The Phonology of Second Occurrence Focus

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This paper investigates the question of whether and how ‘Second Occurrence Focus’ (SOF) is realized phonetically in German. The apparent lack of phonetic marking on SOF has raised much discussion on the semantic theory of focus (Partee 1999, Rooth 1992). Some researchers have reported the existence of phonetic marking of SOF in the postnuclear area (Rooth 1996, Beaver et al. 2007). In our experimental study with German sentences, we examined sentences both with prenuclear SOF and with postnuclear SOF, comparing them with their first occurrence focus (FOF) and non-focus counterparts. The results show that the phonetic prominence of focus (higher pitch/longer duration) is realized differently according to the type of focus as well as according to the position of the target expression. We account for these differences by considering several phonetic effects, those that are information structure-related and those that are phonologically motivated.

Keywords: Second Occurrence Focus (SOF), German, prosody

1. INTRODUCTION

The phonetic realization of ‘Second Occurrence Focus’ (SOF) is related to the question of the interface between LF and PF in grammar. In this paper, we investigate the question of whether and how SOF is realized phonetically in German. Our experiment provides novel data, in that phonetic realization of SOF expressions is examined in two different phonological environments: in a postnuclear area, which all the preceding studies have looked at, and in the prenuclear area. It will be shown that prenuclear SOF has different phonetic realization from postnuclear SOF.

After an overview of the theoretical issues of SOF and a discussion of the problems that it presents for the model of grammar in the next section, the experiments are discussed in sections 3 to 5. In sections 3 and 4, the production experiment is addressed, and in section 5, the perception experiment. A discussion follows in section 6. The paper ends with a conclusion in section 7.
2. THEORETICAL BACKGROUND

The phenomenon of second occurrence focus (SOF) was first described by Partee (1999: 215–216) in the following terms:

If only is a focus sensitive operator (i.e., needs an intonationally prominent element in its scope), then the two occurrences of only eats vegetables in [(1)] should have the same analysis. However, if there is no phonological reflex of focus in the second occurrence of vegetables, then this leads to the notion of “phonologically invisible focus”. The notion of inaudible foci at best would force the recognition of a multiplicity of different notions of ‘focus’ and at worst might lead to a fundamentally incoherent notion of focus.

(1) (a) Everyone already knew that Mary only eats [vegetables]$_F$

(b) If even [Paul]$_F$ knew that Mary only eats [vegetables]$_{SOF}$, then he should have suggested a different restaurant.

Partee indirectly assumes an obligatory phonetic realization of focus. If there are foci without accents, no coherent notion of focus can be obtained. As Krifka (2004: 190) puts it (his Hypothesis I): ‘If an operator is analyzed as focus-sensitive (i.e., associated with a focus) in one type of use, it must be analyzed as focus-sensitive (associated with a focus) in all types of use’. Association with focus, an expression coined by Jackendoff (1972), means explicitly that certain expressions have a focus in their syntactic domain, where focus is specified by a syntactic feature F, which in turn is realized by intonational prominence. The conclusion one has to draw from Partee’s comment is that if there is no phonological correlate on a SOF, then there is also no focus.

Following Rooth (1992, 1999), researchers such as Bartels (2004), von Fintel (2004), Krifka (2004), and Beaver et al. (2007) distinguish (though not necessarily with the same terminology) between two types of theories of focus: ‘weak’ grammaticized theories of focus, which need both a focus-marking F and a phonological (and phonetic) realization of focus, and ‘strong’ theories of focus, in which the relationship between focus and grammar functions in a laxer manner, and resolution of focus is pragmatic. In the latter view, the quantificational domains of some operators may be restricted contextually or situationally. This model predicts that focus can be left phonetically unrealized, since focus does not need to be
grammatically marked. All the authors assume that the phonetic realization of focus is crucial for deciding between the semantic theories. Krifka (2004) takes for granted Partee’s claim that SOF is ‘inaudible’, but other authors, like Rooth (1996), Bartels (2004) and Beaver et al. (2007), answer Partee’s challenge by proving that SOF is phonetically realized. The different opinions correlate with different views about strong and weak interpretations of focus.

Rooth, Bartels and Beaver et al. have conducted experiments to investigate whether SOF expressions are realized phonetically. Examples of the experimental material used by Beaver et al. to show the phonetic realization of SOF appear in (2) and (3).

(2) (a) Both Sid and his accomplices should have been named in this morning’s court session.
    (b) But the defendant only named [Sid]F in court today.
    (c) Even [the state prosecutor]F only named [Sid]SOF in court today.

(3) (a) Defense and Prosecution had agreed to implicate Sid both in court and on television.
    (b) Still, the defense attorney only named Sid [in court]F today.
    (c) Even [the state prosecutor]F only named Sid [in court]SOF today.

In the examples above, the areas of interest are both the first and the second postverbal phrases (NP Sid and PP in court) of the last sentence in a discourse (=c). The (a) sentence first introduces a context in which both phrases are new. Then the (b) sentence introduces a context in which one of the phrases is a first occurrence focus (FOF)—Sid in (2), and in court in (3)—and the other one is in the background. In (c), the FOF in (b) is now a SOF and the other phrase is still part of the background. The SOF effect is obtained by realizing a new focus in (c) (the state prosecutor) with a nuclear pitch accent, and by simply repeating the postverbal phrases. But, since one of them is still in the restrictor of the ‘old’ focus operator only, it is also focused. The phonetic realization of this focus, however, is much more subtle than that of the FOF in the (b) examples, and hence raises the question formulated by Partee. The researchers mentioned above (Rooth 1996, Bartels 2004, Beaver et al. 2007) all find some phonetic correlates of focus, though no pitch accent.
In the remainder of this section, we first address the question of the phonetic correlates of SOF. The second question has to do with the relevance of the phonetic facts for the model of grammar, and more specifically, whether it is correct to base a semantic theory on the presence or absence of phonetic correlates of SOF.

2.1 Phonetic correlates of SOF

Rooth (1996), Bartels (2004), Jaeger (2004) and Beaver et al. (2007) examine phonetic properties of SOF expressions, and find no or only a very slight increase in pitch on the SOF as compared to the counterparts in the minimal pair examples. They find instead other phonetic correlates, like a small increase in duration (an average of 6 ms in Beaver et al.). On the basis of such results, all the authors conclude that the prominence on SOF is different from a plain pitch accent. Rooth (1996, 2009) calls it a ‘metrical accent’, and Beaver et al. a ‘phrasal stress’, which differs formally from a pitch accent. According to them, focus is marked both by phrasal stress and a nuclear pitch accent, whereas SOF is marked only by phrasal stress.

In an utterance like (2c), the SOF Sid is a focus by virtue of being associated with a focus operator, but crucially, it is embedded in a larger expression which is itself discourse-given, and which is usually realized in a lower pitch than discourse-new material (cf. Sugahara 2003, Ishihara 2004 for similar claims for Japanese). Furthermore, SOF typically appears in a postnuclear area, because it very often follows the FOF, which obligatorily attracts the nuclear pitch accent. That is, SOF typically appears in an environment where no pitch accent can be placed due to postnuclear deaccenting. As a result, SOF expressions are usually realized with a compressed or deaccented pitch contour. The question which all the experiments on SOF mentioned above have explicitly or implicitly attempted to answer is whether the phonetic correlates of focus associated with a focus operator can be detected in such an environment, where pitch realization is generally suppressed regardless of information structural status. This is of course an important question to be answered, because this is exactly where the debate came from.

In this study, we approach this question differently: we examine phonetic realizations of pre- and postnuclear SOF, and compare them, as well as compare them with FOF and non-focus expressions. This approach allows us to examine pure phonetic effects of focus that are not affected by additional effects such as postnuclear deaccenting. We will claim that the phonetic correlates of SOF first result from the combination of being focused and being
given, and second vary according to its position in the sentence. We will show below that in a prenuclear position, there is pitch prominence on SOF as compared to its non-focused counterpart. Our experiment was conducted with German data, but we expect that our general conclusions are valid for English as well, since those aspects of intonation which bear on SOF are similar in both languages.

There are also a few other pieces of evidence showing that SOF is phonologically marked. Rooth (1996), Krifka (2004), and Von Fintel (2004) mention the absence of weak pronouns in a SOF location as another important clue for the special status of these items. Second Occurrence Focus on a pronoun blocks cliticization. Compare the data in (4). The sentences in (4b) and (4c) are SOF. As shown in (4c) the cliticized rendition of the pronoun is not possible in this context. This set of data is relevant for the discussion of whether SOF is accented or not, despite the absence of pitch accent, and seems to indicate that it is.

(4) Pronouns

(a) Mary’s boyfriend only likes her

(b) Even her boss only likes her

(c) # Even her boss only likser

As discussed most forcefully by Rooth (2004, 2009), the SOF sentences are to be considered in their context. They involve two foci embedded in each other where First Occurrence Focus has wider scope than SOF (see also Büring 2006 for this observation). Rooth (2004: 480) shows, with sentences like those in (5), that SOF is not just a matter of syntactic parallelism, involving repeated phonetic material. New material in (5B) can stand for first occurrence focused constituents in (5A). The point is important because it eliminates analyses relying on the mere copying of phonological material.

(5) A: The provost and the dean aren’t taking any candidates other than Susan and Harold seriously.

B: Even the [CHAIRman]F is only considering [younger]SOF candidates.
2.2 Phonetic realization of SOF and postnuclearity

It is important to pin down the phonetic and phonological correlates of SOF, since the argument regarding its being accented or not has been crucial in the discussion about the best interpretation of focus. To achieve this goal, it is also important to take into consideration additional phonological factors that may involve the realization of SOF expressions. We point out in this section that pre- and postnuclearity is one such factor to be taken care of.

The accent status of SOF has been considered a major point of debate for deciding between weak and strong theories of semantic focus. In weak versions, only is a focus operator (in the same way as even, also or some adverbs), and as such it is expected to be associated with an element bearing an accent. If there is no accent on the element over which it takes scope, two solutions are possible. The first one is to claim that only has at least two interpretations, one associated with focus, and the other one not. This is the worst case, which no researcher has been willing to defend (see Partee’s comment above). The other interpretation implies giving up the obligatoriness of association with focus, and endorsing the view that it is optional. In this latter solution, the domain of quantification is based on pragmatic reasoning, like letting contextual factors play a role. A sentence like (6), for example, does not mean that there is no sunshine on earth, but has to be understood as a comment on a contextually given place in which the speaker is located, or about which she has some knowledge. In other words, the restrictor of the quantifier no sunshine is further restricted by the context of utterance.

(6) There is no sunshine.

The ‘strong’ theory of focus, on the other hand, assumes that focus operators are like quantifiers and that their domain can be restricted by context and only by context. Rooth shows with the help of examples like (7) that the domain of only can be fixed by the context variable of the preceding expression. As a result, accents on elements in the scope of a focus operator may be absent. In (7), rice in the main clause is expected to be focused because it is associated with only. Thus it should have an accent. But instead, an accent is present on eat because of the contrast with grow. The explanation for the absence of an accent on rice is that the domain of quantification is pragmatically driven. This happens entirely without the help of focus. The context of grow rice and the context of eat rice are anaphorically related, and define a given environment for each other. Rooth assumes that there is no focus on rice, and
takes this fact as evidence that focus-sensitive effects are optional, arguing for the strong theory of focus.

(7) People who \([\text{grow}]_F \text{rice}\) usually only \([\text{eat}]_F \text{rice}\).

It should be noted, however, that the phonetic marking of focus can be masked by independent phonetic/phonological effects, as Rooth (2009) recognizes. The discussion regarding the strong/weak theories of focus is based on a tacit assumption that focus is *always* phonetically marked. Given this assumption, if no phonetic marking is found on a phrase, it has to be treated as a non-focused element. Association with focus, or the lack thereof, has been judged based on the existence/absence of phonetic marking (in most cases, pitch accent) on the phrase that is in the quantificational domain of focus operators.

Rooth’s (2004) explanation for the absence of accent on *rice* predicts that if this noun is expanded with a relative clause like *that absorbs a lot of water*, as in (7’), the entire complex noun phrase should be deaccented in both clauses, since the anaphoric effect he postulates on the context should be observed in the larger NP as well. This does not seem to be true though, since the first occurrence of *water* is preferably accented.

(7’) People who \([\text{grow}]_F \text{rice that absorbs a lot of water}\) usually only \([\text{eat}]_F \text{rice that absorbs a lot of water}\).

In our opinion, there is an alternative explanation for the absence of accent on *rice* in a sentence like (7), as there could be in the sentences (2) and (3), which has nothing to do with contextual or anaphoric quantification. *Rice* could be deaccented on prosodic grounds (see Féry & Samek-Lodovici 2006 for such an explanation). In (7), an accent on *rice* would compete with the adjacent accent on *eat*, and the latter one wins because it has an additional contrast value that *rice* does not have. Furthermore, the SOF expressions in (2) could be deaccented because they are found in a postnuclear environment, in which no pitch accent can be realized. We find that deaccenting, or at least a strong reduction of pitch accents, is a consequence of postnuclearity, a phonological effect that is independent of the focus or non-focus status of SOF, an effect compatible with Rooth’s and Beaver et al.’s results. But we also find that SOF expressions are accented when they are prenuclear. As soon as SOF expressions are in a phonological environment where they can be accented, they are accented. This is demonstrated in the next section.
3. Production Experiment

3.1 Stimuli and hypotheses

In order to distinguish phonetic correlates of SOF and other factors such as postnuclear deaccenting, we investigated realizations of SOF in a prenuclear position as well as those in a postnuclear position in our material.

Six expressions, underlined in (8), were chosen as the target expressions. Three of the target expressions (8a–c) were inserted in the subject position, and three (8d–f) in the object position. Hereafter, we will call the former group the subject set and the latter the object set. Three different focus operators were used in our stimuli: nur ‘only’, auch ‘also’ and sogar ‘even’, as shown in (8).

(8) Stimulus expressions (see appendix for all conditions)

(a) Nur Peter hat eine Krawatte getragen.
only Peter has a tie worn
‘Only Peter wore a tie.’

(b) Auch Melina hat beim Aufbau mitgeholfen.
also Melina has at.the set-up helped
‘Melina, too, helped set up.’

(c) Sogar Monika hat Mailand geliebt.
even Monika has Milan loved
‘Even Monika loved Milan.’

(d) Eva hat nur ihren Bruder eingeladen.
Eva has only her brother invited
‘Eva only invited her brother.’

(e) Ingo hat auch einen Jaguar gekauft.
Ingo has also a Jaguar bought
‘Ingo also bought a Jaguar.’

(f) Michael hat sogar ein Lied gesungen.
Michael has even a song sung
‘Michael even sang a song.’

Each expression is inserted in five different contexts, illustrated in (9): (9a) FOF, (9b) prenuclear SOF, (9c) postnuclear SOF, (9d) prenuclear Non-Focus, and (9e) postnuclear Non-
Focus context. Thanks to the V2 property of German, we can place SOF and Non-Focus expressions in different locations, either sentence-initially (prefield) or sentence-medially (middle field). When SOF and Non-Focus are in the sentence-initial position, they are followed by a nuclear pitch accent in the middle field. We call them ‘prenuclear SOF’ and ‘prenuclear Non-Focus’, respectively. When they are in the sentence-medial position, they are preceded by a nuclear accent in the sentence-initial position, hence becoming the ‘postnuclear SOF/Non-Focus’. SOF interpretation is elicited by providing the FOF sentence (9a) as a context, as shown in (9b) and (9c). In the Non-Focus conditions, (9d) and (9e), the target words are already mentioned in the preceding wh-questions, and no focus operator is involved.

(9) Contexts for one sentence of the subject set ((1a–e) in the appendix)

(a) FOF

Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen. Nur Peter hat eine Krawatte getragen.

‘Most of our colleagues were dressed casually at the staff outing.’

(b) SOF: Prenuclear

Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen. Nur Peter hat eine Krawatte getragen.

‘Only Peter wore a tie.’

(c) SOF: Postnuclear

Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen. Nur Peter hat eine Krawatte getragen.

‘Only Peter even wore a suit.’
(d) Non-Focus: Prenuclear
Wen hat Peter geküsst?
who,ACC has Peter kissed
‘Who did Peter kiss?’

Peter hat Maria geküsst.
‘Peter kissed Maria.’

(c) Non-Focus: Postnuclear
Wen hat Peter geküsst?

Maria hat Peter geküsst.

As for the FOF context, the (a) sentences in the subject set ((1a)–(3a) in the appendix) contain FOF expressions in a sentence-initial position, while those in the object set ((4a)–(6a) in the appendix) contain FOF expressions in the sentence-medial position. One of the sentence-medial FOF examples (i.e., (a) examples in the object set) is given in (10).

(10) FOF context for one of the object sets ((4a) in the appendix)

Viele Frauen haben mehrere Verwandte zum Dorffest eingeladen.
many women have several relatives to the village fair invited
‘Many women invited several relatives to the village fair.’

Aber Eva hat nur ihren Bruder eingeladen.
but Eva has only her brother invited
‘But Eva only invited her brother.’

In sum, our material has six different conditions, with two factors being alternated: position in the sentence (pre- and postnuclear, or sentence-initial and medial) and focus type (FOF, SOF, Non-Focus). Since our design is not a complete 2 × 3 factorial design (because the subject set lacks postnuclear FOF data, and the object set lacks the prenuclear FOF data), we need to separate the data set into two groups when we compare the FOF conditions with others.

With this material, we will examine the following two hypotheses in (11). First, we expect to find a three-way difference between FOF, SOF, and Non-Focus, FOF being the most prominent and Non-Focus the least (Hypothesis 1). Second, we also expect different realizations according to location in a sentence, the sentence-initial expressions being more
prominent than the sentence-medial counterparts (Hypothesis 2). This is expected to hold for FOF, SOF and Non-Focus. We used the term ‘sentence-initial/medial’ (instead of pre-/postnuclear) to cover all the three focus conditions (FOF/SOF/Non-Focus) in terms of sentence position. (Note that FOF always attracts the nuclear accent of the sentence and hence never appears pre- or postnuclearly.) We use the term ‘prominence’ as a cover term for both pitch and duration.

(11) Hypotheses

(a) Hypothesis 1:
FOF words are more prominent than SOF words, which are themselves more prominent than Non-Focus words.

(b) Hypothesis 2:
Sentence-initial words are more prominent than sentence-medial ones.

3.2 Recordings

Recordings were made in a sound-proof booth on a DAT recorder. A short set of instructions familiarized the subjects with the procedure and made them practice with a few examples. The contexts and answers were presented in a PowerPoint presentation, in a series of two slides per stimulus. On the first slide, the context was presented both acoustically and visually, and the target sentence appeared on the second slide. The informant read the sentences as naturally as possible. The experiment was self-paced and the speakers were instructed to repeat the sentences if they felt that they had made a mistake.

The 30 sentences used for this experiment were part of a larger production experiment, including 200 sentences altogether. Each context was organized in one block of the 6 different sentences. The blocks were separated from each other by 17 or 20 other sentences.

Our speakers were 29 female students at the University of Potsdam. They were reimbursed for their time. They were monolingual speakers of German in their twenties, coming from the Northern area of Germany.
3.3 Measurements

The recordings were analyzed using the acoustic speech analysis software Praat© (Boersma & Weenink 1994–2008). The sound waves were manually divided into labeled sub-strings with the help of spectrograms. The divisions assigned one or two domains of measurements, depending on whether there was an article (or a possessive) preceding the target noun. In (12a) only one domain was defined, whereas in (12b), two were needed. The measurement on the article was necessary because in many cases, the falling nuclear accent started on the syllable preceding the accented syllable, a phenomenon called ‘early peak’. This is well documented in the literature on German intonation (Kohler 1990), and it is visible in Figure 1-ii below.

(12) (a) Nur # Peter # hat sogar einen Anzug getragen.
‘Only Peter even wore a suit.’

(b) Auch Maria hat nur # ihren # Bruder # eingeladen.
‘Also Maria only invited her brother.’

Two values were measured. First, the highest peak of the domain defined by the target noun (plus the preceding article when present), and second, the duration of the target noun (not including the article). The values were assigned by a script in Praat, but the authors manually verified all the sentences. In approximately 30% of the cases, changes were necessary because of microprosodic distortions in the pitch tracks (especially in the nouns Peter and Monika). Statistic analyses were done using the statistical computing environment R.

4. RESULTS

Figure 1 illustrates examples of realizations for the six contexts: (i) sentence-initial FOF, (ii) sentence-medial FOF, (iii) prenuclear SOF, (iv) postnuclear SOF, (v) prenuclear Non-Focus, and (vi) postnuclear Non-Focus. From these pitch tracks one can see that sentence-initial/medial FOF (i.e., nuclear elements) (i, ii) as well as prenuclear SOF/Non-Focus (iii, v) preserve accents of the target expression (Peter, Bruder), but that this is not true for postnuclear SOF/Non-Focus (iv, vi).
The speakers were extremely consistent in their renditions of the sentences, and only very little variation in phrasing and height of pitch accents could be established, so that we can propose a unified prosodic structure for our sentences, as illustrated in (13). The preverbal
argument was phrased individually in its own p-phrase, and carried a rising bitonal tone if it was a prenuclear accent (13b, c, e), or a falling bitonal tone if it was the nuclear accent (13a, d, f). The trailing tone was at the same time the boundary tone of the p-phrase. The VP was also forming its own p-phrase and it was always ended by a low boundary tone of the intonation phrase which contained the entire sentence. The argument contained in the VP was forming its own p-phrase, and carried a bitonal falling tone when it was the nuclear accent, and no accent otherwise. We assume that phrasing is dependent on the syntax, and can be recursive, whereas the height of individual accents is determined by information structure (see Féry & Ishihara 2009 for a more detailed version of this model).

\[
\begin{align*}
\text{(13)} & \quad H^*L_p \quad \text{L}_I \\
\text{(a)} & \quad [[\text{Nur} \ \text{PETER}]_p [\text{hat} \ [\text{eine Krawatte}]_p \ \text{getragen}]_p]_l \\
\text{(b)} & \quad [\text{L}^* \ H_p \quad H^*L_p \quad \text{L}_I] \\
\text{(c)} & \quad [[\text{Nur} \ \text{ihren} \ \text{BRUDER}]_p [\text{hat} \ [\text{auch} \ \text{MARIA}]_p \ \text{eingeladen}]_p]_l \\
\text{(d)} & \quad [\text{H}^*L_p \quad \text{L}_I] \\
\text{(e)} & \quad [\text{L}^* \ H_p \quad H^*L_p \quad \text{L}_I] \\
\text{(f)} & \quad [[\text{EVA}]_p [\text{hat} \ [\text{ihren Bruder}]_p \ \text{eingeladen}]_p]_l
\end{align*}
\]

4.1 Pitch (F0)

Let us first consider Hypothesis 1, which claims that FOF is more prominent than SOF, which itself is more prominent than Non-Focus (FOF > SOF > Non-Focus). As mentioned in section 3.1, only the subject set has the sentence-initial FOF data, while only the object set has the sentence-medial FOF data. Therefore, comparison of the FOF conditions with SOF/Non-Focus is done by using the subject set data for sentence-initial FOF, and the object set data for sentence-medial FOF. Figures 2-i and 2-ii show the mean highest log-transformed F0 on the target expression in the sentence-initial contexts (the subject set data) and in the sentence-medial contexts (the object set data), respectively.
Figure 2: Mean log-transformed F0 for FOF/SOF/Non-Focus in sentence-initial/medial conditions (with 95% Confidence Interval)

Both sentence-initially (Figure 2-i) and sentence-medially (Figure 2-ii), FOF is realized significantly higher than SOF (sentence-initial: two-sided t-test, $t(166) = 2.1382$, p-value < 0.05; sentence-medial: $t(166) = 9.1975$, p-value < 0.001).\(^5\) Note, however, that the difference between FOF and SOF is much larger sentence-medially.

SOF and Non-Focus can be compared using the entire data set, that is from the subject and the object sets together, as displayed in Figure 3. The difference between SOF and Non-Focus is statistically significant both sentence-initially and medially (sentence-initial: $t(334) = 5.2528$, p < 0.001; sentence-medial: $t(334) = 2.1601$, p < 0.05).\(^6\)
This means that Hypothesis 1 is confirmed both sentence-initially and medially. However, the clear difference in the realization between the sentence-initial and the sentence-medial SOF still needs to be explained, because this very low realization of SOF has been the very origin of the discussion of SOF. This will be taken up in section 6.

In the next step, Hypothesis 2 (sentence-initial > sentence-medial) is examined for the SOF and Non-Focus contexts, using the entire data set, as shown in Figure 3. We see that Hypothesis 2 is confirmed: in SOF and Non-Focus conditions, sentence-initial expressions are realized higher than their sentence-medial counterparts. Both for the SOF and the Non-Focus contexts, the mean difference between pre- and postnuclear conditions is statistically significant (SOF: t(320.263) = 18.0173, p < 0.001; Non-Focus: t(334) = 14.372, p < 0.001). The two FOF conditions cannot be compared statistically since they are composed of different sentences. However, a glance at the values of FOF in sentence-initial and sentence-medial position in Figure 2 suggests that the sentence-initial FOF is realized higher than the sentence-medial FOF.

In sum, we have found the following for pitch:

(14) Summary for pitch

(a) Hypothesis 1 (focus type):
• In a sentence-initial/prenuclear position, the focus type hierarchy (FOF > SOF > Non-Focus) was established for pitch.
• In a sentence-medial/postnuclear position, the contrast between SOF and Non-Focus is radically reduced.

(b) Hypothesis 2 (sentence position):
• Prenuclear SOF/Non-Focus is realized higher than postnuclear SOF/Non-Focus.
• Sentence-initial FOF is expected to be realized higher than sentence-medial FOF.

4.2 Duration
In order to render the durations of target expressions comparable to each other, we performed a regression analysis to factor out the effect of the different word lengths in the target expressions. Figures 4-i and 4-ii show the mean residual durations of the target expressions in the sentence-initial contexts (obtained from the subject set) and in the sentence-medial contexts (obtained from the object set), respectively. A higher residual value indicates longer duration (i.e., negative values indicate shorter duration than positive ones).
Let us first consider the result in terms of Hypothesis 1 (i.e., FOF > SOF > Non-Focus hierarchy). Sentence-initially, there is no significant difference between FOF and SOF ($t(166) = 0.1175$, $p$-value = 0.9066), while the difference between them is significant sentence-medially ($t(166) = 3.704$, $p < 0.001$). Not surprisingly, the difference between FOF and Non-Focus is significant both sentence-initially and sentence-medially. The difference in duration between SOF and Non-Focus, which is analyzed based on a comparison involving all data shown in Figure 5, is significant both sentence-initially and medially (sentence-initial: $t(334) = 9.4808$, $p < 0.001$; sentence-medial: $t(334) = 7.0647$, $p < 0.001$). In sum, the lack of significant difference between sentence-initial FOF and SOF requires an explanation. Otherwise, Hypothesis 1 holds for duration.

Consider next the results of Hypothesis 2 (sentence-initial > sentence-medial) for duration. Figure 5 shows the mean residual duration of SOF and Non-Focus obtained from the entire data set. Once again, the FOF data cannot be compared as they consist of different sentences.
The contrast is significant in the SOF conditions \( t(307.259) = 6.0713, p < 0.001 \), but not in the Non-Focus conditions \( t(294.307) = 1.0052, p = 0.3156 \).

In sum, we have found the following for duration:

(15) Summary for duration

(a) Hypothesis 1 (focus type):
   - Sentence-initially, no significant difference between FOF and SOF could be found, but they are both longer than Non-Focus.
   - Sentence-medially, there is a significant difference between FOF and SOF, as well as between SOF and Non-Focus.

(b) Hypothesis 2 (sentence position):
   - SOF is longer sentence-initially than sentence-medially.
   - Non-Focus does not show any difference between the positions.

5. Perception experiment

A perception experiment bearing on the acceptability of our context-answer pairs was conducted in order to verify whether the sentences with SOF (and thus two focus operators) are accepted by German native speakers.

5.1 Method

36 students at the University of Potsdam participated in the experiment on acceptability judgment. The sentences in (8), in the contexts exemplified in (9b–e), were pre-recorded in the accent structure shown in Figure 1. One native speaker spoke the context sentences, and another the target sentences. The context-answer pairs were then inserted into a perception experiment containing a large number of fillers, run with an adapted version of Doug Rhodes’ program Linger, which randomized the order of presentation of the sentences for each participant. The sentences were presented acoustically only, over headphones. Each participant had 8 sentences to rate, two versions of each sentence, in a Latin Square design. Altogether, 4 different sets of sentences were presented. The aim of this experiment was to compare the acceptability of the SOF sentences with straightforwardly well-formed sentences. We chose to compare them with the non-focus versions of the same sentences, instead of with
the FOF versions, since the existence of pairs of sentences in both cases (prenuclear and sentence-medially) allowed a symmetry in the design of the experiment. The judgments were established on a scale from 1 to 7, 7 being the best and 1 the worst.

5.2 Results

The results are displayed in Figure 6.

As expected, the Non-Focus sentences got very high ratings (5.5 and 6) and can thus serve as a point of comparison. As for the SOF sentences, both of them got scores above 3.5, an indication that they are accepted by German speakers, even though their markedness may render them difficult to process. The postnuclear version was rated higher (4.5) than the prenuclear one (3.6). We assume that the presence of two focus operators in a single sentence renders the semantic processing rather difficult, and that a side effect of this increase in processing effort is a reduction in their acceptability (see for instance Fanselow & Frisch 2005 for this effect).
6. DISCUSSION

6.1 Interpretation of the experimental results

Hypothesis 1 claims that the focus hierarchy FOF > SOF > Non-Focus is implemented by means of the phonetic correlates of pitch and duration. Hypothesis 2 expects pitch and duration to have a greater effect sentence-initially than sentence-medially. The experimental results generally support these hypotheses despite cases where the expected differences were not found. These cases are explained below.

Beaver et al. (2007) find that duration exhibits more reliable cues for SOF than pitch in the postnuclear position. We find that pitch is reliable prenuclearly, since pitch height in a SOF expression is lower than in a FOF but higher than in a Non-Focus one. Prenuclearly, on the other hand, pitch can be considered as less reliable, as the difference found was minimal. This observation is in line with Rooth’s and Beaver et al.’s results. Additionally, we find that, prenuclearly, duration only contrasts focused items with non-focused ones—the former are longer than the latter—and does not distinguish between FOF and SOF. Prenuclearly, however, we again find the FOF > SOF > Non-Focus hierarchy. We also find an effect of duration depending on the position in the sentence. Early focused items are longer than late ones. This result does not apply for Non-Focus. Clearly, a new interpretation is needed.

As shown in the results, pitch and duration were implemented differently in our target expressions, but both covaried with the information structure as well as with the phonology. We thus propose to formally distinguish two types of effects that affect the realization of FOF/SOF/Non-Focus: information structure-driven effects on the one hand, and purely phonological effects on the other hand. The information structure-driven effects yield the focus type hierarchy in Hypothesis 1, both in sentence-initial and medial contexts. However, phonological effects, some of which yield the effects related to the sentence position hierarchy in Hypothesis 2, interfere with the realization of the information structure-driven effects, and suppress or overwrite them in certain contexts.

The information structural effects are summed up in (16).

(16) Information structure-driven effects

(a) Focus boosts prominence (higher pitch/longer duration).

(b) Givenness weakens prominence (lower pitch/shorter duration).
In effect, information structure-driven effects create the FOF > SOF > Non-Focus hierarchy. Focused material (FOF/SOF) is realized with higher pitch and longer duration than Non-Focus. Given material (SOF/Non-Focus), in contrast, gets a weaker prominence. FOF, being only focus, is the most prominent of all conditions, and Non-Focus, being only given, is the least prominent. SOF, being both focused and given, underlies both effects. As a result, it is realized more prominently than Non-Focus, but less so than FOF.

In addition to these effects, pitch and duration are also affected by purely phonological factors:

(17) Phonologically driven effects

(a) Downstep decreases the height of non-initial accents.

(b) Postnuclear deaccenting suppresses postnuclear accents.

(c) Final lengthening in phonological phrases increases duration.

These factors obliterate or enhance the information structure-related effects in different contexts, creating more variety in the phonetic realization than we would expect if only information structure-driven effects were at play. The next two subsections discuss how the information structure-driven effects and the phonologically driven effects interact in pitch and duration realization.

6.2 Pitch

If we think of sentences with a neutral focus structure (in which the whole sentence is presentational or ‘all-new’) as having a default pitch contour, we can draw an idealized tonal top line of registers like the one in (18), see Féry & Ishihara (2009) for a detailed presentation of our model. In the course of a sentence, accents are downstepped relatively to immediately preceding ones (see Pierrehumbert 1980 for English, Féry & Kügler 2008 for German). A pitch accent later in a sentence is therefore realized lower than a sentence-initial pitch accent. Accordingly, sentence-initial FOF is expected to be realized higher than sentence-medial FOF, because the latter is not the first accented element in its sentence and is subject to downstep (see Figure 2).
In the illustrations hereafter, the continuous double lines show the highest value of the default intonation contour, i.e., the level of high accentual peaks. Note that the form of the accents in the illustrations can stand for both a rise (LH) and a fall (HL). The only important point is the accentual H, which is involved in downstep.

(18) Downstep on non-initial pitch accents (= (17a))

Considering the pitch configuration (18) as the default case, we can now show the effect of narrow focus on pitch as raising the top line; see (16a). In (19), this is illustrated first for a sentence-initial accent. The continuous double line shows the same value as in (18), but now the high tone of a focus accent is higher than in a sentence without narrow focus, as indicated by the single line. Such a configuration was visible in Figure 1-i above, with a sentence-initial FOF, where there is an early narrow focus.

(19) Sentence-initial raising due to narrow focus (= (16a)); see Figure 1-i: sentence-initial FOF

Top line raising because of narrow focus can also take place sentence-medially, as shown in (20). Such a configuration arose in our data in the sentences with sentence-medial FOF (see Figure 1-ii). The second accent was still clearly lower relative to the first one, under the influence of downstep. Notice that our data do not contain neutral sentences such as illustrated in (18), so that we cannot show the raising. But we rely on other studies on German which establish the raising effect of narrow focus on a late accent (see Uhmann 1991, Féry & Kügler 2008 among others).
Counteracting the raising effect of focus, a lowering effect due to givenness (16b) is also identifiable, as in (21), which illustrates a prenuclear Non-Focus (cf. Figure 1-v).

(21)   Sentence-initial lowering due to givenness (= (16b)); see Figure 1-v: prenuclear Non-Focus

A prenuclear SOF is lower than a sentence-initial FOF because it is influenced by both the raising factor shown in (19) and the lowering effect shown in (21). But it is higher than a prenuclear Non-Focus, which is only affected by a lowering factor. (22) illustrates a prenuclear SOF (cf. Figure 1-iii).

(22)   Sentence-initial raising due to focus (= (16a)) and lowering due to givenness (= (16b)); see Figure 1-iii: prenuclear SOF

If the early accent is raised due to focus and bears the nuclear pitch accent, the potential late accent is suppressed due to postnuclear deacenting (see (17b)). This is illustrated in (23). In our examples, the late accent is suppressed when the nuclear accent is in the sentence-initial position, i.e., sentence-initial FOF (Figure 1-i), sentence-medial/postnuclear SOF (Figure 1-iv), and sentence-medial/postnuclear Non-Focus (Figure 1-vi).
Prenuclear accents, in contrast, are not suppressed, and may be realized in different ways: without changes (as in Figure 1-ii: first phrase in the sentence-medial FOF condition, cf. (20)), both raised and lowered (as in Figure 1-iii: sentence-initial/prenuclear SOF, cf. (21)), or only lowered (as in Figure 1-v: sentence-initial/prenuclear Non-Focus, cf. (22)).

In sum, as far as pitch is concerned, we discussed two information structure-driven effects on pitch: F0-raising due to focus (16a) and F0-lowering due to givenness (16b). These effects are fully realized in the sentence-initial context. As a result, we saw a three-way contrast among FOF/SOF/Non-Focus: FOF is subject to F0-raising, SOF to both raising and lowering, and Non-Focus to lowering only.

In the sentence-medial context, phonologically driven effects affect the realization as well. Downstep (17a) lowers the non-initial pitch accents. As a result, a sentence-medial FOF is realized lower than a sentence-initial one, although both bear the nuclear pitch accent. Postnuclear deaccenting (17b) prohibits pitch accentuation after a nuclear pitch accent. This effect suppresses the information structure-driven effects in the postnuclear context. Hence postnuclear SOF and Non-Focus show only a minimal difference.

6.3 Duration

We saw that for duration, the FOF > SOF > Non-Focus hierarchy was observed sentence-medially, and FOF and SOF showed no significant difference sentence-initially. The best candidate for the source of this contrast appears to be prosodic phrasing and concomitant final lengthening.

As proposed for pitch, the effects for duration can be separated into information structure-driven (16a–b) and phonologically driven ones (17c).

(16) Information structure-driven effects

(a) Focus boosts prominence (higher pitch/longer duration).
(b) Givenness weakens prominence (lower pitch/shorter duration).

(17) Phonologically driven effects (duration)

(c) Final lengthening in phonological phrases increases duration.

The information structure-driven effects amount to an increased duration for focused items, and a decreased duration for given items. We saw in the results for duration in section 4.2 that both FOF and SOF have a longer duration than a corresponding Non-Focus. The difference between FOF and SOF is only observed sentence-medially. Since SOF is at the same time focused and given, the absence of difference between FOF and SOF in sentence-initial position must be explained by phonological phrasing, the other source of difference in duration.

As has been illustrated in (13), a sentence-initial constituent forms its own prosodic phrase (p-phrase), but an argument and a following participle are united into a single phrase. As a result, the duration of the sentence-initial material is partially due to focus effect, and partially to phrase-final lengthening. It appears that this phrase-final lengthening masks the givenness effect expected on SOF and we do not find any significant difference in the sentence-initial position between FOF and SOF.

Sentence-medially, where FOF, SOF, and Non-Focus are all followed by the verb, focused material in the sentence-medial position is included into a larger prosodic phrase (cf. Figures 1-ii, 1-iv). In this case, we do not expect final-lengthening effect to the same extent as in the pre-verbal position. As a result, the information structure-driven effects can be fully observed: FOF is lengthened by focus, while SOF is both lengthened by focus and shortened by givenness.

As for Non-Focus phrases, they are shortened due to givenness (cf. Figures 1-v, 1-vi). There is no difference between the two sentence positions.

In sum, duration is affected by both focus and phrasing. First, FOF is typically longer than Non-Focus, due to the sole effect of focus and givenness, respectively. Second, SOF, being both focused, like FOF, and given, like Non-Focus, is also subject to an additional phrasing effect. If it is phrase-final, it is as long as FOF because of the phrase-final lengthening, while phrase-internally, it is longer than Non-Focus, but shorter than FOF.
6.4 Implications

In this last subsection, we return to the question of the relevance of phonological and phonetic cues for semantic interpretation. Our study contributes to a series of studies which show the importance of considering the phonological and tonal system of a language when designing experiments as well as when assessing experimental results in relation to information structure.

In view of the data obtained, we are able to claim that FOF is phonologically and phonetically more prominent than SOF, which is in turn more prominent than Non-Focus. Though the effects of this hierarchy on the two correlates examined, pitch and duration, were not parallel, this is due to independent factors of the intonational system of German, namely postnuclear deaccenting, downstep, and phrasing.

SOF expressions are realized by the phonetic means adequate for the positions in which they occur, and these are different in pre- and postnuclear locations. Fine-grained differences between accents are realized by pitch and duration, but only prenuclearly in German.

In view of the relevance of SOF for the theory of focus, it is now possible to give a clear answer to the question of whether SOF triggers phonological prominence. The answer is positive, and confirms Beaver et al.’s findings: this prominence is less than a FOF accent, but more than a Non-Focus accent. It is only when independent phonological factors block pitch prominence that no accent can be realized, but this is independent of the intrinsic prominence of SOF.

Returning briefly to the remarks on semantic theories based on the phonetic presence of accents in section 2, our results are compatible with both a strong and a weak version of focus theories. Recall that the weak version is dependent on physical correlates of focus because it assumes the focus to be grammaticalized, both syntactically and phonologically. The strong theory of focus, on the other hand, predicts that focus can be dissociated from accent, since it is triggered by contextual considerations. Common sense leads us to prefer a weak theory, since it is more constrained and relies on only one focusing device. A further important conclusion of our experiments is that SOF must be interpreted in the phonology as arising from both the effects of focus (pitch raising, longer duration) and the effects of givenness (pitch lowering, shorter duration).
7. Conclusion

In this paper Second Occurrence Focus was investigated for German. Until now, this phenomenon had been looked at exclusively from the point of view of its implications for theories of focus. Weak theories of focus, which require (pitch) accents on elements associated with a focus operator, have been thought to be jeopardized if SOF is realized without any prominence. Strong theories of focus, which propose that focus is modulated by contextual effects, cannot explain why SOF can be accented at all, since an accent is not necessary in order for the SOF to be correctly interpreted. In this paper, we have tackled the issue from a different angle and discussed the phenomenon from the point of view of phonology.

The results of our experiments in German, bearing on the phonetic correlates of first occurrence focus (FOF), second occurrence focus (SOF) and unfocused (Non-Focus) expressions, both in sentence-initial/prenuclear and sentence-medial/postnuclear contexts, indicate that it is crucial to keep issues of semantic theories and the phonological realization of accents apart. Prenuclear SOF expressions are realized with pitch accents, albeit weaker than those accompanying FOF, but stronger than on Non-Focus expressions. In a postnuclear context, SOF has a longer duration than Non-Focus, but the difference in height between pitch accents is much less than in the prenuclear position. We concluded that this difference is due to phonological factors only. This conclusion should have implications for the way phonological experiments bearing on other parts of grammar are designed.
Appendix

Stimuli

(a) FOF

(1a) Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen.

‘Most of our colleagues were dressed casually at the staff outing.’

Nur Peter hat eine Krawatte getragen.

‘Only Peter wore a tie.’

(2a) Die Fleissigsten haben bei der Theateraufführung etwas beigetragen.

‘The most hard-working people helped with the performance.’

Auch Melina hat beim Aufbau mitgeholfen.

‘Melina, too, helped set up.’

(3a) Die Reisegesellschaft war von Italien ganz begeistert.

‘The tourist group was very enthusiastic about Italy.’

Sogar Monika hat Mailand geliebt.

‘Even Monika loved Milan.’

(4a) Viele Frauen haben mehrere Verwandte zum Dorffest eingeladen.

‘Many women invited several relatives to the village fair.’

Aber Eva hat nur ihren Bruder eingeladen.

‘But Eva only invited her brother.’

(5a) Meine Brüder sammeln Autos, vor allem Mercedes und BMWs.

‘My brothers collect cars – mainly Mercedes and BMWs.’

Ingo hat auch einen Jaguar gekauft.

‘Ingo also bought a Jaguar.’

(6a) Bei der Weihnachtsparty waren alle guter Laune.

‘At the Christmas party, everybody was in a good mood.’

Michael hat sogar ein Lied gesungen.

‘Michael even sang a song.’

(b) SOF: Prenuclear

(1b) Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen. Nur Peter hat eine Krawatte getragen.

‘Most of our colleagues were dressed casually at the staff outing. Only Peter wore a
Nur Peter hat sogar einen Anzug getragen. ‘Only Peter even wore a suit.’

Die Fleissigsten haben bei der Theateraufführung etwas beigetragen. Auch Melina hat beim Aufbau mitgeholfen. ‘The most hard-working people helped with the performance. Melina, too, helped set up.’

Auch Melina hat sogar beim Getränkenverkauf geholfen. ‘Melina, too, even helped sell drinks.’

Die Reisegesellschaft war von Italien ganz begeistert. Sogar Monika hat Mailand geliebt. ‘The tourist group was very enthusiastic about Italy. Even Monika loved Milan.’

Sogar Monika hat auch Venedig geliebt. ‘Even Monika also loved Venice.’

Viele Frauen haben mehrere Verwandte zum Dorffest eingeladen. Aber Eva hat nur ihren Bruder eingeladen. ‘Many women invited several relatives to the village fair. But Eva only invited her brother.’

Nur ihren Bruder hat auch Maria eingeladen. ‘Also Maria only invited her brother.’

Meine Brüder sammeln Autos, vor allem Mercedes und BMWs. Ingo hat auch einen Jaguar gekauft. ‘My brothers collect cars – mainly Mercedes and BMWs. Ingo also bought a Jaguar.’

Auch einen Jaguar hat sogar Markus gekauft. ‘Even Markus also bought a Jaguar.’

Bei der Weihnachtsparty waren alle guter Laune. Michael hat sogar ein Lied gesungen. ‘At the Christmas party, everybody was in a good mood. Michael even sang a song.’

Sogar ein Lied hat auch Waldemar gesungen. ‘Also Waldemar even sang a song.’
Die meisten unserer Kollegen waren beim Betriebsausflug lässig angezogen. Nur Peter hat eine Krawatte getragen. ‘Most of our colleagues were dressed casually at the staff outing. Only Peter wore a tie.’
Sogar einen Anzug hat **nur Peter** getragen. ‘Only Peter even wore a suit.’

Die Fleissigsten haben bei der Theateraufführung etwas beigebracht. Auch Melina hat beim Aufbau mitgeholfen. ‘The most hard-working people helped with the performance. Melina, too, helped set up.’
Sogar beim Getränkenverkauf hat **auch Melina** geholfen. ‘Melina, too, even helped sell drinks.’

Die Reisegesellschaft war von Italien ganz begeistert. Sogar Monika hat Mailand geliebt. ‘The tourist group was very enthusiastic about Italy. Even Monika loved Milan.’
Auch Venedig hat **sogar Monika** geliebt. ‘Even Monika also loved Venice.’

Viele Frauen haben mehrere Verwandte zum Dorffest eingeladen. Aber Eva hat nur ihren Bruder eingeladen. ‘Many women invited several relatives to the village fair. But Eva only invited her brother.’
Auch Maria hat **nur ihren Bruder** eingeladen. ‘Also Maria only invited her brother.’

Meine Brüder sammeln Autos, vor allem Mercedes und BMWs. Ingo hat auch einen Jaguar gekauft. ‘My brothers collect cars – mainly Mercedes and BMWs. Ingo also bought a Jaguar.’
Sogar Markus hat **auch einen Jaguar** gekauft. ‘Even Markus also bought a Jaguar.’

Bei der Weihnachtsparty waren alle guter Laune. Michael hat sogar ein Lied gesungen.
At the Christmas party, everybody was in a good mood. Michael even sang a song.

Also Waldemar even sang a song.

Who did Peter kiss?

Peter kissed Maria.

What did Melina see?

Melina saw an accident.

Who did Monika invite?

Monika invited her father.

Who invited her brother?

Eva invited her brother.

Who bought a Jaguar?

The teacher bought a Jaguar.

Who sang a song?

The boys’ choir sang a song.
‘Who did Peter kiss?’
Maria hat Peter geküsst.
‘Peter kissed Maria.’

(2e) Was hat Melina gesehen?
‘What did Melina see?’
Einen Unfall hat Melina gesehen.
‘Melina saw an accident.’

(3e) Wen hat Monika eingeladen?
‘Who did Monika invite?’
Ihren Vater hat Monika eingeladen.
‘Monika invited her father.’

(4e) Wer hat ihren Bruder eingeladen?
‘Who invited her brother?’
Eva hat ihren Bruder eingeladen.
‘Eva invited her brother.’

(5e) Wer hat einen Jaguar gekauft?
‘Who bought a Jaguar?’
Der Lehrer hat einen Jaguar gekauft.
‘The teacher bought a Jaguar.’

(6e) Wer hat ein Lied gesungen?
‘Who sang a song?’
Der Knabenchor hat ein Lied gesungen.
‘The boys’ choir sang a song.’
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Rooth attributes this observation to Susanne Tunstall.

In Ishihara & Féry (2006), we used a subset of the entire data (15 subjects). In this paper, we included all the subjects’ data in the analysis.

Note that we measured only the target expression in each sentence. Therefore the results in Figure 2 do NOT indicate the relative height between FOF and SOF in the same sentence (e.g., Anzug and Peter in (9b,c)), or that between FOF and Non-Focus (e.g., Maria and Peter in (9d,e)).

For the t-tests here and hereafter, the F test is done to check the variance of the two samples. If the two variances are significantly different, Welch’s correction is made on the t-test.

In Figure 2-ii (data from the object set), this difference is not significant ($t(166) = -0.1608$, p-value = 0.8724).

This experiment was conducted as a response to a comment by a reviewer, who questioned the felicity of the prenuclear SOF sentences.
The additional result that postnuclear Non-Focus sentences were judged better than the prenuclear ones with half a point difference may be due to the fact that a postnuclear Non-Focus is unambiguously unaccented, whereas a prenuclear one gets a prenuclear accent.

A similar phenomenon is also observed in Japanese. When a phrase receives a narrow focus interpretation, an F0-boosting is observed on the focused phrase, and the pitch contours of all the following phrases are compressed. In the case of Japanese, however, pitch accents are still visible in the postnuclear region. Hence it may be better called post-focal reduction or compression rather than deaccenting. See Ishihara (2004) and the references therein.