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A Study of Player Technique and Equipment Setup and Their Effects on Trumpet Tone

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One of the pinnacles of performance practice is that of creating a recognizable, individualistic sound. There are differing opinions on this matter in relation to how a trumpet sound is formed and changed through both player technique and equipment setup. The purpose of this study is to take an objective point of view on the matter, using what others have said as well as the science of sound production on the trumpet, to find a window in to how players use technique and equipment to their advantage in creating the sound they desire.

Benade, Arthur H. "The Physics of Brasses." ***Scientific American*** **229, no. 1 (1973): 24-35.**

This article takes a purely scientific approach at explaining how brass instruments function. This is a great introductory work for the purpose of the research topic at hand, as it explains how overtones work, how sound is produced on the instrument, and what scientists use to evaluate the type of tone produced by a given player. It also looks at what causes a sound to be resonant, or full and balanced. With several images, graphs, and spectral analyses of brass sound production at a basic level, this establishes a foundation from which we can look further into some of these other sources and make greater sense of what they are teaching. This article looks at the sound production of different types of instruments within the trumpet family, including older instruments, modern trumpets, and even cornets. This gives it even more value, as it offers as much information on the topic at a scientific level as would likely be needed for most research

purposes. All of the graphs and analyses are explained in a way that makes them understandable to anyone sincerely interested in the topic.

Farkas, Philip. *The Art of Brass Playing; a Treatise on the Formation and Use of the Brass Player's Embouchure.* Bloomington, Ind.: Brass Publications, 1962.

Farkas is known as one of the most important pedagogues in the field of horn playing but has done extensive work with other brass instruments as well. He played for many years as principal horn in the Chicago Symphony Orchestra, and taught at Indiana University Bloomington after leaving his post with the CSO. This treatise by the renowned teacher examines how brass playing works. Farkas is careful to take an objective approach when studying this, trusting science over opinions, including his own. He presents factual evidence in picture and x-ray form to examine what is actually taking place when playing a brass instrument. Considering this, the above work will be a valuable tool as a means of comparing what other professionals think is taking place against what science has shown is occurring.

Haas, August William. "The Art of Playing Trumpet in the Upper Register." DMA diss., University of Miami, 2011.

August Haas graduated in 2011 with a DMA from the Frost School of Music at the University of Miami. He has since gone on to an incredibly successful playing career in New York. This dissertation is incredibly valuable to the topic at hand as it offers historical and scientific information on playing the trumpet, including the design of mouthpieces and instruments. Perhaps the most important feature of this dissertation is the inclusion of eighteen interviews with some of the most well-known trumpet players of our time. These interviews

discuss equipment and player approach to produce a brighter sound, one with a pronounced presence of higher overtones. This alone sets this apart as an incredible source of knowledge for trumpet players.

Hanson, Frank E. "Trumpet Timber: A Comparative Investigation of the Tone Quality of Two Professional C Trumpets." DMA diss., The Ohio State University, 1988.

This dissertation goes into extensive depth on both a spectral analysis of tones as well as seeking opinions from four of the most well-known orchestral trumpet players of the time. The study uses two different professional model instruments and records excerpts from orchestral repertoire on either instrument. They are then analyzed by a computer for the presence of overtones, the power behind attacks and decays, and then for listener approval of the sound by an outside professional source. Other studies which have been conducted on trumpet tone production are also cited and used throughout, making this a comprehensive tool for a scientific view of trumpet playing, as well as including some professional opinion.

Hickman, David, and Amanda. Pepping. *Trumpet Pedagogy: A Compendium of Modern Teaching Techniques*. Chandler, Ariz.: Hickman Music Editions, 2006.

This book gives an in-depth view into most topics related to the trumpet, starting from the first sounds a student produces, to medical conditions that may affect a player's career. As part of this extensive work, equipment and technique are covered in great detail. This book evaluates approaches from other pedagogues alongside that of the authors'. While these other insights offer some additional light on the topics, the authors still take a fairly subjective approach, and will often share other opinions as a means to show other schools of thought. The authors will also

occasionally discredit the ideas shared from other pedagogues. This is also valuable, in that it shows that there are conflicting ideas on the topic, a reason for further research.

David Hickman has been one of the most sought after international soloists and teachers in the trumpet world since 1974. He is recognized worldwide as one of the most important modern pedagogues of trumpet. His students have gone on to work with orchestras, universities, and other organizations around the world. Amanda Pepping is one of those students who has become an acclaimed solo artist and music editor for repertoire in the trumpet world. Their views on trumpet playing and teaching are respected by most everyone in the field, so this joint work proves to be a priceless resource for anyone researching or teaching anything related to trumpet.

Igarashi, Juichi, and Masaru Koyasu. "Acoustical Properties of Trumpets." ***The Journal of the Acoustical Society of America*****25, no. 1 (1953): 122-28.**

This article also analyzes tone production on the trumpet in an objective and scientific manner. It differs from the Benade article in that it uses an outside source to compare two recordings of trumpet tone. One is deemed by the listener as a poor trumpet tone, and the other as a good trumpet tone. The article then uses spectral analysis to determine the difference between the two. It also talks extensively about the basic production of sound on the trumpet and how that works with both artificial means and having a player produce the sound. The author discusses in the conclusion about the differences between having a player on the instrument and using some sort of artificial method. There are distinct differences in the sound of the artificial production that are explainable through analysis of the sound and the method with which the sound is produced.

Johnson, Keith. *The Art of Trumpet Playing*. 1st ed. Ames: Iowa State University Press, 1981.

Keith Johnson, professor of trumpet at University of North Texas, has established himself as one of the most popular and sought-after players and teachers in the world of trumpet. He has played on hundreds of albums as a guest artist, and is regularly featured as a guest with orchestras and other groups around the world. It has also become prestigious and competitive to gain entrance to his trumpet studio, as he has become a renowned figure in trumpet pedagogy. His book, *The Art of Trumpet Playing*, takes a very subjective look at how he approaches trumpet playing at a fundamental level. Topics range from basic sound production to more advanced things such as upper register playing and manipulation of the tone. Many of the techniques he teaches in this book differ from those taught by David Hickman. This makes the two works worth even more when evaluated together. With differing opinions, it is worthwhile to also see what they have in common. Those commonalities show that there are things that must remain constant when playing the trumpet. With differences, we see that there are perhaps varying ways of approaching the same musical goals and concepts. When comparing this and the Hickman work to that of Farkas, we begin to see that different schools of thought might seem wildly different but are simply thinking about the same objective differently.

Kusinski, John Stanley. "The Effect of Mouthpiece Cup Depth and Backbore Shape on Listeners' Categorizations of Tone Quality in Recorded Trumpet Excerpts." PhD diss., University of Miami, 1984.

This dissertation is interesting, as it does use some computer analysis to see what if any difference is made by changing the cup and backbore shapes of a trumpet mouthpiece. However, the main portion of the investigation was to see if listeners were capable of discerning differences between cup shapes and backbore shapes. What is perhaps most intriguing is that through the listening tests, the results were only slightly better than chance results, thus stating that listeners were statistically unable to identify the difference between recordings of the same excerpts performed with differences in cup shapes, and then another set of examples with differences in backbore shape. The listeners were organized into three groups, one of which was a group of brass players. Even this group was unable to statistically distinguish between varying mouthpiece design. The author does admit to the limitations at hand, as only one performer recorded all of the excerpts, and that more extensive searching for participants would likely yield different results during the listening portion of the investigation. This study shows a different side of the spectrum, in that most professionals agree that changing cup and/or backbore design will influence the sound that is produced.

Macaluso, Charles A, and Jean-Pierre Dalmont. "Trumpet with Near-perfect Harmonicity: Design and Acoustic Results." ***The Journal of the Acoustical Society of America*** **129, no. 1 (2011): 404-14.**

This article investigates the difference in harmonicity, or the presence of overtone frequencies in the sound, when altering the bell of the trumpet. The specificity of the study gives it appeal, as researchers can investigate whether only changing one design element of the instrument can have an impact on the sound produced. After digging into the math behind the

design of the trumpet bell and the physics behind the sound production, a bell design is produced. The study is compared to a second instrument, one with a generic bell that is used on mass produced instruments sold in stores. Everything else about the instruments remains the same, including the production of the sound which is done by an artificial mouth device, making sound production technique constant between the two. Graphics depicting the results show a clear difference between the two instruments. Not only does the bell designed by the author have more presence of overtones, the tones that are produced are more in tune with the overtone series, making the overtones sound even more prominent and providing the listener with a more balanced and pleasant tone to listen to. This article is incredibly valuable as it has clear results that illustrate needed information for the research topic at hand.

Poirson, Emilie, Jean-François Petiot, and Joël Gilbert. "Study of the Brightness of Trumpet Tones." ***The Journal of the Acoustical Society of America*** **118, no. 4 (2005): 2656-66.**

This study is multi-faceted and a worthwhile read for the research topic at hand. This study uses three modes of producing trumpet sound; a musician, an artificial mouth device that is mechanical in nature, and an electronically simulated sound. A variable cup depth mouthpiece was used to change the design of the cup easily, which effects could then be analyzed after recordings were made. What is most interesting is that after studying the results of the investigation, it becomes apparent that musicians can influence the tonal characteristics beyond what the equipment dictates. This is seen in that both spectral and human analysis of the sound produced by the musician after adjusting the cup depth showed little to no difference between the

two sets. However, when the artificial mouth device produces the sound, the technique of sound production doesn't vary, and a difference in tonal characteristics appears in both spectral and human analysis. This article supports statements made by Keith Johnson in his book *The Art of Trumpet Playing*.

Tarr, Edward H. "Trumpet." ***The New Grove Dictionary of Musical Instruments.*** **Edited by Stanley Sadie. London: Macmillan Press Limited, 1984. iii: 639-54.**

Edward Tarr is one of the foremost scholars on the history of the trumpet. This includes both its use/repertoire and the design differences that have come about with modern technology. His article in the aforementioned dictionary is comprehensive regarding the design of the instrument, starting with the first trumpets used in ancient times up to the instrument as used in present day performance. He discusses design elements of mouthpieces, the instrument itself, and how this will alter the sound. While not as in-depth regarding the science behind the sound, it offers a valuable look at what has changed over time. With an understanding of this, a researcher can reference recordings made with the varying instruments and mouthpieces to determine differences in sound production of each. While listener perception can vary between individuals, as well as terminology used to describe tone, a general idea of sound can be agreed upon by most through listening to examples of professional players with good command of the instrument.

Zicari, Massimo, Jennifer Macritchie, Lorenzo Ghirlanda, Alberto Vanchieri, Davide Montorfano, Maurizio C Barbato, and Emiliano Soldini. "Trumpet Mouthpiece Manufacturing and Tone Quality." ***The Journal of the Acoustical Society of America*** **134, no. 5 (2013): 3872-86.**

This study, also a scientific evaluation, looks at six different options for mouthpiece design, and goes a step further than other studies by looking at different cup shapes altogether. Other studies have evaluated larger or smaller "U" shaped cups. This study does that and investigates "V" shaped cups. Variations of rim design are also included with this study. The results show differences in the levels of overtones produced while changing cup shape and rim shape. This is interesting as the rim shape is often overlooked as an acoustical element in the design. It is most often viewed simply as a means of finding different comfort levels, however this study shows drastic differences in the presence of certain frequencies when the rim design is changed. This study, especially being more modern, is a valuable tool as a means to look at the science behind mouthpiece design and its effect on the type of tone produced.