Corpus Data and Experimental Results as Prosodic Evidence: On the Case of Stressed *auch* in German

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1. Introduction*

Additive particles (like German *auch*, English *also*, Dutch *ook*, etc.) belong to the class of focus particles, as they typically associate with a focused element in their c-command domain. As illustrated in (1a), the associated focus carries the nuclear accent, whereas the particle itself remains unstressed. However, additive particles – in contrast to exclusive or scalar particles like *nur/only* and *sogar/even*, respectively – can also relate to a preceding constituent and carry the nuclear accent themselves, cf. (1b). The associated constituent (AC; indicated by square brackets throughout this paper) is added to a contextually given set by means of the particle. In (1a), the relevant set includes places where Cornelius used to study, and in (1b), it is the set of people that studied at the place under discussion. Crucially, only in (1a) the AC is marked by the nuclear accent (indicated by capitals).

(1) a. *Cornelius hat auch* [*HIER*] *studiert.* 'C. also studied here.'
Cornelius has also here studied
b. [*Cornelius*] *hat AUCH hier studiert.* 'C. studied here, too.'

In German, the AC of stressed *auch* can be located either in the prefield (i.e., preceding the finite verb in verb-second clauses), cf. (1b), or in the middlefield (i.e., following the finite verb in verb-second clauses or the complementizer in verb-final embedded clauses), cf. (3) below.

Constructions like (1b) pose a serious problem for existing theories of focus particle constructions (cf. Büring and Hartmann 2001 and references therein), as two requirements assumed to be crucial are not fulfilled in the case of stressed *auch*: on the one hand, the particle does not c-command the AC; on the other hand, the AC does not bear the focus accent. For this reason, the concept of association with focus has been questioned (cf. Reis & Rosengren 1997). Krifka (1999) presents a different approach, comple-

menting the original concept of focus sensitivity with the *Contrastive Topic Hypothesis* given in (2).

(2) The associated constituent of stressed postposed particles is the contrastive topic of the clause in which they occur. (Krifka 1999: 113)

Krifka argues that sentences like (3), taken from Reis and Rosengren (1997: 253), are compatible with his proposal, as multiple topics are possible if they are not equally ranked. In (3), both *einen Gauguin* and *Peter* are assumed to be topics, the former having scope over the latter.

(3) *Mensch, Paul besitzt einen Gauguin!* 'Boy, P. possesses a Gauguin.'
Einen Gauguin besitzt [*Peter*] *auch*
a Gauguin possesses Peter also
'Peter possesses a Gauguin, too'
(, aber ihm fehlen andere Impressionisten).
(, but he doesn't have other impressionists).

Another crucial assumption is that – although they have the semantic properties of contrastive topics – ACs of stressed *auch* are not necessarily marked as such prosodically. This is in contrast with the extensive literature on the prosodic properties of contrastive topic constructions in German, which relates them to the so-called hat pattern intonation involving a rising accent on the topic and a falling nuclear accent (cf. Féry 1993, among others). More specifically, Frascarelli and Hinterhölzl (in press) claim that German contrastive topics are marked by L*H accents. Braun (2005), on the other hand, stresses the importance of gradual phonetic parameters such as peak height instead of categorical distinctions between accent types.

This paper deals with (i) the specific prosodic realization of constituents associated with stressed *auch*, (ii) possible generalizations about the optionality of the prosodic marking, and (iii) its perceptual relevance. We will address evidence from two different sources, a spoken language corpus (Section 2) and several controlled production and perception experiments (Section 3), and discuss the relation between the results as well as their theoretical consequences (Section 4).

We will present supportive evidence for the prosodic marking of ACs of stressed *auch* and show that there is no 1:1 mapping between the status of being associated with the particle and accentuation. ACs must be accented under certain circumstances, but rather than a particular accent type, grad-

ual phonetic parameters – as proposed by Braun (2005) – are decisive for the marking.

2. Corpus study

We analyzed a corpus of 225 utterances with stressed *auch* extracted from 9 movies and 12 episodes of a TV series.[1] The constituents associated with the focus particle were determined on the basis of context information, and their prosodic properties were analyzed using the software Praat. Finally, we annotated all occurring accents in terms of GToBI (Grice et al. 2005).

The corpus is heterogeneous with respect to the syntactic structure of the utterances, the syntactic function of the ACs, and their location. More specifically, it contains verb-first (9.8%; imperatives and polar interrogatives), verb-second (69.7%; declaratives), verb-final (4.9%; embedded argument and adjunct clauses), and elliptical (verbless) structures (15.6%). The ACs serve as subjects, objects, adverbials, and predicatives, and they are located in the prefield (47.1%) or in the middlefield (32%).[2]

In most utterances, *auch* is associated with a single constituent (93.3%). However, there is a small group of utterances (6.7%) containing two ACs distributed over the clause. We will first discuss the former type of construction and briefly return to the cases with 'conjoined' ACs in Section 2.2.

2.1. Utterances with a single AC

The overall results of the accent annotation in the group of utterances with a single AC (N = 210) show that only 52.4% of ACs are accented, carrying LH* (25.7%), L*H (16.7%),[3] or H* (10%) accents, whereas the remaining ACs are either unaccented (45.7%) or deleted due to ellipsis (1.9%). Note, however, that the corpus contains much more pronominal (76.7%) than non-pronominal ACs (23.3%). Due to the suspected influence of this factor on the overall accent distribution, we looked at the two groups separately. As shown in Figure 1, unaccented ACs exclusively fall into the pronominal category, whereas non-pronominal ACs always carry an accent. We observed that most accented pronominal ACs are located in the prefield; the pronominal ACs in the middlefield are mostly unaccented.

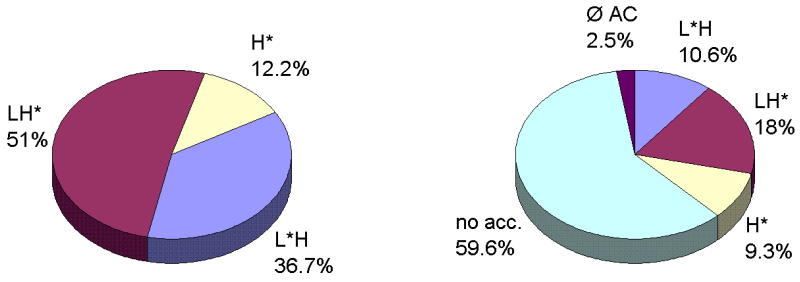

Figure 1: Accent distribution for non-pronominal ACs (left panel, N = 49) and pronominal ACs (right panel, N = 161)

A comparison of the accent distribution between the groups of accented non-pronominal (N = 49) and pronominal (N = 61) ACs reveals that LH* is the most frequent accent in both groups, its proportions being quite similar (51% of the non-pronominal and 47.5% of the accented pronominal ACs). L*H is the second most frequent accent, having, however, a higher proportion in the group of non-pronominal ACs (36.7%) compared to the pronominal ones (27.9%). On the other hand, the high accent H* is more frequent among the pronominal (24.6%) than among the non-pronominal ACs (12.2%). One might speculate that the frequency differences are partly due to phonetic factors. For example, some cases of H* on pronouns might actually be realizations of underlying LH* accents that are difficult to produce on short pronouns, especially at a high speech rate. Before we continue with the discussion of possible factors influencing the distribution of the accent types, a few examples will be presented for their illustration.

Examples (4), (5), and (6) and the corresponding f_0-tracks in Figures 2 and 3 show, respectively, the accents LH*, H*, and L*H on non-pronominal ACs. Both in (4) and (5), the f_0-peak is reached on the stressed syllable, but the production of (4) has an additional distinctive f_0-rise preceding the peak. In contrast, the stressed syllable in (6) sounds low, and the f_0-maximum is delayed into the following auxiliary.

(4) [*Einen Sprachfehler*] *haben Sie auch.*
a speech_defect have you also
'And you have a speech defect, too.'

(5) *... einen mit Himbeergeschmack? ...* [*Kirsch*] *wär auch ok.*
one with raspberry_taste cherry would_be also ok
'One with raspberry taste? … Cherry would do as well.'

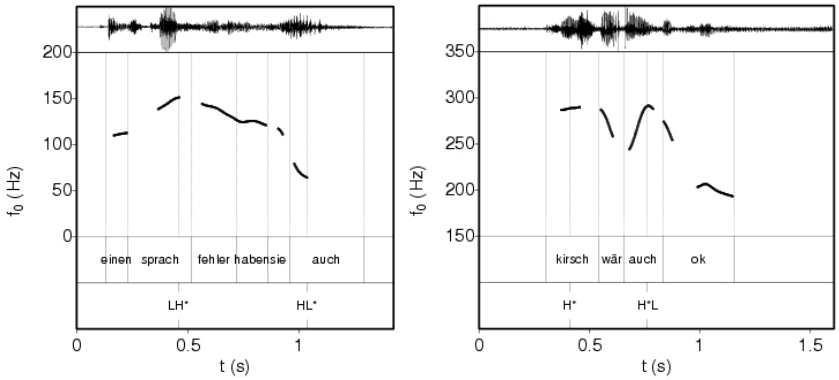

Figure 2: f_0-tracks for examples (4) – left panel and (5) – right panel

(6) *Aber* [*ein Auto*] *hab' ich auch nicht gehört.*
but a car have I also not heard
'But I haven't heard a car either.'

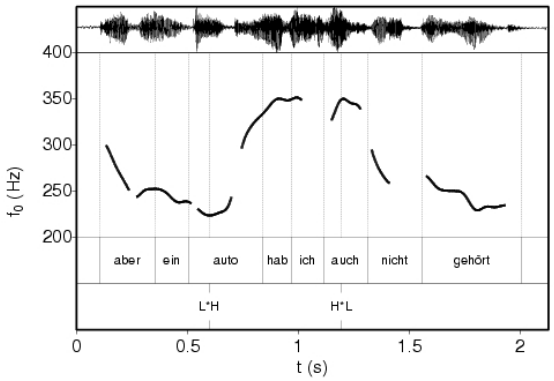

Figure 3: f_0-track for example (6)

The counterparts of (4) and (6) with pronominal ACs carrying LH* and L*H accents are illustrated in (7) and (8), respectively (cf. also Figure 4).

(7) [*Wir*] *wissen auch nicht, wie das Ritual genau abläuft.*
we know also not how the ritual exactly proceeds
'We don't know either what the exact procedure for the ritual is.'

(8) *Hören sie,* [*ich*] *hab' auch Angst.*
listen you I have also fear
'Listen, I'm also scared.'

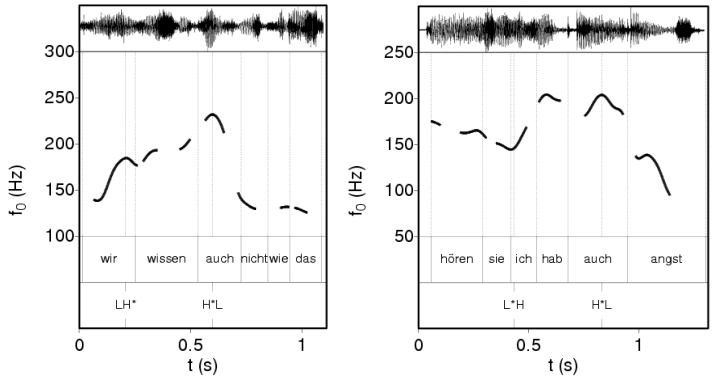

Figure 4: f_0-track for examples (7) – left panel and (8) – right panel

Although the relative frequencies of the individual accents in the groups with pronominal and non-pronominal ACs differ, all three types of high or rising accents are obviously available for both groups. An inspection of the contexts did not reveal any information-structural or semantic regularities underlying the accent distribution. Rather, paralinguistic meaning components (irony, emotion, etc.) seem to be among the relevant factors.

An example for the utterances with unaccented pronominal ACs is given in (9a). If we take into account that such deictic/anaphoric ACs may be dropped in pro-drop languages, cf. the Czech counterpart of (9a) in (9b), the missing accent is not surprising. Even German allows 'topic drop' of anaphoric ACs in the prefield, cf. (10).

(9) a. Bist [du] auch bei Mr Chomsky in Geschichte?
are you also at Mr Chomsky in history_class
'Do you also attend Mr Chomsky's history lectures?'
b. Nechodíš [Ø] TAKY k Chomskému do dějepisu?
not-attend-2Sg also to Chomsky-dat in history_class-gen

(10) A: *Und was ist mit Monica*? 'And what about Monica?'
B: [Ø] *Wird auch da sein*. 'She will be there, too.'
will also there be

In some cases with unaccented ACs, a non-associated element in the prefield bears a rising accent. Moreover, in cases like (11) and (12), this accent does not evoke alternatives of the prefield element, but again rather signals paralinguistic meaning. Note that this prosodic pattern is also compatible

with a context in which the accented element can be interpreted as the AC of the particle.

(11) A: *Ich hab 'ne lebhafte Fantasie.* 'I have a rich fantasy.'
B: *Den Eindruck hab* [*ich*] *auch.* 'I have this impression, too.'
this impression have I also

(12) A: *Wo sind deine anderen Kleider?* 'Where are the other clothes?'
B: *Auf diese Frage hätt* [*ich*] *auch gern ne Antwort.*
to this question would I also like_to_have an answer
'I too wish I had an answer to this question.'

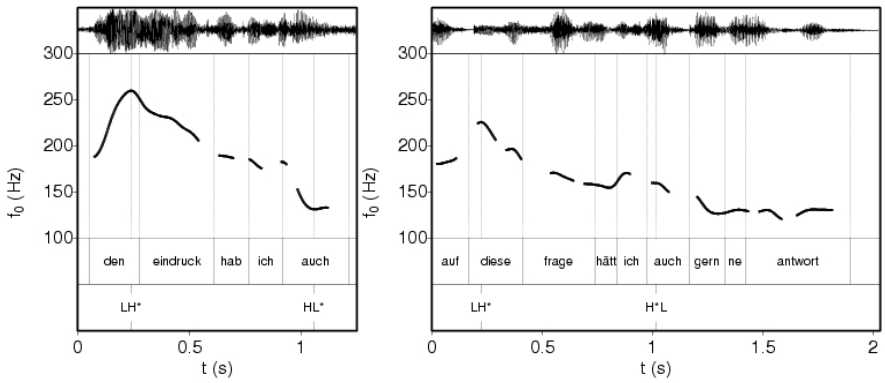

Figure 5: f_0-tracks for examples (11) – left panel and (12) – right panel

2.2. Conjoined ACs

A small group of utterances (N = 15) illustrated in (13) and (14) represents a phenomenon not discussed in the theoretical literature. Here the focus particle associates with a pair of elements analogous to 'complex foci' (i.e., association of one operator with a pair of foci, cf. Krifka (1992)). As Krifka's (1999) view excludes multiple topics that are equally ranked (see the discussion of (3) above), 'conjoined ACs' represent a complication that is yet to be accounted for.

(13) *Wir brauchen dich, und* [*du*] *brauchst* [*uns*] *doch auch.*
we need you and you need us PRT also
'We need you and you need us as well.'

(14) *Ich wünschte* [*ich*] *hätte* [*mein Geschenk*] *auch dabei*.
I wish I had my present also here
'I wish I had brought my present with me, too.'

The first AC is usually located in the prefield, but there are also cases with both ACs in the middlefield and elliptical structures without a finite verb. Various accentuation patterns can be found: both ACs accented or unaccented, only the first or the second one accented.

2.3. Conclusions

In the utterances of our corpus, ACs of stressed *auch* are either unaccented or marked by high or rising pitch accents. We found no 1:1 correspondence between accentuation and association with stressed *auch*. The accented ACs are not characterized by a specific accent type – high and rising accents with early or late peaks were found appropriate for both pronominal and non-pronominal ACs in the prefield and middlefield. A substantial proportion of the ACs do not carry an accent at all; however, the precondition for leaving an AC unaccented seems to be its pronominal status. Under certain circumstances, the AC can even be dropped, and there can be prenuclear accents on non-associated elements. In many cases, prosodic information is thus not sufficient for the identification of the AC, and context information must be taken into account.

3. Experimental studies

The exploratory corpus analysis cannot go beyond a categorical classification of pitch accents. A laboratory experiment, on the other hand, allows us to investigate the relevance of both categorical and gradual factors. A speech production study with balanced materials controlled with respect to their segmental properties and two speech perception studies were carried out, facilitating a detailed quantitative examination of the gradual phonetic parameters involved in the prosodic marking of constituents associated with stressed *auch*. For reasons of space, we will concentrate on the basic ideas of the experimental setup and the results here; for a more detailed report see Sudhoff and Lenertová (2006).

3.1. Speech production study

In our speech production study, we examined ambiguous constructions with two potential ACs to the left of *auch*, cf. (15).

(15) [*Der Rudi*] *hat* [*im Juni*] *wahrscheinlich auch einen Vortrag gehalten.*
the Rudi has in June probably also a talk given
'In June, Rudi probably gave a talk, too.'

Here, both the subject *der Rudi* and the adverbial *im Juni* 'in June' can be associated with the particle. Our expectation was that such constructions should call for a disambiguation in terms of prosodic marking, depending on which element serves as the AC. We elicited minimal pairs of utterances by embedding the sentences in two different contexts, cf. the English translation of the contexts for (15) in (16). The first context triggers association of the particle with the subject of (15), the second one with the adverbial.

(16) a. *Can you tell me which of the PhD students gave a talk in June? heard that only Martin gave one at that time.*
b. *Can you tell me when Rudi gave talks this term? I only know of the one in May.*

The independent variables were the position of the intended AC (prefield – PF or middlefield – MF), and its syntactic function (subject or temporal adverbial). 7 female speakers each received 20 critical items (5 lexicalizations in 4 conditions) for production, which were randomized and interspersed with fillers. A total of 107 utterances entered the analysis.[4]

From the qualitative analysis of the target utterances, we obtained the following results: ACs of stressed *auch* are consistently marked by rising pitch accents, either L*H (81.3%) or LH*. However, the corresponding non-associated elements are frequently accented, too (80.8% in the PF; 29.1% in the MF), carrying L*H, LH*, or H* accents. Moreover, the AC and the corresponding non-AC in a given utterance are often characterized by the same accent type.

A comparison of the f_0-contours revealed a high degree of consistency within the experimental conditions. From the mean contours displayed in Figure 6, it follows that the syntactic function of the ACs does not influence the intonation. On the other hand, the contour shapes differ considerably between PF and MF association. In the conditions with PF association

(upper panel), there is a steep rise on the AC and only a very small rise on the non-AC in the middlefield. The conditions with MF association (lower panel) are also characterized by a steep rise on the AC, but here, the non-AC in the prefield shows a rise of almost the same extent.

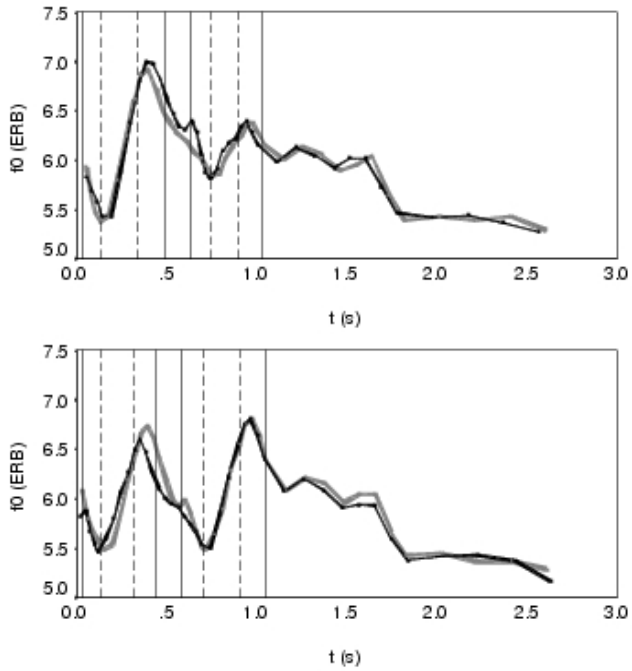

Figure 6: Mean contours for PF association (upper panel) and MF association (lower panel); gray line: AC = subject; black line: AC = adverbial

Statistical comparisons between the potential ACs were made with respect to the following dependent variables: f_0-minimum (*f_0-min*), f_0-maximum (*f_0-max*), f_0-excursion (*df_0*), duration of the stressed and post-stressed syllable (*dur-s_{23}*), and temporal alignment of the f_0-minimum (*al-min*) and f_0-maximum (*al-max*). The absence of an effect of the syntactic function enabled us to pool the data with associated subjects and adverbials in identical positions. As the potential ACs were carefully controlled with respect to their segmental properties, we were able to compare them not only between the utterances of one minimal pair (produced by the same speaker), but also within utterances.

The comparison of ACs and non-ACs in the same position of lexically identical utterances (comparison between utterances) revealed that ACs are

characterized by a higher f_0-maximum and a lower f_0-minimum than their non-associated counterparts, resulting in a greater f_0-excursion. In addition, ACs show a later peak alignment and a longer duration than non-ACs. These differences are statistically significant for both association positions (PF and MF). There is no significant effect of association status on the alignment of the f_0-minimum. The mean values of the dependent variables as well as the statistical results are given in Table 1.[5]

Variable	pos.	assoc.	non-ass.	p
f_0-min (ERB)	PF	5.30	5.42	< .001
	MF	5.42	5.74	< .001
f_0-max (ERB)	PF	7.13	6.75	< .001
	MF	6.93	6.44	< .001
df_0 (ERB)	PF	1.83	1.33	< .001
	MF	1.51	0.70	< .001
dur-s_{23} (ms)	PF	346	300	< .001
	MF	340	281	< .001
al-min (ms)	PF	-47	-41	n.s.
	MF	-48	-44	n.s.
al-max (ms)	PF	193	173	< .003
	MF	185	139	< .001

Table 1: Comparison between utterances: paired t-tests (one-tailed); N = 48; α = .0042 (Bonferroni adjustment)

The comparison of ACs and non-ACs within utterances substantially confirmed these results. Due to the fact that the local minimum is mostly located in the pre-stressed syllable, which could not sufficiently be controlled, *f_0-min* and *al-min* were left out of consideration. With the exception of *al-max* for MF association, all comparisons show significant effects in the expected direction, cf. Table 2. The comparison within utterances also confirmed that the differences between ACs and non-ACs are significantly greater for PF association than for MF association.[6]

variable	ass. PF	non-a. MF	p	non-a. PF	ass. MF	p
f_0-max (ERB)	7.19	6.45	< .001	6.71	6.91	< .001
df_0 (ERB)	1.92	0.70	< .001	1.33	1.52	< .003
dur-s_{23} (ms)	352	277	< .001	300	343	< .001
al-max (ms)	196	137	< .001	173	185	n.s.

Table 2: Comparison within utterances: paired t-tests (one-tailed); α = .0063 (Bonferroni adjustment); left: PF association (N = 55); right: MF association (N = 52)

The accent types found in the speech production experiment correspond to the ones observed in the corpus study: ACs of stressed *auch* are marked by rising pitch accents (L*H and LH*). However, the accent type cannot be sufficient for their identification, as non-associated elements often carry the same accents. Rather, continuous prosodic parameters seem to be decisive, confirming the findings of Braun (2005). Moreover, the position of the AC is relevant for the magnitude of the prosodic marking: Although the differences between ACs and non-ACs are significant for both association positions, they are much greater for PF association. Nevertheless, we expect the cases with MF association to be interpreted correctly, as the accent on the associated MF element should be perceived as more salient.

Most of the differences in f_0, duration, and alignment between ACs and non-ACs observed in the production data cannot be expressed in terms of different GToBI labels. Whether they are nevertheless perceptually relevant was tested in two speech perception experiments.

3.2. Speech perception study I (original stimuli)

The first perception study was based on the original utterances from the production experiment.[7] For each utterance, we calculated four parameters expressing the clearness of the prosodic marking: The differences between ACs and corresponding non-ACs with respect to the variables f_0*-max*, df_0, *dur-*s_{23}, and *al-max* were transformed into scales ranging from 0 to 1, where 0 corresponds to the smallest difference and 1 to the greatest. Due to the different prosodic patterns observed, PF and MF association were considered separately. Owing to this procedure, we were in a position to relate the listeners' judgements both to the GToBI annotation and to the gradual phonetic properties of the utterances.

32 subjects were auditorily presented the stimulus utterances (without context, randomized, and interspersed with fillers) and had to select one of two possible continuations given on a computer screen. As each continuation is compatible with only one interpretation of an utterance, the selection indicates which element was interpreted as the AC of *auch* by the subjects. For the example in (15) above, for instance, the choice was between *'... and not only in May'* (association with the adverbial) and *'... and not only Martin'* (association with the subject).

In 72.4% of the cases, the listeners chose the continuation corresponding to the original context of the utterance. The percentage of these matching

answers, however, clearly differs between the stimuli with intended PF association (84.5%) and MF association (58.3%). It is not immediately clear why this difference should occur. We will return to this point in Section 3.3.

The relation between the listeners' judgements and the categorization of the accents on the potential ACs does not show a consistent picture. Expectedly, utterances with an accented AC and an unaccented non-AC were assigned the intended interpretation more often than utterances with accents on both potential ACs. Within the latter group, however, the results cannot be explained on the basis of the accent distribution. For utterances with intended PF association and identical accents on the AC and the corresponding non-AC (either L*H or LH*), the matching results are clearly above chance level (75.9%). As for the utterances with intended MF association, we find matching results above chance level (66.4%) for cases with an L*H accent on the non-AC and an LH* accent on the AC. Clearly, other factors than accent type must be relevant for the disambiguation of the utterances.

Now consider the relation between the judgements and the gradual phonetic properties of the stimulus utterances, which are not expressed by the GToBI labeling. As shown in Table 3, we found significant correlations (Pearson's *r*) between the percentage of correct responses and the derived parameters for f_0-*max*, df_0, and *dur*-s_{23}, but not for *al-max*. We conclude that the identification rate for a given utterance in the perception task crucially depends on the clearness of the prosodic marking characterizing the utterance (expressed in terms of gradual phonetic variables). Of course, the proportion of the contribution might differ between the parameters with significant effects, especially since the parameters are probably interrelated.[8] A comprehensive examination of the individual parameters' influences lies beyond the scope of this study.

parameter	PF association		MF association	
	r	p	r	p
p-f_0-*max*	.502	< .001	.525	< .001
p-df_0	.626	< .001	.385	< .007
p-*dur*-s_{23}	.253	< .05	.387	< .007
p-*al-max*	.223	n.s.	-.092	n.s.

Table 3: Correlations between the percentage of correct responses and the derived parameters for PF association (N = 49) and MF association (N = 42)

Two questions could not be answered on the basis of this perception experiment. First, what is the source of the different proportions of correct responses for PF and MF association? More specifically, are they due to the unbalanced stimulus materials or other effects of the experimental design, or is there a general tendency for association of stressed auch with the prefield element? Second, is it possible to establish perceptual categories on the basis of the prosodic variables examined in the production study? This would be desirable, as the GToBI accents have proved not to be suitable categories for the AC/non-AC distinction. These questions will be addressed in the next section by means of a second perception experiment, making use of manipulated stimulus materials.

3.3. Speech perception study II (manipulated stimuli)

The stimuli of the second perception study are based on the sentence in (17), taken from the materials of the production experiment. It was produced by a female speaker with a neutral intonation and similar prominence on both potential ACs. By the joint manipulation of f_0*-min*, f_0*-max*, *dur-*s_{23}, and *al-max* followed by a resynthesis using Praat's PSOLA algorithm, we created 11 stimulus versions.[9] The parameter settings for the two extreme versions – Stimulus 1 is supposed to be a clear case of PF association and Stimulus 11 of MF association – are based on prototypical utterances from the production study. Their f_0-tracks resemble the mean curves for PF and MF association given in Figure 6 above.[10] The values for the 9 intermediate stimulus versions represent equal steps on the scale between the extremes, cf. the plotted f_0-tracks in Figure 7.

(17) [*Der Wiener*] *hat* [*um sieben*] *wahrsch. auch einen Anruf bekommen*.
the Viennese has at seven probably also a call received
'The Viennese fellow probably received a call at seven, too.'

44 subjects took part in the experiment. The task and mode of presentation were the same as in the first perception study. Each stimulus version was included 6 times, and two critical items were always separated by a filler item preventing the subjects from making direct comparisons between the different versions.

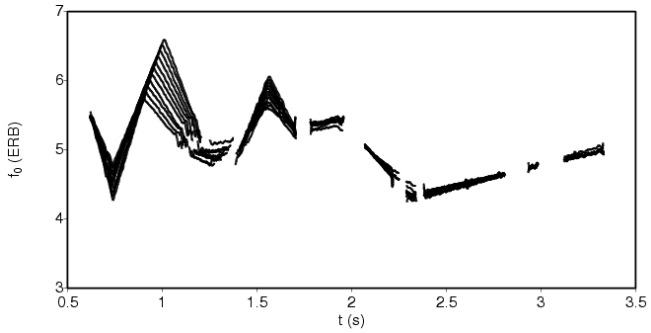

Figure 7: f_0-tracks of the 11 resynthesized stimulus versions

A manual inspection of the individual subjects' decisions revealed two different patterns. About 1/3 of the subjects (group A) turned out to be insensitive to the prosodic variation in the data. All 11 stimulus versions received about the same percentage of choices for PF and MF association from these subjects. The remaining 2/3 of the subjects (group B) made their decisions on the basis of the prosodic information; their judgements clearly differ across the stimulus versions. The aggregated results of both groups are given in Figure 8.

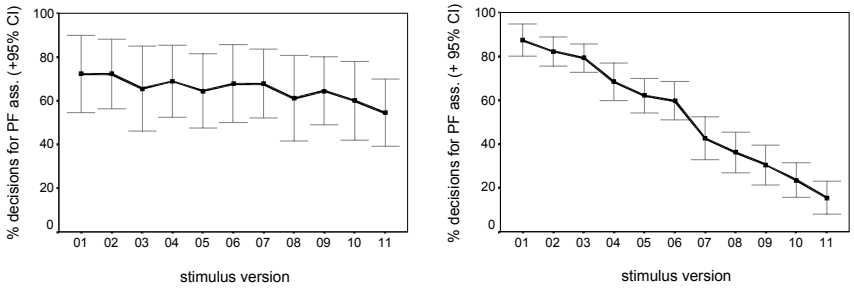

Figure 8: Percentage of decisions for PF association across the 11 stimulus versions; left panel: group A (15 subjects); right panel: group B (29 subjects)

For the majority of the subjects (group B), the importance of prosodic cues for the interpretation of ambiguous utterances containing stressed *auch* could thus be confirmed. Interestingly, Stimuli 1 and 11 (the clear cases of PF and MF association) were interpreted in accordance with the expectations in similarly high proportions (87.4% and 84.5%, respectively). Contrary to what one might expect, the results of group B (right panel of Figure 8) do not show an s-shaped curve, but a rather linear relationship between

prosodic realization and interpretation. Subjects did not assign the gradually differing stimuli to distinct perceptual categories.

3.4. Conclusion

In the production study, we found gradual differences between ACs and non-ACs rather than consistent differences in accent type. ACs as well as the corresponding non-ACs were often characterized by rising pitch accents in the construction type examined, but the former show a higher f_0-maximum, lower f_0-minimum, greater f_0-excursion, later peak alignment and longer duration than the latter. These findings support a description of the AC/non-AC distinction in terms of continuous phonetic parameters instead of categorical accent labels.

The perception studies showed that the listeners' interpretive preferences crucially depend on the prosodic realization of the utterances. More specifically, we found a correlation between the strength of the prosodic marking (defined in terms of the phonetic variables discussed above) and the percentage of decisions for a particular association position. For the majority of the subjects, the identification of the ACs seems to be governed by the relative magnitude of the prosodic parameters characterizing the candidates. As shown by the second perception experiment, there is no preference for the association of *auch* with the prefield element if prosody is used as a clue (group B). On the other hand, if prosodic information is neglected, a preference for PF association emerges (group A).[11]

4. General discussion and summary

In this paper, the prosodic marking of constituents associated with the stressed variant of the focus particle *auch* was examined by means of a corpus study and several speech production and perception experiments. The different methodical approaches with their specific data types facilitated an investigation of the phenomenon from various perspectives, providing insights relevant both for the grammar of stressed *auch* and for general theories of the mapping between prosodic form and meaning. Concerning the former issue, we interpret the results as consistent with Krifka's *Contrastive Topic Hypothesis*: ACs of stressed *auch* are often, although not always, characterized by prosodic properties typical for con-

trastive topics, and this prosodic marking is relevant for the interpretation of the utterances.[12] However, the data does not support a straightforward relation between (prosodic) form and function, contrary to the view assuming a direct mapping from accent types to semantic or information structural categories.

The corpus study and the speech production experiment show that ACs of stressed *auch*, if accented, carry high or rising pitch accents. As the nuclear accent on the focus particle itself is a falling accent (H*L or HL*), the overall intonational pattern is that of a bridge contour. Due to the nature of the data, the actual accent distribution differs between corpus and experimental study. The corpus data suggests the distinction between non-pronominal and pronominal ACs, only the latter showing the optionality of the prosodic marking proposed by Krifka. In both sources, different accents could be observed on the elements associated with *auch*. However, their relative frequencies differ between the data types. The corpus contains a greater proportion of LH* and H* accents and a lower proportion of L*H accents than the experimental data. This can be partly attributed to the lexical properties of the ACs (pronominal vs. non-pronominal status) and to the ambiguous character of the materials used in the production study. The experimental studies showed that ACs of stressed *auch* are characterized by a number of additional prosodic properties, expressed in terms of gradual phonetic variables, and that these parameters are perceptually relevant: At least in the absence of contextual information, the listeners' judgements crucially depend on prosodic cues.

The question arises whether the prosodic properties of elements associated with stressed *auch* should be described in terms of discrete phonological categories or gradual phonetic parameters. The first possibility was explored in the corpus study and the qualitative analysis of the production data, the relevant phonological categories being the pitch accent types defined in the GToBI system. It could be shown that there is no 1:1 correspondence between association with *auch* and a particular accent: On the one hand, we found that various types of accents are appropriate for ACs, on the other hand, the same accents can be observed on non-associated elements, and the AC and some other element can even carry the same accent in one utterance. Thus, the mostly successful performance of the subjects in the perception study cannot be interpreted as resulting from the accent distribution. This is corroborated by the evaluation of the relation between the matching results and the accent distribution on the ACs and non-ACs in the stimulus utterances, which did not yield a coherent picture.

Thus, a description of the prosodic properties involved in the marking of ACs in terms of GToBI accents seems to miss the point. The second possibility – the description of the prosodic properties of constituents associated with stressed *auch* in terms of continuous phonetic parameters – seems to be more adequate. This method captures the relevant differences between ACs and non-ACs in the production data and allows more reliable predictions about the subjects' interpretation of a given utterance in the perception experiment. Prosodic variation with respect to variables such as f0-peak, f0-rise, or duration is not captured by the GToBI annotation at all.

The findings presented in this paper are important for our understanding of the relation between prosody and semantics / information structure. On the one hand, the different pitch accents carried by the ACs of *auch* in the corpus and production data do not correspond to different semantic or information structural categories, which casts doubt on the appropriateness of the GToBI categories for this purpose. The various prosodic realizations observed in the data seem to convey paralinguistic meaning; however, it has to be clarified what the relevant categories of this meaning component are and by what means they can be prosodically expressed. On the other hand, it has been shown that the variation of continuous phonetic parameters can be a decisive factor for truth-conditionally and information structurally relevant meaning components. A theoretical model of the relation between prosody and meaning accounting for the status of gradual phonetic parameters is still to be developed. However, there is no doubt that quantitative data from controlled experiments should be taken as evidence in investigating prosodic effects.

Finally, the interdependence of prosodic structure and meaning cannot be seen independently of other factors such as syntactic structure or (linguistic) context. In the utterances elicited in our production study, the syntactic position of the ACs influences the magnitude of the prosodic differences between ACs and non-associated elements, and the speech perception experiments revealed that hearers use a default strategy based on word order if they cannot access prosodic information for the identification of the AC. As for the context, it can override preferences for association with a particular element based on the prosodic structure (as in the corpus study), and it can encourage a clear prosodic marking of the ACs (as in the speech production study).

Notes

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1. The examples used in this paper stem from the following sources: *Kleine Haie* (D 1992, ex. (1b), (4)); *Das merkwürdige Verhalten geschlechtsreifer Großstädter zur Paarungszeit* (D 1998, ex. (5), (11)); *Buffy – Im Bann der Dämonen* (Season 1, USA 1997, ex. (6)-(9), (12)); *Lügen und Geheimnisse* (F/UK 1996, ex. (10), (14)); *Gloomy Sunday – Ein Lied von Liebe und Tod* (D 1999, ex. (13)).
2. In the remaining 20.9% of the utterances (elliptical utterances and the structures discussed in Section 2.2), the position of the AC could not reliably be determined.
3. Following the GToBI annotation rules in Grice et al. (2005), we based the distinction between the accent types L*H and LH* on the timing of the peak: if it is reached within the stressed syllable, we annotated LH*, if it is delayed into the post-stressed syllable, we annotated L*H.
4. The utterances of one speaker were excluded as it turned out that she was not naïve with respect to the purpose of the study. Of the remaining 120 utterances, 13 had to be excluded for various reasons, including the production of the unstressed variant of *auch*, hesitations, and a defective recording.
5. Only 96 utterances could be used for the comparison between utterances, because in case one utterance of a minimal pair was excluded, the other one had to be excluded as well, resulting in 48 minimal pairs.
6. t-test for unrelated measures, two-tailed, $p < .001$ for f_0-*max*, df_0, and *al-max*, and $p < .009$ for *dur*-s_{23}
7. To keep the experiment at a reasonable length, we only used the utterances of 5 speakers (except the defective or unacceptable utterances that had not been included in the analysis), the total number of stimuli being 91.
8. Moreover, we cannot conclude that peak alignment is perceptually irrelevant. Its effects could be outweighed by the effects of the other parameters.
9. We varied all parameters with significant effects in the production study. The variation of f_0-*min* and f_0-*max* is automatically accompanied by a variation of df_0.
10. Note that the accents on the ACs and non-ACs in all stimulus versions fall into the L*H category of the GToBI system.
11. Presumably, the two groups of subjects following different strategies in the perception task were also present in the first study, explaining the overall preference for PF association.

12. For a proposal how the *Contrastive Topic Hypothesis* can be utilized to integrate constructions with stressed *auch* into a general syntactic theory of the grammar of focus particles in German, see Sudhoff (to appear).

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