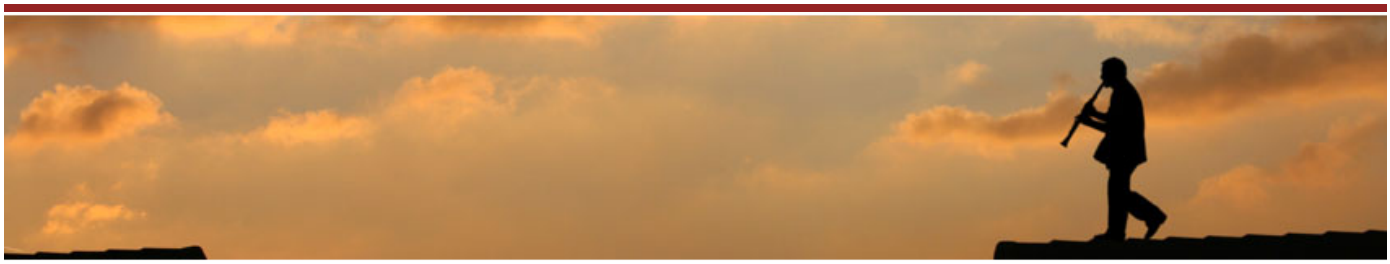

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Lessons from Research in Motor Learning on Playing and Teaching the Clarinet

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Good afternoon. It is my great pleasure to be here this afternoon. I would like to begin by thanking Dr. John Cipolla for organizing this session so carefully. It's deeply appreciated.

My goal this afternoon is to present some ideas drawn from research in motor learning and apply them to playing and teaching the clarinet. I will begin with a disclaimer: I'll be discussing biological, laboratory research being carried out at the molecular and cellular levels; research in human kinetics, particularly as applied to athletics; and research in music education. My perspective is one of a music educator and a student of music psychology. When I put on my clarinetist hat, however, I find myself saying "Of course" "This is what we do." So, with these thoughts in mind, knowing that at best I may only affirm what good clarinetists already know, let's begin by discussing the nature of motor learning and the first point that I would like to make this afternoon: motor learning is different.

It is "non-declarative." It results in skills, procedures, habits and actions. It is largely learned unconsciously, and involves much repetition. It tends to be learned slowly but remembered for a long time, which is the opposite of semantic knowledge that tends to fade over time. It is also a phased process and what is known as our *mirror neuron system* plays a key role. We're all familiar with the outcomes of motor learning, e.g., bicycling, dancing, walking and, of course, many aspects of playing the clarinet.

Phases of learning

Next, I would like to unpack the idea that motor *learning progresses through distinct phases of fast and slow learning*. After practicing something new --say a small, difficult chunk of music-- to the point where it stops improving and starts to level off, a map of the new skill is formed in our brains. This process is referred to as the *acquisition* phase of learning and can take anywhere from a few minutes to an hour or so. Because of the time involved, it is sometimes referred to as *fast learning* (not to be confused with fast playing).

Following acquisition, a four to six hour phase of "slow learning" or *consolidation* begins even though no overt practice is occurring. Cortical networks are reorganized and, at a microscopic level, the synaptic connections and strengths change. Gradually, the skill becomes stabilized, and much more resistant to interference. At that point, *consolidation-based stabilization* is said to have occurred. When all goes well, and we returns to the skill, it may initially be at a level lower than where it was at the end of the last session but it evens out. The first few trials typically function as a sort of warm-up.
During consolidation, the skill is subject to interference: distractions, learning a new task, emotional responses, and more may affect the musician's ability to reproduce the skill at the level achieved during practice. In laboratory settings, drugs have been given to animals during the consolidation phase that have completely erased the new skill from the animal's repertoire.

When this happens, our memory for the skill may erode.

The moral of the story is clear: Don't overdue it. Learn one thing at a time very well. Live an organized, healthy life.

This brings us to the second main point of this session: motor learning progresses through distinct phases.

Sleep

Let's talk now about sleep. Research (and common sense) suggests that sleep –especially deep sleep (i.e., Stage 2 non-REM sleep) –the sleep that occurs at around 6:00AM if one began to sleep soundly at midnight—continues to enhance the learning that took place during acquisition. What's interesting is that *Consolidation-based enhancement* often occurs without any additional physical practice and has been demonstrated to result in improvements in accuracy, speed, and evenness. The more difficult the skill, the more benefits that appear to accrue. Sleep helps skills to become more automated and reproducible, even in the face of distraction (Atienzo & Cantero, abstract presented in Walker, 2005) –which is clearly important point clarinetists!

Alas, however, learning a new, related skill prior to sleep seems to squelch the enhancement process. This was nicely illustrated by Robert Duke and Carla Davis, music researchers, who had a group of novice piano players learn a five-finger passage. Half of the group learned a second, similar passage later in the day. The following day, those who did not practice the second excerpt showed an improvement on the first passage. Those who learned the second skill demonstrated consolidation but not enhancement.

So, the third and fourth points of this presentation are: get a good night's sleep. And to quote Mies Van Der Rohe: "Less is more."

Focus of attention
Now, this elegant, "perfect world" learning model assumes a few very important elements: First, that skill *acquisition* has actually occurred. That is, that the learner has spent enough time repeating the skill so that it reaches the point where a map of the skill is embedded in our neural system. And, second, it assumes that our lives are so sufficiently organized and agitation-free that we are able to progress through an uninterrupted consolidation phase followed by a good night's sleep without any tossing, turning, worry, anxiety etc. These, of course, are huge assumptions and the real world is rarely so cooperative. In fact, our attention is often spewed in different directions and, being human beings, we are often beset by emotional turbulence.

I believe, however, that we can learn to optimally focus our attention so that we can acquire the right skills, and then take advantage of the consolidation and enhancement processes.

I would like to turn our attention to how we *focus our attention*. Research strongly suggests that focusing one's attention internally, on the execution of a skill is detrimental to performance. Although at some level every accomplished musician knows this, the statement is counter-intuitive to much of current methodology practiced in schools and studios today. Some teachers argue that a focus on execution is appropriate for younger students, or frankly, for those who just seem to need it, whatever their age.

The problem with this approach, however, is that, during performance, we are at risk of regressing to a point where we deliberate about execution. The higher the stakes the more likely we are to regress. This is what happens when we lose focus, *choke,* get the *yips* (i.e., shaking or twitching). So if the problem is that we regress during performance to a time when we focused attention internally, then perhaps we need to learn how to perform in a way that is conducive to an external focus. And this brings us to the nature of practice for it is here that we set about the work of skill acquisition.

I will share some of the outcomes of two studies that I have worked on recently one a well controlled quantitative study, the other much more qualitative in nature. In the first, piano novices were asked to perform a two-note phrase (A-F) as fast and as evenly possible. One group focused on the fingers; the next on the keys; the last on their sound. Not surprisingly, those who focused externally, on their sound, performed best.

In another study of musical practice, 18 serious musicians agreed to practice a piece of music they knew relatively well for about ten minutes while being videotaped. They were explicitly asked to focus on the expressive aspects of their music, which they selected themselves. Musicians represented three levels of development: high school, college, and professional. They played a variety of instruments, including the clarinet. After ten minutes were up, they were asked to view their video and describe what they were thinking into a hand held microphone.

Let's start by listening in on the practice of a very pulled-together violist named Michael: [PLAY EXCERPT]

Michael's focus of attention was on musical expressivity and the effect what he was doing was having on the sound he was creating. He is in the present. Perhaps it is going too far, but I sensed an almost Zen-like repetition of the phrase he was practicing, a constant contracting, expansion and chaining process. His words focused on description and questions about his work, but were not evaluative. He acknowledges problems and asks himself questions. He experiments with different fingering possibilities. He uses metaphors: simple, long, a little bit, airy, stronger conviction, narrative, grow, sunk, consonant, open feeling. His words tend to pull one away from an internal focus, towards an external focus away on the music, on the sound, and on the effects of his fingering experiments.

Contrast Michael, a professional with an active musical performance career, with the internally oriented words of an aspiring high school violinist: This excerpt describes just a few minutes of practice:
I wasn't very happy
That messes me up.
Could have been better.

Then I get flustered.
I have a fear of it.
Doing that yourself is kind of scary.
Right now my hand is getting really tight.
It's just my left hand –I get overwhelmed with that. It inhibits me rather than …helping me.
Hold—not long enough.
I tend to flail my fingers out a lot.
I'm not happy.
I press way too much.
I'm pressing too much.
I knew it could be better.

I think the point is clear: Her focus of attention is internally oriented. It is negative. She is unhappy. Flustered. Fearful. Concerned with pain. She was far from alone in the way she described her practice.

The research literature on focus of attention suggests that if one focuses on the *effects* of one's actions rather than the actions themselves it will more likely induce an external focus of attention. One subject in this study, an accomplished marimba player and teacher illustrated this beautifully. In his own words:

I'm not worried about correctness of notes --I'm just going big picture about [sic] 'What is this phrase supposed to be doing?'

So now back to slow again because I was going into the next 4 bars -- so I can hear the flavor of the music.

Big picturewise, not worried about notes at all --making sure the RH is coming off the LH so I can hear the melody.

Just reinforcing what I want to do --just want to make sure the phrasing goes along with the mood of the music.
Marimba, pro
In summary, then, the fifth point of today's session is: Focus attention externally, on the effects of one's actions.

Watching and listening can be as effective as physical practice.

The final area that I will discuss this afternoon pertains to simply watching and listening –two commonplace activities among clarinetists.

Research suggests that our temporal lobes play a relatively minor role in motor skill while the *mirror neuron system* is highly active. We are compulsive copiers --we cannot help ourselves: Even when we do not actually engage in an observed behavior, our mirror neurons fire when we observe the actions –and even the emotions-- of another. Observation is intrinsic to learning any motor skill, even when we cannot see all the nuances of the behavior.

What does recent research on the nature of observation teach us? The first is that a model offers something different –something having to do with the parameterization of a skill—a sense of the points that make up the skill –that is unique and essential to learning. This becomes a template to match in performance—a way of focusing on effect.

The second is that, when learning a new skill, *learning models*, rather than experts, make the best models, particularly when they are observed receiving feedback and instruction.

Third, observing (and then matching) a model, tends to produce an external focus of attention which we know is a very good thing.

There is a concern by some that exposure to too much modeling induce a dependency on the model. This has not, however, been born out in studies in non-music areas: continuous exposure does no harm. It's interesting to note that many aspects of instruction do produce dependency: continuous feedback, excessive prompting and cueing being among them, but modeling does not seem to have the same deleterious effects on independent performance. I want to emphasize however, that the most effective learning involves an independent performance, not the teacher playing along with the student. I mention this because I frequently observe it in student teachers: they just don't stop playing, singing or counting while the student plays. This is prompting, not modeling, and needs to be faded. The student MUST have the opportunity to play alone and learn to rely on his or her own internal cues to a good performance.

Finally, research suggests that the most effective retention and even more importantly, transfer, of a skill occurs when the learner has control over the timing of a model, where and how they focus their attention on the model, and even whether or not they receive feedback with respect to how well they are performing. (This

is somewhat counter-intuitive to educators who feel they are in the best position to point out relevant features of a model.)

So, to summarize, the sixth point: *Observing a model can be as effective and, under some circumstances, more effective than physical practice.*
One approach that takes advantage of the benefits that accrue from modeling involves the use of an observational partner, or dyad practice, as it is called. In dyad practice, two learners work together to achieve a goal. They deliberately rotate trials, and take time to talk about their work. If asked, one may provide feedback to the other. This process has been shown to be effective in learning an array of skills, primarily in athletic performance. Although yet to be tested in a music situation, it holds promise and tends to be a myth buster with respect to common practice in studio teaching.

Summary

In summary then, are the five points from this afternoon's session:

1) Motor learning is different
2) Motor learning progresses through distinct phases.
3) A good night's sleep enhances motor learning.
4) Less is more.
5) Focus attention externally, on the effects of one's actions.
6) Watching and listening can be as effective as physical practice.
7) Dyad practice is a promising teaching and learning technique.

Like all serious musicians, clarinetists routinely engage in highly sophisticated, complex motor behavior. Applying lessons acquired through the growing area of research in motor learning may enhance the quality and efficiency of our work as performers and teachers. It is also an area where further research is needed. We need to find out if findings observed in studies in the biological sciences and non-musical contexts transfer to music performance where creation of a beautiful sound is the ultimate goal. So far, the evidence is compelling.

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