[Wed AM 1.1 LB] Timbral noisiness modulates activity in motor and limbic regions

Zachary Wallmark (1)*, Choi Deblieck (2), and Marco Iacoboni (3)

(1) Southern Methodist University. Dallas, Texas, USA
(2) University of Leuven. Leuven, BELGIUM
(3) University of California, Los Angeles. Los Angeles, California, USA
* =zwallmark@smu.edu

What areas of the brain are involved in the positive and negative appraisal of musical timbre? Based on the results of a parallel behavioral experiment showing a strong correlation between perceived motor exertion and timbral noisiness, we hypothesized that timbres with salient noise components (e.g., growled saxophone) would drive greater activation in motor areas than the same sound generators in non-noisy conditions (normal saxophone tone). To test this hypothesis, we investigated neural activity associated with timbral noisiness using fMRI ($N = 15$). Participants listened to isolated instrument and vocal signals performed in "normal" and "noisy" versions (duration 2 s); they also performed a ratings task evaluating implied bodily exertion, valence, and "noisiness" of each signal (outside the scanner). Using multivariate regression on motor and limbic regions of interest, we found that negative valence is related to activity in pre/primary motor cortices and insula, among other areas, while perception of "noisiness" modulates activity in amygdala and hippocampus. We interpret these findings to indicate the possible contribution of the human mirror neuron system in the perception of certain spectral components of timbre. We further hypothesize a functional connection between motor and limbic systems in the generation of timbre-mediated affect, with anterior insula serving as a probable relay.

[Wed AM 1.2 LB] Is a salient timbre more difficult to mask? – Considering the effect of auditory masking on saliency, blend and segregation of timbre

Song Hui Chon (1)*, David Huron (1)

(1) Ohio State University. Columbus, OH, USA
* =chon.21@osu.edu

Timbre saliency refers to the attention-capturing quality of timbre. It has been reported that a highly salient timbre does not blend well with other concurrent timbres. In a recent study, timbral blend was negatively correlated with segregation, suggesting that blend and segregation occupy two end points along a single continuum for timbre combinations. Auditory masking is a phenomenon that we experience every day. Both pitch and loudness affect the mutual masking of concurrent sounds. Recently, it has been suggested that auditory masking might account for the high voice superiority effect—that is, a higher perceptual importance is given to auditory streams of higher pitch.

This paper reports on the effect of auditory masking on saliency, blend and segregation of timbre. We hypothesize that when a highly salient timbre is paired with a less salient timbre, the more salient timbre will mask the other more effectively than vice versa. Further, we hypothesize that the degree of blend between each pair of concurrent timbres will be inversely proportional to the residual (or unmasked) signal power of the timbre that is a more effective masker.

Stimuli consisted of 15 orchestral instrument timbres (clarinet, English horn, flute, French horn, harp, harpsichord, marimba, oboe, piano, tubular bells, trombone, trumpet, tuba, cello, vibraphone), equalized in terms of pitch, loudness and duration to minimize their impacts on auditory masking. A computational masking model was implemented in MATLAB based on Bosi & Goldberg (2003). The model takes a pair of unique timbres in input and determines which is the better masker based on the residual signal power.

Data analysis is in progress. Masking studies of two complex tones matched for pitch and loudness are rare, and require extra analytic caution. Both detailed methods and results will be reported.