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A Comparative Study of Air Support in the Trumpet, Horn, Trombone and Tuba

Dr. Jonathan Kruger
Department of Fine Arts,
Rochester Institute
of Technology
Rochester, New York, USA
jhkgsl@rit.edu

Dr. James McClean
Department of Physics,
SUNY-Geneseo
Geneseo, New York, USA
mclean@geneseo.edu

Dr. Mark Kruger
Department of Psychology,
Gustavus Adolphus College
St. Peter, Minnesota, USA
mgk@gustavus.edu

ABSTRACT
Arnold Jacob's observations about air-pressure, airflow, and brass performance were replicated and extended in order to better understand the similarity and differences in skills required to perform on the trumpet, horn, trombone, and tuba.

Keywords
Music Performance, Music Pedagogy, Expertise, Brass Instruments.

INTRODUCTION
Several studies have measured airflow and blowing pressure during brass performance (Fletcher & Tamoplosky, 1999). None has been more significant for brass players, however, than the observations made by Arnold Jacobs, the former principal tubist with the Chicago Symphony Orchestra. Jacobs's observations done between 1959 and 1960 with Dr. Benjamin Burrows were never published. Only

anecdotal comments made by Jacobs in subsequent interviews and master classes remain. Jacobs claimed that blowing pressure (intra-oral pressure) increases as players ascend in range and that airflow in the horn subsequently decreases. Jacobs went further to claim that intra-oral pressure and airflow were consistent at a given pitch and decibel level, regardless of the instrument being played. According to Jacobs, a tuba player and a trumpet player create the same amounts of intra-oral pressure and airflow in their respective instruments when performing the same enharmonic pitch. The purpose of this study is to replicate Jacob's unpublished research and to extend it by measuring airflow, intra-oral pressure, and sound simultaneously and by measuring changes continuously rather than recording only peak measurements.

METHOD
Eleven musicians (three on trumpet, two on horn, four on trombone, and two on tuba) performed musical exercises in the same concert pitch (Bb) selected to allow comparison of air support systems as a function of pitch, loudness, and articulation. Airflow was measured in liters per second by using an airflow sensor (PTL-1) and amplifier (MS-IF2)

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produced by Glottal Enterprises. The sensor was attached to the end of the bell of each instrument. Air pressure inside the mouth was measured using a fine (external diameter < 1.6 mm) Tygon microbore surgical plastic tube attached to gas pressure sensor produced by Vernier Electronics (GPS-BTA). Sound was recorded using a microphone placed approximately one meter from the bell of

Figure 1: Trumpet player

each performer's instrument. A trumpet performer playing with equipment attached is seen in Figure 1. Airflow, intra-oral pressure, and sound were sampled at 11,000 Hz using LABVIEW (National Instruments) software and Coulbourn's Lablinc V hardware.

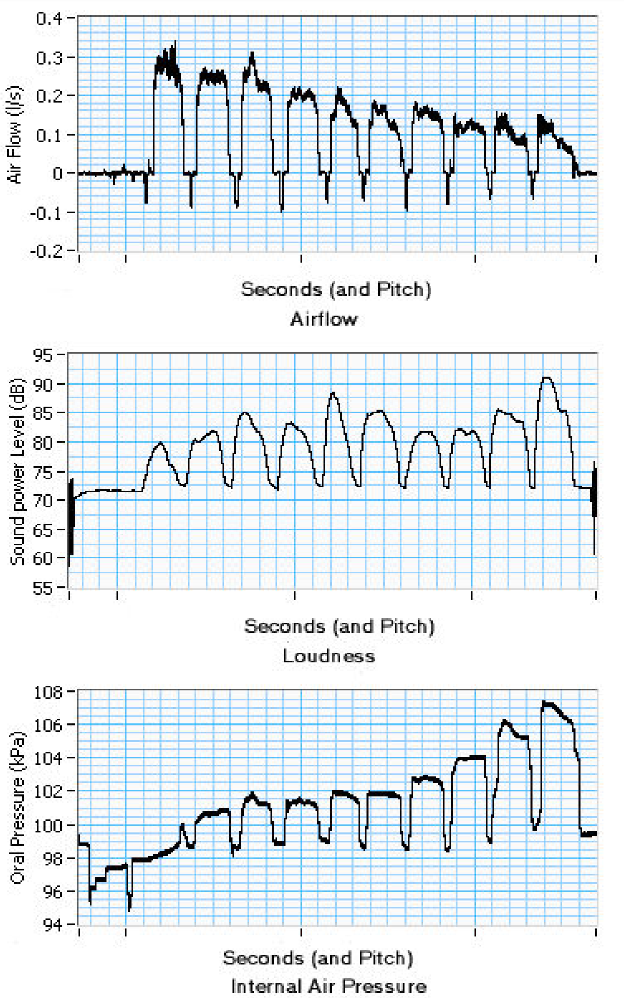

Figure 2: Trumpet - Ascending Arpeggio (Concert Bb)

RESULTS AND CONCLUSIONS

Intra-oral compression does increase as pitch increases and airflow decreases as pitch increases in each of the four members of the brass family. Both measures are also sensitive to changes in loudness (dynamic). Figure 2 shows changes in airflow and internal air pressure for a trumpet performer ascending the open pitches from the G below middle C upward while playing as close as possible to 85 decibels. As Jacobs observed, the larger bore instruments require less intra-oral compression and produce more airflow when playing in their normal ranges than the higher instruments. Contrary to Jacob's assertion about the similarity of instruments playing the same pitch, we observed measurable differences.

ACKNOWLEDGMENTS

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