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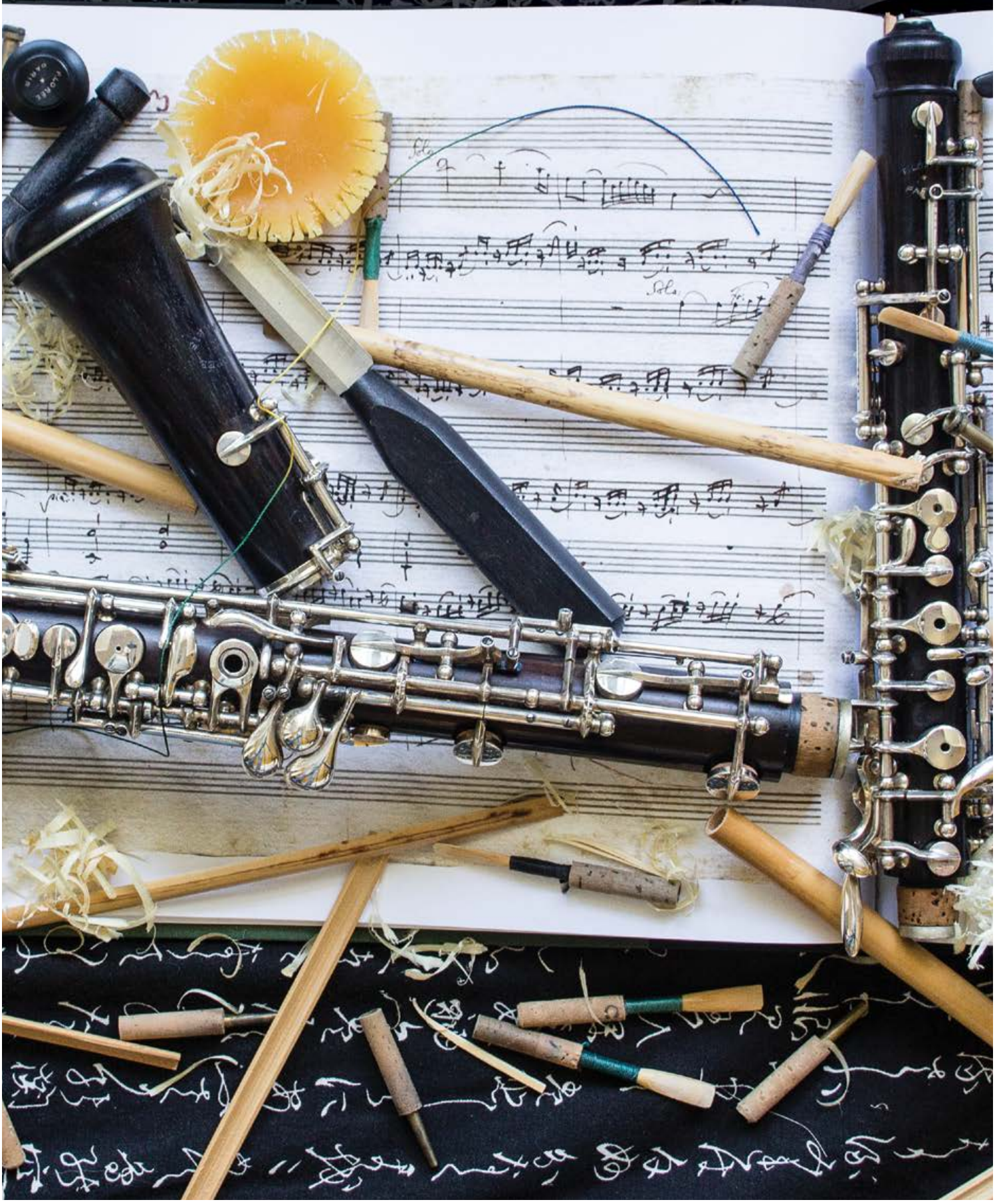

HEALTH MATTERS:
Face the Music: New Frontiers for Training Facial Muscles

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In **HEALTH MATTERS**, Dr. Stephen Caplan discusses health issues relevant to double reed players.

Double-reed players obsess over reeds. We're always on a quest for the perfect reed. We search for new sources of cane, and invest hard-won cash in equipment to assist us in reaching our goal: profilers, knives, staples, shaper tips…the list seems endless. There are more books, dissertations, and articles on the subject of reed making than almost any other subject related to double reeds.

However, the place where the reed meets our face—the embouchure, or what I like to refer to as the "reed my lips joint"—gets relatively little attention. We all recognize how important the relationship is between the reed and embouchure. Because of the delicate response of the cane, a poor relationship of reed and facial muscles at the embouchure can impact every aspect of our music making: tone production, intonation, endurance, dynamic range, and articulation. But compared to the voluminous attention given to every detail of reed making, our understanding of how the muscles of the face work with the reed is quite paltry.

Therefore, I was glad to find a poster presentation entitled *Facial Muscle Activation Patterns Across Woodwind Instruments* that was a prize winner at the Performing Arts Medicine Association's conference in 2019.[1] This is a report by an excellent team of researchers at the Texas Center for Performing Arts Health at the University of North Texas (UNT). Dr. Sarah Dunbar was the principal investigator as well as the subject of this study.

Figure 1.
Dr. Sarah Dunbar.

At the time, she was a student at University of North Texas, and a woodwind doubler. Dunbar had a history of chronic jaw pain. Because of this, she had surgery on her temporomandibular joints (TMJ), but unfortunately this didn't seem to relieve the pain she felt when playing woodwind instruments. Frustrated, she quit music entirely because of the pain she was experiencing.[2]

However, she couldn't stay away for long, and with determination (as well as the help of physicians, chiropractic treatments, acupuncture, and physical therapy), Dunbar forged a successful career as a musician. Her research identifying the patterns of muscle activation in the face as

she played different woodwind instruments helped her to understand how each instrument affected her facial muscles, and why some of the instruments were more painful for her to play than others. Dr. Dunbar remains an active performer who has won many honors. She performs internationally, and currently serves as Assistant Professor of Saxophone at Jacksonville State University in Alabama.

The UNT study was the first known study to use electromyography (EMG) to compare muscle activation patterns between various woodwind instruments. EMG is a procedure that uses electronic sensors to detect and quantify muscle activity. For this study, eight sensors were placed on Dunbar's face while she performed musical excerpts on saxophone, bassoon, oboe, flute, and clarinet. For each instrument she played a two octave C major scale and then played "Twinkle, Twinkle, Little Star" in the key of C. The EMG results showed that facial muscle activation patterns for each instrument were quite distinct. In order for us to understand these differences, we have to look at the individual face muscles that were monitored.

Eight muscles were monitored with EMG sensors for this study (figs. 2 and 3). Part of the value of Dunbar's research is that she worked with medical doctors at the UNT Health Science Center anatomy lab to determine which muscles to monitor. They also investigated what specific location to place each of the EMG sensors in order to get the most accurate result. The researchers decided to monitor these four muscle groups: the sternocleidomastoid, temporalis, zygomaticus major, and masseter muscles (see fig. 4). These muscles were monitored on both the left and right side of the face, therefore, eight sensors were used during the study.

Figure 2. Dunbar playing bassoon with EMG sensors.

Figure 3. Playing oboe with EMG sensors.

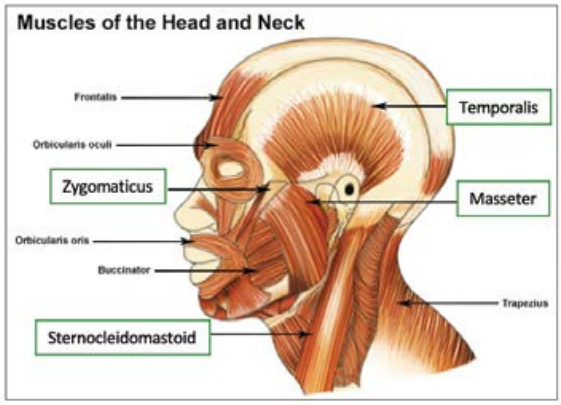

Figure 4. Muscles of the face and neck.

In a personal interview, Dr. Dunbar explained to me that other muscles were considered for study, however, in some cases, the various instruments she played got in the way of sensor placement, or else the sensors themselves were too large to properly measure the muscle. She explained that now there are smaller (and more expensive) sensors available that might allow someone to measure the activation of some of these other muscles.

Two of the muscle groups measured in this study are movers of the jaw—the masseter and the temporalis. The masseters are located in the cheek area and the temporalis are located above the masseters, and behind the eyes. Together, these muscle groups contract to bring the teeth closer together. Releasing these muscles allows the jaw to lower, assisting us in forming an embouchure. The temporalis is also responsible for moving the jaw forward and back. These muscles help double reed players with all sorts of things related to music making, and also the things we like to do after playing music—eating and drinking! But contracting these muscles is also commonly associated with stress. Clenching the teeth requires excess contraction of the masseter, and furrowing the brow in "concentration" often involves contraction of the temporalis, as well.

The two other muscle groups studied were the sternocleidomastoid (SCM) and the zygomaticus major. The zygomaticus major muscles, like the temporalis and masseter, are directly related to embouchure formation. These are the "smile" muscles that move the corners of the mouth upward. The SCM muscles, located in the neck, aren't directly related to the embouchure, but when they are chronically tense then they may affect the free movement of muscles in the face. These SCM muscles help move the head in a variety of ways—tilting and rotating the head to the opposite side, while lifting the chin up.

Generally, we are only able to speculate about how all these muscle groups help us create music as wind players. What muscle movements help us find more resonance in the low register versus the high register? What muscles are activated to help us make a crescendo or diminuendo? EMG studies have the potential to help us answer these and many other questions pertaining to the muscles of our face and how we use them for double reed performance.

This UNT research study is a first step towards a new understanding of how the embouchure works, but it also has immense value towards helping us understand how to help players who are experiencing problems like TMJ dysfunction, embouchure dystonia, velopharyngeal incompetence, muscle fatigue, cramping, or tingling. It is however, only a first step. It looks at only one instrumentalist playing a very limited range of music. The results of this study are particular to this one performer, and should *not* be generalized to apply to all woodwind players. In fact, a similar study using EMG to measure muscle

activity in trumpet players, showed just how much variation there can be from one player to another when performing the same musical excerpts.[3]

The accompanying graphs (figs. 5-9) highlight the EMG measurements of each muscle group for each instrument Dunbar played. You can clearly see how much the right side of Dunbar's face is working compared to the left side for each instrument. The concluding remarks of this study state: "Bilateral discrepancies in muscle activation are concerning, and could explain why pain might be experienced for this particular musician." Dunbar

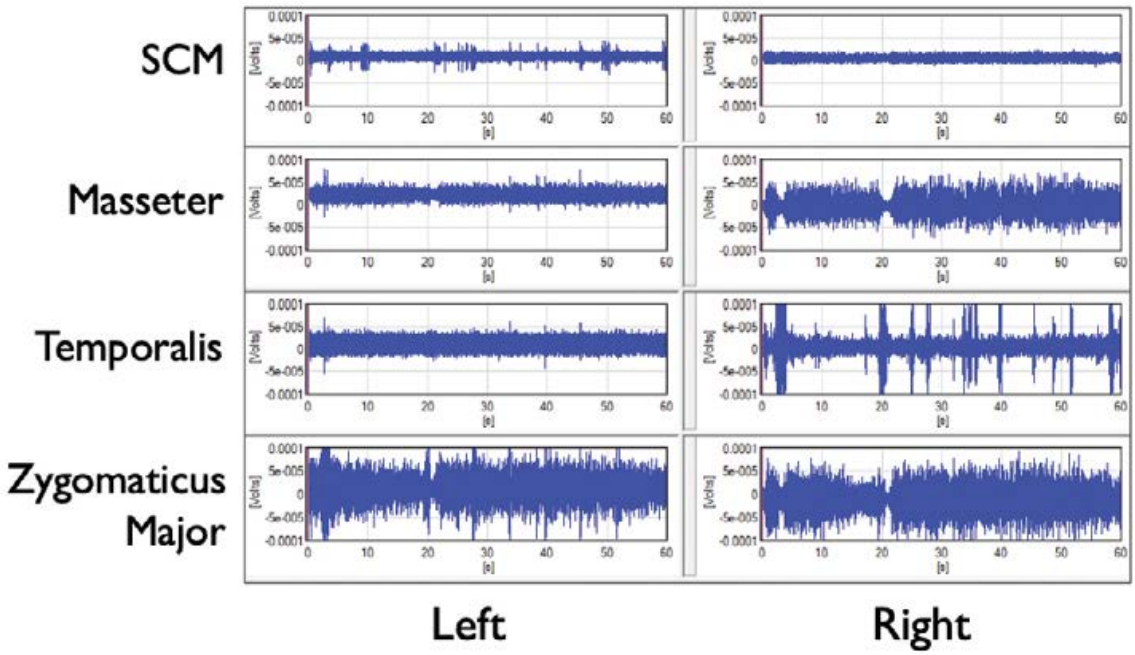

Figure 5. Graph of activation patterns of four muscles for oboe.

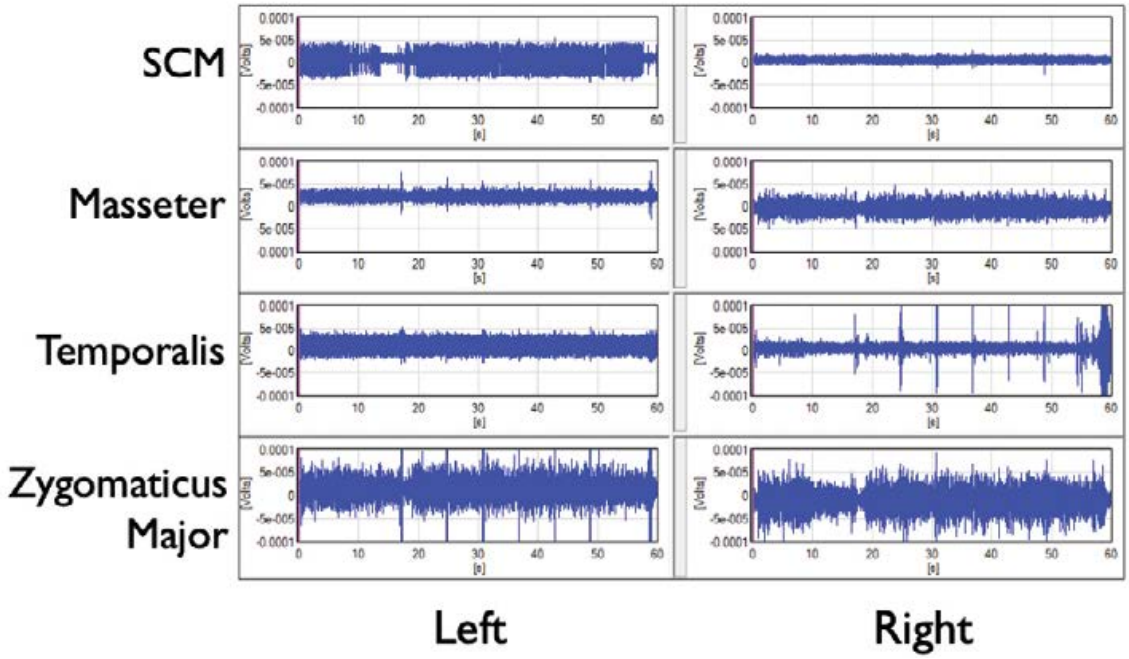

Figure 6. Activation patterns for bassoon.

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explained to me that she suspects that an unbalanced use of the muscle groups may have contributed to the TMJ pain she experienced. She also said that the study confirmed for her that tension in the masseter muscle might have been the largest factor in the pain she felt. She generally finds the flute (which shows minimal masseter activity) the least painful instrument to play. The saxophone and oboe show a lot of activation, especially of her right masseter muscle, and are the instruments that cause her the most jaw pain when playing.

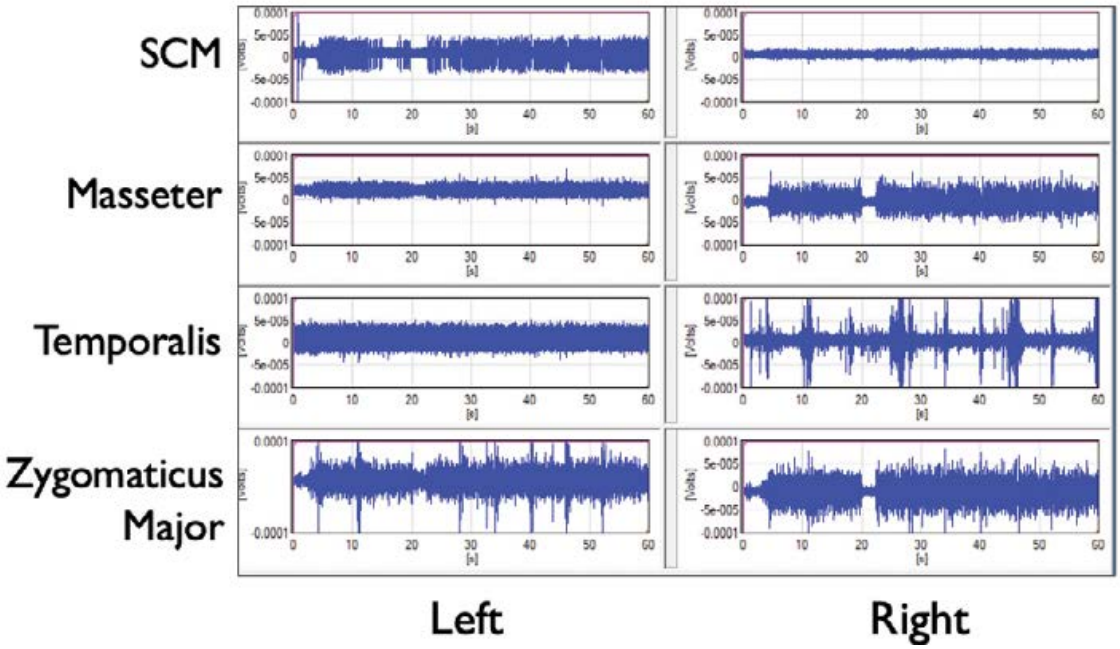

Figure 7. Activation patterns for saxophone.

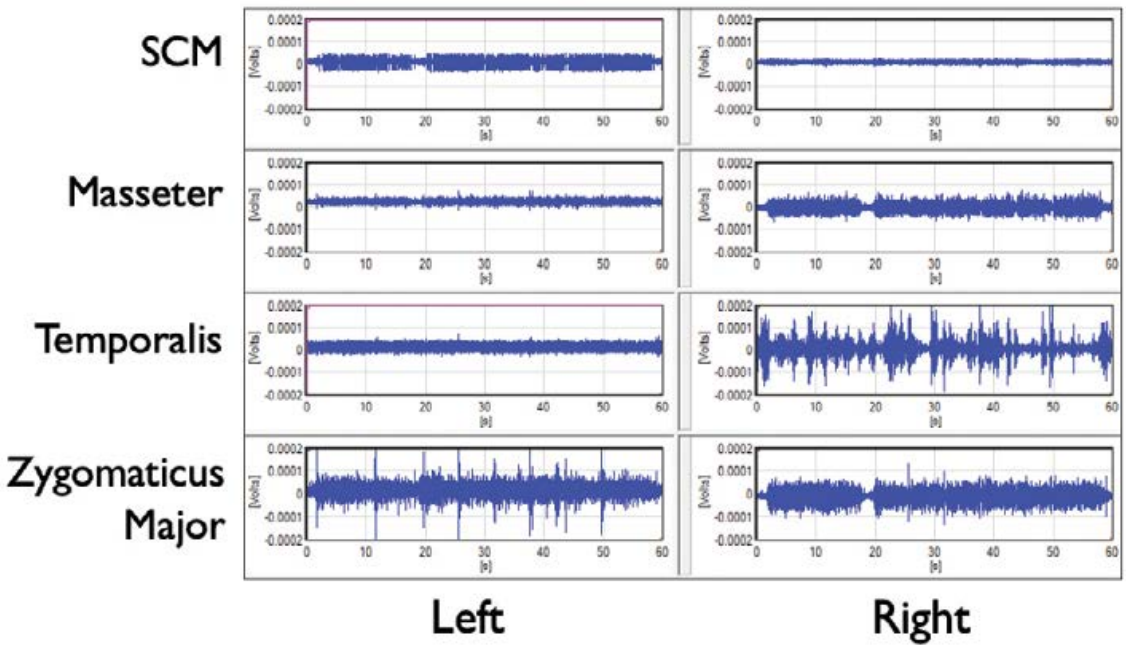

Figure 8. Activation patterns for clarinet.

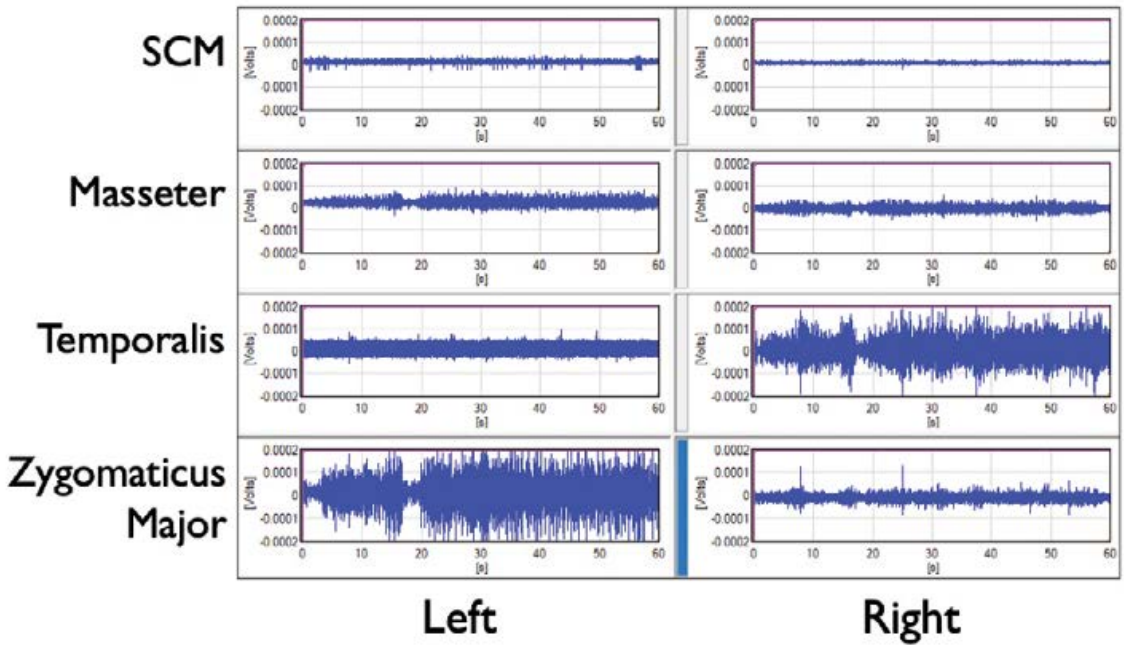

Figure 9. Activation patterns for flute.

Particular to oboe and bassoon playing, there are a few things one can infer from this graphic analysis. One can see that the left SCM is much more active for the bassoon than for the oboe. One sees a similar activation in the SCM between bassoon playing and saxophone playing. This is most likely due to the instrument's orientation to the right side when playing, therefore the left SCM is used to tilt the head towards the reed. Since the oboe is held directly in front of the player, the SCM is not activated to the same degree as on bassoon. The activation of the other three muscle groups is similar between the two double-reed instruments, especially when compared to the patterns for flute, saxophone, and clarinet. However, one sees that both zygomaticus major muscles are more highly activated for Dunbar when she plays oboe. Dunbar also is more actively engaging both masseter muscles, but especially the right masseter muscle, when playing oboe compared to her bassoon playing. Dunbar told me that generally she feels oboe playing puts more stress on her embouchure than bassoon playing, which is reflected in this graphic analysis.

Music is an art form. Many musicians feel strongly that music is the greatest art form precisely because its beauty is beyond human understanding. These musicians object to laboratory analyses of musical expression. However, we live in a time when science is completely reshaping every aspect of our existence. Athletes and dancers are embracing scientific methods to help them attain greater achievements and sustain longer careers. It's time for musicians to face the music, as well. Today, performers are confronted with ever-increasing demands: music that stretches our abilities, and working conditions that put a strain on us. Science and medicine can help us to function optimally in this ever-evolving environment, so that we can continue to bring comfort to others through the mystery of our art.

Sarah Dunbar and her colleagues at UNT have helped us to better understand how the muscles of the face and neck may impact double-reed playing. Dunbar has told me that she hopes to do further studies using EMG technology. She is particularly interested in using the technology to better understand how our facial muscles respond to different

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reed strengths used on the different instruments. I hope others will follow suit and use the tools of modern science to give us a clearer understanding of which facial muscles we use to make music, and how they help us accomplish our musical goals.

There are not very many studies explaining how wind players use their facial muscles, but there are two related studies that I find particularly interesting. The first, entitled "Changes in Dento-Facial Morphology Induced by Wind Instruments," is a recently published study and literature review.[4] It describes many fascinating results: from better understanding how playing an instrument affects the development of the teeth and jaw, and vice versa; to exploring the relationship of good breathing techniques in order to relieve stress in the face; to the difference in muscle activity between less experienced, and more advanced instrumentalists. The second study, "Speed, Amplitude, and Asymmetry of Lip Movement in Voluntary Puckering and Blowing Expressions," though not written specifically for musicians, has many interesting ideas that could influence wind pedagogy.[5] This article explains that instructing people to "blow" rather than "pucker" will result in producing lip movements of greater amplitude and longer duration. Instead of EMG, these researchers used a very sophisticated video analysis to determine the activation of the facial muscles.

Finally, there's a new device that oboe players are using to help them train the embouchure, the "Obofit." I have not tried it yet, but many fine oboe players are endorsing it. Dr. Andrea Ridilla says, "The Obofit teaches what words fail to express. Learn by sensation: the Obofit helps to release the wrong muscles that 'grab' the reed, and lower support muscles instantly begin to do their job."[6] Some double reeders may also be familiar with P.E.T.E. the "Personal Embouchure Training Exerciser" originally developed for trumpet players. There is a version of P.E.T.E. now made for woodwind players. The manufacturer claims that regular use of P.E.T.E. "will result in increased endurance and flexibility."[7] I have not personally tried this device either. I can see how it could be useful, though. But I also believe that double-reed players already have a personal device that will give them these same results—their reed! Practicing a variety of exercises on the reed alone, without the instrument, can help players increase their awareness of the blowing muscles, as well as improve muscle tone and coordination. However, as the saying goes, "different strokes for different folks." Some musicians are attracted to a device they can use away from their instrument.

The innumerable reed-making gadgets currently available prove that double-reed players are attracted to devices. Maybe more attention should now be paid to the muscles used to control those reeds. Whatever means we use—EMG, external devices, video analysis, or just practicing—improving our understanding and increasing our awareness of the "reed my lips joint" and all the muscles that make it work, will continue to improve double-reed playing.

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Endnotes

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