

PERCEPTUAL AND VIBRO-ACOUSTIC EVALUATION OF CHANGES IN THE SHAPE OF THE VOCAL TRACT

PERCEPČNÍ A VIBRO-AKUSTICKÉ HODNOCENÍ ZMĚN TVARU VOKÁLNÍHO TRAKTU

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Abstract: In the study recordings of one male subject (M, 39 yr.) who modified different parts of vocal tract (lip opening, tongue position, opening and vertical position of the larynx) in two pitches (D3 and D4) were analyzed acoustically and by means of electroglottography (EGG). Three respondents perceptually evaluated the paired stimuli, which represented extreme positions of vocal tract modifications. Listening evaluation was performed on the properties of loudness, brightness, resonance, support, sharpness, position and openness. A specific task was to evaluate the articulation movement position (AMP) of the paired stimuli. With the exception of the AMP and the quality in D4, all the properties evaluated had a good consistency of agreement. The results indicated which measured parameters and evaluated properties were most affected by what articulation movement. Factor analysis divided the evaluated properties into two factors in both pitches. The factor of brightness and sharpness was dominant in the lower pitch, and it was connected with loudness. This factor was secondary in the higher pitch and was connected with position and openness. In both pitches, this factor positively correlated with differences in contact quotient and the center of spectral gravity (COG) in the band from 0 – 2.5 kHz, and corresponded negatively with the level of the fundamental and COG in the range 2 – 5 kHz, and in the lower pitch with SPL as well. The factor of resonance and support dominated in D4 and it was connected with loudness; it correlated with the maximal contact in the EGG signal and with the maximum of SPL in the spectral band of 2 – 4 kHz. In D3 this factor was secondary and perceptually was connected with position and openness; it correlated only with the parameter of singing power ratio.

Keywords: perceptual assessment, voice acoustics, vocal tract, voice quality

1. INTRODUCTION

Vocal Tract (VT) settings play an important role in influencing the resulting voice quality. From the point of view of the linear model of the source and the filter, the changes in the size of the individual VT cavities are manifested in the form of changes in the positions of the formants, respectively VT resonance with consequent change in voice timbre [1].

The effect of the singer's formant creation by the clustering of the third to fifth formant is described best. This formant is formed by a special VT adjustment when the enlarged pharyngeal passes into a narrowed entrance and a generally lowered larynx [2]. However, Sundberg's assumption of the necessary of pharyngo-epilaryngeal ratio 6:1 was not confirmed by the MRI [3], even though a lowered larynx and hypopharyngeal enlargement were associated with better singing voice quality and increased energy in the singer's formant. The properties of the lower part of the VT (larynx, hypopharynx) affect resonance in the region around 3 kHz, but also interact best with vocal oscillation and, in the case of a narrowing of the epilaryngeal cavity, lower the oscillation threshold pressure [4].

Professional voice production is generally connected with an increase in VT volume; in singing especially the oral cavity volume increases, and in speech the pharyngeal cavity as well

1. ÚVOD

Nastavení vokálního traktu (VT) sehrává důležitou úlohu při ovlivňování výsledné kvality hlasu. Z pohledu lineárního modelu zdroje a filtru se změny velikosti jednotlivých dutin VT projevují v podobě změn poloh formantů, resp. rezonancí VT s následnou změnou barvy hlasu [1].

Asi nejdéle je popsán efekt vzniku „pěveckého“ formantu sloučení 3–5. formantu, který vzniká speciálním nastavením VT při přechodu rozšířeného hltanu do zúženého vchodu a celkově sníženého hrtanu [2]. Sundbergův předpoklad nutného poměru ploch hltanu a vchodu hrtanu 6:1 se však dle měření MRI nepotvrdil [3], i když snížení hrtanu a rozšíření hypopharyngu souviselo s pěveckou kvalitou hlasu a nárůstem energie v oblasti pěveckého formantu. Vlastnosti spodní části VT (hrtan, hypopharynx) ovlivňují rezonanci v oblasti kolem 3 kHz, ale také nejlépe interagují s kmitáním hlasivek, a v případě zúžení epilaryngální dutiny snižují prahový tlak kmitání hlasivek (oscillation threshold pressure) [4].

Profesionální hlasový projev je obecně spojen se zvětšením objemu VT, při zpěvu se zvětšuje zejména ústní dutina, při mluvě i hltanová [5]. Zvětšení rezonančních prostor ústní i hl-