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Processing German past tenses

The impact of sentence onset and dialect

Abstract: This study investigates the impact of the Uniform Information Density principle on the use and processing of German past tenses, focusing on the perfect and the preterit. It examines whether sentence-initial temporal versus tense-neutral adverbs affect acceptability and processing speed, and how regional variation – particularly the decline of the preterit in some dialects – modulates this effect. The findings from an acceptability judgement study and a self-paced reading study indicate that temporal adverbs ease the processing of preterit constructions, especially in dialect regions where the preterit is less common. It thus provides evidence for the influence of dialects on the processing of Standard German and supports the Uniform Information Density-based notion of optimal information distribution.

Keywords: Past tense, German, Uniform Information Density, dialects, rating experiment, self-paced reading experiment

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1 Introduction

Ever since the papers by Fenk & Fenk (1980), the concept of distributing information evenly across an utterance to facilitate successful communication has been a prominent topic in (psycho-)linguistics. This idea has gained further prominence in recent years for phonetic variation (Aylett & Turk 2004) and syntactic variation, particularly the omission or placement of optional words (Levy & Jaeger 2007).

The idea of a Uniform Information Density (UID) (Levy & Jaeger 2007) has been applied to various cases both in English and German (see Juzek 2024 for an overview). However, to my knowledge, the relationship between UID and the selection and usage of past tenses, especially in German, has not been extensively explored.

The past tenses locate an event at a time before the actual speech time (Reichenbach 1947), which is called 'PAST' throughout this paper. In German, the 'Perfekt' (present perfect) and the 'Präteritum' (simple past or preterit tense) can be used accordingly.[1] While there are semantic differences between these tenses (e.g. Musan 2002; Welke 2005), they are somewhat interchangeable (Hennig 2000: 26—29, among others). This interchangeability is particularly evident in German dialects because several of them have lost their preterit forms in their verbal paradigm (Fischer 2018: 1, 29). Consequently, the preterit is no longer used in these regions and is fully replaced by the perfect tense. Since dialects and the standard variant influence each other, it can be inferred that the interchangeability of the two tenses is also present in the standard German variant (Fischer 2018: 131—136; Hennig 2000: 29—31).

Moreover, past tenses are frequently accompanied by temporal adverbials, which – like the tense itself – convey past time reference. These adverbials often appear as frame- or scene-setters at the beginning of the sentence (Speyer 2008; 2009; 2010), positioning the temporal information early in the utterance. Building on this observation – and assuming that the preterit and perfect are fully interchangeable in isolated, contextless sentences – this paper examines how sentence-initial adverbials influence past-tense processing within the framework of the UID principle. Example (1) illustrates the idea.

(1) a. *Gestern hat die Angestellte die Blusen gebügelt.*
Yesterday has the employee the blouses ironed.
'Yesterday, the employee has ironed the blouses.'

[1] The Plusquamperfekt 'plusquamperfect' also locates an event in the past though it mostly fulfills the task of locating an event in the past before another event or reference time.

b. *Gestern bügelte die Angestellte die Blusen.*
Yesterday ironed the employee the blouses.
'Yesterday, the employee ironed the blouses.'

c. *Vielleicht hat die Angestellte die Blusen gebügelt.*
Perhaps has the employee the blouses ironed.
'Perhaps, the employee has ironed the blouses.'

d. *Vielleicht bügelte die Angestellte die Blusen.*
Perhaps ironed the employee the blouses.
'Perhaps, the employee ironed the blouses.'

The sentences in (1) should differ in terms of UID. In (1a) and (1b), the PAST information is spread across two units, the temporal adverb *gestern* 'yesterday' and the grammatical tense on the verb(s). This should facilitate processing of these clauses by spreading the PAST information across two words, especially in the preterit condition in (1b). In finite preterit verbs, lexical, valency and congruence information are clustered. This could result in an unwanted information peak when the PAST information is also only located in this single word (1d). However, in (1b), the PAST information is spread across the verb *and* the adverb, reducing the information load on the finite verb and, thus, smoothing out the information profile.

This paper aims to provide evidence for the influence of UID and tense, and seeks to answer the following questions: Are the perfect and preterit tenses perceived and processed differently depending on the sentence onset – with the preterit tense being rated higher and read faster when a temporal adverb occurs at the sentence onset? Can these differences be linked to UID? Are there differences depending on the dialect region of a participant due to the preterit loss there?

Thus, I have conducted a rating experiment and a self-paced reading study in a context-free setting to test the following more specific hypotheses using an acceptability judgement task and a self-paced reading experiment.

The remainder of this paper will be structured as follows: Section 2 focuses on the theoretical background about information theory (2.1), and the uniform information density (2.2). Section 3 presents differences between perfect and preterit tense (3.1), the preterit loss (3.2), and the adverbials at the sentence onset (3.3). Section 4 specifies the hypotheses, my expectations, and the processing claim about tense and sentence onset, and the overarching experimental setups. Section 5 presents the experiments and their results, which are discussed in Section 6. A summary in Section 7 closes the paper.

2 Surprisal and Uniform Information Density

2.1 Surprisal

In Shannon's (1948) fundamental, mathematical work on information theory, communication is described as a transfer of information. Communication is considered successful when no information is lost, even in challenging conditions such as noisy environments where individual words may not be comprehended. Nevertheless, communication as a whole does not necessarily break down with the misunderstanding of a single word. This is because words (or constituents) are not independent; rather, they influence each other's predictability, making certain elements like *car* in (2) more (2a) or less expected (2b). In more technical terms, this means that information transfer is successful when adding a certain amount of redundancy reduces the error rate of a signal to utilize the channel most optimally (Shannon 1948).

(2) a. I drive a car.
b. I buy a car.
c. I drive Susan's car.

There are fewer objects that can be *driven* (2a) compared to objects one can *buy* (2b). Thus, *car* is more expected after *drive* and carries less information, hence more redundancy, than after *buy*, where it is less expected.[2] Following the simplified account of Shannon's basic idea, hearers find reconstructing (2a) easier than (2b) due to the greater expectancy of *a car* after *drive*.

Accordingly, there is a negative correlation between the probability of a word and its informational content: The less likely a word is, the more information it conveys and vice versa. This information can be calculated and results in the so-called surprisal value (see Hale 2001 for the name and Shannon 1948: 379—389 for the definition): S(unit) = -log2 p(unit|context).

High surprisal values indicate more processing effort (e.g. Demberg & Keller 2008; Hale 2001) and depend on the amount of context, described as n-grams. Unigram models take only the frequency of a word into account (*car* in (2)). Bigram models include one previous word (*a* in (2a/b), *Susan's* in (2c)), trigram models two previous words (*drive/buy a* in (2a/b), thus the different expectancy would only be visible when one uses a trigram model) and so on.[3] Large and transformer-based language models can take even more context into consideration and use this information for prediction (Naveed et al. 2023). Though this study does not calculate surprisal

[2] Of course, this example is highly simplified and there are numerous contexts where the information what is driven is vitaly important.

[3] The general frequency of words (in a corpus) influences this value. Surprisal values are usually calculated using corpora that are divided into test and training data. Frequencies and likelihoods are gained in the training data and mapped on the test data (Manning and Schütze 2005 among others). Thus, the surprisal values often depend on the training data.

values to predict processing effort and will hence not elaborate further on the technical details of language models, the predictive power of certain elements is important. A less technical understanding of surprisal and prediction is given by Levy (2008).

He states that listeners and readers predict upcoming words based on the input they have comprehended so far (Levy 2008, among others). Even after only partial input, they keep various options about the sentence continuation in mind and assign different probabilities to them. Cognitive capacity is consumed when a probable continuation is ruled out, and the other possible clause continuations obtain a new (higher) probability assignment (Levy 2008: 1135—1136). In (2), it would be highly expected to find a determiner after both verbs. If this expectation was not met, for example, in (2c), more cognitive capacity would be consumed at *Susan's*, compared to the determiner *a*.

The examples mentioned above are on a lexical level. This notion of prediction and expectancy words, however, also applies on a more grammatical level. Thus, one would predict a direct object after the verbs in (2).

This also has implications for tense processing: once a temporal adverb such as yesterday is encountered, comprehenders are likely to rule out continuations that are incompatible with a past-time interpretation. As a result, a past tense verb becomes highly expected and should be processed more quickly and with less effort (Steinhauer & Ullman 2002).

2.2 The Uniform Information Density Principle

The previous section has shown that elements can differ in informativeness. These differences form the basis of the *Smooth Signal Redundancy Hypothesis* (Aylett & Turk 2004) and the UID Hypothesis (Levy & Jaeger 2007), which will be called *UID principle* throughout the paper. When one does not only consider single surprisal values but those of a whole sentence, the different values must be viewed in relation to one another.

Highly informative, i.e., very unexpected, content creates peaks in the information profile. Very uninformative, that is, highly expected, content results in a trough (Figure 1). This change from very high to very low surprisal values is considered very hard to process and should be avoided.

To avoid information profiles as in Figure 1, speakers have various techniques to smooth out the profile, for example, by distributing very informative content over a longer signal or more than one linguistic unit. Thus, information is transmitted "at a constant rate", which helps speakers to "ensure that their message is being communicated as rapidly as possible" (Collins 2014: 656).

Levy and Jaeger (2007) examine this issue in the context of English object relative clauses, where the relative pronoun can either be omitted or included. When omitted, the first word

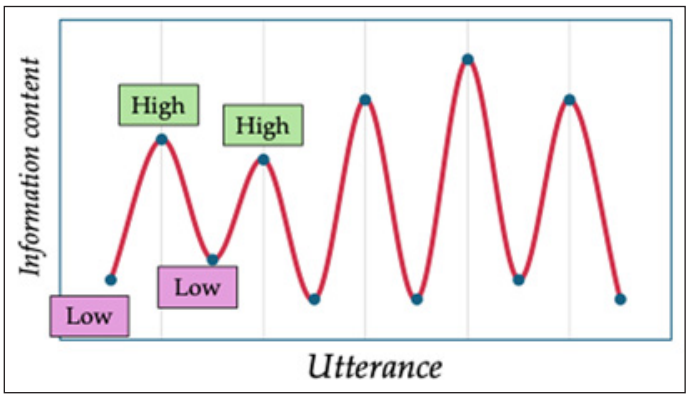

Figure 1: Schematic description of the change in low and high surprisal values, which results in an uneven information profile (Graphic taken from: Wall & Voigtmann 2025)

of the clause must both introduce the clause and carry its own lexical meaning. This dual function becomes problematic when that word is highly informative or when the relative clause is unexpected. Not using a relative pronoun might result in a change of low and very high information content, as indicated by Figure 1. Including the relativizer anchors the clause type explicitly, reducing the informational burden on the following word and making both it and the clause as a whole easier to process because the information profile is less "spiky" (Figure 2). A smooth information profile, as in Figure 2, is said to be preferable for processing. How this relates to the question of tense processing is shown in Section 4.1.

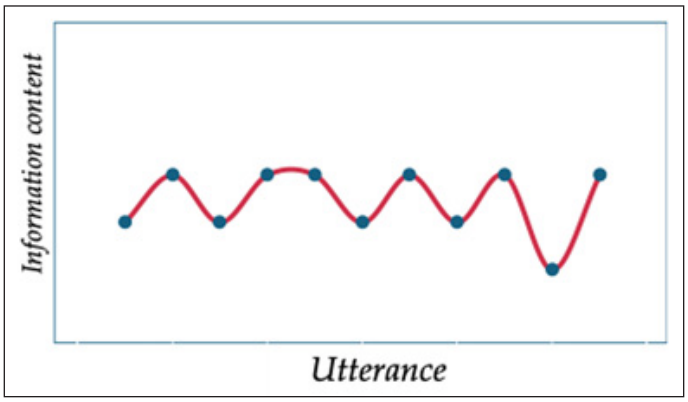

Figure 2: Schematic description of change in low and high surprisal values that results in an even information profile (Graphic taken from: Wall & Voigtmann 2025)

The UID principle has been successfully applied in various studies, e.g. on topic drop (Schäfer 2021, 2025) and fragments (Lemke 2021), but also on word order variation (Collins 2014; Ortmann et al. 2024; Wallenberg et al. 2021). However, there have also been mixed and negative results, as summarized, for example, by Juzek (2024).

3 Perfect and preterit tense in German

3.1 Perfect and preterit tense

Tense – especially past tense – is deictic, meaning it is interpreted relative to the time of speaking (Reichenbach 1947). As mentioned in the introduction, both past tenses considered here locate an event before the speech time (PAST).

This PAST location unifies preterit and perfect tense in modern German. However, when the reference time is also included, as demonstrated to be particularly useful to describe English tense by Rothstein (2006: 171—172), the perfect and the preterit differ. In preterit, the event time coincides with the reference time, making it suitable for referring to singular or repetitive past events and providing a simple context reference (Wöllstein & Bibliographisches Institut 2022: 214). The latter can be made explicit in examples like (3):

(3) We arrived in Oxford, which was by the River Thames.

At the 'speech time' of writing this article, *Oxford* is still located by the river *Thames*. Due to the location of reference time parallel to the event time, sentences like (3) are not ungrammatical and do not imply that the information of the context is no longer true.

Welke (2005: 299) emphasizes that the preterit is primarily used to indicate the temporal relevance of past events. However, he acknowledges its potential to express incompleteness and the progression of an event, contrasting it with the perfect tense.

In perfect tense, speech and reference time are parallel (Reichenbach 1947; Rothstein 2006: 25—27; Wöllstein & Bibliographisches Institut 2022: 210—212). This implies four interpretations as identified by Fischer (2018): futuristic, universal, perfective, and imperfective. Unlike the "präteritale" 'imperfective' interpretation of the perfect tense, which is essentially synonymous with the preterit usage (Fischer 2018: 133), the perfective interpretation signifies the temporal relevance of the past event for the present.[4]

The perfect seemingly carries a more intricate semantic interpretation than the preterit. It has been frequently proposed that the perfect tense yields a compositional interpretation; a present reading is visible in the auxiliary while a past or resultative meaning is attributed to the participle. This interpretation aligns with Musan's (2002) notion of the resultative state of the perfect tense and is further explored by Rothstein (2006: 130) to explain the connection between the perfect tense and events that still retain significance in the present. However, the possibility of the resultative state as an interpretation often depends on the verb's aspectuality,

[4] The other two categories are subordinate and will not be considered here.

as suggested by Welke (2005: 231—235). Aspect, not being a grammatical category in German (Vater 1994), but rather encoded in the verb stem or affixes (Leiss 1992: 30—45), is, thus, not coded via tense.

Welke (2005) expands upon Musan's (2002) interpretation of the perfect tense, but follows her on the relevance of the perfect event for the present speech time and on the notion of universality. Building on the latter, he adds a more external perspective on events to describe the totality of an event and to express completeness (Welke 2005: 299).

A different perspective is presented by Löbner (2002: 271), who argues for an ambiguity between "a non-past perfect and a past non-perfect". He bases his argumentation on several factors. Firstly, the perfect tense can occur in *als*-sentences ('when'), which are "incompatible with present or future time reference" (Löbner 2002: 267), and in *wenn*-sentences ('when'), that only have a "future perfect reading of the [perfect tense]". Additionally, perfect tense in *bevor*-clauses ('before') are also compatible with both readings. Perfect tense can also occur in *nach-dem*-clauses ('after'), but without a "present time reference" (Löbner 2002: 268). Secondly, he us es the compatibility of the perfect tense with the particles *schon* ('already') and *noch* ('still') (Löber 2002: 269–270).[5] However, independently of the occurrence of particles in a sentence, even the perfective aspect reading is situated completely in the past if a matching time referent like an adverb is given in the context (Löbner 2002: 260). Finally, Löbner (2002: 266–267) refers to the possibility of using the perfect tense in narratives, where the preterit is expected.

Preterit and perfect are generally associated with different contexts and registers. Preterit is linked to the written medium, including storytelling, reviews and private letters (Hennig 2000: 69, 72, 74), whereas the perfect is linked to the spoken medium, including dialouges in novels as well as audio and screenplays (Latzel 1977: 113).

Latzel (1977: 93—94) further suggests that the perfect tense is more commonly used with first and second person singular and in questions, which aligns with the oral medium's preference for the perfect tense and its spoken conception (Ágel & Hennig 2007; Koch & Oesterreicher 1985, 2007).

Perfect is also found in the written medium, for example, in law and instructional texts (Fischer 2018: 136), official letters (Hennig 2000: 69) or for structural purposes (Fischer 2018; Welke 2005). Hennig (2000: 65—69, 179—184) also examined talk show dialogues and found no preference for one tense over the other. However, these dialogues did reveal that certain verbs are more likely to be in the preterit tense than others. These verbs share an imperfective semantic.

[5] Note here, that neither noch nor schon were used in the items (see Section 4.2). Thus, I will not go into more detail about their different readings, but see Löbner (1989) for the distinction.

Complex constructions, such as the usage of auxiliaries or modal verbs, make preterit more likely (Fischer 2018: 381). This is attributed to the German sentence brackets, abbreviated as LSB (left sentence bracket) and RSB (right sentence bracket) here (Höhle 2018; Reis 1980; Wöllstein 2014). For instance, the usage of modal verbs fills both sentence brackets (4a), as does the perfect tense in general (4b).

(4) a. *Peter* $[wollte]_{\text{LSB}}$ *seine Hausaufgaben* $[machen]_{\text{RSB}}$.
Peter wanted his homework do
'Peter wanted to do his homework.'

b. *Peter* $[hat]_{\text{LSB}}$ *seine Hausaufgaben* $[gemacht]_{\text{RSB}}$.
Peter has his homework done
'Peter has done his homework.'

c. *Peter* $[hat]_{\text{LSB}}$ *seine Hausaufgaben* *[machen wollen]*$_{\text{RSB}}$.
Peter has his homework do want
'Peter has wanted to do his homework.'

When speakers use the preterit tense in these constructions (4a), they bypass complex constructions in the right sentence bracket, such as infinitive pro participio constructions (4c) (Askedal 1986a; 1986b; Bech 1955; Schallert 2014), while still maintaining the construction that distributes the syntactic predicate over both sentence brackets. A similar line of argument regarding the loss of the preterit is presented by Abraham (2004), as will be discussed in the following section.

The list of differences between preterit and perfect tense could be continued, especially with regard to their semantics (see, for example, Ogihara 2011). Nevertheless, it is possible to state a certain interchangeability of the two tenses, especially in the context of this study. Firstly, both refer to events that occurred before the speech time, excluding the subordinate and infrequent perfect functions. Secondly, they overlap to some extent and can lose their dividing effects in certain situations (Welke 2005: 297). Thirdly, there is no clear preference for perfect or preterit in contextless one-sentence-utterances (Hennig 2000: 29—31).

3.2 Preterit loss in the German Dialects

The standardized national variant of German is a rather modern phenomenon. Until the 19th century, dialects dominated everyday life and were even used in official communication (von Polenz 2013: 212—213, among others). They were gradually superseded by the standard variants. Even today, dialects persist in everyday communication and differ significantly from the standard variant.

The most prominent and well-documented regional differences in German are found at the phonetic and lexical levels (Niebaum & Macha 2014: 115–122; Wenker 1888; Wiesinger 1983). Syntactic variation also exists, and particularly relevant to this study is the loss of the preterit tense 'Präteritumschwund' in several, primarily southern, regions of Germany (Fischer 2018; 2021). In these areas, the preterit is no longer actively used or formed and has been largely replaced by the perfect tense. This is possible because, since its emergence in Old High German (750–1050 CE), the perfect tense has been able to take on more and more functions that were previously attributed to the past tense (Fischer 2018: 395; 2021: 351—353; Sapp 2009, among others). Thus, the decline of the preterit and the expansion of the perfect tense are closely linked (Fischer 2021: 351—353)

Based on dialect grammars, Fischer (2018) shows that in northern dialect areas, more preterit forms are documented while southern German regions only obtain preterit forms occasionally, e.g. for *to be* or modal verbs. The documentation of preterit forms corresponds to the usage frequency of the tense; in northern regions, preterit is used more often than in southern regions (Fischer 2021: 336). This North-South divide is also evident in Kasper and Pheiff's (2023: 43–47) usage-based study. Though preterit forms can be found all over Germany, they are more frequent in the northern German regions compared to the southern German regions.

There is, however, a transition zone from Rhine Franconian to Moselle Franconian, to Ripuarian, to northern Hessian in the West and to East Franconian in the east (Fischer 2021: 333), where more preterit forms are kept. This shows that the isoglosses of preterit usage are not identical to the dialect isoglosses themselves; only a north-south divide can be observed (Fischer 2021: 335).[6]

Besides the areal distribution of preterit loss or maintenance, certain verbs keep preterit better than others. This phenomenon applies to frequently used verbs, syntactically intricate verbs that construct complex predicates, morphologically irregular verbs, and verbs related to states and activities (Henriksson 2006: 45). Consequently, mostly strong and irregular verbs, as well as preterit present verbs, tend to retain their preterit form. This observation corresponds to the token frequency of these verbs in a spoken German corpus comprising both dialectal varieties and forms closely approximating Standard German, although the verbs in question are not necessarily among the most frequently occurring overall (Fischer 2021). Fischer (2021: 343) argues that the irregular preterit forms are more lexicalized than the regular weak verb forms, more economical in articulation and are more distinguishable from their present form due to the stem vowel change. These results are also confirmed by Kasper and Pheiff (2023: 40–41); the strong and frequently used verb *kommen* ('come') is chosen and translated more often as preterit by speakers of dialects, regional dialects, and standard German than the weakly inflected and less common word *wohnen* ('live').

[6] However, there is a geographic overlap – to some degree – between preterit maintenance regions and areas that have kept the apocope in the dialects (Fischer 2018: 331—332).

The preterit preference for verb types like modals, that build complex predicates even with preterit and present tense,[7] is linked to psycholinguistic and processing explanations, though not tested with this methodology (Abraham 2004).

Abraham (2004: 243—244) argues that in Upper German, where the preterit has been entirely lost, the use of the perfect tense and the "tun-periphrasis" consistently results in the verb being distributed across both sentence brackets. He claims that this structural pattern facilitates processing as it spares recipients from having to adjust to shifting verb positions in verb-second clauses, among other factors not addressed further here. Crucially, Abraham (2005: 119–122) later also suggests that distributing the predicate across both brackets enables earlier identification of the subject via the finite verb in the left bracket, which agrees with it. However, this argument ignores the fact that a finite full verb is also congruent with the subject and thus performs at least a similar identification function. Moreover, the advantage described above should only come into play when differentiating the person of the subject (e.g. first person vs. third person), because fewer syncretisms occur with certain verbs (e.g. *to be*), but also not with all verbs in not all tenses. The predictive character of auxiliary verbs in the left clause bracket is also very limited overall, as Voigtmann (accepted) points out with reference to Levy (2008). If no valency information appears in the left clause bracket, there are more possibilities for filling the middle field, but these are more difficult to predict, which in turn implies processing difficulties. Consequently, it is not surprising that Sapp (2009) does not find empirical evidence for this claim in historical data, and Drinka (2004) also provides evidence against it. Fischer (2021: 343), nonetheless, builds upon Abraham's (2004; 2005) ideas to explain why modals and *sein* ('to be') maintain their preterit usage effectively and suggests that using them in the preterit tense prevents the right sentence bracket from becoming overly complex, as described above.

Despite obvious problems with Abrahams' (2004; 2005) ideas, I will also take the spread of the predicate across both sentence brackets into consideration here, as it has implications for UID, which will be explored in section 4.1. after discussing adverbials.

3.3 Adverbials at the sentence onset

Following the ideas already presented in the introduction, this section examines adverbials, which are among the most frequent elements found at the sentence onset (Speyer 2008; 2010).

Syntactically, adverbials are constituents that can be realized as noun phrases (NP), prepositional phrases, adjective phrases, clauses, or adverb phrases (e.g. van der Auwera 1998) that are used in this study and function as adjuncts (Frey 2003). Semantically, adverbials usually serve as

[7] These tenses are the only two synthetic verb forms in German if they are presented in active voice.

modifiers, providing contextual specification for the verbal or sentential reference (Maienborn & Schäfer 2011: 1391).

Maienborn & Schäfer (2011: 1393, highlighting by S.V.) classify the following adverbials: "*[p]redicational adverbials* assign a (gradable) property to the verbal or sentential referent they combine with. *Participant-oriented adverbials* introduce a new entity that takes part in the eventuality described by the verb. '*Functional adverbials*' is the cover term for the remaining adverbials."

Within predicational adverbials, sentence adverbials constitute a notable subclass. I focus on the further subclasses of epistemic and evaluative adverbials here (Maienborn & Schäfer 2011: 1396). Epistemic adverbials (e.g. *maybe*, *surely*, *probably*, *perhaps*) express the speaker's assessment of the truth value of the proposition (5a). Evaluative adverbials (e.g. *luckily*) convey the speaker's attitude toward the situation described in the sentence (5b). They "cannot appear in the scope of sentence negation [or] questions" (Specht 2023: 37) and differ in veridicality. According to Schäfer (2013: 39—42), the veridicality of epistemic adverbials – that is, their implication for the truth of the proposition – is scalar. Adverbials expressing higher certainty are considered more veridical than those indicating uncertainty (e.g. Ernst 2009). Evaluative adverbials, on the other hand, are always veridical.

(5) a. Maybe/ surely/ probably/ perhaps, Susan made the cake.
b. Luckily, Susan reads a lot.

Crucially for this study, sentence adverbials are frequently and unproblematically placed in the sentence-initial position and are not tied to a specific tense, as illustrated in (5). For this reason, they are classified here as tense-neutral (or simply neutral) adverbials.

Even more commonly found at the sentence onset are scene- or frame-setting adverbials (Speyer 2008: 285). Speyer (2008: 280) defines them "as an expression that names a crucial restriction on the situation (such as: the place, the time, etc. . .) in which the proposition is true", which aligns with the definition by Maienborn & Schäfer (2011: 1400): "[F]rame adverbials […] set a frame for the overall proposition."

The most relevant frame-setters here are temporal adverbials, which are often inherently linked to tense.[8] Interestingly, temporal adverbials appear more frequently at the sentence onset when they serve the restrictive, scene-setting function. This highlights their relevance to the current investigation. Unlike sentence adverbials, temporal adverbials are both non-veridical and tense-specific. When used, they enable both speaker and hearer to anticipate the requirement of a past tense verb. Ogihara (2006), among others, even assumes that only they, rather than tense affixes,

[8] Speyer (2008) also mentions the exitance of temporal adverbials that do not convey this meaning.

carry tense information either overtly as in (1a/b) or covertly. Even when one does not consider this formal framework, overt temporal adverbials distribute the PAST information between the temporal adverbial and the finite verb. This early signalling aligns with the principle of UID, whereby spreading information reduces processing difficulty and prevents information overload, thus facilitating efficient communication. In contrast, sentence adverbials do not serve this anticipatory or distributive function with respect to tense, which makes them good candidates to be contrasted with temporal adverbials.

Nonetheless, the following points should be critically noted: According to Maienborn & Schäfer (2011), sentence and temporal adverbials belong to two different classes, differ in their veridicality, are negated differently and must be accommodated differently in questions. Nevertheless, I have deliberately decided to use these two classes because they take scope over the elements below them (Frey 2003), occupying the highest positions in the sentence. It is not crucial here that the position of the sentence adverbials is even higher than that of the frame-setters because I do not combine the two adverbials in a sentence (see Specht (2023) for a processing account of combined adverbials). Secondly – and perhaps more importantly – both classes should be perceived as unmarked at the beginning of the sentence and should not introduce contrastivity. Contrastivity and the high likelihood of a focus reading prevent the usage of other frame-setters like local adverbs. The focus sensitivity of temporal adverbs has mostly faded (Eckardt & Speyer 2014: 517), and I do not assume a contrastive focus reading for sentence adverbs because the only likely set of alternatives (e.g. Rooth 1992) are other sentence adverbs. Consequently, the use of sentence adverbials allows possible effects to be attributed to PAST information rather than focus.

4 Experimental setup

4.1 Hypotheses and expectations

To answer the research question stated in Section 1, this paper investigates the following hypotheses:

(H1) In context-free settings, German sentences in the perfect or preterit tense are rated as differing in naturalness depending on whether they begin with a temporal or a sentence adverb.

(H1.1) Preterit tense sentences with a temporal adverb are rated as more natural than those with a neutral adverb.

(H2) The ratings differ depending on the dialect region of the participants.

(H3) A temporal adverb at the sentence onset facilitates processing of the finite verb, especially in the preterit tense and depending on the dialect region of the participants.

One of the most evident differences between the perfect and preterit tenses lies in their construction. The perfect tense is analytic, formed by combining an auxiliary verb and the past participle of the lexical verb. In German main clauses, the lexical verb is positioned in the right sentence bracket, almost at the end of the clause, while the auxiliary verb occupies the second position, in the left sentence bracket (e.g. Wöllstein 2014). On the other hand, the preterit tense is synthetic, indicating the tense through a suffix for weak verbs and/or stem vowel change for strong or irregular verbs (Wöllstein & Bibliographisches Institut 2022: 665).

In contrast to the perfect tense, the lexical, valency, modus, congruency, and tense information are encapsulated within a single word in the preterit tense and are processed in this single word. This concentration of information can lead to an unwanted information peak (see Figure 3), which may hinder processing according to the UID principle (Collins 2014; Levy & Jaeger 2007; Meister et al. 2021). However, there are several strategies to mitigate this issue. For instance, placing the subject in front of the finite verb addresses congruency information (Schäfer 2021), and the speech time reference issues can also be resolved earlier, as discussed in the introduction.

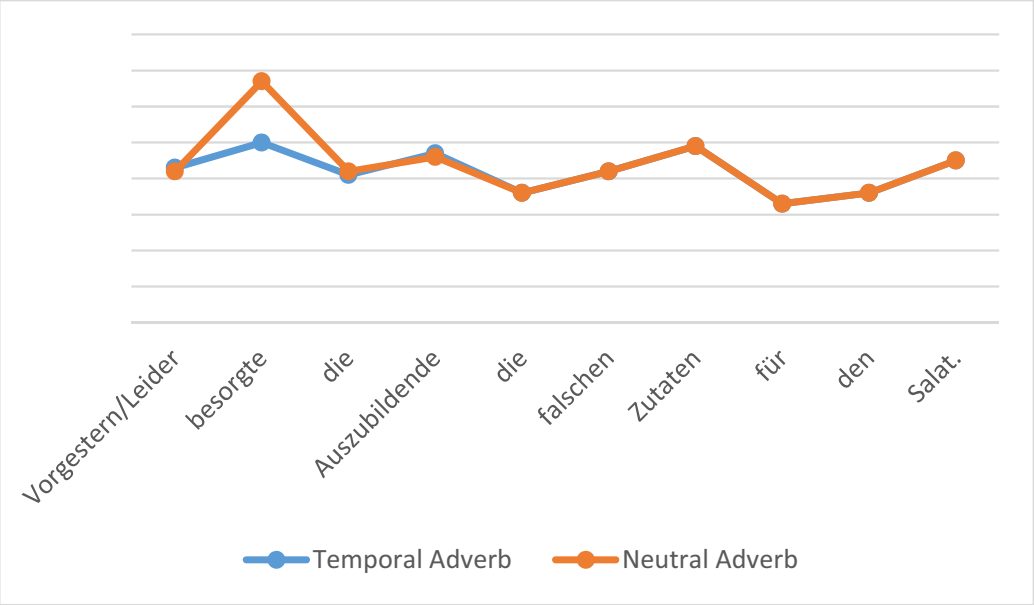

Figure 3: Schematic plot of the expected surprisal value differences in preterit sentences depending on the sentence onset (example 6b/c)

In general, the advantage of giving the PAST information early should apply to both the preterit and perfect tenses. However, the perfect tense is analytic, with the lexical verb positioned at the end of the clause, where locality effects can be observed and facilitate processing (Levy

2008). Consequently, there is less information on the finite verb, leading to a natural spread of information.[9] As a result, the positive processing effect of the early PAST information should be more pronounced for the preterit tense compared to the perfect tense.

There is one additional factor coming into play here: The preterit loss regions. It is well known that frequency (e.g. Díaz-Campos & Balasch 2023; Divjak 2019) as well as habituation to a phenomenon (Frank et al. 2016, among others) influences processing. It can also influence acceptability judgements as people might show a preference for what is more familiar to them. Hence, people from regions that have lost the preterit tense have less exposure to it compared to those who maintain it, since they read preterit but are less likely to hear it in Standard German or dialectal conversations. This reduced familiarity can lead to processing difficulties and differences in the acceptability judgement.

Accordingly, I propose that recipients from the preterit loss regions profit more from the information spread introduced by the temporal adverbial at the sentence onset with preterit case. For them, the missing familiarity with the preterit tense must be added to all information conveyed in the finite preterit verb. Consequently, the information should be perceived as even more significant for them.

It should also be mentioned that reading times are rarely measured that early in a clause. However, articles that instruct readers on self-paced reading experiments (e.g. Jegerski 2014; Mitchell 2018) make no statements about the position of the critical region. As there are effects visible, as will be shown in Section 5.2, this should not be a major concern.

4.2 Experiments

To test the hypotheses, two different experiments are used: an acceptability judgement task for H1 and H2 and a self-paced reading experiment for H3.

Acceptability judgement or simple rating studies are classically represented by questionnaires. Participants read sentences like those presented in Section 4.3 or in example (1) and judge the acceptability of sentences either on a scale or categorically. In this experiment, a 7-point Likert Scale with 7 being completely natural and 1 being completely unnatural is used. The experiment was conducted online using PCIbex (Zehr & Schwarz 2022). After an introduction explaining the task to judge the naturalness of the sentences, without giving information about the research question, participants saw single sentences and the Likert-Scale on their screen at home. Having assessed the sentences, they could continue to the next one at their own speed.

[9] Processing difficulties on the constituents in the middle field may, nevertheless, apply, but will not be considered here.

Acceptability judgement experiments like this are so-called offline experiments (Sichelschmidt and Carbone 2003: 116) and cannot make direct statements about processing at a specific point of the sentence, as the internal mechanisms governing the judgements stay hidden from the experiment leader; one can only observe the result (Sichelschmidt and Carbone 2003: 116).

In the context of the UID principle, it is expected to observe better judgements for sentences with a more uniform profile because the participants intuitively show a preference for informationally well-formed sentences (for another application of an acceptability judgement task in UID-related studies, see Schäfer 2025: 338–354 or Lemke 2021: 189–199).

The second experiment is a self-paced reading study. This belongs to the on-line group of experiments, more precisely a reaction time experiment (see e.g. Scharlau et al. 2003). In contrast to the acceptability judgement task, participants can assess processing (Scharlau et al. 2003: 190) because they measure how long it takes for a reaction to occur after a stimulus. Longer reaction times indicate processing difficulties (Scharlau et al. 2003: 191).

In the self-paced reading design used here, participants read sentences online on a computer at home. Again, the platform for the experiment was PCIbex (Zehr & Schwarz 2022).

These sentences are initially given only by lines. Each line represents a word and is exactly as long as the word (Figure 4). When participants press the space bar, a word appears in place of the line. If they press the space bar again, this word disappears, and the next one appears, which is called a linear and non-cumulative design (Jegerski 2014). Because the presentation is word-for-word, reaction time differences can also be measured for each word, allowing for a detailed determination of where difficulties arise.

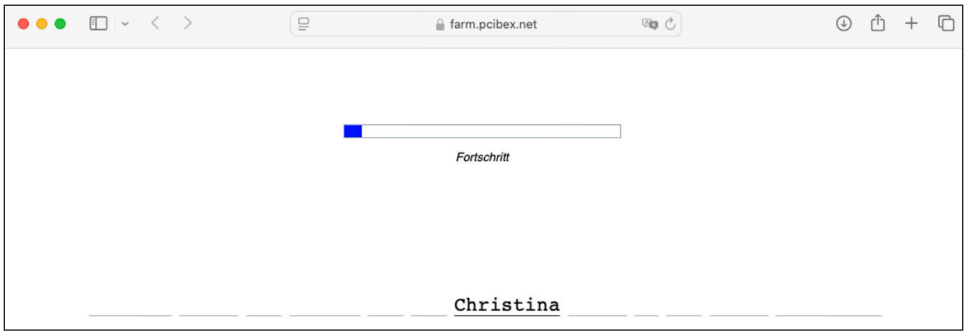

Figure 4: Screenshot of a sentence from the practice phase of the self-paced reading experiment

In an instructional part of the task, the participants were asked to read the sentences carefully and at their usual reading speed to understand the content. The latter was tested with polar comprehension questions after every sentence. These could be answered by pressing “j” for

Yes and "f" for No. Before the actual experiment, there was a practice phase of four items to familiarize the participants with the settings.

4.3 Items

The experimental design used in the two experiments has a 2 × 2 design[10] with 24 token sets. The two factors are tense (preterit vs. perfect) and the sentence onset (temporal adverb vs. tense-neutral adverb).

All items are simple main (verb-second) clauses. The subjects are in the third person singular since the first and second person are more frequent in perfect (Latzel 1977). To have a comparable spillover region across items behind the critical region of the finite verb (Mitchell 2018), the subjects are job descriptions with a definite article (e.g. *the physician*). Only transitive or intransitive weak verbs with one argument in the accusative or oblique case (PP) were used. If necessary, adjuncts have been added to make the sentences sound more natural and to prevent acceptability ratings from depending on clumsy sentences rather than the experimental conditions.

For the sentence onset condition, I included the temporal adverbs *gestern* 'yesterday', *letztens* 'recently', *neulich* 'the other day' and *vorgestern* 'the day before yesterday' (6c/d) and for the sentence adverbs *bestimmt* 'surely', *leider* 'unfortunately', *vielleicht* 'perhaps', and *wahrscheinlich* 'probably' (6a/b) were used.

(6) a. *Leider hat die Auszubildende die falschen Zutaten für den Salat besorgt.*
Unfortunately has the trainee the wrong ingredients for the salad got.
'Unfortunately, the trainee has got the wrong ingredients for the salad.'

b. *Leider besorgte die Auszubildende die falschen Zutaten für den Salat.*
Unfortunately got the trainee the wrong ingredients for the salad.
'Unfortunately, the trainee got the wrong ingredients for the salad.'

c. *Vorgestern hat die Auszubildende die falschen Zutaten für den Salat besorgt.*
the-day-before-yesterday has the trainee the wrong ingredients for the salad got.
'The day before yesterday, the trainee got the wrong ingredients for the salad.'

[10] This design classification refers to a multifactorial crossed design. Thus, both the effect of a single factor (tense or sentence onset) and the interaction between the factors (e.g. whether the influence of tense depends on a certain sentence onset) can be interpreted (see Sichelschmidt and Carbone 2003: 119–120).

d. *Vorgestern* *besorgte* *die* *Auszubildende* *die* *falschen* *Zutaten*
the-day-before-yesterday, got the trainee the wrong ingredients
für *den* *Salat.*
for the salad.
'The day before yesterday, the trainee got the wrong ingredients for the salad.'

As distractors for the experiments, each participant saw 74 sentences, including eight ungrammatical catch phrases and ten fillers. The fillers are from two other experiments about gapping and sluicing in German. They are in present tense and share no critical lexical material with my items.

4.4 Participant recruitment and allocation to the preterit loss region

The participants were recruited through Prolific (Prolific 2024) and paid about 4€ for the 20 minutes that each experiment took on average. The sum is based on the standard minimum wage (€12.50/h) in Germany. To keep the personal information to a minimum, participants were only asked to state whether their native language is German and name the *Landkreis* 'county' they have lived longest in.

The question about the county serves as an approximation to the preterit loss regions. In classical dialect syntactic research, which is strongly focused on basic dialects (Abraham & Leiss 2016; Fleischer et al. 2012; Niebaum & Macha 2014; Weiß 1998) and usually regionalizes rating items (Fleischer et al. 2012: 10—12), the county would not be a sufficient localization for the dialect, especially because administrative regions rarely correspond to isoglosses.[11] Additionally, the preterit loss isoglosses cannot be transferred one-to-one to the individual dialects in any case (Fischer 2018; 2021).

Of course, this type of data collection jeopardizes a controlled distribution across the two preterit loss regions. In fact, the participants were not evenly distributed across the experiments; the proportion of preterit maintenance region (PMR) participants was higher in both the rating and the self-paced reading experiment. However, unless the test subjects are specifically approached in the individual regions, which drastically extends the duration of the data collection, this problem cannot be solved, as no corresponding, census-based pre-screening outside the UK and the USA is available via Prolific.

A further argument for the approximation via the counties and the length of stay is that the Preterit Loss is not a phenomenon directly recognizable as dialectal for untrained individuals as it does not rely on a certain pronunciation or lexicon. This also speaks in favor of the transferability to

[11] Rheinfranconian can serve an example here. This dialect is spoken in parts of Saarland, parts of Rhineland-Palatinate and parts of Hesse and even in a small part of Bavaria (e.g. Wiesinger 1983: 847).

Standard German, which is the focus here. If a participant has spent most of their life in a Preterit Loss region (PLR), I assume it is very likely that they will adapt to the customs of this region regardless of whether they originally come from a Preterit Maintenance region. In concrete terms, this means that they should find preterit unusual in (oral) conversation and generally use it less frequently, i.e. only in written texts from genres typically associated with preterit like narratives.

Having received the county information, the county was located on a map of Germany and mapped to the preterit loss or maintenance regions in Fischer (2021: 349). Fischer's (2018; 2021) data is, however, based on dialect grammars from the 19th and early 20th centuries. Furthermore, she claims that the preterit loss might already have progressed into the transition zone. Within this transition zone, she describes a gradation depending on the verb type (Wöllstein & Bibliographisches Institut 2022: 357–359): In the northern part of the transition zone, preterit is lost only with weak and rare verbs. That means that preterit is kept with strong and modal verbs and, thus, technically with a larger group of verbs than in the southern region of the transition zone where preterit is also lost with modals and strong verbs. This is relevant because the predictions made here depend heavily on frequency and habituation. Participants in the southern transition zone, therefore, encounter the past tense less frequently than those in the northern transition zone.

Thus, I chose to divide the participants into two groups: Preterit maintenance region (PMR) north of Mainz (about 50° 0′ 0.0" N) and preterit loss regions (PLR) south of 50° 0′ 0.0" N. This is again only an approximation as the county borders are not exactly mappable to this geographic coordinate of latitude, but it should work well enough for the purpose of this study.[12]

5 Results

5.1 Experiment 1: rating study

5.1.1 Results

48 self-proclaimed native speakers of German, of which one was excluded due to a lack of county specification, (PMR: n = 30, PLR: n = 17) were asked to rate the grammatical acceptability of the sentences on a 7-point Likert Scale with 7 being completely natural and 1 being completely unnatural.

[12] As it was requested by a reviewer, I also ran the statistics, presented in the following section, with a subset of participants excluding those who have lived longest in the transition zone. For the rating experiment, that meant, however, the exclusion of 18% (n = 9) and for the self-paced reading experiment of 20% (n=20) of the participants. This reduces the reliability of the data which is one reason why I will present the data with all participants here. The other reason is that the results did not change significantly from those presented here.

To ensure transparency, however, the data and statistics on the reduced data set will still be made available (see Section 8).

The ratings were expectedly high (Table 1, Figure 5), indicating that all sentences are perceived as grammatical and rather natural. This was intended by the choice of onset. Also, the differences in the mean ratings are small. The highest ratings are found for items with temporal adverbs (6.55); the lowest ratings are given for sentences with a neutral onset and preterit in both dialect regions (6.05, 6.25).

Looking at the low ratings, one finds that the effect is driven by the ratings of items beginning with *vielleicht* 'perhaps'. They receive a mean rating below 6 (Table 2) in every condition, though they also belong to the group of "evaluating sentence adverbs" (Nübling 2016: 586). *Leider* 'unfortunately' was expected to be the odd-one-out in that group as it does not express a degree of uncertainty (Hoberg 1973) but comments on the speaker's attitude towards the proposition (Nübling 2016: 586). Possible explanations for the deviation of results are discussed in Section 5.1.2.

Table 1: Mean Ratings per condition and dialect region with confidence interval, experiment 1

Adverb	Tense	Region	Mean Rating	95% confidence interval	
Neutral	Perf	PLR	6.32	6.20	6.45
Temporal	Perf	PLR	6.30	6.19	6.42
Neutral	Pret	PLR	6.05	5.92	6.18
Temporal	Pret	PLR	6.39	6.27	6.49
Neutral	Perf	PMR	6.43	6.30	6.55
Temporal	Perf	PMR	6.55	6.44	6.67
Neutral	Pret	PMR	6.25	6.12	6.39
Temporal	Pret	PMR	6.55	6.43	6.66

Table 2: Ratings for *vielleicht* 'perhaps' in experiment 1

Adverb	Tense	Region	Mean Rating	95% confidence interval	
vielleicht 'perhaps'	Perf	PLR	5.82	5.70	5.95
	Pret	PLR	5.56	5.44	5.67
	Perf	PMR	5.98	5.85	6.11
	Pret	PMR	5.95	5.84	6.06

To test whether these differences are statistically significant, I used a cumulative link mixed model (Christensen 2023) in R (R Core Team 2024). The dependent variable was the rating result. The independent predictors were the sum-coded sentence onset (neutral −0.5, temporal 0.5), the

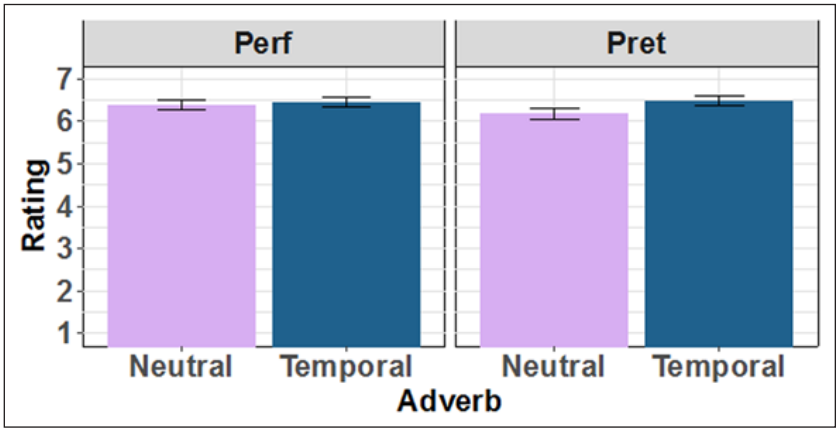

Figure 5: Mean Ratings, experiment 1. All plots are created with ggplot 2 (Wickham 2016)

sum-coded tense (perfect −0.5, preterit 0.5), the dialect region (PMR −0.5, PLR 0.5), the centered and scaled position of the items and the three-way interaction between onset, tense and dialect region. As random effects (Table 4), I included the random intercept of the participants, the nested random effects of onset and item to account for the variation caused by *vielleicht* and other adverbs. The results of the analysis are presented in Table 3.

Table 3: Results of the regression analysis, experiment 1. AIC: 2075.08

	Estimate	Std. Error	z-value	p-value	
Adverb	0.53	0.39	1.36	0.17	
Tense	−0.28	0.19	1.45	0.15	
Dialect region	0.46	0.45	1.03	0.30	
Position	−0.001	0.002	−0.58	0.56	
Adverb:Tense	0.77	0.38	2.00	0.05	*
Adverb:Dialect Region	0.099	0.29	0.34	0.73	
Tense:Dialect Region	0.07	0.29	0.25	0.81	
Adverb:Tense:Dialect Region	0.15	0.58	0.26	0.79	

The interaction between tense and the adverb at the sentence onset is significant ($z = 2.00$, $p < 0{,}05$, Figure 6). The rating of sentences differs depending on the tense *and* the sentence onset. The sentence onset does not significantly influence the rating of perfect sentences, but preterit sentences are more acceptable when they start with a temporal compared to a tense-neutral adverb.

Table 4: Random effects, experiment 1

Group	Variance	Std. Dev.
Item:Onset	0.379	0.6156
Participants	1.808	1.3447
Onset	0.225	0.4745

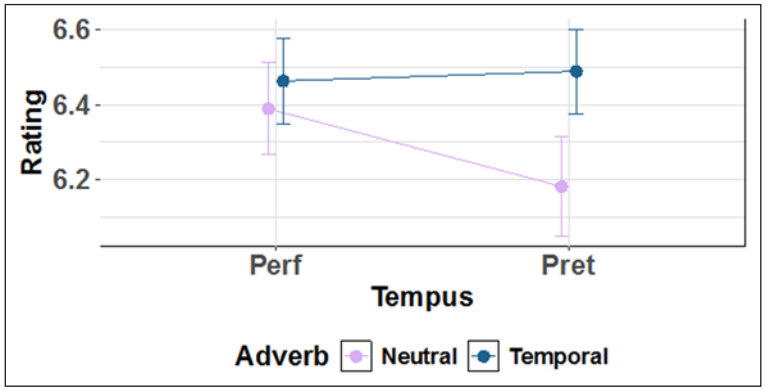

Figure 6: Interaction plot between tense and sentence onset. The y-axis displays the mean ratings

5.1.2 Discussion

The items in experiment 1 were generally very acceptable, as the item design was meant to be unobtrusive. As already mentioned, both sentence adverbs and temporal adverbs are among the most common words at the onset and are, thus, expected to be best suited to manipulate the tense information without confounding the results by adding another unwanted layer of interpretation.

However, this was apparently not as successful as anticipated, as the sentence adverbials showed an unexpected variation in their ratings. I originally anticipated *leider* 'unfortunately' to show the highest degree of variation since it belongs to the class of evaluating sentence adverbials (Nübling 2016: 586), whereas the other three adverbs express how likely the speaker considers an event to be. However, this was not the case as its mean ratings were quite close to those of all other adverbs, including the temporal adverbs.

However, it was *vielleicht* 'perhaps' that showed the greatest variability and the lowest acceptability. The items beginning with *vielleicht* express the highest degree of uncertainty about the clauses' propositions and evoke a contrastive focus reading for the subject (7).[13] Without

[13] Maienborn & Schäfer (2011: 1396) state "that maybe is […] not gradable but shares the general characteristics of the other predicationals used here." Why the gradability or lack of it should influence the ratings must remain an open question here.

context, these clauses might seem odder than the other items beginning with a sentence adverb, and the rating might reflect this rather than the intended conditions. However, in using the adverbs as random effects, the model can include this variability.

(7) *Vielleicht hat die Sekretärin den Tisch im Restaurant reserviert.*
perhaps has the secretary the table in restaurant booked
'Perhaps, the secretary has booked the table in the restaurant.'

The statistical analysis has shown a significant interaction between the sentence onset and the tense, which is in line with the predictions about the UID's influence. The temporal adverb spreads the PAST information across two words: the adverb itself and the predicate. This is especially helpful in the preterit sentences, where lexical, valency modus, congruency (since the subject is placed behind the finite verb, and first and third Person Singular showcase syncretism in the preterit verb), and tense information must be processed on one word if additional processing aids like temporal adverbs or adverbials are missing. In spreading at least the tense information, the unwanted information peak is avoided, which is generally preferred according to UID (Levy & Jaeger 2007).

However, the results must also be interpreted with a certain caution. Fischer (2018: 135) claims that the existence of a temporal adverb like *da*, *dann*, *damals* ('then') increases the likelihood of observing preterit in written corpus data. The acceptability might, consequently, reflect a mere frequency pattern. Nevertheless, if this is the case, one can argue that this preference might result from an even spread of information, which should facilitate processing. The influence on online processing can, however, not be directly tested with acceptability rating studies but with self-paced reading experiments like the one presented in the next section.

5.2 Experiment 2: Self-Paced reading study

5.2.1 Results

96 participants were recruited through Prolific (Prolific 2024) and needed 18.5 minutes on average to complete the experiment. Eight participants were excluded because their accuracy in answering all comprehension questions, including the fillers, was either below 80% (mean accuracy: 94.4%) or they failed to specify the county in which they had lived the longest.[14] Thus, the data of 88 participants (PMR: n = 55, PLR: n = 33) is analyzed here.

Figure 7 presents the descriptive statistics of the reading times. The critical region, the finite verb, is found in region 2, the spillover region is region 3 and 4, which build the subject NP throughout all items.

[14] The accuracy for the tense items was 97.2% on average. The 'county' specification was given as 'Germany'.

The preterit sentences seem to be read slower than perfect sentences, nearly independent of the sentence onset and the dialect regions. Since the preterit is built with a full verb, its processing effort 'spills over'.[15] Furthermore, differences between the dialect regions become obvious, which were not visible in the acceptability judgement data. The PMR-data (right side of the plot) suggests only an effect of tense but not of the sentence onset in regions 2 to 4, that is, from the finite verb to the subject-NP. In the PLR-condition, however, participants seem to speed up at the subject in the preterit and temporal adverb condition, which would be interpretable in favor of UID.

To test whether these observations are statistically significant, I conducted a linear mixed-effect regression (Bates et al. 2015) in R (R Core Team 2024) for the reading times on the finite verb and the spillover region (determiner and noun of the subject) following Mitchell (2018). The regions were analyzed separately since they were presented word by word. Prior to analyzing the data, reading times under 100 and over 5000 seconds were excluded.

The dependent variables are the log-transformed, centered reading times (logRT). The independent variables are the item position (centered and z-transformed), the sum-coded adverb at the sentence onset (neutral: −0.5, temporal: 0.5), the sum-coded tense (perfect: −0.5, preterit: 0.5), the sum-coded dialect region (PMR −0.5, PLR 0.5) and the length in characters for the

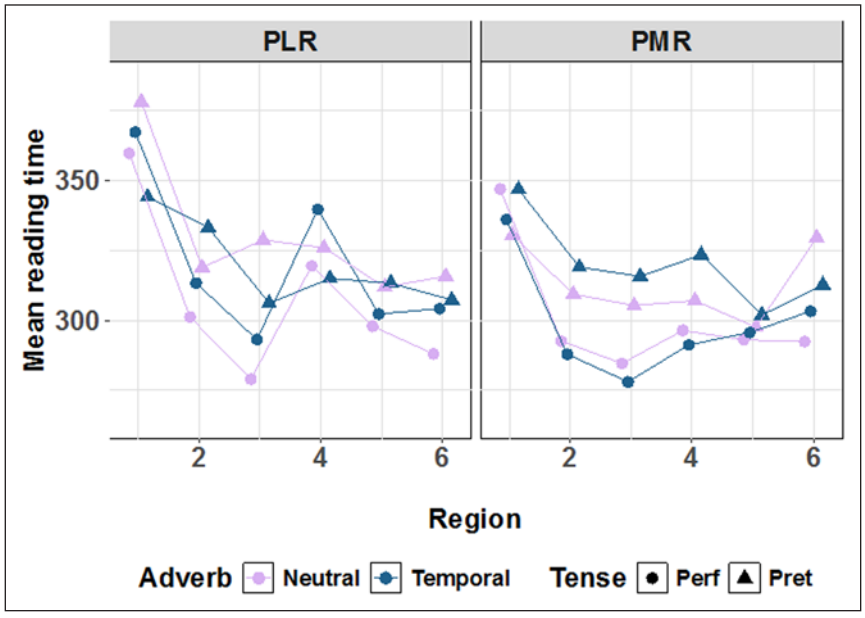

Figure 7: Mean reading times of the sentences. Region 1 is the sentence onset, region 2 the finite verb, region 3 the definite article of the subject-NP, and region 4 the head noun of the subject-NP

[15] I thank a participant from the RAILS conference for this suggestion.

finite verb and the NP, which was also centered and z-transformed. The three-way interaction between tense, adverb and dialect region was also included, as were the random intercepts for the participants for the analysis of the finite-verb-region. For the article- and the noun-region, I included the random intercepts for the items and a random intercept and random slopes for the tense and the participants.

Reading times on the critical region (finite verb)

The results of the linear regression are presented in Table 5.[16] The only significant result is provided by the item position, which is expected, as participants are known to speed up during an experiment when they get used to the task and the procedures. There is also a tendency for preterit to be read slower, but its significance level is above the threshold (t = 1.88, p = 0.6). This result can be attributed to the preterit verb conveying more meaning than the auxiliary in the perfect sentences.

Table 5: Results of the regression analysis, experiment 2. Critical region: finite verb. Random effect: Participant): var = 0.04, std = 0.21. | Onset: var = 0.00008 std = 0.009 | Residual: var = 0.05, std = 0.22

	Estimate	Std. Error	df	t-value	p-value	
Intercept	5.688	0.023	86.58	248.86	<0.001	***
Adverb	0.003	0.011	6.24	0.25	0.80	
Tense	0.042	0.022	1935.94	1.88	0.06	.
Dialect	0.053	0.046	88.18	1.157	0.25	
Length	0.004	0.011	1770.32	0.38	0.71	
Position	−0.094	0.005	2041.71	−19.67	<0.001	***
Adverb:Tense	0.011	0.019	2043.76	0.551	0.58	
Adverb:Dialect	0.007	0.019	2041.03	0.336	0.74	
Tense:Dialect	−0.012	0.019	2040.61	−0.627	0.53	
Adverb:Tense:Dialect	−0.053	0.039	2040.88	−1.358	0.17	

Reading times on the spillover region “article”

Since processing difficulties often become visible after the critical region, this section focuses on the spillover region, the article. The results of the linear regression[17] can be found in Table 6.

[16] lmer(logRT ~ Adverb*Tense*Dialect + Length + Position + (1| Participant)+(1|Onset), region2). The inclusion of the items as random effects instead of the sentence onset resulted in a non-converging model in R. 18 items were excluded here, because the reading times were either below 100 or above 5000 seconds.

[17] lmer(logRT ~ Adverb*Tense*Dialect + Position + (1| Item) + (Tense| Participants), region3).

21 values with reading times either below 100 or above 5000 seconds were excluded.

Again, there is an influence of the item position relating to habituation. Furthermore, the influence of the tense is clearly visible: Participants slow down in preterit sentences ($t = 6.46$, $p < 0.01$). Slower reading times in the preterit condition are also visible in the interaction between tense, adverb and the dialect region (Figure 8). Here, an effect of the sentence onset and the tense is visible for one of the two participant groups.

For the PMR-participants (Figure 8, left side), only the main effect of tense is significant; preterit sentences are read more slowly. The sentence onset does not influence the reading times for this participant group.[18] This changes for the participants from the preterit loss regions (PLR, right side Figure 8). These participants speed up in the preterit condition when a temporal adverb stands at the sentence onset, which is in line with the hypothesis ($t = -1.91$, $p < 0.05$). Spreading the tense information facilitates processing, especially for the preterit. In the perfect condition, the sentence onset does not yet influence the reading times of the PLR-participants.

Table 6: Results of the regression analysis, experiment 2. Region: Spillover (article)

	Estimate	Std. Error	df	t-value	p-value	
Intercept	5.65	0.02	88.64	248.41	<0.001	***
Adverb	−0.007	0.01	94.04	−0.72	0.47	
Tense	0.076	0.01	65.64	6.46	<0.001	***
Dialect	0.03	0.05	87.69	0.59	0.56	
Position	−0.08	0.01	2022.87	18.12	<0.001	***
Adverb:Tense	−0.02	0.02	93.92	−0.91	0.36	
Adverb:Dialect	−0.005	0.02	1929.16	−0.27	0.78	
Tense:Dialect	0.005	0.02	86.25	0.22	0.83	
Adverb:Tense:Dialect	−0.09	0.04	1929.17	−2.34	<0.05	*

Table 7: Random effects, experiment 2, spillover region (article)

Group	Variance	Std. Dev.	Correlation
Item	0.0003	0.02	–
Participants	0.042	0.20	–
Tense|Participants	0.003	0.05	0.7
Residual	0.046	0.21	–

[18] The significance level was tested using the sim_slopes-command from the interactions-package in R (Long, 2019): sim_slopes(mod, pred= Adverb, modx =Tense, mod2=Dialect, johnson_neyman=T).

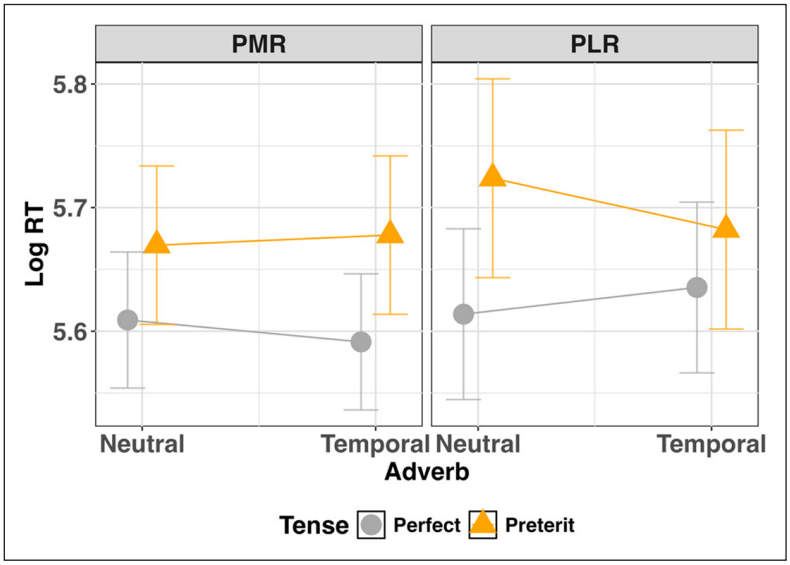

Figure 8: Interaction plot Adverb:Tense:Dialect Region, experiment 2, region 3. The interaction plots are created with ggeffects (Lüdecke 2018) and ggplot (Wickham 2016) in R

Reading times on the spillover region "noun"

The same predictors and the same interaction as before are significant in the second spillover region, i.e., on the noun phrase.[19] Preterit items are generally read slower ($t = 2.62$, $p < 0{,}05$), participants speed up in the course of the experiment ($t = -20.77$, $p < 0{,}001$), longer NPs are read more slowly, and the three-way-interaction is significant ($t = -3.07$, $p < 0.05$) as shown in Table 8 and Figure 9. The interaction of Tense with Dialect Region is now significant as well ($t = -2.50$, $p < 0{,}05$), showing that people from PMR read preterit items faster than perfect, while PLR-people read the two tenses equally fast. In contrast to the results of the article-region, the sentence onset now significantly influences the reading times of the PLR-participants in the perfect items as well: Perfect is read slower in the temporal adverb condition. This is contrary to the hypothesis and will be discussed in the following section.

5.2.2 Discussion

The reading time data for the spillover region suggests that the processing of the preterit is facilitated when it is accompanied by a temporal adverb, compared to a neutral adverb, particularly for participants from regions where the preterit is in decline. This finding supports the hypothesis that the distribution of information across multiple linguistic units can ease cognitive processing, especially in contexts where a given structure, like the preterit, is less

[19] lmer(logRT ~ Adverb*Tense*Dialect+ Position +Length + (1| Item) + (Tense|Participants), region4). 20 values with reading times either below 100 or above 5000 seconds were excluded.

Table 8: Results of the regression analysis, experiment 2. Critical region: spillover (noun)

	Estimate	Std. Error	df	t-value	p-value	
Intercept	5.68	0.03	89.51	202.42	<0.001	***
Adverb	0.001	0.01	95.96	0.11	0.91	
Tense	0.03	0.01	75.22	2.62	0.01	*
Dialect	0.07	0.06	87.96	1.17	0.25	
Length	0.035	0.006	93.30	6.28	<0.001	***
Position	−0.10	0.005	2011.27	−20.77	<0.001	***
Adverb:Tense	−0.02	0.02	95.85	−0.91	0.37	
Adverb:Dialect	−0.007	0.02	1923.38	−0.33	0.74016	
Tense:Dialect	−0.06	0.02	87.38	−2.50	<0.05	*
Adverb:Tense:Dialect	−0.12	0.04	1923.41	−3.07	<0.05	**

Table 9: Random effects, experiment 2, spillover region (noun)

Group	Variance	Std. Dev.	Correlation
Item (Intercept)	0.0007	0.03	–
Participants (Intercept)	0.06	0.25	
Tense|Participants	0.004	0.06	−0.36
Residual	0.048	0.22	–

familiar. That familiarity influences processing is well known (Frank et al. 2016). In the PLR, speakers encounter the preterit less frequently, as it is unlikely that they *hear* it. If at all, they read it and even in written registers, perfect is also used and possibly with more frequency as it can be used in a wider range of contexts.[20] Even in texts that primarily employ the preterit, instances of the perfect are attested, suggesting limited habituation to the preterit form.

Thus, when the preterit appears with a tense-neutral adverb, PLR-participants face a double cognitive strain. Not only are they less accustomed to the preterit itself, but they must also extract all temporal information from a single word rather than distributing it across the verb and the adverb.

[20] Even modern novels are often written in present despite the preterit's propensity for narration (e.g. Meisnitzer 2016). This does not imply that they produce the perfect tense more frequently; rather, it constitutes another instance of the absence of preterit usage.

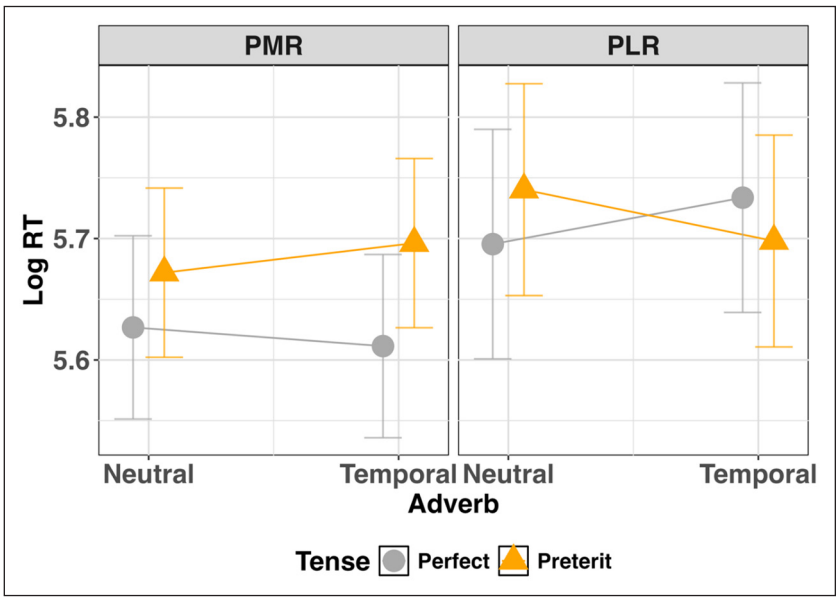

Figure 9: Interaction plot Adverb:Tense:Dialect Region, experiment 2, region 4

Besides providing evidence for hypothesis (H3), it also provides tentative evidence that dialectal variation, such as the preterit loss, can influence the perception and processing of Standard German, highlighting the interplay between regional linguistic habits and cognitive mechanisms in language comprehension. Still, this claim may be too bold here and needs further investigation with a more balanced sample of participants and other phenomena.

It is unlikely that the effect, observed in the article and the noun, is linked to integration difficulties that depend on the finite verb. Even in languages with a rather free word order, such as German, there is a preference for subjects to occur early in the sentence. When they are not placed at the sentence onset, they should therefore appear as soon as possible behind the finite verb and, indeed, they form the next constituent in the sentences. So, at least from a syntactical point of view, there should not be any integration problems. Semantically, I do not expect any problems because the items were designed to be as lexically unobtrusive as possible. Accordingly, I will interpret the effects on those two words as actual spillover effects and, thus, evidence for the hypothesis.

6 General discussion

The current paper aimed to find evidence for the following hypotheses (Section 4.1) using an acceptability judgement task and a self-paced reading experiment.

The acceptability judgment task provides partial support for hypothesis (H1), and full support for its specification in hypothesis (H1.1), as it reveals a significant interaction between tense and sentence-initial adverb type. The sentence onset does not significantly influence the acceptability of perfect tense sentences, but of preterit tense sentences. They are rated higher when they start with a temporal adverb.

I attribute the observed result fully to the Uniform Information Density principle (Levy & Jaeger 2007). UID states that information should be distributed as evenly as possible across utterances to avoid peaks and troughs in the information profile. In the case of preterit sentences, such an unwanted peak is created on the lexical verb in the preterit sentences because participants must process various kinds of information in one word. By presenting words before the finite verb which anticipate some information, the peak can be smoothed out. In this study, the anticipating word is the temporal adverb. Having seen it and expecting grammaticality, recipients know that the verb must be presented in one of the past tenses. As soon as they encounter a full verb instead of an auxiliary, they further know that the tense will be the preterit. In terms of UID, this means that the processing cost of the tense information is spread and, thus, smoothed.

The reason for this effect not being found in perfect sentences is that they already spread parts of the information across two units. The perfect tense is analytic. When recipients encounter the finite auxiliary verb, they basically process all the information they also need to process in preterit sentences – except for the lexical and valency information. Accordingly, the information content of said finite verb is already lower.[21] A counterargument that can be put forward here is that the auxiliaries *haben* 'have' and *sein* 'be' can lead to temporary ambiguities and should, therefore, require a processing effort similar to full verbs in preterit because the auxiliary could be misinterpreted as a homonymous full verb in the present tense (in the neural sentence onset conditions). However, this explanation appears unlikely given the results of a cloze task in the linear, non-cumulative self-paced reading design with the same items. Only 1.56% of all responses indicated a full verb interpretation, and even in the neutral adverb condition, this number only rose to 3.13%. These findings suggest that, while ambiguity may theoretically exist, it does not significantly impact participants' interpretation – at least after having perceived the whole sentence. Whether online processing difficulties arise in the perfect tense conditions (as well) was tested in the self-paced reading study.

Before this second experiment is discussed, I will quickly examine the second hypothesis (H2). Due to the preterit loss in some German regions, it was assumed that the ratings may differ depending on the regions in which the participants have lived longest. However, that was found not to be the case. I attribute this to the fact that the sentences were presented in written form. The preterit

[21] However, not having seen the valency information early in the sentence might result in processing difficulties concerning complements and their order, as described by Voigtmann (accepted).

is linked to the written medium (e.g. Hennig 2000), and even participants from the preterit loss regions are used to the preterit there. Furthermore, in the acceptability judgement task, there is no time pressure for comprehension. It might be interesting to test whether the ratings would differ depending on the stimulus presentation, though this goes beyond the scope of the current study. In addition, the results could also be influenced if the sample of PMR and PLR participants were more balanced or if participants could be found from regions where the preservation or loss of the past tense is particularly pronounced. It would also be interesting to test in further studies to what extent the results presented here change when strong verbs are used instead of weak verbs, which preserve the past tense better. These ideas and concerns also relate to the third hypothesis.

The last hypothesis of this paper (H3) was tested with experiment 2, a self-paced reading study. It was expected that participants would read the finite verb faster in the temporal adverb condition, especially when combined with preterit tense, and that there would be a difference depending on the dialect regions. However, the expected effect was not found on the critical region itself but on the spillover region. On the subject of the sentences, I find evidence for the hypothesis: Participants from the preterit loss regions read both the article and the noun behind the finite verb in the preterit-temporal onset condition significantly faster than in the neutral condition in preterit. The effect is not found for the participants from the preterit maintenance regions. When a tense-neutral adverb precedes the preterit, PLR-participants experience increased cognitive load: they are both less familiar with the preterit and must derive temporal information solely from the adverb, rather than from both verb and adverb. This not only supports the hypothesis but also suggests, albeit tentatively, that dialectal features like preterit loss can shape how Standard German is processed, pointing to an interaction between regional linguistic patterns and cognitive processing. Nevertheless, this interpretation requires further empirical support.

To summarize: I find evidence for hypotheses (H1.1) and (H3), but not for hypothesis (H2), which had the weakest claim in any case.

Despite these results, some open questions remain, especially considering the processing of perfect sentences in experiment 2. The reading time data on the noun-spillover-region indicates that the perfect items were processed more slowly when accompanied by temporal adverbs, suggesting that they require additional processing effort. Tentatively, I want to suggest that the differences between the regions depend on the habituation to the preterit only in written sources as an explanation. Fischer (2018: 135) states in reference to Sieberg (2003) that a temporal adverb increases the likelihood of observing preterit in (written) corpus data. It could be that the PLR-participants do not only expect a past tense but the preterit after reading a temporal adverb. Integrating the perfect in these conditions might cause difficulties. However, further research is needed to relate the findings of this study to this explanation, for example, by changing from a written stimulus presentation to an auditory one, where there should be less habituation to preterit for the people from the PLR.

7 Summary

This paper explores how the UID principle influences the processing of German past tenses – specifically the preterit and the perfect – and how regional dialect variation affects this process. UID predicts that distributing information evenly across an utterance facilitates comprehension by avoiding processing peaks. The preterit, being synthetic, concentrates information in the verb and may cause such peaks, while the analytic perfect (auxiliary + participle) distributes information more evenly. Temporal adverbs (e.g. *gestern*, 'yesterday') introduced early in a sentence help pre-signal tense and support this distribution, unlike tense-neutral adverbs (e.g. *vielleicht*, 'perhaps'). Additionally, the decline of the preterit in southern German dialects (PLR) may reduce speakers' familiarity with this tense.

To find evidence for the hypothesis, two experiments were conducted. The acceptability judgement task found that preterit sentences were rated as more acceptable when preceded by temporal adverbs. No such effect was found for perfect sentences, and no regional differences emerged – likely due to the written format, where the preterit remains common. The self-paced reading experiment shows that, in spillover regions (subject noun phrases), PLR participants read preterit sentences with temporal adverbs significantly faster than those with neutral adverbs. This supports the UID-based prediction that information distribution eases processing, especially when the familiarity with a tense is low. Unexpectedly, PLR participants read perfect sentences with temporal adverbs more slowly, possibly reflecting an expectation for the preterit after such adverbs.

The findings support the UID principle, showing that early temporal adverbs help distribute tense information and reduce processing load – especially for speakers less familiar with the preterit. This highlights how dialectal variation can shape the processing of Standard German. Open questions remain regarding the delayed processing of perfect sentences in PLR regions and the limitations of early region measures in self-paced reading.

8 Data availability, ethics and consent and funding and acknowledgement

The data used for this study is available here:

https://osf.io/9f3c6/overview?view_only=cee85fbb1c4d43f3b02e5c89494ed4be

The reported experiments were conducted as filler experiments in a series of experiments supervized by Bozhidara Hristova (Saarland University) in the context of project B3 in CRC 1102 »Information Density and Linguistic Encoding«. The experiments are covered by the

prolongation (#2021-22-211122) of the ethics lab vote for experimental studies conducted within CRC 1102 (#2017-07-180423), issued by the ethics committee of the Deutsche Gesellschaft für Sprachwissenschaft (DGfS). Before the experiments, participants provided informed consent by checking a checkbox.

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