

# OROFACIAL GESTURES FOR MARKING DIFFERENT FOCUS TYPES AND DOMAINS

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## Introduction

We report on a production experiment investigating articulatory means of differentiating different focus structures in German, concentrating on tempo-spatial aspects of supralaryngeal gestural coordination. In this study we designed a corpus to investigate articulatory marking of (a) background vs. focussed target words, amounting to the unaccented-accented dichotomy, as already investigated in other studies [6], as well as, within the accented category, (b) the marking of broad as opposed to narrow focus [2] and (c) contrastive as opposed to non-contrastive focus [5].

This study investigates to what extent focus structures contribute to adjustments in articulatory gestures. Those fine articulatory adjustments are generally interpreted as hyperarticulation (mainly related to tongue dorsum movements [4]) and/or sonority expansion (mainly related to jaw and lip movements [3]). For the presented lip kinematics we hypothesised an increase in sonority (in line with greater displacement of the upper and lower lips) in the target syllable in the following order: contrastive (corrective) focus > narrow focus > broad focus > background.

## Methods

The speech material included question-answer pairs eliciting four different focus structures (broad, narrow and corrective contrastive focus on the test word, and the test word as background). Test words consisted of two syllables, with the stressed syllable containing one of the four target vowels /i:/, /a:/, /o:/ or /u:/. The speech material is shown below for /a:/ in *Bahber* ['ba:bə]:

Question-Answer-Pairs:	test words in:
1. Was gibt's Neues? <i>What's new?</i> [ Melanie will <u>Frau Bahber</u> treffen ]F	broad focus
2. Wen will Melanie treffen? <i>Whom does Melanie want to meet?</i> Melanie will [ <u>Frau Bahber</u> ]F treffen.	narrow focus
3. Will Melanie Frau Werner treffen? <i>Does Melanie want to meet Mrs. Werner?</i> Melanie will [ <u>Frau Bahber</u> ]F treffen.	corrective focus
4. Will Norbert Frau Bahber treffen? <i>Does Norbert want to meet Mrs. Bahber?</i> [ Melanie ]F will <u>Frau Bahber</u> treffen.	background
(Answer lit.: <i>Melanie wants Mrs. Bahber to meet</i> ) Focus marked with [...]F	

Three native speakers of Standard German (Düsseldorf) were recorded with an ElectroMagnetic Midsagittal Articulograph EMMA (Carstens Articulograph AG100) and a time synchronised DAT-recorder. Sensors were placed on the vermillion border of the upper and lower lip, as well as on the tongue body (additionally two sensors on the nose and the upper gums for reference). The subjects heard the questions and were instructed to answer them in a contextually appropriate manner. Using the speech database system EMU, we identified landmarks in the acoustic domain (segmental boundaries, F0 landmarks) and in the articulatory domain (articulatory maxima and minima and related peak velocities). For the lip kinematics, the lip aperture index was calculated by the Euclidean distance between the sensors of the upper and lower lip, including movements in the horizontal and vertical plane [1]. We related temporal and spatial coordination (stiffness and durations of the opening and closing gestures for the former, displacement for the latter) to acoustic durations of target syllables and formant values of target vowels.

## Results and discussion

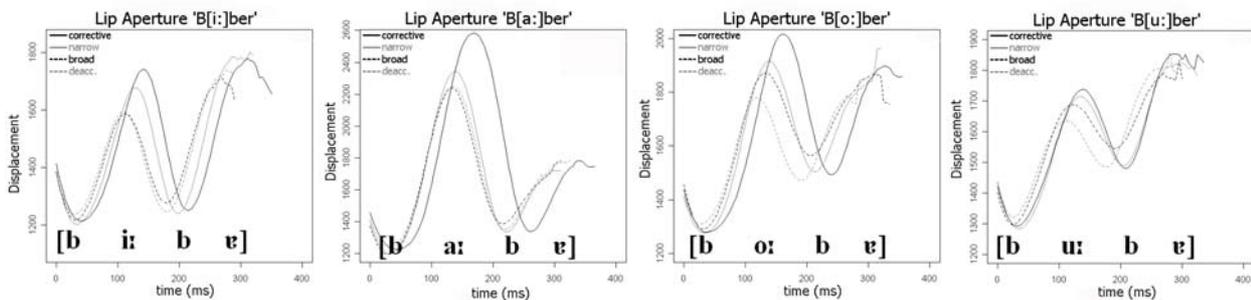
We refer to preliminary results of one speaker (C), full results for three speakers will be presented at the Summerschool. Figure 1 shows averaged trajectories of the inter-lip distances during the production

of the CV.CV sequences in the target words *Bieber*, *Bahber*, *Buhber* and *Bohber* in different focus conditions. High displacements indicate that the lips are open during the vowel production, low values that the lips are closed. We found fine adjustments of the lip movements (lip aperture) in the following focus conditions:

- I. In the rounded vowel condition, [u:] and [o:], the lips were wider apart in focus target words than background ones. That was not the case in the unrounded vowel condition [i:] and [a:], where displacements remained the same.
- II. In all vowel conditions, considerably higher displacement was found for narrow as opposed to broad focus.
- III. In all vowel conditions, considerably higher displacement was found for contrastive as opposed to non-contrastive focus.

The higher displacements in lip aperture refer to a greater amount of articulatory effort. For the unrounded vowel condition, we found the following order (> = greater aperture): contrastive (corrective) focus > narrow focus > broad focus ≥ background. For the rounded vowel condition, we found contrastive (corrective) focus > narrow focus > broad focus > background. The increase in lip aperture can be related to sonority expansion, a strategy used to produce a louder vowel in the tonic syllable and therefore to enhance the syntagmatic contrast with adjacent syllables (tonic and pre/post tonic) as well as across different segments (consonants and vowels) within the tonic syllable.

Additional durational measurements of the lip opening gesture during CV production confirmed the articulatory findings (correction > narrow > broad ≥ background). The same was found for acoustic measurements of syllable and word duration.



**Figure 1:** Averaged trajectories (7 repetitions each) for the lip aperture (inter-lip distance) in the four target words with different focus structures, one speaker. The highest displacements were found in corrective focus condition (solid black lines), followed by narrow focus (solid grey lines), broad focus (dashed black) and background (dashed grey).

These (preliminary) results are in line with the findings for contrastive focus [5] in French. In our German data, we found spatial and temporal variations of inter-gestural coordination (lip aperture) to mark differences in focus structure for (a) focus and background and (b) narrow and broad focus and (c) contrastive and non-contrastive focus.

## References

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