

# Where to associate stressed additive particles? Evidence from speech prosody

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## Abstract

Theoretical approaches mostly associate stressed additive particles (e.g., *auch* in German) with contrastive topics. Empirical data show that these associated constituents (ACs) are produced more prominently than unassociated ones; however, they are not produced as contrastive topics. This paper compares the prosodic realizations of ACs, contrastive and non-contrastive topics. We found no differences in accent types but later alignment for contrastive than non-contrastive topics; ACs lie in-between. An unrestricted sentence completion task tested whether listeners produce more additive particles upon hearing fragments with contrastive compared to non-contrastive topics. Completions containing additive particles were generally very rare, but crucially more frequent in sentences with a contrastive topic compared to a non-contrastive topic. We conclude that stressed additive particles associate with prominent accents, which may often be contrastive topics.

**Index Terms:** intonation, additive particles, contrastive topic, alignment, information structure

## 1. Introduction

The grammar of additive particles in German (*auch*) has been studied extensively in the literature [1-3]. The unstressed version of *auch* associates with the constituent bearing the nuclear, focal accent (1). The stressed version of *auch*, however, is associated with a constituent to its left, marked as AC example (2).

- (1) Peter hat auch [ein BIER]<sub>F</sub> getrunken.  
Peter has also a BEER drank  
Peter drank a beer (and also something else)
- (2) [Peter]<sub>AC</sub> hat AUCH ein Bier getrunken.  
Peter has ALSO a beer drank  
Peter drank a beer (and others also did)

It has been argued that the stressed *auch* associates with contrastive topics [4-6]. The prosodic realization of contrastive topics, has been subject to a number of production studies over the last ten years. [7], for instance, has shown that contrastive topics are produced with larger f<sub>0</sub>-range, later peak alignment and longer duration of the stressed syllable. Labellers showed only low agreement in annotating topic accents produced in two different pragmatic contexts (contrastive and non-contrastive). Recently, [8] conducted a production study on the prosodic realization of ACS. In their materials (see (3)), the additive particle could be associated with the constituent in the preverbal field (the person called *Rudi*) or in the middle field (the adverbial *in July*).

- (3) Der Rudi hat im Juli AUCH... (Rudi has in July ALSO)

Thanks to a very clever design (controlling the vowels in the two potential associated constituents *Rudi* and *Juli*), comparisons could be made within and across sentences. While both associated and unassociated constituents were realized by rising prenuclear accents, acoustic measures revealed that associated constituents were realized with a larger f<sub>0</sub>-range (lower f<sub>0</sub>-minimum and higher f<sub>0</sub>-maximum), earlier alignment of the minimum, and later alignment of the f<sub>0</sub>-maximum. This suggests that the AC can be disambiguated in perception. [8] further conducted two 2AFC sentence-completion tasks in which participants had to decide whether the stressed additive particle was associated with the preverbal or post-verbal constituent. With natural stimuli, participants yielded 72% correct, with resynthesized stimuli 84%; however, one third of the participants did not appear to be sensitive to the prosodic manipulation, weakening the generalizability of their findings.

While [8] showed that ACs are marked differently than unassociated ones, it is still unclear whether ACs are realized like contrastive topics.

Our aim is three-fold: First, we investigate whether the clear acoustic differences between associated and unassociated constituents can be replicated by means of a between-subjects design, in which participants may be less aware of the contrast [9]. Second, we test whether associated constituents are prosodically realized like contrastive topic accents (and vice versa, whether unassociated constituents are realized like non-contrastive topics). Third, we investigate whether stressed additive particles also occur in open sentence completion tasks that do not bias listeners towards additive particles.

## 2. Production experiment

We first tested whether native German speakers with no prior intonation training produce contrastive topic accents when the sentence contains a stressed additive particle. In contrast to [8], we used a between-subjects design so that participants read each sentence in only one of the conditions. We included two control conditions to be able to compare the prosodic realization of the AC to contrastive and non-contrastive topics. Contrastive topics were elicited via a context with a parallel structure contrasting both the sentence-initial subject and an argument [10]. In the non-contrastive topic condition, a change in subject-NP (necessary for comparison across conditions) was followed by anaphoric material that referred to constituents in the context (rather than contrasting with them). Examples are shown in (4).

### 2.1. Methods

#### 2.1.1. Materials

Twelve triplets of German utterances were constructed, consisting of identical subject-NPs followed by an auxiliary or

modal verb and an argument (4). Some also included sentence adverbials or another argument. All target sentences were preceded by an identical context utterance. In a) context and target utterance contrasted in the subject *and* the argument. In b) they contrasted only in the subject, followed by anaphoric material. In c) the sentence contained a stressed additive particle (*auch*) and rest of the sentence was repeated. Practice trials also consisted of a context and a target sentence, but without a contrast or particle.

(4) Context: The mason wanted to climb on the chair.

Target sentences:

- a) *Contrastive topic condition*: Yes, and the carpenter wanted to climb on the table.
- b) *Non-contrastive topic condition*: Yes, and the carpenter wanted to hand him the wood.
- c) *Additive-particle condition*: Yes, and the carpenter also wanted to climb on the chair.

### 2.1.2. Participants

Eleven native German speakers participated for course credit. None of them had training in intonation or prosody. All of them were naïve with respect to the purpose of the experiment.

### 2.1.3. Procedure

Intonation was manipulated as within-subjects factor. To this end, three lists were constructed. Each list contained all target sentences, four in each condition and six practice trials. Participants were assigned randomly to a list. They heard the context sentences and read the target sentences at normal speed with no further instructions.

## 2.2. Results

Following earlier studies, we manually annotated the stressed syllable of the subject-NP as well as the low (L) and high (H) tonal targets in the prenuclear region [7, 8, 11, 12]. From these annotations, we extracted the L-alignment relative to the start of the stressed syllable and the H-alignment with respect to the end of the stressed syllable. Furthermore, we calculated the f<sub>0</sub>-excursion of the rise in semitones and the duration of the stressed syllable since these variables differed for contrastive and non-contrastive topics in German [7]. Finally, the prenuclear accents on the subject-NP were labelled according to GToBI [13], i.e. L+H\* had a low tonal target before the stressed syllable, L\*+H had it within the stressed syllable.

In 88% of the cases, participants produced L\*+H, the remaining cases were L+H\*. As shown in Table 1, accents were distributed equally across conditions ( $\chi^2(2) = 1.3, p > 0.5$ ).

Table 1. Number of accent types, split by condition

Accent type	Contrastive topic condition	Non-contrastive topic condition	Additive particle condition
L*+H	59	54	57
L+H*	6	10	7

The acoustic variables were analyzed using mixed-effects regression models with *participants* and *items* as crossed random factors and *condition* (non-contrastive topic, contrastive topic, additive-particle) as fixed factor [14, 15]. Residuals beyond 2.5 sd of the mean were removed and the model was refitted. Results

showed that L-alignment was 23 ms later in the contrastive topic condition compared to the non-contrastive topic condition ( $p < 0.05$ ). Furthermore, H-alignment was 27 ms later in the contrastive topic condition compared to the non-contrastive topic condition ( $p < 0.05$ ), see Table 2. No other differences were significant.

The acoustic measures in the additive-particle condition lay in-between the contrastive and non-contrastive topic condition, i.e. they differed neither from the non-contrastive topic condition nor from the contrastive topic condition (all  $p$ 's  $> 0.2$ ).

Table 2. Mean values for L- and H-alignment

Acoustic variables	Contrastive topic condition	Non-contrastive topic cond.	Additive particle condition
L-alignment relative to start of stressed syll. in ms	93.5	70.3	83.2
H-alignment relative to end of stressed syll. in ms	56.4	29.3	42.1

## 2.3. Discussion

The distribution of accent types is similar to [8], i.e. conditions were not disambiguated by means of different pitch accent. The acoustic analyses showed that contrastive topic accents were realized with later alignment of the f<sub>0</sub>-rise than non-contrastive topics, corroborating the findings by [7] and [16]. It should be noted that the differences across conditions were smaller here than in the earlier studies, which might be attributed to the present between-subjects design (while the earlier studies were within-subjects comparisons). Nevertheless, there are clear acoustic differences between contrastive and non-contrastive topics in German, implying that speakers were sensitive to information structural differences.

The additive-particle condition prosodically differed from the contrastive topic condition, which weakens the claim that additive particles are associated with contrastive topics. Hence the differences for associated and unassociated constituents reported in [8] may not be as large as the difference between contrastive and non-contrastive topics. It is conceivable, though, that prosodic differences between associated and unassociated constituents are dependent on the degree of ambiguity and speaker awareness (both larger in [8] than in the current study).

Even though ACs prosodically differed from identical noun phrases that are produced as contrastive topics in this reading task, listeners may still be inclined to associate additive particles to contrastive topics. In a previous perception experiment ([8]), participants performed a forced choice task, disambiguating the AC. Here, we conducted an unrestricted sentence completion task, which better hides the purpose of the experiment.

## 3. Sentence completion experiment

In the unrestricted sentence completion experiment we investigated whether participants are more likely to continue a sentence with a stressed additive particle when they hear a fragment with a contrastive topic accent (L\*+H) compared to a non-contrastive topic accent (L+H\*) or a corrective focus accent (H\*L-). The latter condition was included to also present a constituent with a distinct accent shape (nuclear fall as compared to prenuclear rises in the former two conditions).

### 3.1. Methods

#### 3.1.1. Materials

The materials were structurally similar to the sentences in the production experiment. The additive particle condition was replaced by a corrective focus condition (Context: *The mason wanted to climb on the chair*. Target: *The carpenter wanted to climb the chair*). In order to provide a better link between the sentences, we added the prelude “I have heard” to the context and the prelude “And I have heard” to the target sentences. The context sentences were read by a male speaker of Standard German, the target sentences by a female German speaker. The target sentences were read in three conditions, contrastive topic, non-contrastive topic and corrective focus (different subject-NP, all else equal to the context). The female speaker was cued by appropriate contexts. To validate the intonational realizations, we manually annotated the stressed syllable as well as the low and high tonal targets in the prenuclear region [7]. Then, we extracted the same variables as in the production study. Mean values are shown in Table 3.

Table 3. Mean values for L- and H-alignment, f0-range, duration of stressed syllable, and duration of f0 rise

Acoustic variables	Contrastive topic (L*+H)	Non-contrastive topic (L+H*)	Corrective focus (H*L-)
L-alignment relative to start of stressed syll. in ms	130.6	101.7	70.5
H-alignment relative to end of stressed syll. in ms	85.5	25.0	-51.0
F0-range of rise in st	9.2	7.7	5.2
Duration of stressed syllable in ms	307.3	266.3	273.1
Duration of f0 rise in ms	263.2	197.4	151.6

The acoustic variables were analysed in the same way as for the reading task (only removing *speaker* as random factor). Compared to non-contrastive topics, contrastive topics had a significantly later alignment of the L and H targets (all  $p$ 's < 0.05), a larger pitch range ( $p = 0.05$ ), a longer duration of the stressed syllable ( $p < 0.0001$ ) and a longer duration of the f0-rise ( $p < 0.001$ ). Compared to the two topic conditions, the corrective focus condition was produced with earlier L and H targets ( $p < 0.005$ ), a smaller pitch range ( $p < 0.0001$ ) and a shorter duration of the f0 rise ( $p < 0.05$ ).

#### 3.1.2. Participants

Twenty-four participants from the University of Konstanz, different from those in the production experiment, took part in the sentence completion study for course credits. None of the participants had training in intonation or prosody.

#### 3.1.3. Procedure

For the experiment, only a single token of the prelude was used for all contexts and for all target sentences. Between the end of the context sentence and the start of the prelude of the target sentence, there was a 500 ms pause. The target sentences were cropped two syllables after the subject-NP (leaving the subject-NP and the following auxiliary or a modal verb, e.g., “*The*

*carpenter wanted to*”). Cutting was performed at a positive zero-crossing to avoid artefacts. This procedure resulted in audio files like “*I have heard the mason wanted to climb on the chair. And I have heard, the carpenter wanted to*”. Furthermore, we used four practice trials, all with a non-contrastive topic accent. The practice trials were constructed and presented in the same way as the target sentences.

The experiment was conducted via the web. Participants saw an instruction to use headphones and to quit distracting programs on their computers. They were further told that they would hear short dialogues between a man and a woman and that the woman’s utterance would stop after a few words. Their task was to type in their first thought about how the woman would continue. In each trial, participants heard the context and the target sentence up to (and including) the ambiguous region. On the screen, there was a text box with 50 characters into which the continuation could be typed. Participants could listen to the auditory stimulus as often as they wanted by clicking on a ‘play’ button. The next trial started after clicking a ‘next button’.

The experiment consisted of 40 trials, four practice and 36 experimental trials. Intonation condition was manipulated as within-subjects factor. We constructed three lists so that each list contained each of the 36 sentences in only one of the three intonation conditions. The four practice trials were added at the beginning of each list. Stimulus order of the experimental trials was randomized for each participant.

### 3.2. Results

Participants’ continuations were manually coded, blind to intonation condition; the coder only saw the context and the continuations. She initially had five categories, *single contrast in the VP* (either same or synonymous verb as in context but different object, e.g., *buy a tent* vs. *buy a house* or same object but different verb, e.g., *buy a tent* vs. *rent a tent*), *contrast in the subject-NP* (e.g., *buy a tent* vs. *buy a tent*), *anaphoric reference* (the continuation referred to one element in the context but was not contrastive as a whole, e.g. *buy a tent* vs. *sleep in it*), *non-cohesive response* (e.g., *buy a tent* vs. *never become a fairy*) and *multiple change* (e.g., *buy a tent* vs. *get money from the bank*). Most importantly, we also coded whether responses contained an additive particle (e.g., *buy a tent* vs. *also buy a tent*, German *auch* and *ebenfalls*, all coded as non-contrastive). For the analyses, the categories *anaphoric reference*, *non-cohesive response* and *multiple change* were recoded as non-contrastive, leaving four categories, see Table 4. To verify the coding, a random selection of 10% of the trials were annotated by a second coder. He was instructed in the same way as the first coder. From a confusion matrix of the two coders, we calculated kappa, a measure of interrater agreement [17]. For the four categories, unweighted kappa was 0.8 ( $N = 84$ ,  $SE = 0.06$ ), which represents good to excellent agreement [18]. From this high agreement we deduce that the coding of the entire data set is trustworthy.

We analysed 854 valid data points. The distribution of continuations is shown in Table 4. A multinomial logistic regression model with *continuation type* as dependent variable and *intonation condition* as fixed factor showed that additive particles were significantly more frequent in the contrastive than in the non-contrastive topic condition (estimate = 1.01,  $t = 2.0$ ,  $p < 0.05$ ). The number of additive particles in the corrective focus condition did not differ from those in the other two conditions (all  $p$ 's > 0.2). Note that half of the continuations with additive particles came from three of the 36 items.

Table 4. *Number of continuation types in the three intonation conditions*

Type of continuation	Contrastive topic (L*+H)	Non-contrastive topic (L+H*)	Corrective focus (H*L-)
Single contrast in verb phrase	138	104	107
Single contrast in subject-NP	1	4	41
Non-contrastive (no additive particle)	134	170	128
Non-contrastive (with additive particle)	13	6	9

### 3.3. Discussion

The prosodic differences between the contrastive and non-contrastive topic conditions were realized more systematically by the single speaker in the sentence completion task than by the multiple speakers in the reading task. We attribute this effect to differences in the study design (within vs. between-subjects).

Although participants were not restricted in their answers and not biased towards additive particles in this task, additive particles occurred more than twice as often in the contrastive topic condition compared to the non-contrastive topic condition. This finding extends the reported association of additive particles with contrastive topic accents [8] to a less constraining setting. It is interesting to note that additive particles also occurred in the corrective focus condition. In this condition, the subject-NP is produced with a prominent nuclear fall, H\*L-, rather than a prenuclear rise. Possibly, the relative prominence of an accent [19] may be more important for its role as an associated constituent for an additive particle than a particular pitch accent type (or the semantic contributions associated with it).

## 4. General Discussion

When participants are not aware of the nature of additive particles (e.g., by using a between-subjects instead of a within-subjects design), the constituent stressed additive particles are associated to is not marked as prominently as a contrastive topic accent. Instead, its prosodic realization acoustically lies between a non-contrastive and a contrastive topic accent. Conceivably, the actual realization of the associated constituent may play a more decisive role, in potentially ambiguous sentences, where the associated constituent has been shown to stand out as relatively more prominent than the unassociated one [8]. Whether or not the differences between the current study and the findings by [8] are due to differences in materials or speaker awareness, or potentially also to dialect [20] will have to be addressed in future studies.

The sentence completion data clearly showed that additive particles occurred more often in the contrastive topic condition than in the non-contrastive topic condition, supporting the analysis that additive particles associate with contrastive topics [4, 5]. The additional occurrence of additive particles in the corrective focus condition (produced with a prominent nuclear fall) will make it necessary to dissociate relative prominence of a pitch accent from its type in order to arrive at a full understanding of the association of additive particles in German.

## 5. Acknowledgements

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