

SPECTRAL ENVELOPE PERSISTENCE AT SINGING SCALES WITH VARIOUS DYNAMIC SHAPINGS

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Background. One of the main goals in classical voice training is to achieve the timbral consistency over the pitch and the dynamic range of the voice. In the case of steady sounds, the timbre is determined primarily by sound's spectral envelope. In reality, it is not clear how stable is the voice spectrum when professional singers have to fulfil various vocal tasks. According to the source-filter theory, the voice properties depend on the vibration characteristics of the vocal folds and the shape and size of the vocal tract.

Aim. The aim of the study was to investigate whether and in how wide limits the voice spectrum of classically trained professional vocalists varies when they sing scales with different dynamic shapings, and whether they use certain strategies to maintain the timbral consistency of their voice during the tasks.

Method. Ten professional male singers sang ascending diatonic scales from D3 to D4 on the vowel /a/ three times – (1) with most habitual dynamics, (2) with the *crescendo*, and (3) with the *diminuendo*. The recordings of their performances were inverse filtered to measure the glottal closed quotient (CQ) for each note that was sung. Using the power spectrums of each note, the level of the fundamental (LH1), the level of the highest spectral peak closest to the first formant (LF1), and the level of the highest peak at singer's formant region (LF3) was measured. We also measured the SPL and captured the EGG signal.

Results and Conclusions. The parameters LH1-LF1 and LF3-LF1, that show the balance between the strategical frequency regions of the spectral envelope, changed systematically in the case of all participants. Some of those changes had purely acoustical reasons and were related to the fact that the locations of spectral partials change with pitch. Several singers used combined articulatory and phonatory strategies to improve the sound's consistency during the task. The strategy of some singers to create the difference between *piano* and *forte* was not the changing of the SPL but modifying the timbre of their voice.