13

Syntax, information structure, embedded prosodic phrasing, and the relational scaling of pitch accents*

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13.1 Introduction

In an intonation language like German, pitch accents are heads of prosodic constituents, which are themselves mapped from the syntax. The pitch accents can be more or less 'strong', and be realized at different fo values, depending on their position in the sentence and on the information structure they convey. This paper proposes that pitch scaling in an intonation language such as German is relational rather than absolute. In other words, the height of a pitch accent depends on the presence of other pitch accents in the same prosodic domain. A pitch accent is higher than it would be in a baseline all-new sentence if it is associated to a narrow focus, and it is lower if it is associated to a given constituent. But if there is no other pitch accent to which it can compare in the same prosodic domain, no adjustment of pitch takes place. This is illustrated with experimental data from German in section 13.3. Other languages may behave differently in this respect, but given our little knowledge of issues concerning phonological scaling of tones in intonation languages so far, it is too early to take a strong position on this issue. Pitch accent scaling is an important component of the relation between syntax and prosody. This paper presents a model in

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which information structures does not change prosodic phrasing, but only influences relative register of prosodic domains—it boosts narrowly focused constituents and lowers given ones. The prosodic phrasing is not touched when information structure changes. The next section introduces theoretical background information on prosodic phrasing and pitch accents, and section 13.3 reviews experiments relevant to the main issue of the paper. Section 13.4 concludes.

13.2 Background

13.2.1 *Prosodic domains and syntax*

A breakthrough in the long history of the theoretical approaches to how syntax shapes prosody was achieved by the emergence of prosodic hierarchies, as proposed by Selkirk (1984), Nespor and Vogel (1986), and many others after them. Prosodic hierarchies capture the insight that morphosyntactic units are mapped to prosodic units of different sizes, even if the mapping is not strictly isomorphic. A grammatical word, for instance, often forms a Prosodic Word, and some morphological operations, like reduplication or hypochoristic formation in many languages, can only be fully understood if their prosodic structure is taken into account (McCarthy and Prince 1990). At a high level of the prosodic hierarchy, sentences correspond to Intonation Phrases (Liberman 1975 [1978/9]; Pierrehumbert 1980; Liberman and Pierrehumbert 1984) and are assigned intonational patterns.

Phonologists largely agree on units like Prosodic Words and Intonation Phrases, but the intermediate prosodic domains have been a matter of debate. Most researchers assume two levels of prosodic phrasing between Prosodic Word and Intonation Phrase, and these have been given a variety of names, as for instance 'Minor Phrase' and 'Major Phrase' (Poser 1984; Selkirk 1986), 'Accent Phrase' and 'Intermediate Phrase' (Beckman and Pierrehumbert 1986; Gussenhoven 2004; Jun 2005), or 'Clitic Group' and 'Phonological Phrase' (Nespor and Vogel 1986 [2008]). Together with a restrictive view of what is allowed in the prosodic mapping from syntax to prosodic structure, like the Strict Layer Hypothesis (Selkirk 1984; Nespor and Vogel 1986 [2008]), which forbids recursive structure, the assumption of a maximum of two layers of phrasing can be interpreted as a prohibition on long sentences.

But of course, in the same way as syntax cannot restrict sentences to a certain length—there is no way of forcing a sentence to have, say, maximally five embedded clauses—there should also be no way of restricting the number of prosodic domains that a sentence may have. For this reason, the prosodic

phrasing resulting from the syntax–prosody mapping should be recursive and unconstrained. As an answer to the contradiction between the few prosodic levels and the recursion prohibition, a few authors have proposed to eliminate the restriction imposed on the prosodic hierarchy, at least for those levels which are situated at the interface between syntax and prosody. Wagner (2005) proposes calling all levels of prosodic structure 'feet', and Ito and Mester (2007) call the levels higher than the metrical foot 'phonological phrase' or just 'phrase.' Ito and Mester distinguish between 'minimal phrase,' 'phrases', and 'maximal phrase'. These three levels of phrasing may present different properties. Only the non-minimal and non-maximal phrases are recursive.

In this paper, the mapping between syntax and prosody results in prosodic domains that are called p-phrases (for prosodic phrases), and that can be embedded into each other. It assumes recursive phrasing at all levels of the prosodic hierarchy, starting at the Prosodic Word. In particular, it includes a recursive phrasing pattern of p-phrases and intonation phrases (called here i-phrases).

We will not be concerned too much about the details of how to construct prosodic phrasing from the syntactic structure. A number of competing theories have been proposed in the literature. To name just a few, consider 'relation-based' theories (Nespor and Vogel 1986 [2008]), 'edge-based' theories (Selkirk 1986), alignment in Optimality Theory (Truckenbrodt 1999; Selkirk 2000; Féry and Samek-Lodovici 2006), and minimalist phase and Spell-Out (Ishihara 2007; Kahnemuyipour 2004; Kratzer and Selkirk 2007). The main idea behind all accounts is that syntactic categories are mapped to prosodic phrases, either in considering syntactic constituents as the base of the mapping (relation-based and phase) or in taking syntactic edges as crucial (edge-based and alignment). Since the concern of this paper is not about how mapping arises, we simply assume the account formulated in Féry and Samek-Lodovici (2006), without entering into detail.

P-phrases have phonetic correlates, the most important ones being the presence of a main pitch accent per p-phrase, considered the 'head' of the p-phrase, and boundary tones. The presence of a pitch accent is often considered as definitional for a p-phrase, an idea that we use in the following discussion.

There are a few problems which are recurrent in all theoretical approaches to prosodic phrasing. These problems are related to the fact that prosodic phrases are projected from the surface syntactic structure, but that this syntactic level does not contain all the necessary information to explain the observed accent pattern.

First, consider German sentences with unergative intransitive verbs. In this kind of sentences, both the subject and the verb are accented.

In a conventional view of prosodic phrasing, which is adopted here for the default prosodic structure, every p-phrase is headed by a pitch accent. If this view is correct, as I assume for the default case, sentences like (1a) consist of two p-phrases. Sentences with unaccusative intransitive verbs have, in contrast, only one accent on the subject and none on the verb. This is illustrated in (1b). Accordingly, they form only one p-phrase.

(1) a. [Ein JUNGE]$_P$ [TANZT]$_P$
a boy dances
'A boy dances.'

b. [Die DIVA ist gestorben]$_P$
The diva is died
'The diva has died.'

Since these sentences have the same surface syntactic structure, it has been assumed that deep syntactic properties are relevant for sentence accent assignment (Krifka 1984; Kratzer 1988; Diesing 1988). The subject is VP-internal in (1b), but VP-external in (1a).[1] In a minimalist model, in which each phase is a spell-out domain with its own pitch accent, it must be assumed that the verb plus subject are a single phase in the case of unaccusatives, but are spelled out in two phases in sentences with unergative verbs.

A second thorny aspect of the phrasing and subsequent accent pattern has to do with the distinction between argument and adjunct (see Gussenhoven 1992). Especially in locative prepositional phrases, but also in other types of prepositional or adverbial phrases, it is sometimes difficult to assess the argumental or adjunctive nature of phrases. Consider the German examples in (2). In (2a), the locative is an argument, but in (2b), it is an adjunct (see also Krifka 1984 for such pairs). The distinction is essential because, according to a large part of the literature (Gussenhoven 1992; Selkirk 1984; Cinque 1993) a verb is part of the p-phrase of an adjacent argument, and is consequently not accented, whereas the same is not true in case of an adjunct. In this latter configuration, both the adjunct and the verb are maximal projections and should be phrased separately (see below for experimental results on accent placement in this kind of sentences).

(2) a. [MORITZ]$_P$ [hat in STUTTGART übernachtet]$_P$
Moritz has in Stuttgart spent-the-night
'Moritz spent the night in Stuttgart.'

[1] In an alternative model, the subject is a specifier in the VP, whereas the object is a complement in the VP.

b. [MORITZ]$_P$ [has in STUTTGART]$_P$ [GESUNGEN]$_P$
Moritz has in Stuttgart sung
'Moritz sang in Stuttgart.'

The third difficult case comes from aspects of information structure which change the pitch accent structure of a sentence. Some authors treat the effects of syntax and information structure on prosody in the same way in that information structure primarily changes the phrasing of sentences. The change in accent structure is then an indirect effect of the changed p-phrasing (Gussenhoven 1992; Truckenbrodt 1999). In a minimalist approach, this view of phrasing means that not only phases are mapped to prosodic phrases, but the information structure also projects phases and spell-out domains. The change in p-phrasing is illustrated in (3) with English examples. In (3a) the sentence is all-new and has two accents, one on the subject and another one on the object. In (3b), only the subject is focused. As a result, the phrasing has changed because there is a unique accent on the subject, and none on the object. All accounts of prosodic phrasing which assume that every p-phrase is obligatorily headed by a pitch accent, regardless of information structure, have to change prosodic phrasing when accent structure is modified.

(3) a. {What happened?}
[MAX]$_P$ [stole a CHICKEN]$_P$
b. {Who stole a chicken?}
[MAX$_F$ stole a chicken]$_P$

In this paper, I propose separating the effects of syntax from those of information structure. Only syntax influences phrasing, and information structure determines the presence and the height of pitch accents. In some cases, pitch accents are just not realized, and a p-phrase can exist without a pitch accent. As a result, example (3) always has the phrasing shown in (3a), regardless of the information structure and pitch accents.

Some problems related to the phrasing of sentences with different information-structure patterns remain that have to do with the contextual framework of the sentences. For example, the same sentence can be thetic or categorical, depending on the context in which it is uttered. If the subject of a presentational sentence is a topic, as in (4a), both the subject and the verb are in separate p-phrases, and both have an accent. But if the whole sentence expresses a unique event, as in (4b), only the subject has an accent, because the subject and the verb are part of the same p-phrase. Since these sentences are both all-new, the difference in accent structure is truly due to a difference in phrasing. In other words, the deaccenting of the particle *durch* is not due to givenness, as in example (3), in which the chicken

had already been mentioned in the context, and was deaccented for this reason. Similarly to (1), in which unergative and unaccusative verbs have different syntactic structures, thetic sentences must be syntactically distinct from categorical sentences. But the difference between thetic and categorical sentences is a discourse-structural one, and not necessarily anchored in the syntax.

(4) a. [Ein ZUG]$_P$ [fährt DURCH]$_P$ (und ein Auto muss an der
A train is-passing through (and a car must wait at the
Ampel warten.)
traffic light.)

b. (Achtung auf Gleis 1.) [Ein ZUG fährt durch]$_P$
Attention on platform 1. A train is passing through

The theoretical status of pitch accents as heads of p-phrases has been instantiated in the form of a metrical structure which calculates the difference in strength of the metrical positions from their level of embedding in a tree or in a grid (Liberman 1975 [1978/9]; Liberman and Prince 1977; Selkirk 1984; Halle and Vergnaud 1987). In some of these approaches (see for instance Selkirk 2002), levels of the metrical structure may strictly correspond to prosodic domains, as shown in (5). The head of an Intonation Phrase (IP) has a stronger metrical position than the head of a p-phrase, which is itself higher than the head of a Prosodic Word (PW). If the number of levels in the prosodic structure is invariable, a one-to-one correspondence between metrical beats and prosodic domains can be established.

(5) (×) IP
(×) (×) (×) (×) p-phrase
(×) (×) (×) (×) (×) (×) PW
Ms Martin went to the market with a basket full of eggs

However, if p-phrasing is recursive, as assumed here, such a correspondence is not necessary. The height of metrical beats is related to the number of embeddings in the p-phrasing. This is illustrated in (6) with names grouped in different ways (see Wagner 2005 and Féry and Kentner 2008 for examples of this kind). In such a case, it is not possible to attribute a specific level of the prosodic hierarchy to a specific grouping. Doing so would inflate the number of prosodic domains in an uncontrollable way.

(6) × p-phrase
× × × p-phrase
× × × × p-phrase
× × × × × × p-phrase
a. (((Lena and Arno)$_P$ and Bill)$_P$ ((and Tom and Anny)$_P$ (and Sam)$_P$)$_P$)$_P$...

× p-phrase
× × p-phrase
× × × × × × p-phrase

b. (((Lena)$_P$ (and Arno and Bill and Tom)$_P$)$_P$ (and Anny and Sam)$_P$)$_P$...

To conclude this section, prosodic domains are mapped from syntactic phrases, but this mapping does not necessarily correlate with specific levels of prosody. Recursion of p-phrases is assumed, which allows a finer-grained scaling of pitch accents, as shown in the next section.

13.2.2 *The height (and strength) of pitch accents*

A problem which has only seldom been addressed in the relevant literature is how to calculate the fundamental frequency (fo) value of accents based on their prosodic and metrical positions (but see Pierrehumbert 1980; Liberman and Pierrehumbert 1984; Truckenbrodt 2004 for proposals involving simple structures). Consider nuclear stress. Since Chomsky and Halle (1968), phonologists and syntacticians regularly mention that the last accent in the sentence is the strongest one, and that it is the nuclear stress. This is certainly true for an accent standing for a narrow contrastive focus, especially if it is an early constituent in the sentence (see (3b)). In this case, the pitch accent is the last one, and postfocal material is flat and low, which gives an impression of extra prominence on the accent. But things are different when the sentence is all-new, that is when no constituent in the sentence is particularly emphasized, as in (3a) or (5). In this case, the nuclear stress is generally the pitch accent with the lowest frequency, the smaller pitch range, and the weakest acoustic energy.[2] The reason for this is to be found in the downstep pattern of pitch accents, which reduces each pitch accent relative to the preceding one (see Liberman and Pierrehumbert 1984 for English and Truckenbrodt 2004 for German).

To account for this effect, it is proposed here that p-phrases have an abstract range inside of which accents are scaled (see Bruce 1977; Clements 1981; Ladd 1990 for similar proposals for different languages). In the unmarked case, a sequence of p-phrases at the same level of prosodic phrasing has pitch registers organized in a downstepped pattern, as illustrated in Figure 13.1. Since the range of a p-phrase is narrower than the range of a preceding p-phrase in the same i-phrase, the pitch accent heading it is lower than the pitch accent preceding it. The reduced prominence of the last accent

[2] Gussenhoven (1992) and Selkirk (2000) deny the presence of nuclear stress in all-new sentences.

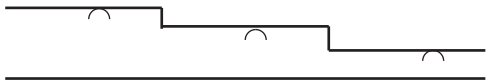

FIGURE 13.1 Downstep pattern of unembedded p-phrases.

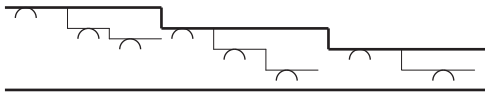

FIGURE 13.2 Downstep pattern of embedded p-phrases.

(the nuclear stress) in an all-new sentence is just a consequence of this pattern. Pitch accents are indicated with the help of a convex form.

Since the p-phrasing is recursive, every p-phrase can itself contain p-phrases, which are also in a downstep relationship to each other. The head pitch accents are thus scaled inside of these embedded p-phrases. A similar proposal of embedding downstepped regions has been made by a number of researchers (Ladd 1990; van den Berg, Gussenhoven, and Rietveld 1992; Truckenbrodt 2007; Féry and Truckenbrodt 2005). This is illustrated in Figure 13.2.

Information structure, like focus or givenness, enlarges or reduces the range of a prosodic phrase. A narrow focus has the effect of raising the top line of the corresponding p-phrase, and a given constituent has the effect of lowering it. This is illustrated in Figure 13.3 and Figure 13.4, respectively (see below, Féry and Ishihara 2009a,b).

As far as givenness is concerned, a difference is made between pre- and postnuclearity. If a given p-phrase appears before the nuclear accent, its range is narrowed, but a pitch accent can still be realized (see Figure 13.4). In the postnuclear region, however, the range is completely compressed, and no

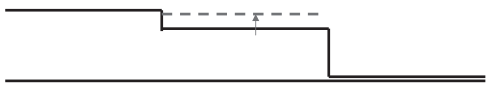

FIGURE 13.3 Raising of the top line of a p-phrase because of narrow focus.

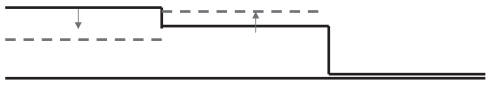

FIGURE 13.4 Lowering of the top line of a p-phrase because of givenness.

pitch accent can be realized anymore.

This model of pitch accent scaling, based on register domains in downstep and upstep relationship with each other makes a number of predictions:

1. Downstep: An early pitch accent is higher than a later one in the same sentence, everything else being equal. Embedding of pitch ranges into each other accounts for finer differences.
2. Reset: A later accent can be higher than a preceding one if the preceding accent is the head of a more deeply embedded p-phrase.
3. Relative height: The scaling of pitch accents is relative. This means that a pitch accent height may only be raised or lowered as compared to pitch accents in the same intonational domain.

In the next section, some experimental data are discussed that confirm these predictions.

13.3 Experimental results

13.3.1 *Downstep occurs in all-new sentences*

The first prediction claims that pitch accents at the same level of prosodic phrasing are in a downstep relationship to each other, as illustrated in Figures 13.1 and 13.2. This has been shown a number of times for a sequence of arguments in simple syntactic structures or in lists, for English, German, and other languages (see, for example, Liberman and Pierrehumbert 1984 and Ladd 1990 for English; van den Berg, Gussenhoven, and Rietveld 1992 for Dutch; Truckenbrodt 2004 for Southern German).

Féry and Kügler (2008) show that in a German simple syntactic sentence, downstep is just one option of how to realize several accents in a sequence. Another one is that the last accent is upstepped and is thus much higher than it would be if downstep had happened regularly. We explain this result with an optional rule of H-raising (see, for instance, Laniran and Clements 2003 for H-raising in Yoruba, and Xu 1999 in Chinese). Notwithstanding the occurrence of H-raising in part of the data, downstep is considered the default realization of a Standard German all-new sentence.

13.3.2 *Reset at a p-phrase boundary*

The second prediction posits that the second of a sequence of two accents can be higher than the first one if they belong to different prosodic domains. This effect has been called 'reset' by Liberman and Pierrehumbert (1984). The constellation has been illustrated in Figure 13.2, and is also visible in

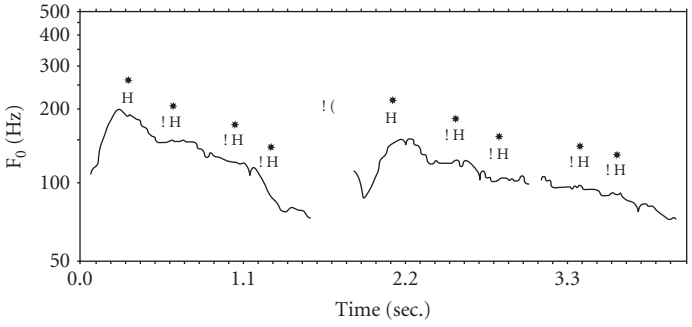

FIGURE 13.5 Partial reset and embedded downstep in the Dutch utterance (*Merel, Nora, Leo, Remy*), *en* (*Nelie, Mary, Leendert, Mona en Lorna*). From van den Berg, Gussenhoven, and Rietveld (1992).

Figure 13.5 from van den Berg, Gussenhoven, and Rietveld (1992). This figure shows that when a larger utterance is divided into two shorter i-phrases, each of them contains downstepped accents, and the first high tone of the second i-phrase is higher than the last tone of the first i-phrase, but lower than the first high tone of the first i-phrase.

Féry and Truckenbrodt (2005) reproduced for German an experiment by Ladd (1990), who showed that a sequence of three syntactically and semantically related English sentences are in a downstep and/or reset relationship, depending on how their internal syntactic and prosodic structure looks. In Féry and Truckenbrodt, two conditions were examined in a production experiment with the patterns in (7) and (8).

(7) First condition: A while [B and C]
{Why does Anna think that craftsmen have more expensive cars than musicians?}
[Weil der Maler einen Jaguar hat]$_A$, [[während die Sängerin einen Lada besitzt]$_B$, und [der Geiger einen Wartburg fährt]$_C$]
'Because the painter has a Jaguar, while the singer owns a Lada, and the violinist drives a Wartburg.'

(8) Second condition: [A and B] while C
{Why does Anna think that musicians have less expensive cars than craftsmen?}
[[Weil die SÄNGERIN einen LADA besitzt]$_A$, [und der GEIGER einen WARTBURG fährt]$_B$], [während der MALER einen JAGUAR hat]$_C$

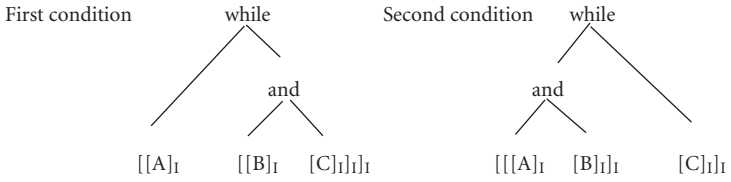

FIGURE 13.6 Two conditions in the experiment reported in Féry and Truckenbrodt (2005).

'Because the singer owns a Lada, and the violinist drives a Wartburg, while the painter has a Jaguar.'

The difference between the prosodic structures of the two conditions is illustrated in Figure 13.6. In the first condition, B and C form a constituent together, and in the second condition, it is A and B which are grouped into a single constituent. In both conditions, the three sentences form a prosodic constituent together, so that the sentence standing alone is also in a relevant scaling relationship to the other two. I assume a recursive structure: all sentences are i-phrases, the grouping of two sentences is also an i-phrase, and the whole utterance is again an i-phrase.[3]

The tonal structure of a sentence of the first condition is shown in (9). Speakers were very consistent in their tonal realizations. Important for the pitch scaling is the value of the first H tone in each sentence.

(9) {Why does Anna think that sportsmen have less expensive cars than craftsmen?}

L*H L*H H_I
[[Weil [der RINGER]P [[einen LADA]P besitzt]P]I A
L*H L*H H_I
[[während [der MALER]P [[einen JAGUAR]P fährt]P]I B
L*H H*L L_I
[und [der WEBER]P [[einen DAIMLER]P hat]P]I]I]I C

'Because the wrestler owns a Lada, while the painter drives a Jaguar and the weaver has a Daimler.'

The production experiment was conducted at the University of Potsdam with five students, native speakers of Standard German, who uttered thirty-two experimental sentences each. The pattern which emerged from the experiment is that the first condition shows a downstep pattern throughout, as in

[3] This assumption differs from the pattern presented in Féry and Truckenbrodt, in which we were more traditional in avoiding recursion of intonation phrases.

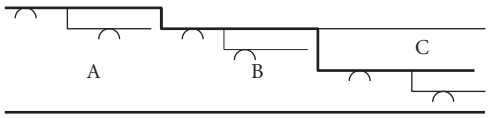

FIGURE 13.7 Result of the production experiment of Féry and Truckenbrodt (2005) for the first condition.

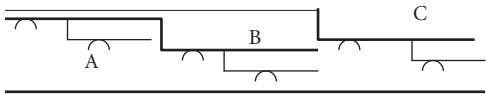

FIGURE 13.8. Result of the production experiment of Féry and Truckenbrodt (2005) for the second condition.

Figure 13.7, but the second condition elicited a reset on the C sentence, as shown in Figure 13.8. The first high tone of this sentence was slightly higher than the first high tone of sentence B. Moreover, this tone was much higher than it was in the first condition.

In short, downstep and reset both play a role in German, and in order to calculate the fo value of pitch accents in all-new sentences, it is necessary to take both into consideration. A model like the one illustrated in Figures 13.7 and 13.8 is helpful to understand the full pattern of tonal scaling.

13.3.3 *Relational scaling*

The third prediction has never been addressed in this form before, and the remainder of this chapter is dedicated to its empirical assessment. It posits that the scaling of the fo value of a pitch accent is essentially relational. Raising or lowering of pitch accents because of information structure only makes sense if it takes place relative to some other pitch accent. The reason for this is that pitch accents are adjusted to register domains which are downstepped relative to their predecessors, and embedded into each other, as shown above. If there is only one prosodic phrase, no downstep and no raising take place, because there is no other register domain relative to which this change can take place. This complex relationship cannot be expressed if pitch accents are addressed directly.

13.3.3.1 *Sentences with fronted objects* In order to test this crucial prediction for the model presented, German sentences with object fronting, as illustrated in (10), are used. In this type of structure, an object is fronted in the sentence-initial,

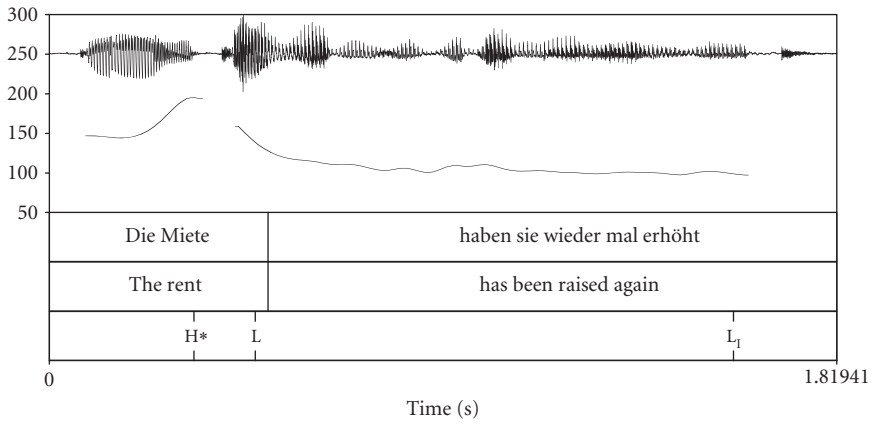

FIGURE 13.9 Pitch track of *Die MIETE haben sie wieder mal erhöht.*

preverbal position. Both a narrow focus on the fronted object and an all-new reading are available.

(10) H*L L_I
[[Die MIETE haben sie wieder mal erhöht]_F]_I
the rent have they again once raised
'They have raised the rent again.'

Figure 13.9 shows a pitch track of this sentence. The only tonal excursion happens on the fronted object, and the remainder of the sentence has a low and flat intonational contour.[4]

Thirty students from the University of Potsdam were recorded. All participants were native speakers of German. Each of them read twelve experimental sentences aloud, as illustrated in (11), as answers to context questions. Additionally, they read 100 unrelated filler sentences presented in a pseudo-randomized order. The object of the target sentences was generic or specific, to check for possible effects of specificity.

(11) Wide focus: {Did you go out afterwards?}
Narrow focus: {What did you drink?}
Ein Bier haben wir getrunken./ Ein Jever haben wir getrunken.
a beer/a Jever have we drunk 'We drank a beer/a Jever.'

[4] See Fanselow (2004) and Fanselow and Lenertová (2008) for syntactic accounts of these sentences.

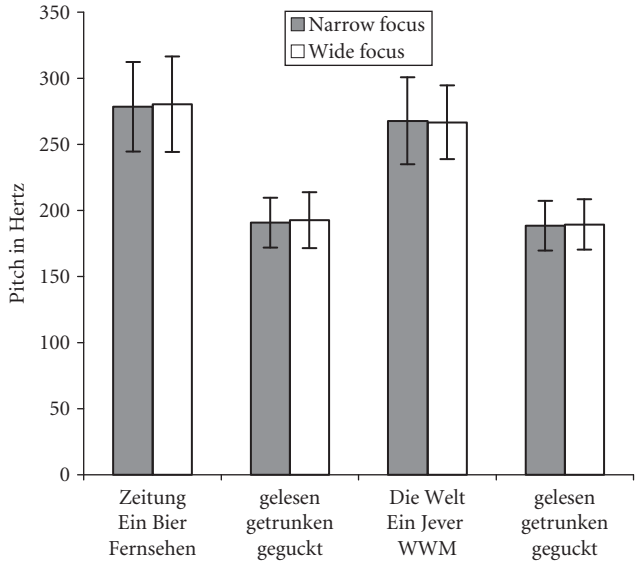

FIGURE 13.10 Averaged pitch accents in fo on the fronted objects of experiment 1. The first and third columns show the object (generic and specific) and the second and fourth columns stand for the verbs.

As predicted, in all sentences (altogether 360 realizations: 12 sentences x 30 subjects), a falling pitch accent was realized on the object and no other accent was present.

There was no difference in fo value between the narrow and the wide focus realization. All instances of the sentences were realized with a single accent on the object. There were some differences in the average fo of the objects and the verbs (see Figure 13.10). In the wide focus condition, the specific objects always had a lower pitch than the generic ones, but the difference is not significant[5] ($t = -0.543$, $df = 54.379$, $p = 0.5893$) and does not relate to the difference in focus context of interest here.[6] Thus no comparison regarding wide or narrow focus was significant ($t = -0.1571$, $df = 693.785$, $p = 0.8752$). No difference in height between an accent on the fronted object in a wide focus context and an accent on the same fronted object in a narrow focus

[5] I am grateful to Heiner Drenhaus for helping me with the statistical analysis of these data. A survey of additional experiments with similar sentences is reported in Féry and Drenhaus (2008).

[6] The remaining comparisons are not significant: verbs in the wide focus condition ($t = 1.0112$, $df = 170.951$, $p = 0.3134$), objects in the narrow focus condition ($t = 0.4405$, $df = 171.677$, $p = 0.6601$), and verbs in the narrow focus condition ($t = 0.9323$, $df = 171.772$, $p = 0.3525$).

context could be found. This result is compatible with the assumption that there is only one p-phrase, and that, in this case, the height of the top line of the p-phrase does not vary because there is no other register to which the unique p-phrase could adjust. For this reason, the pitch accents are scaled to a top line which is identical in the wide focus and in the narrow focus conditions.

13.3.3.2 *Subject + verb and object + verb* In a second experiment, sentences consisting of subject + verb or of object + verb were tested. This experiment shows with another very simple syntactic structure that, if there is only one accent, and thus one p-phrase in the relevant VP, no change in fo value takes place in a narrow focus condition. But as soon as there are two accents in an all-new sentence corresponding to two p-phrases, the height of both accents is affected when a narrow focus is introduced. In such a case, the scaling of the accents is changed. These sentences were again tested in a production experiment, this time with fifteen female German students. The experimental sentences are illustrated in (12) to (15). They were inserted both in a wide focus (WF) and in a narrow focus (NF) conditions. There were four conditions, thus a 2×2 factorial design, and six sentences were constructed for each condition. Altogether 360 realizations were produced.[7]

(12) Subject, WF:
Q: {Why can't I find the ball?}
A: Nun, wahrscheinlich haben ihn [die Kinder mitgenommen]$_F$.
well probably have it$_{ACC}$ the children taken-away
'Well, probably the children took it away.'

(13) Subject, NF:
Q: {Who took the ball away?}
A: Nun, wahrscheinlich haben ihn [die Kinder]$_F$ mitgenommen.

(14) Object, WF:
Q: {What did the children do?}
A: Nun, wahrscheinlich haben sie [den Ball mitgenommen]$_F$.
well probably have they the ball taken-away
'Well, probably they took the ball away.'

(15) Object, NF:
Q: {What did the children take away?}
A: Nun, wahrscheinlich haben sie [den Ball]$_F$ mitgenommen.

[7] Similar sentences in Hungarian and Japanese will be compared to German (see Ishihara and Féry, in prep).

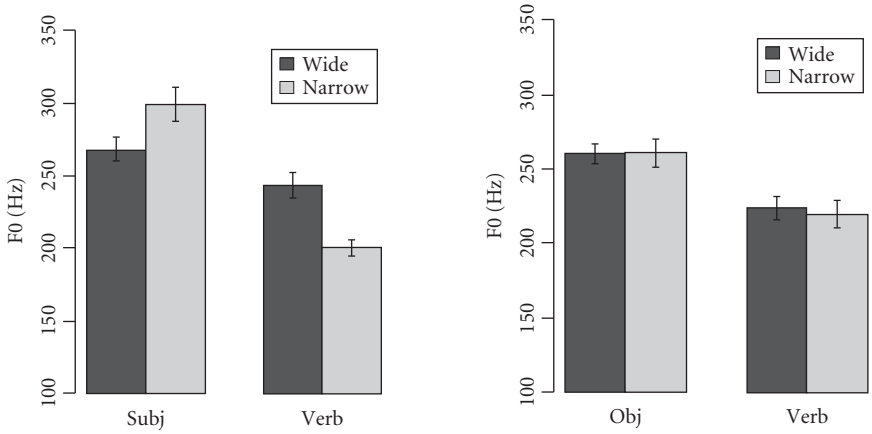

FIGURE 13.11 Mean fo-peak on the argument and on the verb (with 95% confidence interval).

The subject and the object sentences had a different accent pattern. An accent was always realized on the subject or on the object, but (16) shows that an accent was also sometimes realized on the verb in the subject sentences in the wide context condition (51 times in 90 utterances, 57 percent of the time). Otherwise no accent was produced on the verb, except for one case in an object sentence in the wide focus condition, which can be analyzed as a performance error.

(16) Realized pitch accents on the verb

Subject sentences in wide focus	51 (57%)
Subject/Object sentences in narrow focus	0 (0%)
Object sentences in wide focus	1 (1%)

Figure 13.11 shows the pitch height on the verb and on the subject/object in all conditions.

Because of the optional accent on the verb in the subject sentences, the verb was scaled significantly higher in the wide focus context than in the narrow focus context. This happened only in the subject sentences. The pitch accent on the verb in 57 percent of the cases had the effect of considerably raising the average fo of this constituent.

A secondary effect of the optional accent on the verb was a difference in the height of the pitch accent on the subject, which was higher in the narrow focus condition (when the verb was never accented) than in the wide focus condition (when the verb was sometimes accented).

Turning to the fo value of the unique accent in the object sentences, there was no significant difference between the pitch accent heights in the narrow and the wide contexts. This result confirms what was observed in the preceding experiment. The difference between the accent pattern and the concomitant fo value of the constituents is explained by phrasing. The object and the verb form only one p-phrase, both in the all-new and in the narrow focus contexts (Krifka 1984; Jacobs 1993), and, as a consequence, no change occurs in the scaling of the accents.

The subject, in contrast, optionally appears in a separate p-phrase. Following a suggestion by Gisbert Fanselow (p. c.), the subject can syntactically remain in situ in the VP, which leads to a unique p-phrase, as we saw above for the unaccusative sentences, or the subject may be fronted into the Spec IP position. In this latter case, the subject and the verb are separated in two p-phrases; see Fanselow (2004) and Frey (2004) for 'stylistic' or 'formal' fronting of one constituent in V2 sentences. The difference in phrasing between the object and the subject sentences is illustrated in (17). In (17a,b), the two options for the verb are shown for the subject sentences, and (17c) shows the unique phrasing in the object sentences.

(17) Phrasing in subject and object sentences

Subj:	a.	$[_{TP}$ Aux O_{pron}	S V$]_P$		
	b.	$[_{TP}$ Aux O_{pron}	$S_i]_P$ $[_{vP}$ t_i	V$]_P$	
Obj:	c.	[Aux S_{pron} O	V$]_P$		

The difference in phrasing correlates with a difference in metrical structure. Every p-phrase has a head, which means that the two phrasing options for the subject sentences in (17) correspond to different accent patterns, shown in (18) for the wide focus context. Both (18a) and (18c) have only one p-phrase, and thus one metrical head, but (18b) has two heads.

(18) Metrical pattern in the subject and object sentences in the wide focus context

	×	
a.	(S	V$)_P$
	×	×
b.	(S)	(V$)_P$
	×	
c.	(O	V$)_P$

The phrasing exemplified in (18) also corresponds to different register domains, as shown in Figure 13.12. (18a) and (18c) have only one p-phrase (Figure 13.12a). However (18b) has two p-phrases (Figure 13.12b).

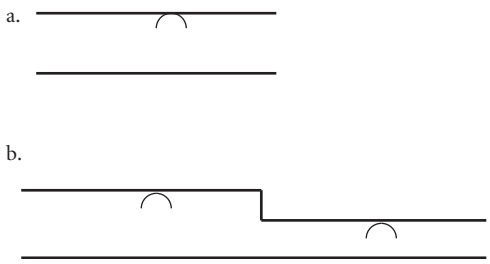

FIGURE 13.12 Difference in phrasing between the object and the subject sentences of experiment 2.

Consider next what happens in the narrow focus condition, as illustrated in Figure 13.13. In the conditions (18a) and (18c), shown in Figure 13.13a, nothing changes when the unique accent stands for a narrow focus. The register domain corresponding to the unique p-phrase has no other domain to which it can adjust. But in Figure 13.13b, narrow focus on the subject raises the top line of the first p-phrase, and lowers the top line of the second p-phrase, at least in those cases in which the subject is in a different p-phrase from the verb.

The pattern shown in Figure 13.13 provides an explanation for the last property of the results in Figure 13.11, namely the difference in height between the fo value of the subject and that of the object in the narrow focus condition. This value is higher on the subject than on the object. In the subject sentences with two p-phrases, a narrow focus has the effect of raising the corresponding top line, as shown in Figure 13.13b. Raising the top line is a purely relational effect, in which the register of one p-phrase is changed relative to the register of another p-phrase. In the object sentences and in the remaining cases of

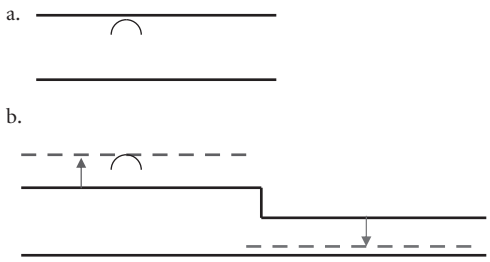

FIGURE 13.13 Pitch register change in the two p-phrases environment.

subject sentences, no readjustment is needed, since there is only one p-phrase. The verb has no accent in both cases, but the reason for the absence of accent is different. In the object sentences and in part of the subject sentence, this is due to the fact that only one p-phrase is formed on the entire sentence. In half of the subject sentences, the absence of pitch accent is due to compression of the post-nuclear register. These are the cases which relate to an increase of the height of the pitch accent on the subject, as shown in Figure 13.13b.

The metrical structure alone cannot account for this difference. It is sometimes assumed that a focus projects a pitch accent at a certain level of the prosodic structure (see, for instance, Selkirk 2002). Then both in (19a) and in (19b), an additional prominence is needed on the argument. Such a representation, however, leads to the expectation that the pitch height of a narrow focus does not depend on the presence of additional p-phrases. The pitch accents of the narrowly focused subject and object are expected to be identical, contrary to what we observe.

(19) Metrical pattern in the subject and object sentences in the narrow focus context

	×		×
	×		× ×
a.	$(S_F/O_F\ V)_P$	b.	$(S_F)(V)_P$

Also, if the metrical structure only reflects the relationship between accents, the difference between object and subject sentences just accounted for is unexpected. In both cases, a higher column of beats corresponds to a stronger pitch accent.

13.4 Discussion and conclusion

In short, the data presented in section 13.2 confirm that p-phrasing and metrical structure are not sufficient to account for all fo values observed in declarative sentences in German. A third component is needed which accounts for the relative scaling of accents. This component has been shown to be an abstract modeling of fo registers corresponding to p-phrases.

Traditionally it has been assumed that pitch accents can change their height on an individual basis: a narrowly focused word is higher than it would be in an all-new context. Similarly a given constituent has a lower fo value. In other words, accents are changed one by one.

The new perspective introduced in this paper is that the fo height of pitch accents is interpreted in relationship to neighboring accents. A change in one part of a sentence triggers changes in the other parts of the sentence.

Accents are purely relational. This explains why some narrowly focused accents increase their height while others do not. In particular, an accent as the head of a unique p-phrase does not change its value when its information structure is changed. This has been demonstrated with data involving object fronting, as well as with the object sentences of experiment 2. However when an accent standing for a narrow focus is in a sentence containing more than one p-phrase, the scaling of fo values is modified, and a narrow focus increases the fo height. This was illustrated with the subject sentences of experiment 2.