On the control of respiratory muscles in trombone performance

V. Fréour[a], B. Uva[b], A. Aliverti[b] and I. Cossette[a]
[a]McGill University, Schulich School of Music, 555 Sherbrooke St. W., Montreal, QC, Canada H3A 1E3
[b]Politecnico di Milano, Dipartimento di Bioingegneria, Pizza Leonardo da Vinci, 32, 20133 Milano, Italy
vincent.freour@mail.mcgill.ca

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From the physiological point of view, instrumental gesture in brass instrument performance can be presented as the action of respiratory muscles and adjustments of respiratory airway geometry, leading to a fine control of the quasi-static mouth pressure driving lip auto-oscillations. Among the different views and conceptions on how the respiratory system works or should work during playing, the roles of certain anatomical components such as the diaphragm or the abdominal musculature are important subjects of debate among musicians.
Today, new experimental tools such as optoelectronic plethysmography allow monitoring of chest-wall volumes with a low degree of invasiveness, hence making measurements during music performance easier to conduct. Along with recording of the quasi-static pressure at different locations within the respiratory system, the pressure developed by the different groups of respiratory muscles can be precisely quantified and the respiratory ”gesture” of a music performer characterized. In this paper, we report experiments conducted on a trombone player. After describing the experimental setup, the net pressure developed by the diaphragm, as well as abdominal and rib cage muscles are extracted and their relationship to the mouth pressure, playing frequency and sound loudness assessed during basic playing tasks. The main results reveal a similar and almost linear variation of the actions of abdominal and rib-cage muscles when the playing frequency is varied, resulting into a sequential and coordinated variations of rib-cage and abdominal volumes. In addition, the diaphragm remains relaxed during playing, hence allowing an optimal coupling between the abdominal and rib-cage compartments.