

Perceived vocal straining for 84 dysarthric patients: free verbalizations, perceptive quantitative assessment and agreement between four expert listeners

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Behavior resulting in voice disorders, the vocal straining may also result from prolonged and / or excessive voice use. Its perceptual characteristics are a measurement of pathological voice quality in the perceptual scale GRBAS (Hirano 1981). This work is a perceptive analysis in the ANR project "DesPho APady" NR-08-BLAN-0125. In addition to the acoustic-phonetic description of a database of 84 dysarthric patients (39 patients with Amyotrophic Lateral Sclerosis ALS, 23 patients with cerebellar syndrome and 22 patients with Parkinson's disease), four speech therapists and phoneticians, expert listeners conducted a perceptual evaluation of the overall grade of dysarthria, the GRBAS, and they freely verbalized the voice and the speech of these patients. The corpus is a three minutes long text "*Le Cordonnier*" (Fougeron *et al.* 2010). Analysis of free verbalizations was carried through the counting and semantic categorization of obtained words (Nosulenko and Samoylenko 1997; Pillot 2006).

Our results show that the overall grade of dysphonia G_{Dysph} is perceived with a similar degree between the listeners, and it isn't significantly different from the overall grade of dysarthria G_{Dysar} (cerebellar: $G_{Dysph}=1$ Standard Deviation $SD=0.7$, $G_{Dysar}=1.2_{0.6}$; ALS: $G_{Dysph}=1.7_{0.6}$, $G_{Dysar}=1.6_{0.7}$; Parkinson: $G_{Dysph}=1.2_{0.8}$, $G_{Dysar}=1.2_{0.9}$). The perceived vocal straining elements the most severely assessed are roughness ($1.1_{SD0.8}$) and the strained voice ($1_{0.9}$) for ALS patients, the breathiness for Parkinson patients ($1_{0.8}$) and the strained voice for cerebellar patients ($0.8_{0.8}$) with a great variability in the obtained data. They show the presence of a perceived vocal straining by these patients, in agreement with the literature (among others: Bunton *et al.* 2007; Pinto *et al.* 2010). The importance of judging these patients as dysphonic ones is thus justified since the inter-listeners agreement within \pm one scale value is situated between 95 and 100% for the G_{Dysph} and the G_{Dysar} of ALS patients, the G_{Dysph} , the breathiness and laryngeal asthenia for cerebellar patients, and the roughness and the G_{Dysph} for Parkinson patients. About 2000 occurrences of free verbalizations were written by the four expert listeners, with an average of 5.9 verbal units per listener per patient (SD 3). Among the seven semantic classes of these verbal units (speech, voice, recording quality, speech obstructed with saliva, breathlessness, linguistic origin of the patient, degradation in time) results for the three pathologies show a similar distribution of percentages of occurrences across the four listeners: half of the total concerns the speech, and a quarter concerns the voice (a third for ALS patients). The four listeners perceive the voice of the cerebellar patients with low pitch (15% of the occurrences "voice"), with a nasal resonance (14%), strained with glottal stops (13%), hoarse, bitonal (11.5 %) and with a tremor (8.2%). The voice of the Parkinson patients is mainly perceived with a low intensity (15%), trembling (13.3%), with a nasal resonance (12.5%), bitonal (10.8%) and with a high pitch (10%). Finally, the voice of the ALS patients is mainly perceived with a nasal resonance (29.3%), strained and pressed voice (16.2%), rough (9%), trembling (7.5%), bitonal (6%) and fatigue with deterioration during the reading of the text (3.7%) according to Duffy (2005). This study confirms and quantifies the perceptual signs of vocal straining in dysarthria. In addition, voice quality has an impact on changes in fundamental frequency, which in turn affect the perception of intelligibility (Duffy 2005).

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