Influencing Factors on the Production of Prosodic Prominence in Parkinsonians

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Introduction: Patients with idiopathic parkinsonism (PD) suffer from a neurodegenerative disorder of the nervous system. Due to a progressive loss of dopaminergic cells in the substantia nigra PD develop problems with motor and non-motor functions. On the motor level the dysfunctions defect the voluntary movements and lead to symptoms like: rigidity, resting tremor and bradykinesia [1]. On the level of cognition PD have problems with the executive functions, cognitive flexibility, memory and control of attention [2]. Furthermore, the speech system gets affected which often leads to dysarthric speech. This hypokinetic dysarthria impacts the phonation, articulation and the respiratory system. The speech deficits include monoloudness, monopitch, reduced stress, imprecise articulation, variability of speech rate, disfluencies and voice tremor [3, 4].

PD affects communication as well as other related functions such as cognition, but complex prosodic aspects such as focus marking are less well studied. Prominence marking in German requires changes in intonation and articulation [5]. Speakers use multiple cues in the phonetic domain to regulate prosodic marking [6], e.g. modulation of F0 and syllable duration.

Method: In the present study, we are analyzing the prosodic marking strategies of PD patients and compare them to the productions of neurotypical speakers. Therefore, we investigate the production of target words in divergent focus structures, contrastive focus and background. We recorded 38 German speakers: 19 patients with idiopathic Parkinson, 13 males and 6 females, aged between 54 - 80 and 19 healthy aged and gender matched controls. All speakers were classified in terms of severity of the disorder, motoric activity level (UPDRS III, [7]), level of cognition (TMT, [8], BTA [9]) and speech problems in terms of dysarthria [10].

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. 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 1368 tokens (9 target words x 38 speaker x 2 focus structures x 2 adjectives). For acoustic measurements, we analyzed the voice range, syllable duration, formant and intensity means and the F0 contours in terms of pitch height and tonal onglide [11].

Results: The results show that, in line with [12], patients can convey contrastive focus by increasing pitch, intensity and duration. Furthermore, they adjust their articulatory movements in terms of formant changes. For the patients group we found influencing factors like motoric and cognitive dysfunction. The more severe the executive dysfunction the more the intensity and F0 get modulated. The motoric abilities influence the articulation of the back vowel. There is a fronting due to motoric impairment.

For the dynamic speech system this reflects abnormalities in the regulation mechanism of expressing prosodic prominence, constantly mediating between linguistic structure and the physical control system. There are some systems which are hyperarticulating and some which are hypoarticulating to produce a communicative output. We will discuss that the patients' system is out of balance, because there is too much effort in the glottal and subglottal system and less output in the supraglottal system. This leads to an inefficient way of marking prominence.

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