Title: Frequency jumps during laryngeal mechanism transitions: influence of vowel, Sound Pressure Level and starting note.

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Abstract :

The vocal frequency range of classical singing corresponds to the use of two different laryngeal vibration configurations, called laryngeal mechanisms M1 and M2. M1 is mostly used for low tones (chest register), and M2 for high tones (head register for women or falsetto for men). The laryngeal transition between M1 and M2 implies generally a frequency jump and a sudden vocal quality change, which is one reason why many operatic singers develop their voice range mainly in only one laryngeal mechanism. However, most alti voices like counter-tenors and contraltos use both M1 and M2, and then have to get trained to smooth the transition. To do it, they generally lower the SPL before the transition. In contrast to classical singing, yodel technique which requires producing clear and large frequency jumps implies a perfect control of the M1-M2 transition to reach the expected frequency after the break. In addition, vowels used in M1 and M2 are not the same. The aim of this study is then to investigate the variations of the frequency jump with SPL, starting note, and vowel.

A first experiment was set up to estimate the vowel influence on the frequency transitions occurring during glissandi Three vowels (/a/, /i/ and /o/) were investigated with 20 male and female singers who did 2 glissandi (ascending and descending) with laryngeal mechanism transitions. In spite of great variability among singers, most of them changed their mechanisms slightly lower on /i/ than on /a/. An interaction between the fundamental frequency and the first formant could explain this lowering.

A second experiment was set up to explore in a controlled manner the influence of Sound Pressure Level (SPL) and the starting note on the frequency jump. The protocol consisted to change the laryngeal mechanism on a given starting note and a given SPL, while trying to keep constant the fundamental frequency and so far as possible the SPL. 7 subjects did this protocol, and the same three vowels were investigated. Furthermore, phonetograms in each mechanism were recorded for other studies. The results show again great differences among singers. However some tendencies were observed. Firstly, the frequency jump tends clearly to increase with SPL. This tendency is clearer for jumps from M1 to M2 than for those from M2 to M1. It justifies the musical strategy used to smooth the transitions. It also shows that in any experiment related to frequency breaks, the SPL must be taken into account. Secondly, the jump seems also to be smaller on /i/ than on /o/ and /a/, which might be linked with a smaller vocal dynamic range on /i/ in mechanism M1. More than SPL, the significant factor for studying the frequency jumps could be the musical nuance. This hypothesis is discussed. The frequency jumps are therefore studied in regard with their phonetographic location.