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Structural priming and the placement of focus-sensitive particles

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The German focus-sensitive particle *auch* ('too') can associate with different constituents (ACs) in an utterance. In terms of position, it can precede or follow its AC. There is a strong preference for using preceding *auch* when the AC is the object. In three sentence fragment arrangement tasks, we investigated whether speakers are structurally primed by the context. To that end, we used context sentences as part of short dialogues with different particles: *nur* ('only'), *kein(e)* ('no'), both of which precede their AC, and *nicht* ('not'), which follows its AC. The results show that the established preference for preceding *auch* is affected by the position of the particle in the context (following *auch* occurred more often when the context contained following *nicht*). Follow-up experiments rule out an explanation based on intonation (Experiment 2) or on the underlying syntactic structure (Experiment 3). We found clear surface structural priming effects for function words with effect sizes similar to those found in studies of structural priming for content words. Furthermore, the findings for sentences used in isolation can be extended to sentences that are part of short dialogues.

1. Introduction

When producing an utterance that is felicitous, given the prior context, speakers are confronted with different challenges. Besides understanding the context and conceptualizing the message they want to express, speakers have to choose suitable lexical items and arrange them in such a way that they (a) result in a grammatical sentence and (b) are in accordance with the demands of the context. In doing that, they can be guided by specific preferences. In languages with flexible word order, speakers can place the constituent that serves as the subject of the sentence in first position, preceding the object (see, for instance, Bader et al., 2000, for the preference for SO-structures over OS-structures), i.e., following a syntactic preference. Another possibility is that they are guided by pragmatic or information structural principles, and place the constituent that serves as the topic of the utterance in first position. Note, however, that these two preferences (syntactic vs. information structural) are often hard to disentangle, since subjects serve as prototypical topics (Reinhart, 1981), and objects are likely to be the focus of the utterance. In the remainder of this article, we will refer to these two preferences as *default mechanisms*. It is worth mentioning that language-specific differences are at play when it comes to reliance on these default mechanisms. In languages such as German, which allows for different word orders, speakers show a wider range of elements in initial position (other than subjects) than, for instance, speakers of English or French. While speakers of English must follow the structural rule of placing the subject in preverbal position, speakers of German can also place the object (when specific information structural conditions are met) or different kinds of adverbs in preverbal position. Thus, a first question is to what extent speakers of German rely on default mechanisms when constructing an utterance, and under which conditions they deviate from them.

A reason for deviating from syntactic preferences, discourse-related and semantic reasons aside, could be the influence of structural properties of the preceding context. This is called *structural priming*, or *syntactic priming*. There is an abundance of psycholinguistic literature that shows that speakers are strongly influenced by structural properties of the context (e.g., Bock, 1986; Branigan, 2007; Pickering & Ferreira, 2008; Ziegler et al., 2019; Ziegler & Snedeker, 2019). In fact, the interactive-alignment model (Pickering & Garrod, 2004) argues that aligning one's speech with that of the interlocutor reduces planning difficulties and eases interaction. Previous research has focused on the positioning of subjects and objects. In the present study, we investigate the role of structural priming in focus-sensitive particles.

A lexical candidate that is suitable for us to use in addressing our question is the German focus particle *auch* ('also, too'), which comes in two versions, one unstressed and the other, stressed. If *auch* is unstressed, it functions as a classical focus particle. It precedes its associated constituent (AC), which, in turn, has the information structural status of a focus (e.g., *Lena mag auch [HASEN]$_F$*, lit., 'Lena likes also hares'; small caps indicate accentuation, […]$_F$ indicates focus). The unstressed version, thus, behaves like other German focus particles, such as German

nur ('only'), *sogar* ('even'), or focus-associating uses of negation particles. If *auch* is stressed, it follows its AC (e.g., *Lena mag Hasen AUCH*, lit., 'Lena also likes hares'). When the AC is placed in preverbal position (e.g., *[Hasen]$_{CT}$ mag Lena AUCH*), the AC has the information structural status of a (contrastive) topic, marked as […]$_{CT}$ (see Dimroth, 2004; Krifka, 1999; Sudhoff, 2010). This illustrates that German *auch* is related to different surface structures (the particle precedes or follows its AC) and to different information structures (the AC of the particle is a focus or a topic), which, in turn, can have consequences for the construction of an utterance: if the AC of the particle is a topic, it is more likely to be clause-initial. Crucially, unstressed, preceding *auch* and stressed, following *auch* are often completely interchangeable.[1] In these cases, speakers of German are free to choose which version of *auch* should be used, and they can base their decision on default mechanisms. Prior experiments show that additive focus particles predominantly precede object ACs (Reimer & Dimroth, 2022), but we do not know whether particular properties of the relevant experiments (see Chapter 2.3) contributed to speakers' preference for this position. This is why we systematically investigate this issue in the current study.

We hypothesise that besides relying on default mechanisms, speakers are influenced by structural properties of the preceding context: they use unstressed, preceding *auch* when the context contains a similar element that precedes its AC, and stressed, following *auch* when the context contains a similar element that follows its AC. Thus, German *auch* enables us to study the influence of (information) structural preferences of the target utterance, on the one hand, and the influence of structural properties of the context, on the other hand. At the same time, research in this area adds to the research on structural priming in the domain of closed-class items, or function words, as, to the best of our knowledge, there are no studies investigating structural priming in relation to focus particles.

This article is structured as follows: In the next section, we will elaborate on the term *default mechanisms* (2.1) and present more in-depth psycholinguistic information on structural priming (2.2). Furthermore, we will introduce the German focus particle *auch* and present the study on German *auch* that this study is built on (2.3). After that, in Sections 3–5, we will present the results of three experiments that employed a sentence fragment arrangement task, in which participants had to integrate the focus particle *auch* in an utterance as part of a short dialogue. Besides investigating to what extent we find instances of structural priming, we also investigated the influence of lexical priming and the influence of intonation. Finally, in Section 6, we summarize and discuss our results, and derive implications for the construction of utterances under the influence of structural properties of the context.

[1] Though not always (see Reimer & Dimroth, 2021).

2. Background

2.1 Default mechanisms

Speakers exhibit several preferences when ordering the words in an utterance, such as syntactic preferences. For instance, they preferably place the constituent that serves as the subject of the sentence before the object (SO-order), mostly in sentence-initial position. This is the canonical word order in German (see, e.g., Jacobs, 1988; Lenerz, 1977; Reis, 1986; von Stechow & Sternefeld, 1988; among others). The seminal corpus study by Hoberg (1981) shows for the middle field (i.e., the region following the finite verb, as in *Heute trifft sie ihn*, lit., 'Today meets she him'), that SO-sentences make 96% of all sentences in their corpus and are, thus, strongly preferred over OS-sentences. With respect to sentence-initial position, subjects are placed in this position in 50% of the cases (e.g., *Sie trifft ihn heute*), and objects, in 7% of the cases (e.g., *Ihn trifft sie heute*) (Bohnacker & Rosén, 2008).

This preference is also observable from the perspective of language comprehension, as shown by Bader and colleagues for German (e.g., Bader et al., 2000). In locally ambiguous sentences, such as (1), from Bader et al. (2000), speakers initially interpret the first noun phrase (NP) *Fritz* as the subject. When they process the second NP *die Oma* ('the grandma$_{NOM}$') and the dative verb *geholfen* ('helped'), the case marking on the definite article leads to a reanalysis, evidenced by longer reading times on, or following, the disambiguating region. However, Weber and colleagues (2006), using a visual-world eye-tracking paradigm, showed that the SO preference can be modulated by intonation.

(1) Fritz hat die Oma nicht geholfen.
Fritz.DAT has the grandma.NOM NEG helped
'The grandma did not help Fritz.'

Bader and Häussler (2010) suggest three types of reasons for why speakers deviate from the preferred SO-order: discourse-related reasons (topics are likely to be placed in sentence-initial position, see Reinhart, 1981), semantic reasons (agents are likely to be animate, to be realized as the subject, and to be placed in first position – the "agent-first-principle"; see Clark, 1965; Jackendoff, 1972), and phonological reasons, such as constituent weight (short NPs precede long NPs; for the phenomenon called Heavy-NP Shift, see Arnold et al., 2000; Wasow, 2002). In a corpus study, Bader and Häussler (2010) investigated these three factors and found that lexical-semantic and discourse-related constraints both play a significant role. According to Bader and Häussler, the main discourse-related constraint is the requirement that topics occur in sentence-initial position. In most cases, subjecthood and topichood go hand in hand, since subjects are prototypical topics (Reinhart, 1981), and objects are likely to be the focus of the utterance.

If, however, topichood and subjecthood do not coincide, and if the topic is not the subject of the sentence, speakers deviate from their preference for placing the subject in initial position,

and, instead, place the topic in initial position, even when it is the object of the sentence. In (2), for instance, *Peter* is the topical subject and is placed in sentence-initial position. *Pasta* is the object; it is the AC of the focus particle *auch* and, as such, has the information structural status of the focus of the utterance (the AC of *auch* is indicated by square brackets, the particle itself is in boldface).

(2) Peter mag Pizza. Peter mag **auch** [Pasta].
Peter.NOM likes pizza.ACC Peter.NOM likes also pasta.ACC
'Peter likes pizza, and he likes pasta, too.'

An OS-structure occurs when the object is the topic, as in (3), where not the AC, but the focus particle itself is the focus.

(3) Peter mag Pizza. [Pasta] mag Peter **auch**.
Peter.NOM likes pizza.ACC pasta.ACC likes Peter.NOM too
'Peter likes pizza, and he likes pasta, too.'

In (3), *Pasta* is the AC of the stressed, following *auch,* and, as such, it is defocused. Keeping the object *Pasta* in the middle field, following the finite verb, and the subject *Peter* in the initial position does render the sentence strongly marked, or even ungrammatical (see (4)).

(4) #? Peter mag Pizza. Peter mag [Pasta] **auch**.

Based on the factors presented above, we assume that the default option for speakers would be to integrate the particle *auch* in its unstressed, preceding version, as in (2). However, speakers have a choice, and both pairs of utterances, (2) and (3), are possible. Which version is the preferred one is an empirical question that has not been systematically answered so far. The goal of the present study is to investigate experimentally whether – beyond the factors presented above – speakers are influenced by structural properties of the context, known as *structural priming*, when constructing an utterance that contains the focus particle *auch*.

2.2 Structural priming

Structural priming (see Bock, 1986; Branigan, 2007; Pickering & Ferreira, 2008; Ziegler et al., 2019; Ziegler & Snedeker, 2019) can be defined as the tendency to repeat a syntactic form in successive utterances (Bock, 1986). A classic example of structural priming is the use of a structure containing a prepositional object versus a double object structure. The seminal study by Bock (1986) showed that prepositional primes (e.g., *The boy is handing a valentine to a girl*) increased the incidence of prepositional utterances by 23%, relative to their frequency following double object primes (*The boy is handing the girl a valentine*), and double object primes increased the incidence of double object utterances by 22%, relative to their frequency following prepositional primes. The alternations involved variation in word order, and the phenomenon,

thus, does not depend on superficial relationships between successive sentences, but on more abstract similarities. As stressed by Branigan (2007), the results show that priming alters the relative likelihood of producing one structure or another. It does not uniquely determine which structure has to be produced (see also Mahowald et al., 2016, for a meta-analysis of 73 peer-reviewed journal articles on syntactic priming).

Besides prepositional objects versus double object structures, priming has been observed for several other structures, including passives (Bock, 1986), transitives (Bernolet et al., 2016), relative clause attachment (Scheepers, 2003), temporarily ambiguous sentences with a main clause interpretation or a reduced relative clause interpretation (Pickering & Traxler, 2006), PP-attachment ambiguity with a VP-attachment or an NP-attachment (Branigan et al., 2005), production/omission of optional complementizers (Ferreira, 2003), and the form of complex NPs (Cleland & Pickering, 2003). It is known that priming occurs between expressions that involve the same syntactic categories, irrespective of whether they are content words or function words (e.g., Bock, 1989). There are several studies that investigated structural priming with respect to function words, such as complementizers (Ferreira, 2003), verb-particle placement (Gries, 1999; Konopka & Bock, 2009), and prepositions (e.g., Bock, 1989; Bock & Loebell, 1990). However, we are not aware of any study that reports on structural priming with respect to focus particles.

Priming appears to be sensitive to surface word order. Hartsuiker and Westenberg (2000), for instance, show that the position of PPs and the relative order of auxiliary and main verbs can be primed, whereas Pickering et al. (2002) show that expressions with the same constituent categories, but different surface word orders, do not prime each other. This suggests, as pointed out in the meta-analysis by Branigan (2007), that the relevant representations are specified for linear order.

An open question, when it comes to structural priming, is whether speakers are primed only by linear order, that is, by the surface structure of a sentence, or also by the underlying structure (known as the deep structure in transformational grammar, e.g., Chomsky, 1965). Bock et al. (1992) did not find that the deep structure of a prime sentence influenced the production of a target sentence with respect to passives. In a passive sentence such as *Five people were carried by the boat*, the subject *five people* is the underlying object of the corresponding active sentence (*The boat carried five people*), and the NP *the boat*, which is part of the optional *by*-phrase, is the underlying subject of the corresponding active sentence. In passive versus active sentences, thus, the surface structure and the underlying structure differ. Bock et al. (1992) used an experimental procedure that involved the production of a priming sentence followed by the description of an event (there is a tendency for the forms of priming sentences to be repeated in picture descriptions; see Bock, 1989). Half of the primes were actives, and half were passives; half had animate subject arguments with inanimate object arguments, and half had inanimate subject arguments with animate object arguments. The results show that inanimate subjects in prime sentences tended to

elicit inanimate subjects in active sentences (e.g., ***The alarm clock*** *wakes the boy*), irrespective of whether those prime sentences were active (e.g., ***The boat*** *carried five people*) or passive (e.g., ***The boat*** *was carried by five people*). However, animate subjects in passive primes (e.g., ***Five people*** *were carried by the boat*) did not elicit animate objects in active sentences (e.g., *The alarm clock wakes* ***the boy***). Thus, participants tended to repeatedly map entities with particular animacy features to the same surface position, indicating that there is a direct mapping of semantic representation onto surface structure representations, not onto deep structure representations. In the present study, we deploy structural priming in order to investigate to what extent speakers deviate from default mechanisms when constructing an utterance in discourse. While Experiments 1 and 2 target the linear order of constituents, Experiment 3 investigates whether the underlying syntactic structure of a context sentence influences the construction of a target utterance.

Priming has also been found to occur in dialogue (see Branigan et al., 2000; Cleland & Pickering, 2003; Haywood et al., 2005). The results of Branigan et al. (2000) have even shown larger priming effects than in Bock's (1986) original study. Therefore, we expect to find priming effects in our dialogue study, as well. The next subsection is devoted to introducing the German focus particle *auch* in more detail, and to presenting the study that the present study is based on.

2.3 The German focus particle *auch*

What is special with respect to the German additive particle *auch,* compared to English *also*, is that German distinguishes between two variants of *auch*, namely, a stressed, following variant and an unstressed, preceding variant. From an information structural perspective, the AC of stressed, following *auch* is claimed to have the status of a contrastive topic (see Dimroth, 2004; Krifka, 1999; Sæbø, 2004; Sudhoff, 2010) or an aboutness topic (Dimroth, 2004; Sudhoff, 2010), whereas the AC of unstressed *auch* is the focus of the utterance. Stressed, following *auch* is often related to the AC being the subject of the utterance, and unstressed, preceding *auch*, to the AC being the object (e.g., Höhle et al., 2009). However, several of these factors are intermingled, and, as mentioned above, speakers might rely on default mechanisms when choosing between the two variants of *auch*: If the AC of *auch* is the subject, it most likely has the information structural status of a topic (Reinhart, 1981), which preferably is the AC of stressed, following *auch.*

Reimer and Dimroth (2022) conducted a sentence fragment arrangement task (see Gauza, 2018) in order to investigate to what extent speakers' choice of preceding versus following *auch* indeed depends on the syntactic function of the AC (whether it functions as the subject or the object). As part of a short dialogue, speakers read a context sentence (see (5–6)). The context sentences contained a claim about something (e.g., about Peter and Mary wanting to eat fruits) and a subsequent claim about one of the two (e.g., Peter only having eaten peaches). The speakers had to reply to that latter claim by formulating a contrastive statement. The contrast was between the lexical items *nur* ('only') and *auch*. For instance, in the context sentence, it was

claimed that Peter was the only person who ate peaches, and the target utterance claims that this is not true, because Mary ate peaches, too. At the same time, the focus particle *nur* in the context sentence, which either associated with the subject (5) or the object (6), indicated which expression should function as the AC of *auch* in the target utterance. Both the a) and b) sentences are felicitous continuations to the context.

(5) Peter und Maria haben Appetit auf Obst. Ich wette, **nur** [Peter] hat Pfirsiche
Peter and Mary have appetite on fruits I bet only Peter has peaches
gegessen.
eaten
'Peter and Maria want to eat fruits. I bet only Peter has eaten peaches.'

a) Nein! **Auch** [Maria] hat Pfirsiche gegessen.
no also Mary has peaches eaten
'No! Maria has eaten peaches, too.'

b) Nein! [Maria] hat **auch** Pfirsiche gegessen.
no Mary has also peaches eaten
'No! Maria has eaten peaches, too.'

(6) In der Obstschüssel liegen Pfirsiche und Bananen. Ich wette, Peter hat **nur**
in the bowl lie peaches and bananas I bet Peter has only
[Pfirsiche] gegessen.
peaches eaten
'In the bowl are peaches and bananas. I bet Peter has only eaten peaches.'

a) Nein! Peter hat **auch** [Bananen] gegessen.
no Peter has also bananas eaten
'No! Peter has eaten bananas, too.'

b) Nein! [Bananen] hat Peter **auch** gegessen.
no bananas has Peter also eaten
'No! Peter has eaten bananas, too.'

In order to construct the target utterance (the a) and b) sentences in (5) and (6)), participants saw the words in randomized order on a screen and had to adjust them (by dragging and dropping) in such a way that they built a meaningful sentence and a coherent reply to the context sentence. After constructing the target sentence, speakers were asked to read it out loud. Reimer and Dimroth measured whether speakers integrated *auch* so that it preceded or followed the respective AC. Note that the audio files indicated that a preceding *auch* was always unstressed, and a following *auch* was always stressed.

The data of the experiment indicate that speakers have a strong preference for following *auch* when the AC is the subject (see (5b)) and for preceding *auch* when the AC is the object,

(see (6a)), indicating that speakers rely strongly on default mechanisms. However, while the preference for preceding *auch* in the object condition was 93% (close to ceiling), the preference for following *auch* in the subject condition was only 69%. That is, there was a reduced preference for following *auch* in the subject condition, which Reimer and Dimroth (2022) attribute to the possible influence of the context sentence: As can be seen in (5), the context sentence contained the German focus particle *nur* ('only'). Compared to *auch*, there is only one version of *nur* in German, which always precedes its AC, even in the subject condition. Thus, from a surface structural perspective, *nur* is similar to preceding *auch*, but different to following *auch*. Reimer and Dimroth (2022) claimed that speakers might have been primed by the context sentence, which led them to insert preceding *auch* (see (5a)) in a condition in which speakers actually have a preference to insert following *auch* (see (5b)). Note that there was no such clash between default mechanisms and structural priming in the object condition. Both the preference for preceding *auch* when the AC is the object and the SVO order of the context sentence lead to the insertion of preceding *auch*.

These data provide a first indication that speakers' choices can be affected by surface structural properties of a context sentence (the presence of another focus particle that precedes its AC), which lead them to deviate from their default mechanisms. However, there is one further possible explanation. It is claimed in the literature that unstressed, preceding *auch* and stressed, following *auch* are related to different questions under discussion (QUD; see Roberts, 2012; also, Klein & von Stutterheim, 1987, von Stutterheim & Klein, 1989, for earlier proposals). While an utterance with unstressed, preceding *auch* answers an underlying *wh*-question (*Who ate pears? → Mary ate pears, and also Peter ate pears*), an utterance with stressed, following *auch* answers an underlying polar question (*Mary ate pears. What about Peter, did he ate pears? → Yes, Peter ate pears, too*) (see Dimroth, 2004). As a consequence, *nur* is the alternative to unstressed *auch (not **only** Mary, but **also** Peter),* while negation is the alternative to stressed *auch,* as semantically, both modify polarity (*No, Peter did **not** eat any pears/Yes, Peter ate pears, **too***). Thus, it is possible that participants used more instances of unstressed, preceding *auch* because they were primed by the lexical item *nur*. In order to examine these instances of priming more closely, we conducted three experiments using a sentence fragment arrangement task. We utilized not only the focus particle *nur (Peter hat **nur** [die Äpfel] gegessen* 'Peter only ate the apples'), but also negation (*Peter hat [die Birnen] **nicht** gegessen/Peter hat **keine** [Birnen] gegessen* 'Peter did not eat any pears'; see below). The context sentences suggest that we are dealing with focus-associating uses of negation, as negation has scope over the direct object, not over the entire VP. Hence, we take all these particles – *auch*, *nur*, and negation – to be focus-sensitive operators.

In Experiment 1, we tested whether the strong preference for unstressed, preceding *auch* in the object condition found by Reimer and Dimroth (2022) can be mitigated by (a) surface structural properties of the context, and (b) lexical properties of the context. We investigate the

influence of the surface structure of the context by using two lexical items that precede their associated constituents – the focus particle *nur* 'only' and the negative pronoun *kein(e)* 'no', and one item that follows its associated constituent – the negation particle *nicht* 'not'.

At the same time, *nur* is a semantic alternative to unstressed, preceding *auch*, and *kein(e)* and *nicht* (both referred to as *negation* in the remainder of this article) are alternatives to stressed, following *auch*. In Experiment 2, we focus on *kein(e)* and *nicht* and manipulate the intonational pattern (hat contour versus two pitch accents) in order to disentangle the influence of the surface structure from the influence of intonation. Experiment 3 seeks to distinguish between the influence of the surface structure of the context sentence and the influence of its underlying structure.

In all three experiments, we operationalize the extent to which participants are primed by the context as the proportion of times that they deviate from the established preference for preceding *auch* in the object condition and, instead, position *auch* following its AC. In all three experiments, the prime and target sentences are part of a short dialogue, while the seminal investigation by Bock (1986) studies sentences in isolation. If sentence production in isolation enhances structural effects, we expect to find priming effects of smaller effect sizes than in the study by Bock (1986).

3. Experiment 1

In Experiment 1, we replicated and extended Reimer and Dimroth's (2022) experiment, and used context sentences containing the particle *nur* (***nur*** *Birnen*, 'only pears'). Furthermore, since *nur* always precedes its AC, we included two further conditions with negation in different positions:

- *kein(e)* (***keine*** *Birnen* 'no pears'), which precedes its constituent and, hence, is positionally similar to *nur*, and
- *nicht* (*Birnen* ***nicht*** 'pears not'), which follows the AC.

The elements in the context (*nur, kein(e), nicht*) were manipulated within subjects.

We tested the following predictions. If the surface structure of the context sentence [*X* + *AC/AC* + *X*] (X = particle) influences the choice of preceding or following *auch* in the target sentence, we expect speakers to use more instances of following *auch* when the context includes the negation *nicht* than when it includes the focus particle *nur* or the negation *kein(e)*. In that case, we expect to find a difference between *kein(e)* and *nicht*, but not between *kein(e)* and *nur*.

If the alternatives to unstressed, preceding *auch* and stressed, following *auch* influence speakers' choices, we expect more uses of preceding *auch* when the context contains *nur*, and more uses of following *auch* when the context contains the negation *kein(e)* or *nicht*. In that case, we expect to find no difference between *kein(e)* and *nicht,* but between both negations and *nur*.

If, however, participants rely solely on default mechanisms (objects are likely to be the focus of the utterance; preceding *auch* associates with a focused constituent), we expect speakers to use preceding *auch*, independent of the elements in the context. In that case, we do not expect to find any difference between the three items in question.

To summarize, *nur* and *kein(e)* are alike in their surface structure position (both precede the AC), while *kein(e)* and *nicht* are alike in that both are lexical alternatives to stressed, following *auch*. We test whether the positional effect is stronger than the lexical effect, i.e., whether *kein(e)* patterns with *nur* (*effect of position/structural priming*), or whether *kein(e)* patterns with *nicht* (*effect of alternative/lexical priming*).

3.1 Materials and methods

3.1.1 Participants

Twenty-one native speakers of German (14 female/7 male; mean age: 22.8 years) took part in this web-based experiment. Participants were recruited with the software hroot (Bock et al., 2014). Each participant was compensated with 3 Euros for participating in the experiment.

3.1.2 Materials

We created 20 short dialogues, similar to the dialogues used in Reimer and Dimroth's (2022) study. Each dialogue consisted of a two-sentence context, which was presented visually, and the target utterance, which participants had to construct based on pre-fabricated fragments. The first part of the context sentence was portrayed as an utterance by speaker A (which is the speaker whose role the participants had to take when constructing the target sentence), and the second context sentence, as an utterance by speaker B (see (7)).

We manipulated the lexical element which was an alternative to *auch* in the second context sentence (the utterance by speaker B). Example (7-B) shows a sentence with the focus particle *nur* (a lexical alternative to unstressed, preceding *auch*), which precedes its AC ([***X*** + *AC*]). Example (7-B') contains the negation *kein(e)* (a lexical alternative to stressed, following *auch*), which also precedes its AC ([***X*** + *AC*]), and example (7-B'') contains the negation *nicht* (a lexical alternative to stressed, following *auch*), which follows its AC ([*AC* + ***X***]).

(7) A: Peter hatte Appetit auf Obst.
Peter had appetite on fruits
'Peter wanted to eat fruits.'

B: Ich wette, Peter hat **nur** [die Äpfel] gegessen.
I bet Peter has only the apples eaten
'I bet Peter only ate the apples.'

B': Ich wette, Peter hat **keine** [Birnen] gegessen.
I bet Peter has no pears eaten
'I bet Peter didn't eat any pears.'

B'': Ich wette, Peter hat [die Birnen] **nicht** gegessen.
I bet Peter has the pears not eaten
'I bet Peter didn't eat any pears.'

Each target sentence was introduced by *Ich glaube, dass* ('I believe that'), which necessitates a subordinate clause in German with the finite verb in sentence-final position. This prevented participants from moving constituents to the preverbal position (as shown in example (2)) and, thus, avoided a potential source of variation (*auch* following its AC in an adjacent position vs. a distant position). The fragments consisted of syntactic constituents; see the boxed words in (8).

Each target sentence contained the particle *auch*, and participants could integrate *auch* in such a way that it preceded the AC (8a) or followed the AC (8b) (the AC in (8) is *die Birnen*). The ordering of the fragments was our dependent variable.

(8) a. Ich glaube, dass PETER AUCH DIE BIRNEN GEGESSEN HAT
b. Ich glaube, dass PETER DIE BIRNEN AUCH GEGESSEN HAT

The 20 dialogue triplets were allocated to three lists by means of a Latin Square design. Each speaker saw each item in only one of the three conditions, but received all three conditions six to seven times. Twenty filler sentences were added to each list. As in Reimer and Dimroth's (2022) study, the filler sentences contained temporal adverbs, such as *gestern* ('yesterday') or *heute* ('today'), instead of the particle *auch*. These adverbs can be flexibly inserted in different positions in the sentence and provide a good way to distract the participants. Within each list, the items were presented in randomized order.

3.1.3 Procedure

The questionnaire was created with SoSci Survey (Leiner, 2014) and made available to participants on www.soscisurvey.com. The experiment started with a short introduction. Participants were instructed to silently read the context sentences (speaker A's and speaker B's utterances) and to assemble speaker A's second utterance by using a set of words which were presented with capital letters in small boxes in randomized order. In order to avoid a linearization effect, the word boxes were arranged not in linear order, but in zigzag fashion (see **Figure 1**). Above the single words there were five empty boxes of equal size arranged in linear order. Participants had to click on the word boxes given or drag and drop them into the empty boxes. It was possible for participants to remove the word boxes they had placed in the empty boxes and reposition them. There were four practice items, similar to the filler sentences.

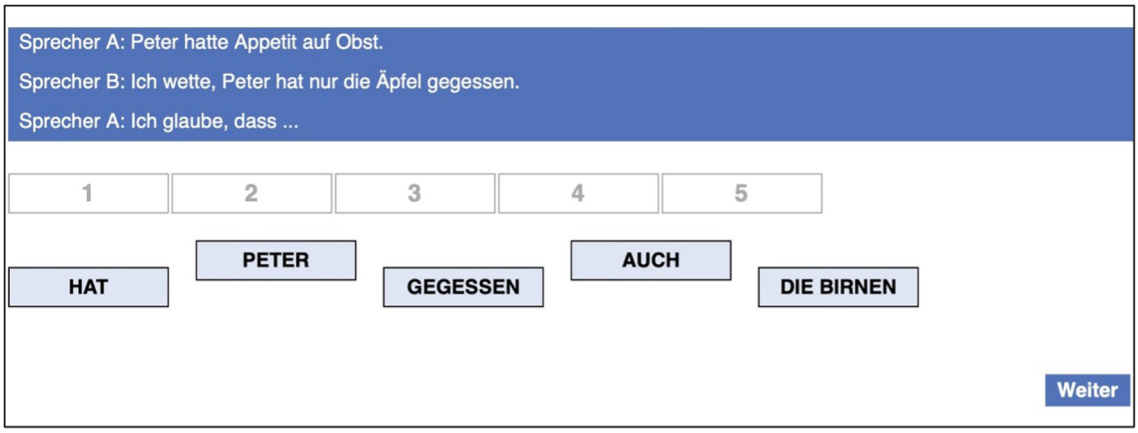

Figure 1: Presentation of an experimental item of the sentence fragment arrangement task.

3.2 Results

The data of two non-native participants were discarded. Thirteen answers (3.4%) had to be excluded, due to an ordering of the fragments that led to an ungrammatical sentence or to an utterance that was not coherent with the specific context, for instance, because the AC of the particle was the subject instead of the object. The remaining sentences were classified as *preceding* ([***X*** + *AC*]: *Ich glaube, dass Peter* ***auch*** *[die Birnen] gegessen hat/Ich glaube, dass* ***auch*** *[die Birnen] Peter gegessen hat*) or as *following* ([*AC* + ***X***]: *Ich glaube, dass Peter [die Birnen]* ***auch*** *gegessen hat*). Overall, speakers had a general preference for *auch* preceding its AC (grand average: 81.4%), and following *auch* was chosen in only 18.6% of the cases.

The two positions were analysed using a mixed-effects logistic regression model (glmer) in R (R Core Team, 2017; package lme4, Bates et al., 2015) with the optimizer "bobyqa" to avoid convergence issues. The fixed-effects factor was the element in the context (3 levels: NUR/KEINE/NICHT), and participants and items were added as crossed random effects (random intercepts; the inclusion of random slopes for the within-group factor context led to non-convergence). The model was refitted after removing 11 data points with residuals larger than 2.5 sd (3% of the data points). The results showed a significant effect of condition ($\chi^2 = 17.9$, $df = 2$, $p < 0.001$). Tukey-corrected pairwise comparisons showed significant differences between NICHT and the other conditions ($\beta_{NUR} = 1.5$, $SE = 0.5$, $z = 3.4$, $p < 0.005$, $\beta_{KEIN} = 1.8$, $SE = 0.5$, $z = 3.8$, $p < 0.001$), but there was no difference between NUR and KEINE ($\beta = 0.2$, $SE = 0.5$, $z = 0.5$, $p = 0.8$); see **Figure 2** and **Table 1**. In other words, relative to the NUR- and KEINE-conditions (on average, 14.5% choice of *auch* following its AC), this proportion increases to 27.1% in the NICHT-condition, and a priming effect of 12.6% in the NICHT-condition.

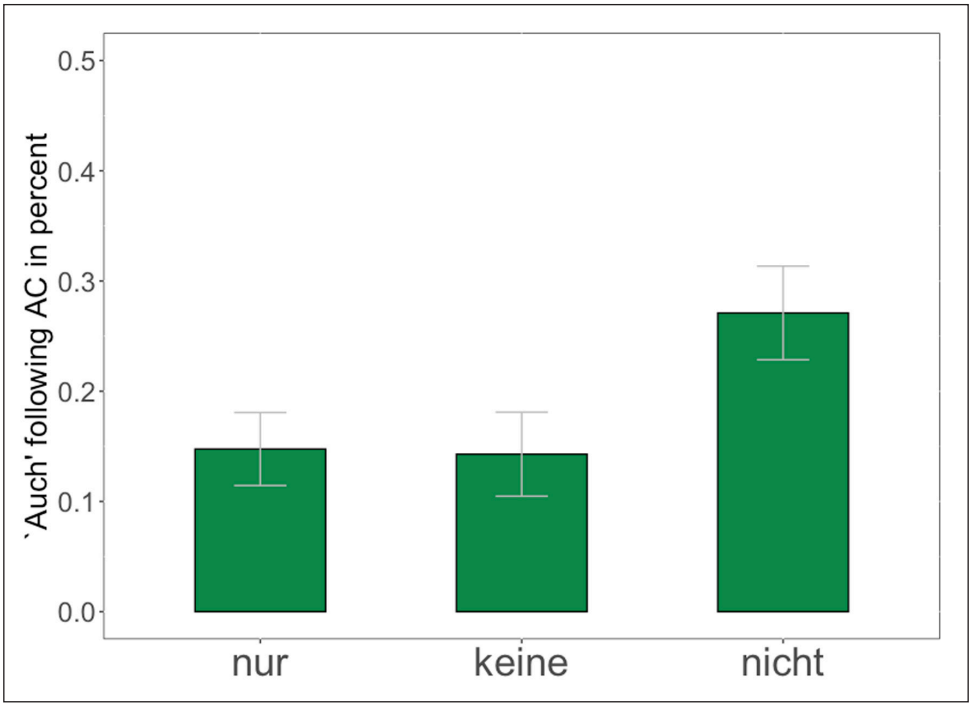

Figure 2: Results of Experiment 1 in % for the three conditions (*nur/kein(e)/nicht*); error bars refer to standard error of the mean.

Table 1: Results of Experiment 1; production of the possible target structures in %, depending on the element in the context sentence (*nur/kein(e)/nicht*).

	nur + **AC**	***keine*** + **AC**	**AC** + ***nicht***
auch + AC	85.4%	85.6%	72.9%
AC + ***auch***	14.6%	14.4%	27.1%

3.3 Discussion

Based on the literature and on Reimer and Dimroth's (2022) study, we expected participants to show a preference for *auch* preceding its AC when the AC is the object. This was borne out by the results of Experiment 1. Our participants showed an overall preference for *auch* preceding its AC (81.4%). This preference was not as high as in Reimer and Dimroth's (2022) study, where the preference was 92.8%. We attribute this decreased preference to the fact that our experimental context sentences included not only preceding *nur*, but also preceding *kein(e)* and, crucially, following *nicht*, as described in the following.

The main focus of the study was whether speakers are influenced by the surface structure of the context, when its structure (e.g., [*AC* + ***X***]) deviates from the structure they actually prefer

for the target sentence (e.g., [***X*** + *AC*]), or whether they are influenced by lexical properties of the context. Our results clearly point to an effect of structural priming: the results for the *kein(e)*-condition pattern with the results for the *nur*-condition – both share the structure that the particle precedes its AC. Compared to these two conditions, participants used more instances of following *auch* when the context contained the lexical item *nicht*, which also follows the object AC. Thus, when the context contains information that is in conflict with default preferences regarding the structure of the sentence, speakers are structurally primed by the context and deviate from their actual preference (integrating preceding *auch*) by 12.6%. The differences in outcomes between *kein(e)* and *nicht* indicate that the type of lexical alternative (in both cases, negation) did not influence the choice between unstressed, preceding *auch* and stressed, following *auch*.

To summarize, speakers strongly rely on default mechanisms when constructing their utterances. However, they also pay attention to the surface structure of the context sentence when choosing between the two variants of the particle *auch*. There were more instances of stressed, following *auch* when the context contained the negation particle *nicht* (which also follows its AC), compared to when the context contained *nur* and *kein(e),* which both precede their ACs. While we excluded effects of lexical priming in Experiment 1, Experiment 2 is designed to pursue another possible factor that might have led to more uses of following *auch* in the condition where the context contained *nicht*, namely, intonation.

The possibility cannot be excluded that participants silently read the three conditions with different intonation contours (see Brown, 1958; Fodor, 1998; Rayner et al., 2012; on the activation of stress and intonation patterns during silent reading). Compared to *nur* and *kein(e)*, *nicht* is expected to be produced with a nuclear accent, which is generally perceived as more prominent than the expected prenuclear accents in *nur* and *kein(e)* (in which the following noun receives the nuclear accent). Post-hoc productions of the KEINE-sequences and NICHT-sequences in (7B') and (7B'') in the given context (7A) by four speakers each (in a between-subjects design, so that each speaker produced only one of the negations) tested this assumption. The results showed that speakers typically produced a rising prenuclear accent on *kein(e)* and the nuclear accent on the noun (*Birnen* 'pears') was downstepped (!H*) or an early-fall (H + L*). *Nicht* was typically produced with a rising (L + H*) or high nuclear accent (H*) and the preceding noun had either a rising accent or was unaccented. In order to control for unwanted confounds due to silent reading, Experiment 2 presented the contexts auditorily in two different intonation contours to test for (a) potential intonational priming (main effect of intonation) and (b) intonational influence on syntactic priming (interaction between intonation and particle in the context).

4. Experiment 2

It has long been noted that instances of preceding and following *auch* differ with respect to intonation. In the case of preceding *auch*, the particle is unstressed, and the AC carries a (falling)

pitch accent. In the case of following *auch*, the AC and *auch* are said to be produced with a *hat pattern* (also called a bridge accent), which combines a rising accent on the AC and a falling accent on the corresponding focus part, i.e., the particle (e.g., Büring, 1997; Büring & Hartmann, 2001; Jacobs, 1997; Sudhoff, 2006). A production study by Sudhoff (2006) showed that ACs were produced with more prominent rising accents than constituents in the same position that were not ACs, both in preverbal position (prefield) and in postverbal position (middle field). However, there was no difference in accent type. When listeners heard a rising prenuclear L* + H accent, they were twice as likely to choose a continuation with stressed *auch*, which associated with the accented constituent (Braun, 2012), than with prenuclear L + H*. Intonation may, hence, be a factor that influences word order.

To investigate whether it is the structure of the context [AC + $\boldsymbol{X}$] that led speakers to use more instances of following *auch*, and not the intonation of the context, we presented the context sentences in Experiment 2 auditorily: We included the conditions KEIN(E) [$\boldsymbol{X}$ + AC] and NICHT [AC + $\boldsymbol{X}$], with different orderings with respect to their AC, and included two intonation patterns. The first contour was the rising-falling hat pattern that occurred frequently in the *kein(e)*-productions and has been discussed in the literature for stressed, following *auch*. The second contour was matched to the hat pattern in terms of accent distribution (it also accented both the noun and the negation particle), but used two falling accents instead (henceforth, the *double-peak contour*).

Given that stressed, following *auch* has been claimed to associate with rising ACs, a strong intonation priming hypothesis predicts that participants will select stressed, following *auch* more often after a hat pattern than after a double-peak intonation (main effect of intonation). On the other hand, the hat pattern could strengthen the observed structural priming found for *nicht* (interaction between intonation condition and context). In any case, Experiment 2 allows us to test whether the structural priming explanation put forward in Experiment 1 holds across different intonation contours.

4.1 Materials and methods

4.1.1 Participants

Fifty native speakers of German (37 female/13 male; mean age: 22.8 years) took part in this web-based experiment. They were recruited and compensated as in Experiment 1.

4.1.2 Materials

In order to achieve a similar number of items per condition, we extended the set of 20 dialogues of Experiment 1 by twelve further dialogues, leading to 32 dialogues. Compared to Experiment 1, we included only the conditions KEINE [$\boldsymbol{X}$ + AC] and NICHT [AC + $\boldsymbol{X}$], which differ in

their structure, and manipulated the pitch accent of the AC and the negation in the second context sentence (speaker B's utterance; see (9) and (10)). The complete context sentences were recorded in the two conditions in a sound-attenuated cabin in the PhonLab at the University of Konstanz by two trained phoneticians (male and female). The duration of the recorded audio file was manipulated so that the two intonation conditions of each item were the same, using the PSOLA manipulation in the PRAAT software package (Boersma & Weenink, 2009). While one intonational realization contained a hat pattern (a rising L* + H on the first word, signaled by "/", and an early fall, H + L*, on the second word, signaled by "\"; see (9B) and (10B)), the other formed a double-peak pattern (H* on the first word, H* on the second; see (9B') and (10B')); see **Figure 3**. All audio-files can be found in the OSF archive associated with this article. The manipulation of the lexical element (which is related to a specific structure either preceding or following the AC) and the intonation led to four conditions.

(9) A: Peter hat Äpfel gegessen.
'Peter ate apples'

B: Ich wette, Peter hat /**KEIne** BIRnen\ gegessen.
L* + H H + L*

B': Ich wette, Peter hat **KEIne** BIRnen gegessen.
L + H* L + H*
'I bet Peter didn't eat any pears.'

(10) A: Peter hat die Äpfel gegessen.
'Peter ate apples.'

B: Ich wette, Peter hat die /BIRnen **NICHT**\ gegessen.
L* + H H + L*

B': Ich wette, Peter hat die BIRnen **NICHT** gegessen.
L + H* L + H*
'I bet Peter didn't eat any pears.'

As in Experiment 1, the target sentence (speaker A's second utterance) was presented in fragments that had to be arranged by the participants.

The 32 dialogue quartets were allocated to four lists by means of a Latin Square design. Each participant received each item in only one of the four conditions. Sixteen filler sentences were added to each list; half of them had a hat pattern, the other half had a double-peak. This time, the filler sentences contained the particle *auch.* Compared to the experimental sentences, the AC of *auch* in the filler sentences was always the subject. Subject ACs are often related to following *auch* (see Reimer & Dimroth, 2022). The fillers could, thus, counterbalance the preference for preceding *auch* that we expected as the default in the target items, where the AC was the object.

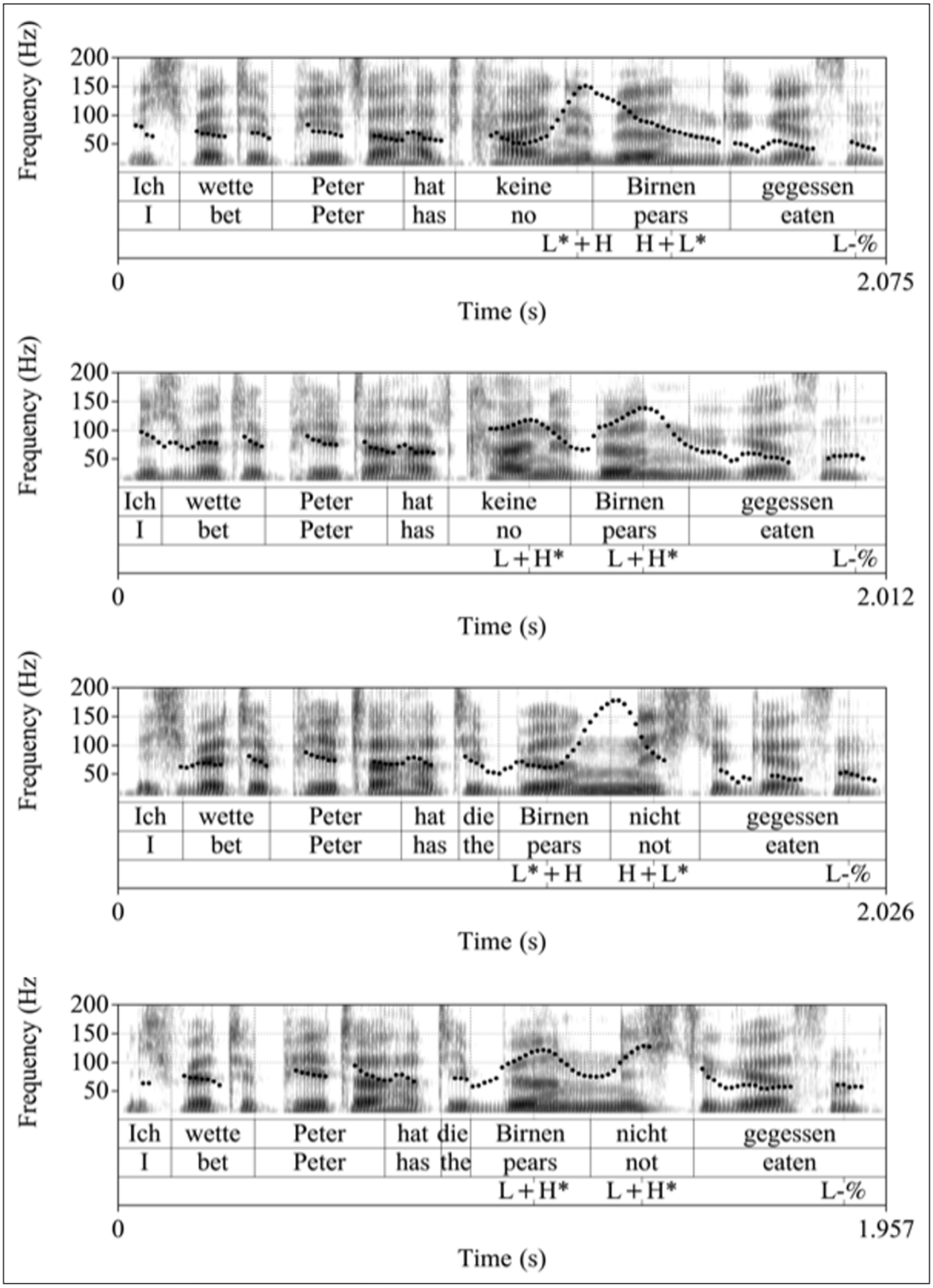

Figure 3: Intonation contours of Experiment 2; hat pattern and double-peak for the *kein(e)*-condition; hat pattern and double-peak for the *nicht*-condition.

4.1.3 Procedure

The experiment was created with SoSci Survey (Leiner, 2014) and made available to participants on www.soscisurvey.com. The questionnaire started with a short introduction. Unlike Experiment 1, participants listened to the context sentences (speaker A's and speaker B's utterances). After listening to the dialogue between speaker A and speaker B, participants were asked to assemble speaker A's second utterance. The arrangement of fragments into utterances was the same as in Experiment 1.

4.2 Results

The data of six participants had to be excluded. Two participants did not have German as their native language (L1); one participant created sentences in which the AC of the particle was the subject, instead of the object, in 97% of the cases; two participants created verb-second sentences in 30%–40% of the cases; and one participant showed mixed errors in over 30% of the cases.

Of all remaining answers, 88 answers (6.3%) had to be excluded, due to an ordering of the fragments that led to an ungrammatical sentence, or to an utterance that was not coherent with respect to the specific context, for instance, because the AC of the particle was the subject instead of the object.[2] The resulting 1320 answers were classified in the same way as in Experiment 1. Speakers had a general preference for *auch* preceding its AC (grand average: 70.1%) and following *auch* was chosen in 29.9% of the cases.

The initial data analysis was similar to Experiment 1. The fixed-effects factors were the element in the context (KEINE/NICHT) and the intonation in the context (HAT PATTERN/DOUBLE-PEAK); participants and items were added as random effects (random intercepts, as the inclusion of random slopes led to convergence issues). The final model was refitted after removing 8 data points with residuals larger than 2.5 sd (0.6% of the data points). The interaction term was not significant at $\alpha = 0.05$, and was, therefore, removed ($\beta = 0.5$, SE = 0.3, $z = 1.8$, $p = 0.08$); the main effect of intonation was not significant either ($\beta = 0.1$, SE = 0.15, $z = 1.0$, $p = 0.3$). The final model showed a main effect of condition only ($\beta = 1.4$, SE = 0.16, $z = 8.7$, $p < 0.001$).

As in Experiment 1, the presence of NICHT led to more uses of *auch* following its AC (38.3%) than the presence of KEINE (19.9%). In other words, relative to the KEINE-condition, we observe a structural priming effect of 18.4% in the NICHT-condition (see **Figure 4** and **Table 2**). This pattern was not influenced by the intonation of the precontext.

[2] This might be attributed to the filler sentences containing *auch* with subject ACs.

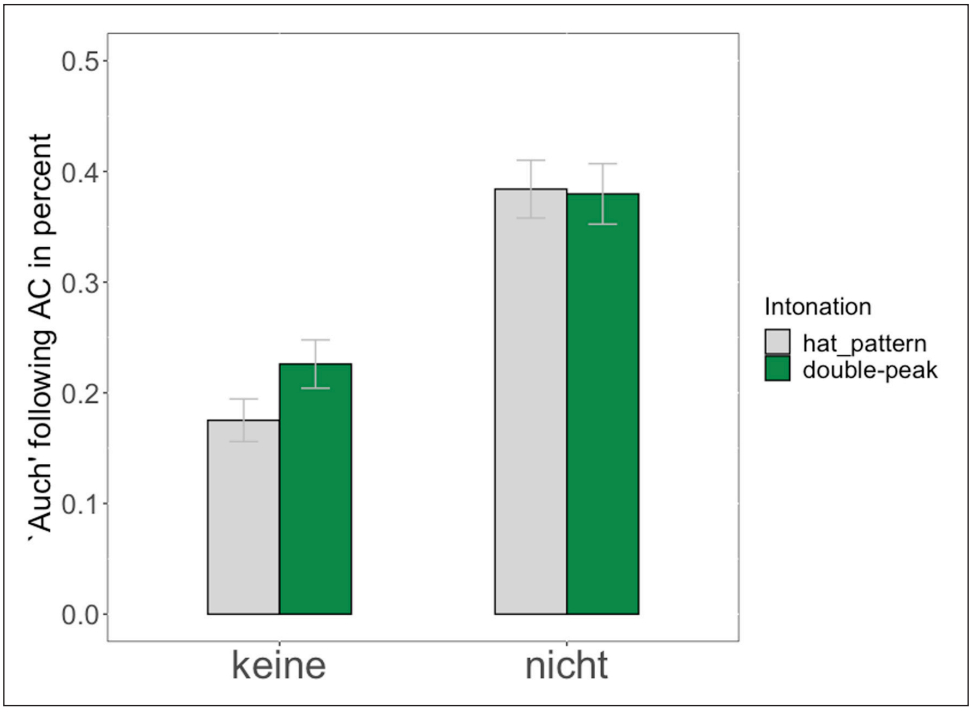

Figure 4: Results of Experiment 2 in % for the two conditions (*kein(e)/nicht*) and the two intonations (hat pattern/double-peak); error bars refer to standard error of the mean.

Table 2: Results of Experiment 2; production of the possible target structures in %, depending on the element in the context sentence (*kein(e)/nicht*) and the intonational realization (hat pattern/double-peak).

	keine + **AC**		**AC** + ***nicht***	
	hat pattern	**double-peak**	**hat pattern**	**double-peak**
auch + AC	82.5%	77.6%	61.5%	61.9%
AC + ***auch***	17.5%	22.4%	38.5%	38.1%

4.3 Discussion

In Experiment 2, we tested whether participants' responses are influenced by intonation, in addition to structural priming. If intonation had an influence, we would expect more uses of following *auch* in the hat pattern-condition, irrespective of the structure of the sentence.

As in Experiment 1, participants had a general preference for integrating *auch* in such a way that it preceded its AC. Crucially, we only found a main effect of element in the context, similar to the pattern reported in Experiment 1. When the context contained the negation *nicht*, speakers used more instances of stressed *auch* that followed its AC than when the context contained the

negation *kein(e)*. Again, participants were primed by the structure of the context. With a priming effect of 18.4%, participants integrated *auch* more often in such a way that it followed its AC – against their actual preferences, but in accordance with the ordering of the negation in the context sentence.

We did not find a main effect of intonation, indicating that the hat-pattern intonation in the context did not lead to more uses of stressed, following *auch* in the target sentence. This allows us to refute an intonational priming account. It is possible that the close succession of the two accents (in most cases, there were only one or two syllables between the accents) reduced the perceptual salience of the hat pattern (which maintains a continued high pitch between two accents). Note that, numerically, the number of instances of stressed, following *auch* was, on average, higher in Experiment 2 than in Experiment 1, in which there was no auditory presentation (*nicht*: 38.3% vs. 27.1%; *kein(e)*: 20.5% vs. 14.4%). It is conceivable, hence, that the accents on both the particle and the noun led to a higher proportion of stressed, following *auch* per se.

In any case, the results did not show a main effect of intonation, suggesting that the prior perception of an intonational contour that is more typical for stressed *auch*, following its AC, did not influence the positioning of *auch* in the target sentence. There is, hence, no reason to assume that the results of Experiment 1 were driven by different kinds of silent prosody, depending on the element. Importantly, we replicated the main effect of element in the context reported in Experiment 1 (*nicht* led to more uses of following *auch*), which strengthens the structural priming interpretation.

It is still an open question, however, whether it is indeed the surface structure that primes the participants, or whether it is actually the underlying structure. In Experiments 1 and 2, *kein(e)* and *nicht* differed in their surface structure, but at the same time, they differed in their underlying structure. We therefore conducted a third experiment that further investigated this question.

5. Experiment 3

In Experiment 3, we investigated whether the structural priming effect found in Experiments 1 and 2 was driven by the linear order of the constituents on the surface, or whether the underlying structure influenced the participants' choices. To that end, we used the same negation particles as in Experiment 1 and 2, namely, *kein(e)* (underlying structure [$\boldsymbol{X}$ + AC]), and *nicht* (underlying structure [AC + $\boldsymbol{X}$]). Compared to Experiment 1 and 2, however, we manipulated the surface structure and presented these negations in such a way that both elements *followed* their respective AC. Thus, stranded *kein(e)* and *nicht* differed in their underlying structure ([***keine*** + AC]/[AC + ***nicht***]), but were identical on the surface ([AC + $\boldsymbol{X}$]). If the underlying structure of a context sentence influences speakers in their construction of a target sentence, we expect the

same difference between *kein(e)* and *nicht* found in Experiments 1 and 2. If, however, the surface structure of a context sentence influences speakers, we do not expect any differences between *kein(e)* and *nicht*.

5.1 Materials and methods

5.1.1 Participants

Thirty-one native speakers of German (23 female/7 male/1 not specified; mean age: 22.8 years) took part in the experiment. They were recruited and paid as in Experiments 1 and 2.

5.1.2 Materials

We used sixteen dialogues from Experiment 2 and manipulated the surface structure of the sentence. While in Experiment 2, *kein(e)* preceded the AC, it followed the AC in Experiment 3 ([*AC* + ***keine***]). The surface structure of *nicht* was kept constant; it followed the AC in all experiments ([*AC* + ***nicht***]). Thus, while both negations are related to *different underlying structures* ([***keine*** + *AC/AC* + ***nicht***]), they have the *same surface structure* in Experiment 3 ([*AC* + ***X***]; see (11)).

(11) A: Peter hat Äpfel gegessen.
'Peter ate apples.'

B: Ich wette, [Birnen] hat Peter **keine** gegessen.

B': Ich wette, [Birnen] hat Peter **nicht** gegessen.
'I bet Peter didn't eat any pears.'

A: Ich glaube, …
'I believe …'

As in Experiment 1, the target sentences had to be arranged by the participants. However, we made two changes with respect to the target sentences. First, in order to increase the naturalness of the dialogues, we replaced the full name (which is mentioned twice in the context and, therefore, is highly given) by a personal pronoun ('he/she'). Second, the introductory sentence was not *Ich glaube, dass …* ('I believe that …'), introducing a subordinate clause with the finite verb in sentence-final position, but *Ich glaube, …* ('I believe …'), introducing a main clause with the finite verb in second position. The reason for that was that the modified context sentences in Experiment 3 were strongly marked, and the prefield of the sentence enabled participants to be more flexible in their construction of the utterances.

The 16 dialogue-pairs were allocated to two lists by means of a Latin Square design. Each participant received each item in only one of the two conditions. Sixteen filler sentences were added to each list, containing the particle *auch* that was related to a subject AC. These fillers were the same as in Experiment 2.

5.1.3 Procedure

The experiment was created and executed with the experiment software Gorilla (Anwyl-Irvine et al., 2019). The experiment was conducted on a Dell laptop in the Experimental Lab at the Institute for German Studies at the University of Münster. The experiment started with a short introduction. As in Experiment 2, participants listened to the context sentences (speaker A's and speaker B's utterances). The complete context sentences were recorded in a quiet and neutral manner by a female and a male native speaker of German. There was no particular instruction regarding the intonation of the utterances. The intonational realization was consistent across items. The recording took place in a sound-attenuated cabin in the Phonological Lab at the Institute for English Studies at the University of Münster. After listening to the dialogue between speaker A and speaker B, participants were asked to assemble speaker A's second utterance. As in Experiments 1 and 2, the order of the word boxes was randomized. Compared to Experiments 1 and 2, however, participants were asked to arrange the words in their heads and speak the assembled sentence out loud, while recording their responses. This change in procedure was adopted in order to increase the naturalness of the dialogue task, as the sentences of Experiment 3 were highly marked. Participants had to click on a record button in order to start the recording, and to click the button again to end the recording. They did not have the opportunity to re-record.

5.2 Results

The audio files were transliterated by a research assistant. The data of two participants had to be excluded. One participant did not have German as L1, and one participant recorded all answers with an infelicitous question/uncertainty intonation. The sentences were classified as in Experiments 1 and 2 regarding the position of the particle *auch*.

The model fitting was the same as in Experiment 1. The sole fixed-effects factor was the element in the context (KEINE/NICHT). Participants and items were added as random intercepts. Models with random slopes did not converge. Data points with residuals larger than 2.5 sd from the regression line were removed ($n = 23$, 3.4%) and the model was refitted. As in Experiments 1 and 2, the results show that speakers have a general preference for *auch* preceding its AC (82.3%). Compared to Experiments 1 and 2, however, the difference between KEINE and NICHT was not significant ($\beta = 0.01$, $SE = 0.55$, $t = 0.02$, $p = 0.9$), although there was a numerical trend for the presence of NICHT to lead to more uses of *auch* following its AC (19.1%) than the presence of KEINE (16.4%) (see **Figure 5** and **Table 3**). To statistically corroborate the difference in outcome between the underlying order and the surface word order (i.e., between Experiments 1 and 3), we created a dataset consisting of the data from Experiment 1 without the condition NUR and the data from Experiment 3. The mixed-effects regression model contained the fixed effects experiment (1/3) and element in the context (KEINE/NICHT). The model contained random intercepts for participants and items and was refitted after removing data points with residuals

larger than 2.5 sd (n = 23, 3.4% of the data points). The results showed a significant interaction of experiment and element in the context ($\beta = 1.32$, SE = 0.63, t = 2.1, $p < 0.05$). While there is a difference between the conditions KEINE and NICHT in Experiment 1, there is no difference between these conditions in Experiment 3.

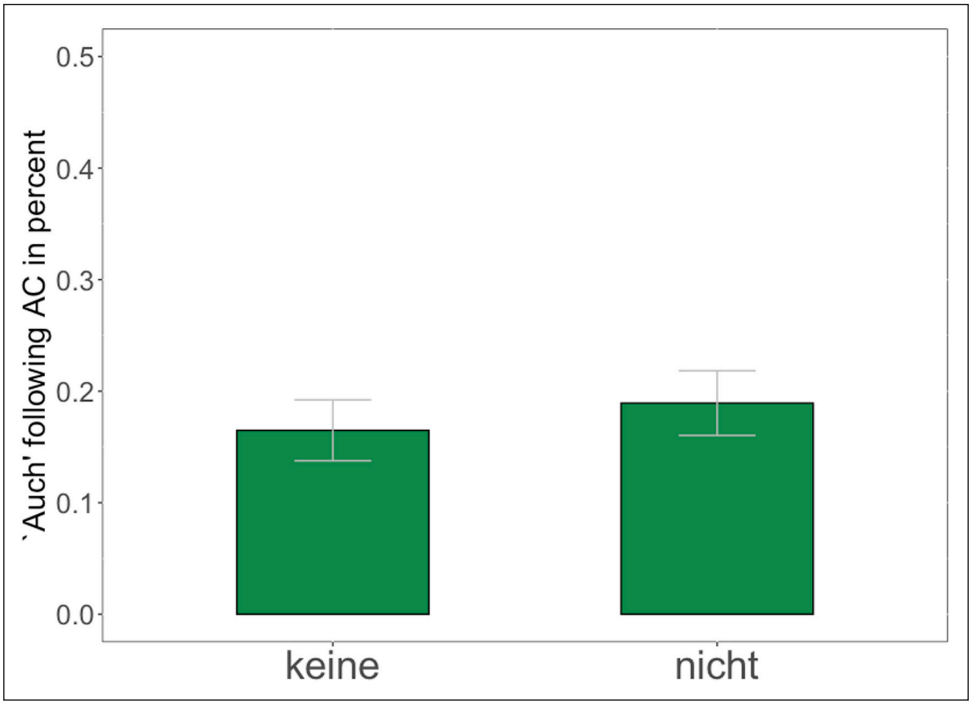

Figure 5: Results of Experiment 3 in % for the two conditions (*kein(e)/nicht*); error bars refer to standard error of the mean.

Table 3: Results of Experiment 3; production of the possible target structures in %, depending on the element in the context sentence (*kein(e)/nicht*).

	AC + *keine*	**AC + *nicht***
auch + AC	83.6%	80.9%
AC + ***auch***	16.4%	19.1%

5.3 Discussion

Experiment 3 tested whether the structural priming effect of Experiments 1 and 2 is triggered by the surface order or influenced by the underlying structure. To that end, we used the same negations as in Experiments 1 and 2 – *kein(e)* (underlyingly [$\boldsymbol{X}$ + *AC*]), and *nicht* (underlyingly [*AC* + $\boldsymbol{X}$]) – but changed the surface structure and presented the sentences in such a way that

both negations *followed* their respective AC. Thus, *kein(e)* and *nicht* differed in their underlying structure ([***keine*** + *AC*]/[*AC* + ***nicht***]), but were identical on the surface ([*AC* + ***X***]). The results showed a general preference for unstressed *auch*, indicating that speakers strongly rely on default mechanisms. This overall preference is also in line with the results of Experiments 1 and 2, indicating that the change in modality (participants did not type in their utterances, but recorded them) did not change the general result. Compared to Experiments 1 and 2, however, there was no significant difference between *kein(e)* and *nicht* with respect to the choice of preceding *auch* – there was merely a tendency for preceding *auch* to be used more often if the context contains *kein(e)*, compared to *nicht*. We hypothesized that if the underlying structure of a context sentence influenced speakers in their construction of a target sentence, the difference between *kein(e)* and *nicht* would be the same across experiments. However, this was not borne out. We therefore conclude that it is the surface structure of the context sentence that influenced speakers' sentence planning. This finding is also in line with Bock's (1989) findings.

Note, however, that we modified the introductory sentence in Experiment 3, in order to enable participants to be more flexible in their construction of the utterances. In contrast to Experiments 1 and 2, it introduced a main clause (*Ich glaube,* …). Due to this modification, the target sentence had a prefield (i.e., a preverbal slot), while the target sentences in Experiment 1 and 2 did not have a prefield. It is an open question whether this modification had an effect on the results of Experiment 3. The prefield of a German main clause is a prominent position for topics, which, in turn, are likely to be the AC of stressed, following *auch*. Following this reasoning, we would have expected participants to integrate *auch* in such a way that it follows its AC, independent of the element in the context. This, in turn, should have led to more uses of stressed, following *auch* compared to the other experiments. This was not the case, however, as only 17.7% of the uses of *auch* were instances of stressed, following *auch*, compared to 27.5% in the corresponding conditions in Experiment 1. A further difference, however, was that we used indefinite object NPs in the target sentences, while we used definite object NPs in Experiment 1 and 2. If speakers decide to place the subject pronoun in the prefield, they might prefer preceding *auch* if the object NP is indefinite, as following *auch* seems to be less acceptable with an indefinite object NP (e.g., *#Ich glaube, er hat Äpfel auch gegessen* vs. *Ich glaube, er hat die Äpfel auch gegessen*). This might have led to the decrease in production of stressed, following *auch* in Experiment 3.

We are aware of the fact that the structure used in Experiment 3 is highly unnatural and that modified sentence structures are often accompanied by specific intonational patterns. An anonymous reviewer pointed out that stranded *kein(e)* is heavily focused and as intonationally prominent as the stressed particle *nicht*, which, in turn, might have led to the result observed in Experiment 3. We conducted a further experiment, similar to Experiment 3, in which participants read the target sentence and typed in their answer. If the results of Experiment 3 were indeed intonationally driven, and if reading and typing eliminate or, at least, de-emphasize intonational

effects, we would have expected to find a difference between *kein(e)* and *nicht* in this further experiment. However, as in Experiment 3, we did not find a difference between *kein(e)* and *nicht*, which leads us to conclude that it is not the intonation that influenced the speakers, but the surface structure. Of course, more controlled experiments are needed to study this specific sentence structure further.

6. General discussion and conclusion

The studies presented in this article addressed several questions. A first question was related to the strength of default mechanisms that speakers of German rely on when constructing an utterance. To that end, we investigated how speakers integrate the German focus particle *auch*, which can either precede or follow its AC in the surface structure. A previous study by Reimer and Dimroth (2022) demonstrated that speakers have a strong preference to integrate *auch* in such a way that it follows its AC when the AC is the subject of the sentence, and precedes its AC when the AC is the object of the sentence. This is most likely due to the information structural status of the AC as a topic/focus. The results of all three experiments in this article indicate that speakers indeed strongly rely on default mechanisms when constructing their utterances, in that they have a preference for placing *auch* before the associated object.

We further asked whether speakers are structurally primed by a context sentence. In Experiment 1, we tested whether surface structural effects of the context (the placement of particles before or after the object) affect participants' word order preferences. Additionally, we tested whether the type of alternative (focus particle *nur* as an alternative to unstressed, preceding *auch*; negation particles as alternatives to stressed, following *auch*) has an influence. We compared the two negation conditions *kein(e)* and *nicht* – one preceding the object, one following it – both of which are alternatives to stressed, following *auch*. In addition, we tested *nur*, which precedes its AC and is an alternative to unstressed, preceding *auch*. The results show that speakers are influenced by surface structural properties of the context and, hence, speak in favour of structural priming. If the context contained the lexical element *nicht* (following its AC), speakers chose following *auch* 12.6% or 18.4% more often than if the context contained the lexical elements *nur* or *kein(e),* respectively (both of which precede their ACs). Thus, the results of our experiments extend Reimer and Dimroth's (2022) findings for the subject condition to the object condition. The priming effect found in Bock's (1986) original study was 22% in the case of double object utterances, 23% in the case of prepositional utterances, and 8% for active and passive utterances each. Thus, the priming effect found in our study lies numerically between the priming effects reported for the two phenomena investigated by Bock (1986) – although our sentences were not presented in isolation, but were part of a short dialogue. Thus, even in dialogues, we find robust structural priming effects (see also Branigan et al., 2000). The type of alternative (*nur* is the alternative to unstressed, preceding *auch,* while negation is the alternative

to stressed, following *auch*) did not affect the results. The negation *kein(e)* did not pattern with the negation *nicht,* indicating that the semantic alternative did not influence speakers' choices.

Another possible explanation for the results is that speakers are not solely primed by the surface structure of the context, but also by the implicit prosody that comes with these structures. To investigate this possibility, Experiment 2 focused on the two negation conditions and presented the context sentences with preceding *kein(e)* and following *nicht* with two different intonation contours: a hat-pattern and a double-peak. In both conditions, the negation and the object noun were accented, but with different pitch accents, namely, a rising L* + H accent that is often related to topichood, and a high accent that is compatible with focus. Given that stressed, following *auch* has been claimed to associate with rising ACs, a strong intonation priming hypothesis predicts that participants will select more instances of stressed, following *auch* after a hat pattern than after a double-peak intonation. We did not find a main effect of intonation, indicating that the hat-pattern intonation in the context did not lead to more uses of stressed, following *auch* in the target sentence. This allows us to refute an intonational priming account. Importantly, we replicated the main effect of element in the context reported in Experiment 1 (*nicht* led to more uses of following *auch*), which strengthens the structural priming interpretation.

One reason why we did not find an influence of intonation might be an artefact of the stimuli used in the experiment. In most cases, there were only one or two syllables between the accents. This close succession of the two accents reduced the perceptual salience of the hat pattern, which maintains a continued high pitch between two accents. Note that, numerically, the number of instances of stressed, following *auch* was, on average, higher in Experiment 2 than in Experiment 1, in which there was no auditory presentation (*nicht*: 38.3% vs. 27.1%, *kein(e)*: 20.5% vs. 14.4%). It is conceivable, hence, that the accents on both the particle and the noun led to a higher proportion of stressed, following *auch* per se. Since this increase in the use of stressed, following *auch* across experiments was observed for both *nicht* and *kein(e)*, and since we do not know which kind of prosody participants in Experiment 1 were imagining when reading the contexts, the conclusion of a strong structural priming account holds, independent of intonation. A more stringent test case for future studies may be materials in which the negation and the noun are more separate (to make the hat pattern more salient) or contours in which either the particle or the noun is accented.

In Experiment 3, we tested whether the priming effect is limited to the surface structure, that is, the linear order of negation and object noun, or also holds for the underlying structure. The instances of structural priming found in Experiments 1 and 2 do not resolve this question. In Experiment 3, we used sentences in which *kein(e)* and *nicht,* which differ in their underlying structure, follow the object and have the same surface structure. We found the same general preference for preceding *auch* as in Experiment 1, but, importantly, the main effect of lexical element disappeared, and there was merely a tendency for following *auch* to be used more often

when the context contained the negation particle *nicht*. Thus, we concluded that the surface structure (*AC* + ***X***), rather than the underlying structure (***keine*** + *AC/AC* + ***nicht***), is the determining factor. Note, however, that the sentences used in Experiment 3 are highly marked. Future studies should try to embed these marked sentence structures in broader contexts, in order to increase the naturalness of the stimuli.

A critical point is that our studies did not include a baseline condition to establish the likelihood of participants producing following *auch* without any structural priming. As pointed out by an anonymous reviewer, such a baseline condition would strengthen the interpretation of the observed effects. While we agree with that, we also see that *auch* needs a specific context in order to be used felicitously, and in order to signal whether it should associate with the subject NP or with the object NP. In our experiments, the particle *nur* and negation indicated which constituent is the associated constituent. Hence, if future studies include a baseline condition without a particle, the context sentences should be elaborated in such a way that the intended interpretation is clear to the participants.

A closer look at the particles used in this study suggests that we are dealing with focus-sensitive operators. Note that our context sentences (e.g., *Peter hat Äpfel gegessen*) support a focus-associating reading where (replacive) negation has scope over the direct object, not over the entire VP (e.g., *Peter hat die Birnen nicht gegessen*). However, Beaver and Clark (2009) show that we cannot put all focus-sensitive operators in one box. *Only* and *always*, for instance, behave quite differently. This is also true for the particles that we investigate in the current article. Interestingly, German *auch* ends up in both categories, mirroring a long discussion concerning its status as focus particle vs. adverbial (e.g., Sudhoff, 2010). *Auch* has properties of both, and the unstressed, preceding variant behaves like a focus particle, whereas the stressed, following variant is better analysed as an adverbial. The same situation holds for (replacive) negation. The unstressed, preceding operators, which are focus-functional in the terminology of Beaver and Clark (2009), are *nur, kein(e)*, and unstressed *auch* (*nur/kein(e)/auch Äpfel*). Syntactically, the "*only*-style" association involves a syntactic mechanism that leads to semantic association. The stressed, following, and often even distant operators *nicht* and stressed *auch* (*Äpfel…nicht/auch*), on the other hand, are focus-sensitive, but not focus-functional in the terminology of Beaver and Clark (2009). Syntactically, they are possibly similar to the "always-style" association, where the object is scrambled across the particle. It does not involve a syntactic mechanism, which leads to pragmatic association. Crucially, while the unstressed and stressed versions of *auch* differ from each other, each version shares features with the other particles investigated in this study, and, as pointed out in Section 1, there are contexts where the two versions are interchangeable. The results indicate that stressed, following *nicht* primes adverbial stressed, following *auch* – both have "always-style" association, and both structures have the object scrambled over the particle. Stranded *kein(e)*, placed in the same surface position as stressed *auch*, works the same way.

Unstressed, preceding *nur* or *kein(e)*, on the other hand, primes unstressed, preceding *auch* – both have "only-style" association. However, this study did only manipulate the linear order of the elements in question, and we can only conclude from the results that the surface structure of the elements influences speakers when constructing their utterances. Future studies should focus on the exact syntactic and semantic mechanisms underlying these elements and their structures.

The present study fills a gap in research on structural priming in function words, as we are not aware of any priming study on focus-sensitive particles. The results of our experiments are in line with other studies on structural priming in the domain of function words, such as complementizers (Ferreira, 2003), verb-particle placement (Gries, 2005; Konopka & Bock, 2009), and prepositions (e.g., Bock, 1989; Bock & Loebell, 1990), indicating that structural priming is largely independent of the lexical content of the primed structures. At the same time, there is a difference between content words and function words. Structural persistence has been observed without content word repetition (e.g., Pickering & Branigan, 1998), and content word distinctions are not correlated with syntactic structure distinctions. However, function word distinctions might be correlated with syntactic structure distinctions, as demonstrated by the word *by*, which tends to be included in passive sentences, but not in the corresponding active sentences (Ferreira, 2003). Thus, the mention of the distinctive function words in a prime sentence might enhance their accessibility, leading to the increased likelihood of their being mentioned, thereby causing speakers to produce a target structure with those function words. Studies of structural priming in the domain of function words offer mixed results. While, for instance, Bock and Loebell (1990) and Levelt and Kelter (1982) found an influence of function word repetition on structural persistence (both in the domain of prepositions), Bock (1989) and Ferreira (2003) argue for structural persistence independent of the repetition of distinctive function words. Ferreira (2003) showed that when speakers produced full or reduced sentence-complement structures once, they were likely to produce full or reduced sentence-complement structures again. Crucially, this effect is unlikely to be due to lexical repetition of the complementizer *that*, as producing phonologically similar or lexically identical instances of *that* in syntactically distinct prime sentences did not lead to the increased production of *that* in subsequent sentence-complement target sentences. Ferreira (2003) asks why a highly accessible *that* fails to influence the selection of a syntactic structure for a full or reduced sentence-complement. The author argues that the distinction between function and content words is likely to be relevant, as function words may be unable to support lexical accessibility effects, whatever the exact reasons might be. Moreover, Ferreira and Firato (2002) show that the mention of an optional *that* in a sentence-complement structure is influenced by manipulations of lexical accessibility in the material that follows *that*, suggesting that the production of function words is influenced by the lexical accessibility of the content word material that follows the function word. Such an interplay between function and content words also exists in the case of the particles investigated in our study. Focus-sensitive

particles associate with an element that mostly consists of content words, and this element either precedes or follows the particle. In our study, we did not manipulate the content word material, but it might be promising to investigate whether factors such as accessibility, specificity, and givenness of the content word material surrounding the particles influence the position of the particle relative to this material. Investigating the information structural factor givenness would also extend the present study, as this study focused merely on the information structural notions of focus and topichood. As an anonymous reviewer pointed out, priming effects are large in discourse, but in discourse, what was new in the last sentence is given in the current sentence. Thus, relying on the information structural dimension given-new forces speakers to deviate from the ordering of the constituents of a prime sentence. Note that this is what we have seen in Experiment 3: participants deviated from the OVS prime sentence and produced an SVO order instead. In our experimental discourse contexts, both subject and object NPs were given from the context, but the givenness of the subject NP was underlined by a pronoun. Future studies should take a closer look at this interplay, by asking whether priming in discourse is really strictly an effect of the surface order of constituents.

To summarize, we found an instance of structural priming in the domain of focus-sensitive particles in German. Although speakers strongly rely on default mechanisms that are based on structural and information structural preferences, they are primed by the surface structure of a context sentence that conflicts with the preferred structure. By means of three experiments with a sentence fragment arrangement task conducted in written and oral form, we showed that this instance of structural priming can be found in focus-sensitive particles (belonging to the group of function words), that it cannot be explained by lexical contrast or intonational structure, and that the linear word order determines the effect, not the underlying structure.

Data accessibility statement

Audio files, stimuli and statistical analyses are available at the following OSF site: https://osf.io/jh5vf/?view_only=8d262cd42b794b72b9256a9572879ad4.

Ethics and consent

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

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Competing interests

The authors have no competing interests to declare.

Authors' contributions

The study was first devised by LR and CD and developed further by LR, CD and BB. The stimuli were developed and the experiments were run by LR; the recording of the audio files was managed by BB. The statistical analysis was run by LR and BB. The manuscript was mainly written by LR, and edited by CD and BB.

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References

Anwyl-Irvine, A. L., Massonié, J., Flitton, A., Kirkham, N. Z., & Evershed, J. K. (2019). Gorilla in our midst: An online behavioural experiment builder. *Behavior Research Methods*. DOI: https://doi.org/10.3758/s13428-019-01237-x

Arnold, J. E., Ginstrom, R., Losongco, A., & Wasow, T. (2000). Heaviness vs. newness: The effects of structural complexity and discourse status on constituent ordering. *Language, 76*, 28–53. DOI: https://doi.org/10.2307/417392

Bader, M., & Häussler, J. (2010). Word order in German: A corpus study. *Lingua, 120*, 717–762. DOI: https://doi.org/10.1016/j.lingua.2009.05.007

Bader, M., Meng, M., Bayer, J., & Hopf, J. M. (2000). Syntaktische Funktions-Ambiguitäten im Deutschen – Ein Überblick. *Zeitschrift für Sprachwissenschaft, 19*, 34–102. DOI: https://doi.org/10.1515/zfsw.2000.19.1.34

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*, 1–48. DOI: https://doi.org/10.18637/jss.v067.i01

Beaver, D. I., & Clark, B. Z. (2009). *Sense and sensitivity: How focus determines meaning*. John Wiley & Sons. DOI: https://doi.org/10.1002/9781444304176

Bernolet, S., Collina, S., & Hartsuiker, R. J. (2016). The persistence of syntactic priming revisited. *Journal of Memory and Language, 91*, 99–116. DOI: https://doi.org/10.1016/j.jml.2016.01.002

Bock, K. (1986). Syntactic persistence in language production. *Cognitive Psychology, 18*, 355–387. DOI: https://doi.org/10.1016/0010-0285(86)90004-6

Bock, K. (1989). Closed-class immanence in sentence production. *Cognition, 31*, 163–186. DOI: https://doi.org/10.1016/0010-0277(89)90022-X

Bock, K., & Loebell, H. (1990). Framing sentences. *Cognition, 35,* 1–39. DOI: https://doi.org/10.1016/0010-0277(90)90035-I

Bock, K., Loebell, H., & Morey, R. (1992). From conceptual roles to structural relations: Bridging the syntactic cleft. *Psychological Review, 99*, 150–171. DOI: https://doi.org/10.1037/0033-295X.99.1.150

Bock, O., Baetge, I., & Nicklisch, A. (2014). hroot – Hamburg registration and organization online tool. *European Economic Review, 71*, 117–120. DOI: https://doi.org/10.1016/j.euroecorev.2014.07.003

Boersma, P., & Weenink, D. (2009). Praat: Doing phonetics by computer (Version 5.1.05) [Computer program].

Bohnacker, U., & Rosén, C. (2008). The clause-initial position in L2 German declaratives: Transfer of information structure. *Studies in Second Language Acquisition, 30*, 511–538. DOI: https://doi.org/10.1017/S0272263108080741

Branigan, H. P. (2007). Syntactic priming. *Language and Linguistics Compass, 1,* 1–16. DOI: https://doi.org/10.1111/j.1749-818X.2006.00001.x

Branigan H. P., Pickering, M. J., & Cleland, A. A. (2000). Syntactic co-ordination in dialogue. *Cognition, 75*, 13–25. DOI: https://doi.org/10.1016/S0010-0277(99)00081-5

Branigan, H. P., Pickering, M. J., & McLean, J. F. (2005). Priming prepositional-phrase attachment during comprehension. *Journal of Experimental Psychology: Learning, Memory and Cognition, 31,* 468–481. DOI: https://doi.org/10.1037/0278-7393.31.3.468

Braun, B. (2012). Where to associate stressed additive particles? Evidence from speech prosody. *13th Annual Conference of the International Speech Communication Association*. Portland, Oregon. DOI: https://doi.org/10.21437/Interspeech.2012-208

Brown, R. (1958). *Words and things.* Free Press.

Büring, D. (1997). *The 59th Street Bridge accent: On the meaning of topic and focus*. Routledge.

Büring, D., & Hartmann, K. (2001). The syntax and semantics of focus-sensitive particles in German. *Natural Language & Linguistic Theory, 19*, 229–281. DOI: https://doi.org/10.1023/A:1010653115493

Chomsky, N. (1965). *Aspects of the theory of syntax*. MIT Press. DOI: https://doi.org/10.21236/AD0616323

Clark, H. H. (1965). Some structural properties of simple active and passive sentences. *Journal of Verbal Learning and Verbal Behavior, 4,* 365–370. DOI: https://doi.org/10.1016/S0022-5371(65)80073-1

Cleland, A. A., & Pickering, M. J. (2003). The use of lexical and syntactic information in language production: Evidence from the priming of noun-phrase structure. *Journal of Memory and Language, 49*, 214–230. DOI: https://doi.org/10.1016/S0749-596X(03)00060-3

Dimroth, C. (2004). *Fokuspartikeln und Informationsgliederung im Deutschen*. Stauffenberg.

Ferreira, V. S. (2003). The persistence of optional complementizer production: Why saying 'that' is not saying 'that' at all. *Journal of Memory and Language, 48*, 379–398. DOI: https://doi.org/10.1016/S0749-596X(02)00523-5

Ferreira, V. S., & Firato, C. E. (2002). Proactive interference effects in sentence production. *Psychonomic Bulletin and Review, 9,* 795–800. DOI: https://doi.org/10.3758/BF03196337

Fodor, J. D. (1998). Learning to parse? *Journal of Psycholinguistic Research, 27*, 285–319. DOI: https://doi.org/10.1023/A:1023258301588

Gauza, H. (2018). *Position und Verarbeitung VP-interner Adjunkte*. Tübingen Library Publishing.

Gries, S. T. (1999). Particle movement: A cognitive and functional approach. *Cognitive Linguistics, 10,* 105–146. DOI: https://doi.org/10.1515/cogl.1999.005

Gries, S. T. (2005). Syntactic priming: A corpus-based approach. *Journal of Psycholinguistic Research, 34,* 365–399. DOI: https://doi.org/10.1007/s10936-005-6139-3

Hartsuiker, R. J., & Westenberg, C. (2000). Word order priming in written and spoken sentence production. *Cognition, 75*, 27–39. DOI: https://doi.org/10.1016/S0010-0277(99)00080-3

Haywood, S., Pickering, M. J., & Branigan, H. P. (2005). Do speakers avoid ambiguities during dialogue? *Psychological Science, 16,* 362–366. DOI: https://doi.org/10.1111/j.0956-7976.2005.01541.x

Hoberg, U. (1981). *Die Wortstellung in der geschriebenen deutschen Gegenwartssprache.* Hueber.

Höhle, B., Berger, F., Müller, A., Schmitz, M., & Weissenborn, J. (2009). Focus particles in children's language: Production and comprehension of auch 'also' in German learners from 1 year to 4 years of age. *Language Acquisition, 16,* 36–66. DOI: https://doi.org/10.1080/10489220802584550

Jackendoff, R. S. (1972). *Semantic interpretation in generative grammar*. MIT Press.

Jacobs, J. (1988). Probleme der freien Wortstellung im Deutschen. *Sprache und Pragmatik, 5*, 8–37.

Jacobs, J. (1997). I-topikalisierung. *Linguistische Berichte, 168,* 91-133.

Klein, W., & Von Stutterheim, C. (1987). Quaestio und referentielle Bewegung in Erzählungen. *Linguistische Berichte, 109,* 163–183.

Konopka, A. E., & Bock, K. (2009). Lexical or syntactic control of sentence formulation? Structural generalizations from idiom production. *Cognitive Psychology, 58,* 68–101. DOI: https://doi.org/10.1016/j.cogpsych.2008.05.002

Krifka, M. (1999). Additive particles under stress. In D. Strolovitch & A. Lawson (Eds.), *Proceedings of Semantics and Linguistic Theory (SALT) 8*, 111–128. CLC Publications, Cornell University. DOI: https://doi.org/10.3765/salt.v8i0.2799

Leiner, D. J. (2014). *SoSci Survey* (Version 2.6.00-i).

Lenerz, J. (1977). *Zur Abfolge nominaler Satzglieder im Deutschen*. Narr.

Levelt, W. J. M., & Kelter, S. (1982). Surface form and memory in question answering. *Cognitive Psychology, 14*, 78–106. DOI: https://doi.org/10.1016/0010-0285(82)90005-6

Mahowald, K., James, A., Futrell, R., & Gibson, E. (2016). A meta-analysis of syntactic priming in language production. *Journal of Memory and Language, 91*, 5–27. DOI: https://doi.org/10.1016/j.jml.2016.03.009

Pickering, M. J., & Branigan, H. P. (1998). The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language, 39*, 633–651. DOI: https://doi.org/10.1006/jmla.1998.2592

Pickering, M. J., Branigan, H. P., & McLean, J. F. (2002). Constituent structure is formulated in one stage. *Journal of Memory and Language, 46*, 586–605. DOI: https://doi.org/10.1006/jmla.2001.2824

Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin, 134*, 427–459. DOI: https://doi.org/10.1037/0033-2909.134.3.427

Pickering, M. J., & Garrod, S. (2004). The interactive-alignment model: Developments and refinements. *Behavioral and Brain Sciences, 27*, 212–225. DOI: https://doi.org/10.1017/S0140525X04450055

Pickering, M. J., & Traxler, M. J. (2006). *Grammatical repetition and garden-path effects* [Manuscript]. University of Edinburgh.

R Core Team. 2017. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/.

Rayner, K., Pollatsek, A., Ashby, J., & Clifton Jr., C. (2012). *Psychology of reading*. Psychology Press. DOI: https://doi.org/10.4324/9780203155158

Reimer, L. & Dimroth, C. (2021). Added alternatives in spoken interaction: A corpus study on German 'auch'. *Languages, 6*, 1–19. DOI: https://doi.org/10.3390/languages6040169

Reimer, L., & Dimroth, C. (2022). Unstressed versus stressed German additive *auch* – What determines a speaker's choice? *Linguistics Vanguard, 8*, 177–184. DOI: https://doi.org/10.1515/lingvan-2021-0154

Reinhart, T. (1981). Pragmatics and linguistics: an analysis of sentence topics. *Philosophica, 27*, 53–94. DOI: https://doi.org/10.21825/philosophica.82606

Reis, M. (1986). Die Stellung der Verbalargumente im Deutschen: Stilübungen zum Grammatik:Pragmatik-Verhältnis. *Lunder germanistische Forschungen, 55*, 139–177.

Roberts, C. (2012). Information structure: Towards an integrated formal theory of pragmatics. *Semantics and Pragmatics, 5*, 1–69. DOI: https://doi.org/10.3765/sp.5.6

Sæbø, K. J. (2004). Conversational contrast and conventional parallel: Topic implicatures and additive presuppositions. *Journal of Semantics, 21*, 199–217. DOI: https://doi.org/10.1093/jos/21.2.199

Scheepers, C. (2003). Syntactic priming of relative clause attachments: Persistence of structural configuration in sentence production. *Cognition, 89*, 179–205. DOI: https://doi.org/10.1016/S0010-0277(03)00119-7

Sudhoff, S. (2006). Corpus data vs. experimental results as prosodic evidence: On the case of stressed 'auch' in German. *International Conference on Linguistic Evidence*.

Sudhoff, S. (2010). *Focus particles in German: Syntax, prosody, and information structure*. Benjamins. DOI: https://doi.org/10.1075/la.151

von Stechow, A., & Sternefeld, W. (1988). *Bausteine syntaktischen Wissens*. Westdeutscher Verlag. DOI: https://doi.org/10.1007/978-3-322-91923-6

von Stutterheim, C., & Klein, W. (1989). Referential movement in descriptive and narrative discourse. In *North-Holland Linguistic Series: Linguistic Variations* (Vol. 54, 39–76). Elsevier. DOI: https://doi.org/10.1016/B978-0-444-87144-2.50005-7

Wasow, T. (2002). *Postverbal behavior*. CSLI Publications. DOI: https://doi.org/10.1075/sl.28.2.15gel

Weber, A., Grice, M., & Crocker, M. W. (2006). The role of prosody in the interpretation of structural ambiguities: A study of anticipatory eye movements. *Cognition, 99,* B64–B72. DOI: https://doi.org/10.1016/j.cognition.2005.07.001

Ziegler, J., Bencini, G., Goldberg, A., & Snedeker, J. (2019). How abstract is syntax? Evidence from structural priming. *Cognition, 193*, 104045. DOI: https://doi.org/10.1016/j.cognition.2019.104045

Ziegler, J., & Snedeker, J. (2019). The use of syntax and information structure during language comprehension: Evidence from structural priming. *Language, Cognition, and Neuroscience, 34*, 365–384. DOI: https://doi.org/10.1080/23273798.2018.1539757