Second Occurrence Focus in German

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Abstract

In a production study on read German, we investigate the tonal, durational and articulatory parameters used in the marking of three different focus structures. Special attention is paid to target words in Second Occurrence Focus (SOF). Such words are both focussed and contextually given. Prominence in SOF items is compared to prominence in items which are focussed and new (First Occurrence Focus, FOF) and those which are in the Background. Results confirm previous findings that SOF is not marked by a pitch accent. However, we observe gradient but systematic adjustments of acoustic and articulatory parameters (word durations and temporal and spacial modifications of opening and closing gestures) leading to an increase in prominence from Background through SOF to FOF. The extent to which single speakers employ different strategies varies. Phonologically, we propose an analysis of SOF prominences as phrase accents.

Keywords: Second Occurrence Focus, articulatory gesture, prominence, sonority expansion, prosody.

1. Introduction

Recent production studies on the prosodic marking of different types of focus (contrastive vs. non-contrastive) as well as different sizes of focus domain (broad vs. narrow) in German revealed that speakers make use of a wide variety of prominence-lending cues for encoding differences in information structure (e.g. Baumann et al. 2007). Results suggest that an increase in prominence – from broad through narrow to contrastive focus – is achieved by tonal means such as rising nuclear pitch accents and higher and later accent peaks, as well as by an increase in acoustic duration and, at least for the difference between broad and narrow focus, by increased articulatory effort (localised hyperarticulation, sonority expansion) in the accented vowel.

In the study reported on here, we investigate the tonal and articulatory marking of

a specific type of focus, namely 'Second Occurrence Focus' (SOF). SOF is indicated morpho-syntactically by a focus sensitive operator like *only* or *even*, and is contextually given (in contrast to 'First Occurrence Focus' (FOF), which is contextually new). A famous example by Partee (1999: 215) is given in (1), where *vegetables* occurs as an FOF element (a) and as an SOF element (b).[1]

(1)   a.   Everyone knew that Mary only eats [VEgetables]**FOF**.
       b.   If even [PAUL]**FOF** knew that Mary only eats [vegetables]**SOF**,
             then he should have suggested a different restaurant.

The apparent conflict between the 'focussedness' and the 'givenness' of SOF elements in terms of their expected prosodic marking has been widely discussed and experimentally investigated in recent years (e.g. Bartels 2004, Krifka 2004, Ishihara & Féry 2006, Beaver et al. 2007, Howell 2007, Rooth 2007, Büring 2008).

The problem can be described as follows: According to *Association with Focus* theories (e.g. Jackendoff 1972), a focus sensitive operator like *only* has to be associated with a focus in its syntactic domain, which is realised by intonational prominence. However, it has been claimed (e.g. by Partee 1999) that SOF – in contrast to FOF – is not necessarily marked by a pitch accent (note the deaccentuation of *vegetables* in (1b) above). The existence of such an 'inaudible focus' would violate the *Association with Focus* theory, since it would imply either that focus (at least SOF) is not necessarily marked by intonational prominence OR that operators like *only* do not associate with focus.

It is important to note that the lack of prominence on SOF items cannot be explained by givenness alone, since there are many instances in West-Germanic languages in which contextually given constituents *do* receive focus prominence, as e.g. in (2), adapted from Büring (2008).

(2)   a.   Who showed up last at John's party?
       b.   JOHN**F** (showed up last at his party).

In fact – and in contrast to Partee's claim – several production studies have shown that SOF may be marked by prosodic prominence as well, although not by pitch accents (e.g. Bartels 2004 and Beaver et al. 2007 for American English, Ishihara & Féry 2006 for

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[1] Pitch accents on relevant syllables are indicated by capital letters.

German). Instead, SOF was found to be prosodically marked by increased acoustic duration and intensity of the focussed item. For German, Ishihara & Féry found a significant durational difference between SOF and Background in postnuclear position (SOF items being longer). In prenuclear position, SOF was even marked by pitch accents.

These findings provide empirical evidence in favour of the *Association with Focus* theory. That is, SOF items *can* be considered to be focussed, and they *are* made prominent by prosodic means. However, they are not marked by fully-fledged (primary) pitch accents, but by increased duration and intensity reflecting secondary prominence or stress.

The aims of our study are the following:

- In addition to the tonal and durational marking of SOF in German, we particularly want to find out to what extent SOF is marked in articulation. That is, we investigate the modifications of the opening and closing gestures of the primary constrictors during the production of target words in three different focus structures (Background, SOF, FOF). Previous studies on SOF have not taken articulation into account.
- We want to examine whether the prominence level of SOF items lies 'in-between' Background and FOF items, as has been suggested by previous studies. More specifically, we want to test whether the prominence of SOF items differs from Background elements (in postnuclear position).
- Based on the outcome of our examination, we expect to gain insights into the phonological status of the prominence level of SOF elements.

2. Method

2.1 Reading materials

For our study, we constructed disyllabic target words (fictitious surnames) consisting of a 'CV:.CV sequence. The open stressed target syllable contained one of the four phonologically long vowels /aː/, /iː/, /oː/ or /uː/. The structure of the target words is summarised in (3).

(3)   **C1 V1** C2 V2
         C1, 2 = bilabial stop [b]
         V1 = [aː, iː, oː, uː]
         V2 = open central vowel [ɐ]

Short discourses of context and target sentences were designed with the test word in FOF, SOF or in the Background, always occurring as the last non-pronominal argument in the sentence). The sequences in (4) served as test material. We also recorded a sequence with the focus operator *sogar* ('even') but limit this report to the *nur* ('only') condition.

(4)   **nur ('only') condition**

      Context: Bei Heuschnupfen wird heutzutage viel zu schnell Cortison verschrieben.
                    (*Today, in case of hay fever, Cortisone is prescribed much too early.*)

      FOF: Eine Akupunktur kann <u>nur</u> [Dr. Bieber]$_{FOF}$ machen.
                    (*An acupuncture can only be done by Dr. Bieber.*)

      SOF: Auch eine Bachblütenkur kann <u>nur</u> [Dr. Bieber]$_{SOF}$ machen.
                    (*Also a cure with bach flowers can only be done by Dr. Bieber.*)

      Context: Wer hat Dr. Bieber so gut ausgebildet?
                    (*Who trained Dr. Bieber so well?*)

      Background: Die beste Klinik der Stadt hat [Dr. Bieber]$_{Background}$ so gut ausgebildet.
                    (*The best hospital in town trained Dr. Bieber so well.*)

2.2 Speakers and recordings

We recorded two native speakers of Standard German. One speaker originated from north of the Benrath isogloss (speaker DM: Low Franconian), and one from south of it (speaker WP: Central Franconian). They were aged 38 and 26 years, respectively.

All recordings were carried out at the IfL Phonetics laboratory in Cologne with a 2D Electromagnetic Midsagittal Articulograph (EMMA; Carstens AG100) and a condenser microphone (AKG C420 head set) attached to a Compact-Flash-Card-Recorder (Marantz PMD670/W1B). Articulatory sensors were placed on the vermillion border of the upper and lower lip, on the tongue dorsum (4cm behind the tongue tip) and on the jaw. Two additional sensors were placed on the bridge of the nose and on the gums of the upper incisors for calculating dynamic helmet corrections. The kinematic data were recorded at 500Hz, downsampled to 250Hz and smoothed with a 40Hz low-pass filter. The time-synchronised acoustic data were digitised at 16bit/44.1kHz. For displaying

and labelling the utterances, all acoustic and physiological data were converted to SSFF-format, the format needed for the EMU speech database system (Cassidy & Harrington 2001).

A total of 336 sentences were recorded (4 target words x 3 focus structures x 2 focus particles x 7 repetitions x 2 speakers). The subjects were asked to read the speech materials from a computer monitor in a contextually appropriate manner and as naturally as possible. The sentences were presented in two blocks per condition (see (4) above). In the first block, three sentences (context, SOF, FOF) were read by the subject. The second block consisted of of a context sentence, which was displayed on the screen and automatically played to the subjects as a pre-recorded audio file. The subject read the answer in this mini-dialogue.

2.3 Labelling procedures

All data were displayed and labelled by hand in EMU. In the acoustic waveform, we identified segments of the target words (C0, V0, C1, V1). In the F0 trace, we annotated pitch accent types (following GToBI; see Grice et al. 2005) for pitch movements on or in the vicinity of the target words. In the kinematic waveform, we labelled vertical movements of the lips and the tongue dorsum corresponding to the 'CV:.C production in the 'CV:.CV-target words. Therefore, we located maxima and minima of the opening and closing movements at zero-crossings in the respective velocity traces (vertical velocity and tangential velocity), as well as peak velocities at zero-crossings in the respective acceleration trace.

Figure 1 provides an example of measure points for segmental, F0 and kinematic (lip movement) labels. As for lip movements, we calculated the Euclidean distance between the upper and lower lip (lip aperture index, LA; Byrd 2000: 6). Low displacements (LA0, LA2) indicate that lips are closed during the consonant production, while high displacements (LA1, LA3) indicate that lips are open during the vowel (P0, P1, P2 = peak velocities of the respective opening and closing movements).
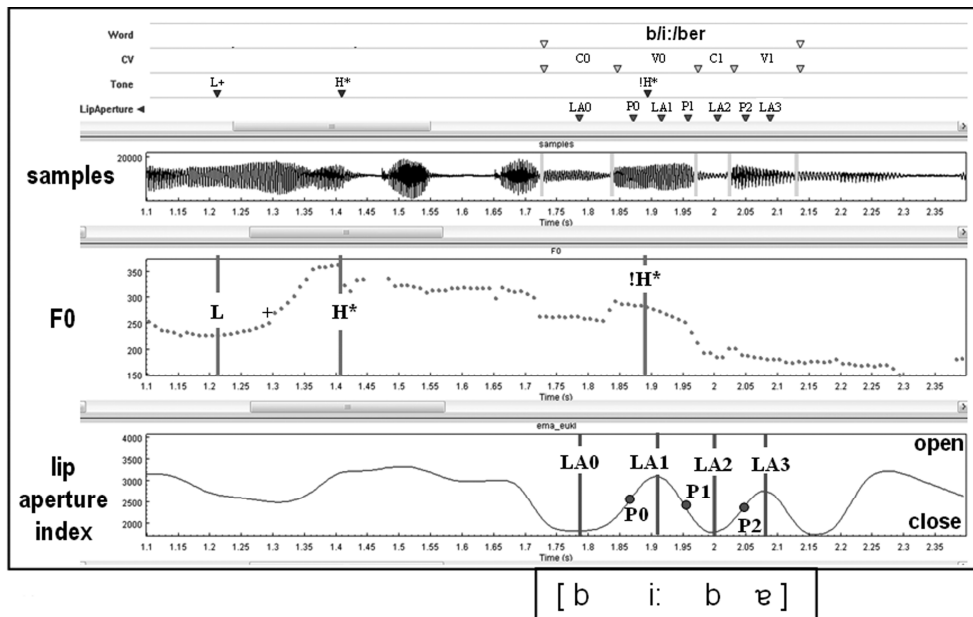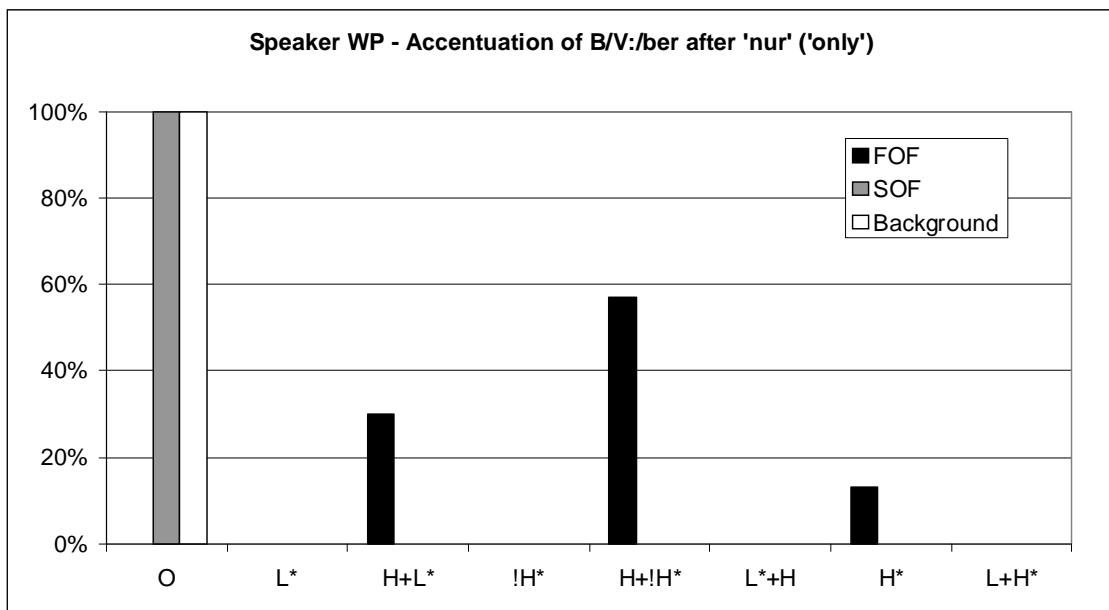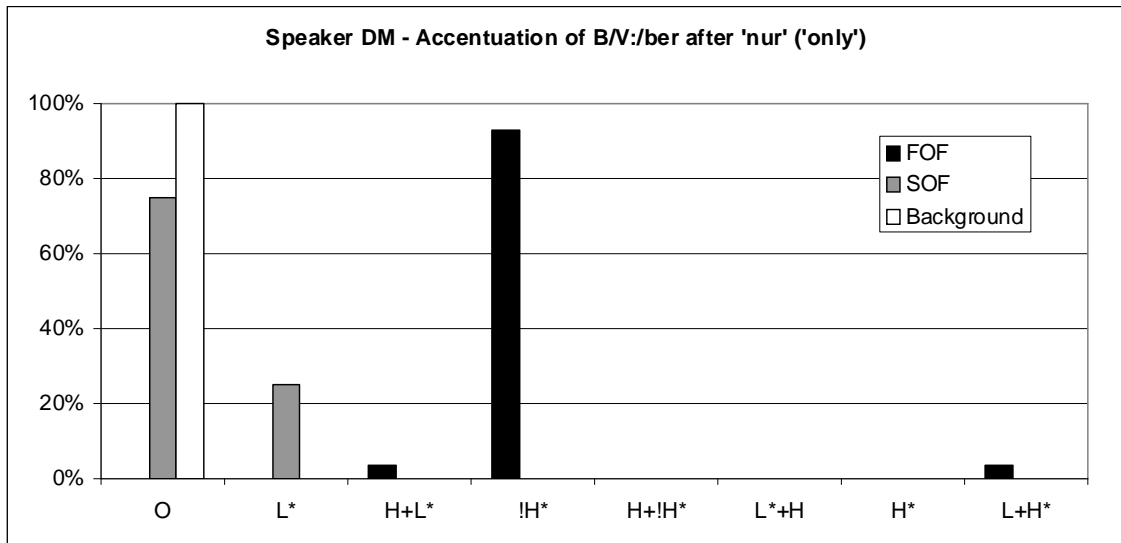
Figure 1: *Labelling scheme with acoustic waveform, F0 trace and kinematic waveform for the lips in the second part of the test sentence* [Eine Akupunktur kann] nur Dr. Bieber machen ('[*An acupuncture can*] only be done by Dr. Bieber')

3. Results and Discussion

3.1 *Tonal marking*

As can be seen in Figure 2, both speakers consistently deaccented Background items. SOF target words were deaccented in 92% of all cases, with speaker DM varying between low pitch accents (7 instances of L*) and deaccentuation. In contrast, FOF items always received a pitch accent. The choice of pitch accent varied between the speakers. Nevertheless, in 81% of all cases speakers used downstepped pitch accents (!H* or H+!H*).

Speaker DM - Accentuation of B/V:/ber after 'nur' ('only')

Speaker WP - Accentuation of B/V:/ber after 'nur' ('only')

Figure 2: *Distribution of accent types on the target word* B/V:/ber *in the three focus structures (in percent), for each speaker separately*

These findings support previous studies which observe that SOF items – occurring as the last argument in a sentence – are generally not marked by pitch accents. Somewhat surprising is the large number of downstepped accents on FOF items, since it has often been claimed that focussed elements which are contextually new should be marked by high or rising (i.e. H* or L+H*) pitch accents. However, the structure of our test sentence displaying a topicalised NP (*Eine Akupunktur...* 'An acupuncture...') triggers a hat pattern with a rising accent on the focus operator *nur* ('only') and a down-

stepped nuclear accent on the target word (see the example in Figure 1).

Although downstepped accents (as well as early peak accents) have been shown to be used to mark accessible (i.e. not new) information in German and are thus less prominent than high or rising accents (Baumann & Grice 2006), it is important to note that they are still fully-fledged (prenuclear or nuclear) pitch accents, in contrast to post-nuclear prominences such as phrase accents (Grice et al. 2000), which are secondary in nature.

3.2 *Durational marking*

We investigate the durational marking of the target words containing the un-rounded vowels, B/a:/ber and B/i:/ber. Note that in our study the domain 'word' is identical with the domain 'foot' since all target words are composed of two syllables with the stress pattern strong-weak. We performed speaker-individual two-way ANOVAs (2 x 3) including the factors VOWEL (B/a:/ber, B/i:/ber) and FOCUS STRUCTURE (Background, SOF, FOF). Since FOCUS STRUCTURE is a three-level factor, we also calculated post-hoc tests.

The main factor VOWEL reached significance for both speakers ($p<0.001$). We found larger word durations for the open vowels (B/a:/ber) than for the closed vowels (B/i:/ber). Averaged across both speakers those differences amount to $\Delta=23$ms in the Background condition and $\Delta=30$ms in FOF. The differences are probably due to different intrinsic vowel durations of open and closed vowels: since the production of open vowels involves a greater amount of jaw lowering they tend to have larger intrinsic durations than closed vowels (Lehiste 1970).

We found a systematic effect of FOCUS STRUCTURE on the durational measures for speaker DM [$F(2, 42) = 70.215$, $p<0.001$] and WP [$F(2, 42) = 34.501$, $p<0.001$]. For both speakers we found three separate subgroups (post-hoc: BG<SOF<FOF). There was no significant interaction between FOCUS STRUCTURE and VOWEL.

Figure 3 provides an example of the effect of FOCUS STRUCTURE on the durational measures. The figure shows means and standard errors for word duration, separately for each target word (B/a:/ber, left figure; B/i:/ber, right figure), for each speaker (DM, WP), and focus structure (Background, SOF, FOF). The corresponding values are shown in Table 1.
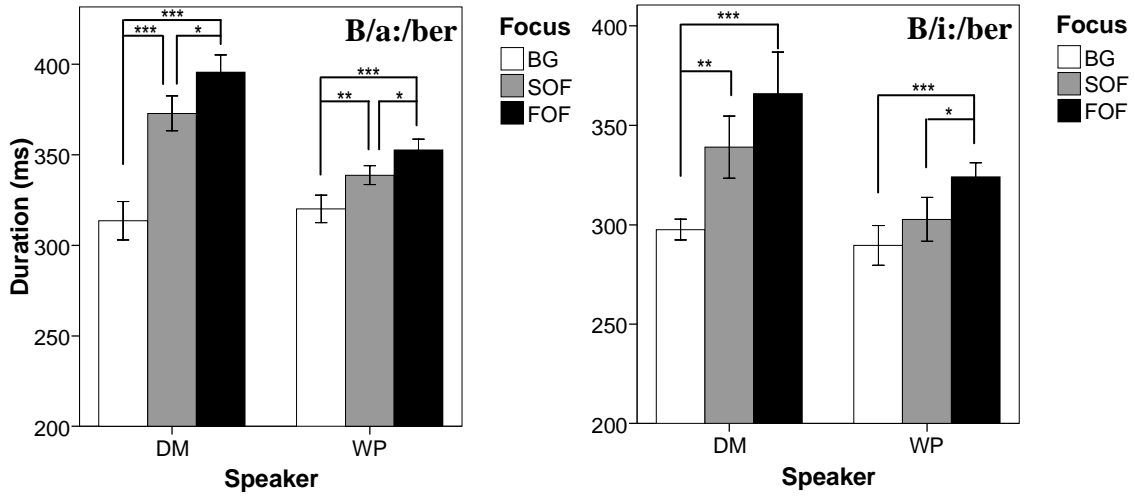
Figure 3: *Acoustic word durations (means and standard errors in ms)*

In the target word B/a:/ber, both speakers produce larger word durations from Background to SOF (DM: Δ=59ms; WP: Δ=19ms), and from SOF to FOF (DM: Δ=23ms; WP: Δ=14ms).

In the target word B/i:/ber, speaker DM produces larger word durations from Background to SOF (Δ=41ms), and from SOF to FOF (Δ=27ms). In contrast, speaker WP produces systematically larger durations only from SOF to FOF (Δ=21ms), but not from Background to SOF.

Vowel	Speaker	BG	SOF	FOF
/a:/	DM	314 (14)	373 (13)	396 (13)
	WP	320 (10)	339 (7)	353 (8)
/i:/	DM	298 (7)	339 (21)	366 (28)
	WP	290 (13)	303 (15)	324 (9)

Table 1: *Mean acoustic words durations (means and standard deviations in ms)*

To sum up: for both speakers we found larger word durations from Background through SOF to FOF, which is tantamount to a gradient but systematic increase in the prominence level of the three focus structures.

The results were very clear and consistent for target words containing an open vowel, B/a:/ber. However, for the closed vowel /i:/, the results were less clear, at least for speaker WP. We interpret this difference to be due to a different degree of coarticulatory resistance of open versus closed vowels. It has been reported for French that an open vowel (/a/) is highly affected by prosodic structure (boundary strength) showing

lower tongue and jaw positions and therefore longer durations at strong prosodic boundaries compared to weak boundaries (Tabain 2003). In contrast, a closed vowel (/i/) involves a higher degree of articulatory precision and is therefore less variable across prosodic contexts (Tabain et al. 2003). The less clear results for /i:/ in our data can thus be explained. In the following, we discuss the articulatory strategies used for target words containing open vowels.

3.3 *Articulatory marking*

All articulatory measures were analysed with one-way ANOVAs for the individual speakers and with a Tukey post-hoc test for the three-level factor FOCUS STRUCTURE (Background, SOF, FOF).

Figure 4 provides averaged trajectories for the distance between the upper and lower lip (Lip Aperture index) during the production of the target word B/a:/ber. Low displacements indicate that the lips are closed for the production of the stop consonants. Going from Background to FOF, we can see an increase in duration and displacement (corresponding to Lip Aperture, Byrd 2000) for both speakers. Furthermore, when comparing Background and SOF, we can see an increase in *durations* for both speakers. However, an increase in *displacement* from Background to SOF is only observable for speaker DM.
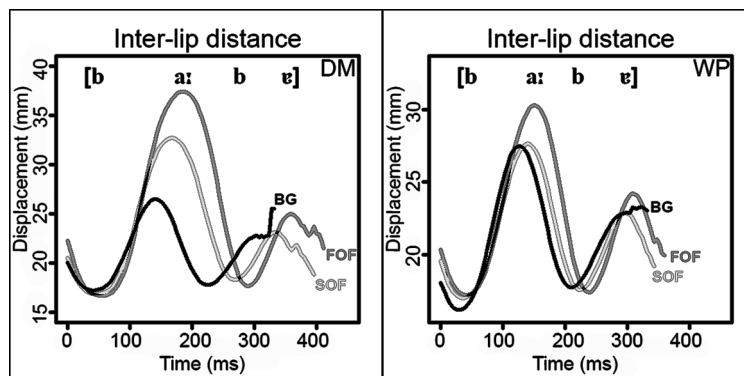
Figure 4: *Averaged trajectories for lip opening and closing movements during the target word B/*a*:/ber for each speaker DM and WP and focus condition*

Table 2 provides means and standard deviations for the separate articulatory measures in the opening and closing gesture of the lips in 'CV:.C-sequences. The opening gesture is defined as the movement of the lips from the maximum closure during the initial

consonant to the maximum opening during the following vowel in the accented sylla-
ble. The closing gesture is the movement from the maximum opening during the vowel
to the maximum closure during the intervocalic consonant; the intervocalic consonant is
the onset of the post-accented syllable. Both gesture types (opening and closing ges-
ture) have been proposed to be controlled differently (Gracco 1994).

In the opening and closing movements, we measured mean durations, maximum
displacements, peak velocities (related to the maximum speed) and time-to-peak veloci-
ties. While the peak velocity is related to the *absolute* (maximum) speed of the move-
ment, the time-to-peak velocity describes the *relative* speed of movement. Time-to-peak
velocity is calculated as the time from the onset to the peak velocity of the opening (or
closing) movement. It serves as an indicator for gestural stiffness (which is an abstract,
primary control parameter within the framework of a mass-spring model; see Saltzman
& Munhall 1989). A gesture with a lower stiffness (= related to an *increase* in time-to-
peak velocity) reaches the target later than a gesture with a higher stiffness. We ex-
pected to find an increase in durations, displacements, peaks velocities and time-to-peak
velocities from Background (unaccented) to FOF (accented) condition in the opening
and closing gesture.

OPENING GEST.		BG	SOF	FOF
DM	dur (ms)	99 (6)	121 (8)	130 (7)
	dis (mm)	9.4 (1.3)	16 (2.5)	20.8 (1.8)
	p-vel (mm/s)	167 (17)	251 (36)	312 (26)
	t2p-vel (ms)	58 (3)	63 (3)	65 (5)
WP	dur (ms)	96 (4)	104 (4)	109 (6)
	dis (mm)	11.5 (1)	10.7 (1.3)	13.2 (1.4)
	p-vel (mm/s)	204 (15)	174 (29)	206 (25)
	t2p-vel (ms)	54 (3)	60 (3)	60 (4)

| CLOSING GEST.		BG	SOF	FOF
DM	dur (ms)	82 (6)	97 (3)	103 (7)
	dis (mm)	9.1 (1.6)	15.1 (2.2)	20.1 (1.9)
	p-vel (mm/s)	186 (33)	271 (38)	352 (31)
	t2p-vel (ms)	40 (5)	53 (4)	58 (5)
WP	dur (ms)	82 (2)	83 (4)	87 (2)
	dis (mm)	10 (0.9)	10.2 (1.7)	13.2 (1.4)
	p-vel (mm/s)	203 (22)	207 (27)	264 (32)
	t2p-vel (ms)	41 (2)	42 (2)	45 (3)

Table 2: *Articulatory measures for opening and closing gesture in the CV:.C sequence*
*during B/*a*:/ber (means and standard deviations in parenthesis) for both speakers*

As can be seen from Table 2, however, the picture is not as clear when comparing
Background to SOF. Nevertheless, we found systematic differences ($p < 0.05$) for both
speakers in these two focus structures. In the following we discuss the strategies em-
ployed by the two speakers separately.

First, we compare the articulatory measurements (opening and closing gesture, lip
movement) for speaker DM. Figure 5 provides medians and quartiles for the respective
measures. In the opening gesture, all values increase from Background to SOF. The
analysis revealed that FOCUS STRUCTURE ($p < 0.01$) induces larger durations ($\Delta = 22$ms),

larger displacements (Δ=6.6mm), higher peak velocities (Δ=84mm/s), as well as higher time-to-peak-velocities (Δ=5ms). The adjustments in the opening gesture are comparable to the closing gesture. In the closing gesture, all values also systematically increase from Background to SOF ($p<0.001$) with larger durations (Δ=15ms), larger displacements (Δ=6mm), higher peak velocities (Δ=85mm/s), and higher time-to-peak-velocities (Δ =13ms).

To sum up the results for speaker DM, she adjusted all parameters in the opening and closing gesture. In a mass-spring model, these adjustments can be explained by a non-proportional change of the control parameters *Target* and *Stiffness*. The size of the whole opening gesture is rescaled in a non-linear way. That type of resizing of a movement corresponds to the articulatory strategy of *non-linear rescaling* (schematised at the bottom of Figure 5).
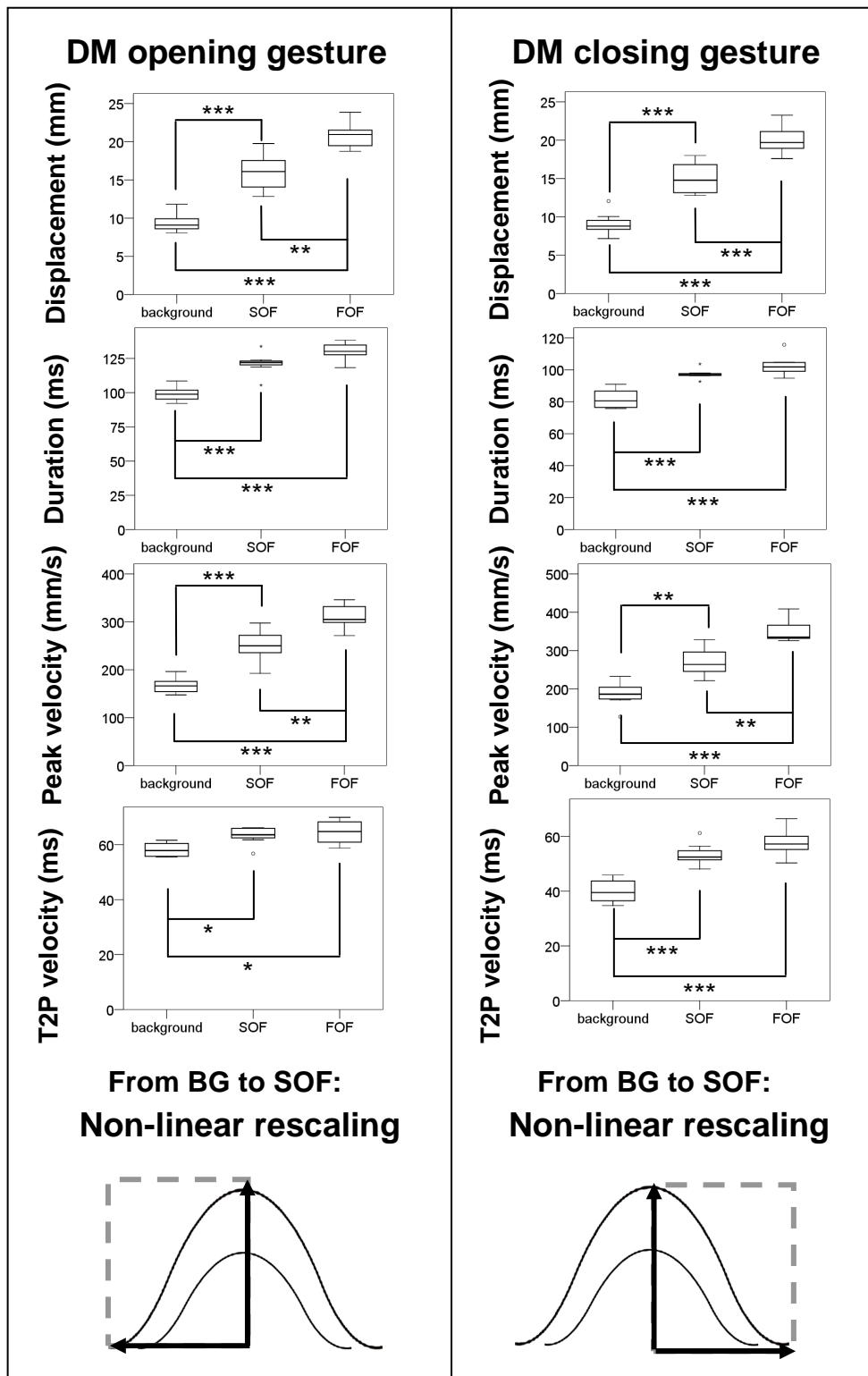
Figure 5: *Articulatory measures for speaker DM (all focus conditions) and stylised strategies for distinguishing Background from SOF*

Figure 6 provides medians and quartiles for the opening and closing gesture for speaker WP. In contrast to speaker DM, WP did not adjust all parameters from Background to SOF. In the opening gesture, we found an increase of the temporal measures (p<0.05) with larger durations (Δ=8ms) and higher time-to-peak-velocities (Δ=6ms). In the closing gesture, focus structure did not reach significance for the respective measures.

Within the framework of a mass-spring model, speaker WP modified the control parameter stiffness in the opening gesture by lowering the stiffness from Background to SOF (=increase of movement duration and time-to peak velocity, see Figure 5). However, in the closing gesture no systematic modifications from Background to SOF could be found.
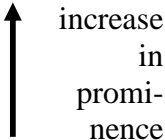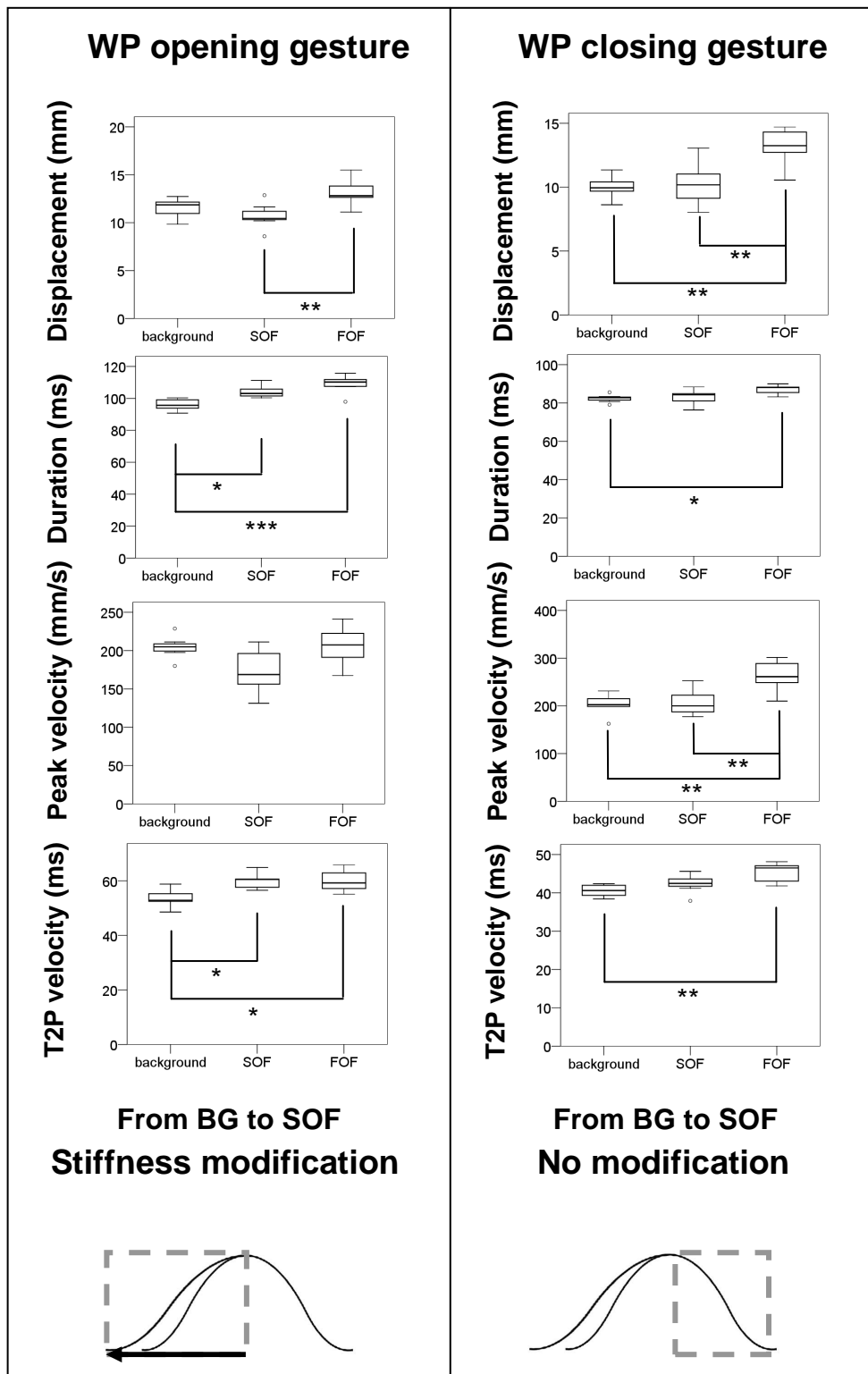
Figure 6: *Articulatory measures for speaker WP (all focus conditions) and stylised strategies for distinguishing Background from SOF*

To sum up the kinematic results for the target word B/a:/ber: both speakers distinguished between Background (unaccented) and FOF (accented) by increasing durations, displacements, peak velocities and time-to-peak velocities. Furthermore, both speakers (DM and WP) distinguished between Background and SOF.

However, when comparing Background and SOF, we found speaker-dependent strategies. Speaker DM modified the opening and closing gestures by adjusting all parameters (non-linear rescaling or resizing of the whole gestures). In contrast, speaker WP only modified the opening gesture and adjusted those parameters related to the stiffness of the movement (lower stiffness from Background to SOF by increasing duration and time-to-peak velocity).

4. Conclusions

We found systematic differences in marking the three focus structures under investigation (Backgound, SOF, FOF) for both speakers. Table 3 provides an overview of the strategies used.

	Tonal	Durational	Articulatory		
	(nuclear) pitch accent	acoustic word duration	stiffness (related to duration of movements)	target (displacement; related to sonority expansion)	
FOF	yes	larger	lower	higher	increase in prominence
SOF	no				
BG	no	smaller	higher	lower	

strategy speaker-dependent

Table 3: *Summary of tonal, durational and articulatory adjustments as prominence increases in the marking of target words in three different focus conditions*

In terms of *accent placement*, the results were consistent – and involved a discrete difference: Background and SOF elements were generally deaccented (speaker DM marked a few instances of SOF by low accents, though), whereas FOF elements re-

ceived pitch accents throughout.

Furthermore, the non-tonal *acoustic parameters* (word duration) considerably increased from Background through SOF to FOF. Those differences in acoustic durations correspond to *articulatory modifications*. We found larger durations of the opening and closing movements in the target 'CV:.C-sequences (stiffness modifications) and higher displacements (resizing of the whole gesture), while opening gestures were more strongly affected than closing gestures (speakers employed different strategies). Within the framework of the H & H theory (Lindblom 1990), we might say that target words are *hypo*articulated in Background position (unaccented) and *hyper*articulated in FOF position (accented) with the prominence level of SOF being intermediate between the two. However, since our articulatory investigations are restricted to lip movements, the higher degree of 'hyperarticulation' is related to a higher degree of *sonority expansion* from Background through SOF to FOF (Harrington et al. 2000). Acoustic and articulatory markings turned out to be gradient in nature but still displayed systematic differences. That is, there is an overlap between the phonetic realisations of Background and SOF items as well as between SOF and FOF items. Furthermore, the extent to which single speakers employ the acoustic and articulatory strategies varies.

The intermediate 'degree of prominence' which can be attributed to SOF items raises the question of its phonological status. Previous studies have tried to attribute various concepts to it, such as 'metrical accent' (Rooth 1996), 'metrical prominence/stress' (Büring 2008) or 'phrasal stress' (Beaver et al. 2004). Interestingly, the prominence on SOF constituents resembles the type of prominence Halliday (1967) claimed to be used for marking 'secondary information focus', which he defines as "information that is either new but subsidiary or given but to be noted" (1967: 209). An example is given in (5), in which *costs* is given information but made prominent by an 'extra' tonic (a 'compound tone' in Halliday's terms: a fall on *reasonable* plus a low rise on *costs*).

(5)   It seems perfectly REAsonable to take the <u>costs</u> into account.

Prominences like these have been analysed by Grice et al. (2000) as 'phrase accents', which are defined as edge tones with a secondary association to either phrase-final or stressed syllables: "Such secondary associations give rise to tonal configurations that may resemble ordinary pitch accents, but do not signal focus or prominence in the same way, reflecting their essentially peripheral nature" (2000:180). This 'peripheral

nature' qualifies phrase accents as markers of 'secondary information', which also seems to apply to SOF elements.

However, phrase accents are defined tonally, and tonal movements on SOF items could not be found in our data. Nevertheless, the marking of SOF may have a tonal element after all: in many cases, the F0 minimum was reached on the lexically stressed syllable in an SOF word. More research is needed to explore the status of postnuclear prominences in general, and of SOF prominences in particular.

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