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

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and H1-H2 are significantly decreased while HRF is consistently increased. Hypo/Hyperarticulated Speech: For hyperarticulated voice, speech clarity tends to be maximized, while hypoarticulation refers to speech produced with minimal efforts. We have shown in [6] that the stronger the degree of articulation, the higher the glottal formant frequency, the maximum voiced frequency and the fundamental frequency.

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Perceived vocal effort and vocal recovery – EJ Hunter, I Titze [invited paper]

Vocal fatigue has become a generic term for a condition in which increased effort or decreased perceptual quality occurs during phonation. It is possible that vocal fatigue is (at least occasionally) a symptom of a yet undiagnosed underlying problem, such as laryngopharyngeal reflux or glottal incompetence from a slight weakness of the vocal folds. Vocal fatigue may also be caused by poor vocal technique or vocal overuse, causing a combination of laryngeal muscle fatigue and lamina propria fatigue (breakdown of extra cellular matrix from excessive vibration).

In an attempt to quantify the relation between vocal fatigue and voice use, perceived vocal ability and effort was compared to accumulated voice use using two datasets. First, the National Center for Voice and Speech vocal dose database was used, containing more than 8400 hrs of observational data (57 teachers). Voice use data of male and female school teachers (spanning two weeks of observation) was compared to repeated perceptual ratings (average of every two hours) of vocal ability and vocal effort. Second, the post-vocal loading (2 hours) recovery of vocal ability and effort of 88 teachers were tracked over two days to find general vocal effort recovery curves.
The vocal non-pathologic recovery trajectories of perceived vocal effort and ability appeared to have both a short-term and long-term process, similar to two aspects of dermal wound healing. By analyzing the result of these processes in conjunction with the vocal dose database, a vocal ability and effort model of exposure and recovery was developed. As this avenue of research is further explored, it may be possible to predict recovery of vocal ability following vocal loading, leading to actual safety limits for vocalization (i.e., optimal vocal vibration exposure and vocal rest periods).

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Perceived vocal straining for 84 dysarthric patients: free verbalizations, perceptive quantitative assessment and agreement between four expert listeners – C Pillot-Loiseau, N Lévêque, S Arpin, S Borel

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: $G_{Dysph}=1_{\text{Standard Deviation SD=0.7}}$, $G_{Dysar}=1.2_{0.6}$; 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 ± 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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