Prosodic prominence in Parkinsonian Speech: A dynamical approach

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Patients with idiopathic parkinsonism (PD) suffer from a neurodegenerative disorder of the extrapyramidal motor system which is released by a progressive loss of dopamine neurons in the substantia nigra. This area of the brain is responsible for motoric activity, cognition and the limbic systems. The major symptoms of this disorder are bradykinesia, resting tremor, rigidity and hypokinesia [1]. Furthermore, the speech motor system gets affected which often leads to dysarthric speech. The speech deficits include monoloudness, monopitch, reduced stress, imprecise articulation, variability of speech rate, disfluencies and voice tremor [2, 3]. PD affects communication as well as other related functions such as cognition, but complex prosodic aspects such as focus marking are less well studied.

Focus marking in German requires changes in intonation and articulation [4]. In prominent positions (e.g. contrastive focus), speakers use a more distinct articulation of prosodic units such as syllables involving larger, longer and faster movements of the vocal tract. When the level of prominence decreases in the phrase speakers adapt to the requirements of localized reduced speech. This leads to the use of multiple cues in the phonetic domain, both intonation and articulatory adjustments, to regulate prosodic marking within a phrase [5].

In the present study, we investigate dynamic changes in prosodic highlighting strategies in PD patients and compare them to the productions of neurotypical speakers. Therefore, we compare the production of target words in divergent focus structure, contrastive focus and background. We recorded 40 German speakers: 20 patients with idiopathic Parkinson in medication ON condition, 14 males and 6 females, aged between 54 - 80 and 20 healthy aged and gender matched controls. All speakers were classified in terms of duration of the disorder, severity of the disorder, motoric activity level (UPDRS III, [6]), level of cognition and speech problems in terms of dysarthria. As speech material, we used a question-answer scenario presented on a computer screen to manipulate focal structure by means of contextualizing contexts. Nine target words were placed in either contrastive focus or background position in sentences such as <Die Fliege hat die grüne **NAse** berührt.> *("The fly has touched the green nose*.") related to pictures on a computer screen [cf. fig.1]. Target words were always disyllabic (CV.CV structure), containing one of the three long vowels /i:/, /a:/ or /o:/, in the stressed syllable, such as <Nase> /na:z@/. In total, we recorded 1440 tokens (9 target words x 40 speakers x 2 focus structures x 2 adjectives). For acoustic measurements, we analyzed the voice range, syllable duration, formant means and contours, the mean intensity and the F0 contours in terms of pitch height and tonal onglide [7].

Preliminary results show that, in line with [8], patients can convey contrastive focus by increasing pitch, intensity and duration [cf. fig.2] but to a lesser extent as the healthy controls do [3, 8] and with more variability. This reflects abnormalities in the regulation mechanism of expressing prosodic prominence, constantly mediating between linguistic structure and the physical control system. Figure 2 shows two different productions of the target word <Wade> /va:d@/ in contrastive focus condition spoken by the same speaker. In the left example, the supralaryngeal adjustments show an articulatory overshoot in the production of loudness in the target syllable, making the utterance sound unnatural. In contrast, the example on the right shows a more balanced production of intensity but a flatter pitch contour. For the upcoming conference, the results of all intonational and articulatory variables will be presented. We will discuss how much variation is tolerated in a dynamical system of prosodic prominence before the expression of prosodic functions is getting instable.

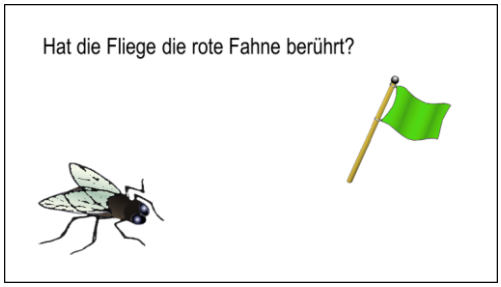

Figure 1. *Stimuli presentation: question-answer scenario - question as audio stimuli and the appropriate answer as production task.*

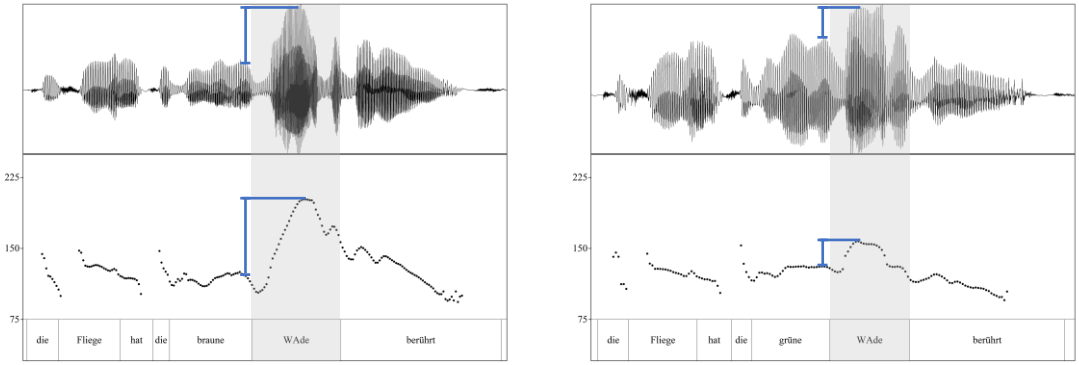

Figure 2. *Acoustic waveform and F0-contour for the target word <Wade> in the utterance <Die Fliege hat die braune/grüne Wade berührt> in Praat [9]: data of one patient – (accented word <Wade> shaded in grey)*

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