Processes in understanding because sentences. In: *Discourse Processes*, 48, 475-500.
- Dillon, Brian, Charles Clifton Jr. & Lyn Frazier (2014): Pushed aside: Paratheticals, memory and processing. In: *Language, Cognition and Neuroscience*, 29, 483-498.
- Doherty, Monika (1985): *Epistemische Bedeutungen*. Berlin: Studia grammatica.
- Egg, Markus & Malte Zimmermann (2012): *Stressed out. Accented discourse particles-the case of DOCH*. Talk at Sinn und Bedeutung, 16.
- Ferreira, Fernanda (2003): The misinterpretation of noncanonical sentences. In: *Cognitive Psychology*, 47, 164-203.
- Ferreira, Fernanda, Karl G. D. Bailey & Vittoria Ferraro (2002): Good-enough representations in language comprehension. In: *Current Directions in Psychological Science*, 11, 11-15.
- Ferreira, Fernanda & Nikole D. Patson (2007): The 'good enough' approach to language comprehension. In: *Language and Linguistics Compass*, 1, 71-83.

- Fodor, Jerry A. (1983): *Modularity of mind*. Cambridge: MIT Press.
- Gibbs, Raymond W. (1984): Literal meaning and psychological theory. In: *Cognitive Science*, 8, 275-304.
- Giora, Rachel (1997): Understanding figurative and literal language: The graded salience hypothesis. In: *Cognitive Linguistics*, 7, 183-206.
- Gotzner, Nicole (2014): *What's included in the set of alternatives? Psycholinguistic evidence for a permissive view*. Paper presented at the Sinn & Bedeutung, Göttingen.
- Gotzner, Nicole, Isabell Wartenburger & Katharina Spalek (2016): The impact of focus particles on the recognition and rejection of contrastive alternatives. In: *Language and Cognition*, 8, 59-95.
- Grosz, Patrick (2010): *German doch: An element that triggers a contrast presupposition*. Paper presented at the Proceedings of the Chicago Linguistic Society.
- (2016). Discourse particles. In: Lisa Matthewson et al. (eds.), *The Companion to Semantics*. New Jersey: Wiley.
- Gutzmann, Daniel (2013): Expressives and beyond. An introduction to varieties of use-conditional meaning. In: Daniel Gutzmann & Hans-Martin Gärtner (eds.), *Beyond expressives: Explorations in use-conditional meaning* (pp. 1-58). Leiden: Brill.
- Hagoort, Peter, Lea Hald, Marcel Bastiaansen & Karl Magnus Petersson (2004): Integration of word meaning and world knowledge in language comprehension. In: *science*, 304, 438-441.
- Harris, Jesse A. & Christopher Potts (2009): Perspective-shifting with appositives and expressives. In: *Linguistics and Philosophy: An International Journal*, 32, 523-552.
- Hartmann, Dietrich (1986). Context analysis or analysis of sentence meaning?: On modal particles in German. In: *Journal of Pragmatics*, 10, 543-557.
- Heister, Julian, Kay-Michael Würzner, Johannes Bubenzer, Edmund Pohl, Thomas Hanneforth, Alexander Geyken & Reinhold Kliegl (2011): dlexDB - Eine lexikalische

- Datenbank für die psychologische und linguistische Forschung. In: *Psychologische Rundschau*, 62, 10-20.
- Helbig, Gerhard (1990): *Lexikon deutscher Partikeln*. Leipzig: Verlag Enzyklopädie.
- Hentschel, Elke (1986): *Funktion und Geschichte deutscher Partikeln. "Ja", "doch", "halt" und "eben"*. Tübingen: Max Niemeyer Verlag.
- Hogaboam, Thomas W. & Charles A. Perfetti (1975): Lexical ambiguity and sentence comprehension. In: *Journal of Verbal Learning & Verbal Behavior*, 14, 265-274.
- Horn, Laurence R. (1996): Exclusive company: Only and the dynamics of vertical inference. In: *Journal of Semantics*, 13, 1-40.
- Jackendoff, Ray S. (1972): *Semantic interpretation in generative grammar*. Cambridge: MIT Press.
- Jacobs, Joachim (1983): *Fokus und Skalen - Zur Syntax und Semantik der Gradpartikeln im Deutschen*. Tübingen: Niemeyer.
- Karagjosova, Elena (2006): Adverbial doch and the notion of contrast. In: *Explicit and Implicit Information in Text Information Structure across Languages*, 69.
- (2009): A unified DRT-based account of accented and unaccented middle field doch. In: *Sprache und Datenverarbeitung*, 33, 77-93.
- (2012): Conjunct adverb doch and the notion of contrast. In: *Linguistics*, 50, 27-64.
- Kellas, George, Stephen T. Paul & Michael Martin (1991): Contextual feature activation and meaning access. In: Greg B. Simpson (ed.), *Understanding word and sentence* (pp. 47-71). Amsterdam: Elsevier.
- Klein, Wolfgang & Alexander Geyken (2010): Das Digitale Wörterbuch der Deutschen Sprache (DWDS). In: *Lexicographica: International Annual for Lexicography*, 26, 79-96.
- König, Ekkehard (1991): *The meaning of focus particles: A comparative perspective*. London: Routledge.

- Kuperberg, Gina R. (2007): Neural mechanisms of language comprehension: Challenges to syntax. In: *Brain Research*, 1146, 23-49.
- Leinenger, Mallorie & Keith Rayner (2013): Eye movements while reading biased homographs: Effects of prior encounter and biasing context on reducing the subordinate bias effect. In: *Journal of Cognitive Psychology*, 25, 665-681.
- Loureda, Óscar, Adriana Cruz, Martha Rudka, Laura Nadal, Inés Recio & Margarita Borreguero Zuloaga (2015): Focus particles in information processing: An experimental study on pragmatic scales with Spanish *incluso*. In: *Linguistik online*, 71.
- Meibauer, Jörg (1994): *Modaler Kontrast und konzeptuelle Verschiebung: Studien zur Syntaxt und Semantik deutscher Modalpartikeln*. Tübingen: Niemeyer.
- (2012): What is a context? Theoretical and empirical evidence. In: Rita Finkbeiner, Jörg Meibauer & Petra B. Schumacher (eds.), *What is a Context? Linguistic Approaches and Challenges* (pp. 9-32). Amsterdam, Netherlands: Benjamins.
- Nieuwland, Mante S. (2013): “If a lion could speak...”: Online sensitivity to propositional truth-value of unrealistic counterfactual sentences. In: *Journal of Memory and Language*, 68, 54-67.
- Nieuwland, Mante S. & Gina R. Kuperberg (2008): When the truth is not too hard to handle an event-related potential study on the pragmatics of negation. In: *Psychological Science*, 19, 1213-1218.
- Nieuwland, Mante S. & Andrea E. Martin (2012): If the real world were irrelevant, so to speak: The role of propositional truth-value in counterfactual sentence comprehension. In: *Cognition*, 122, 102-109.
- Obenauer, Hans-Georg (2004): Nonstandard wh-questions and alternative checkers in Pagotto. In: Horst Lohnstein & Susanne Trissler (eds.), *The syntax and semantics of the left periphery* (pp. 343-383). Berlin, New York: Mouton de Gruyter.

- Potts, Christopher (2005): *The logic of conventional implicatures*. Oxford: Oxford University Press.
- (2007): The expressive dimension. In: *Theoretical Linguistics*, 33, 165-198.
- Potts, Christopher & Florian Schwarz (2008): Exclamatives and heightened emotion: Extracting pragmatic generalizations from large corpora. *Ms., UMass Amherst*, 1-29.
- Rayner, Keith & Susan A. Duffy (1986): Lexical complexity and fixation times in reading: Effects of word frequency, verb complexity, and lexical ambiguity. In: *Memory & Cognition*, 14, 191-201.
- Rayner, Keith & Lyn Frazier (1989): Selection mechanisms in reading lexically ambiguous words. In: *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 779-790.
- Récanati, François. (2010): *Truth-conditional pragmatics*. Oxford: Oxford University Press.
- Rojas-Esponda, Tania (2014): *A QUD account of German doch*. Paper presented at the Sinn & Bedeutung, Göttingen.
- Rooth, Mats (1992): A theory of focus interpretation. In: *Natural Language Semantics*, 1, 75-116.
- Sanford, Anthony J. (2002): Context, attention, and depth of processing during interpretation. In: *Mind & Language*, 17, 188-206.
- Sanford, Anthony J. & Patrick Sturt (2002): Depth of processing in language comprehension: Not noticing the evidence. In: *Trends in Cognitive Sciences*, 6, 382-386.
- Schumacher, Petra B. (2012): Context in neurolinguistics: Time-course data from electrophysiology. In: Rita Finkbeiner, Jörg Meibauer & Petra B. Schumacher (eds.), *What is a context? Linguistic approaches and challenges* (pp. 33-53). Amsterdam, Netherlands: Benjamins.
- (2014): Content and context in incremental processing: "the ham sandwich" revised. In: *Philosophical Studies*, 168, 151-165.

- Schwarz, Florian (2007): Processing presupposed content. In: *Journal of Semantics*, 24, 373-416.
- Schwarz, Florian & Sonja Tiemann (2016): Presupposition projection in online processing. In: *Journal of Semantics*.
- Searle, John R. (1979): *Expression and meaning: Studies in the theory of speech acts*. Cambridge: Cambridge UP.
- (1980): The background of meaning. In: John R. Searle, Ferenc Kiefer & Manfred Bierwisch (eds.), *Speech act theory and pragmatics* (pp. 221-232). Dordrecht: Reidel.
- Seidenberg, Marc S., Michael K. Tanenhaus, James L. Leiman & Marie Bienkowski (1982): Automatic access of the meanings of ambiguous words in context: Some limitations of knowledge-based processing. In: *Cognitive Psychology*, 14, 489-537.
- Swets, Benjamin, Timothy Desmet, Charles Clifton Jr. & Fernanda Ferreira (2008): Underspecification of syntactic ambiguities: Evidence from self-paced reading. In: *Memory & Cognition*, 36, 201-216.
- Swinney, David (1979): Lexical access during sentence comprehension: (Re)consideration of context effects. In: *Journal of Verbal Learning & Verbal Behavior*, 18, 645-649.
- Thurmair, Maria (1989): *Modalpartikeln und ihre Kombinationen*. Tübingen: Max Niemeyer Verlag.
- Tiemann, Sonia, Mareike Schmid, Nadine Bade, Bettina Rolke, Ingo Hertrich, Hermann Ackermann, Julia Knapp & Sigrid Beck (2011): *Psycholinguistic evidence for presupposition: On-line and off-line data*. Paper presented at the Sinn & Bedeutung.
- Till, Robert E., Ernest F. Mross & Walter Kintsch (1988): Time course of priming for associate and inference words in a discourse context. In: *Memory & Cognition*, 16, 283-298.
- Townsend, David. J. & Thomas G. Bever (2001): *Sentence comprehension: The integration of habits and rules*. Cambridge: MIT Press.

- Traxler, Matthew J., Martin J. Pickering & Charles Clifton Jr. (1998): Adjunct attachment is not a form of lexical ambiguity resolution. In: *Journal of Memory and Language*, 39, 558-592.
- van Berkum, Jos J. A., Peter Hagoort & Colin M. Brown (1999): Semantic integration in sentences and discourse: Evidence from the N400. In: *Journal of Cognitive Neuroscience*, 11, 657-671.
- van Gompel, Roger P. G., Martin J. Pickering & Matthew J. Traxler (2001): Re-analysis in sentence processing: Evidence against current constraint-based and two-stage models. In: *Journal of Memory and Language*, 45, 225-258.
- Zimmermann, Malte (2011): Discourse particles. In: Paul Portner, Claudia Maienborn & Klaus von Stechow (eds.), *Semantics: An international handbook of natural language meaning* (pp. 2011-2038). Berlin, New York: Mouton de Gruyter.