

COGNITIVE AND METACOGNITIVE LEARNING STRATEGIES FOR SKILL
ACQUISITION AMONG CONSERVATORY GUITARISTS

BY

EROL OZSEVER

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Peter Miksza, Research Director

Ernesto Bitetti, Chairperson

Kathryn Lukas

Elzbieta Szmyt

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Dedicated to the memory of Lynn and Jane Canfield.

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INTRODUCTION

A Brief History of the Classical Guitar in the Academy

The classical guitar has undergone radical transformations over the past five centuries. From construction and tuning to the expansion of repertoire for the instrument, the guitar is becoming increasingly accepted in the music academy as it is brought to center stage by an increasing number of virtuoso concert artists. Andrés Segovia's (1893-1987) influence brought the guitar from the salons to the concert halls. This development has led to the establishment of classical guitar programs at a myriad of music institutions around the world. The first American institutions established guitar departments in the 1960s, which included the San Francisco Conservatory and the Peabody Conservatory. Additional programs were founded in later years including the Indiana University guitar department in 1989. Due to the relatively short amount of time that the guitar has been a presence in academia, the body of research pertaining to guitar pedagogy is proportionally small. As guitar continues to gain popularity, the need to compile more research on guitar pedagogy becomes increasingly apparent.

Justification

Conservatory music students spend a substantial amount of time in practice rooms throughout their diligent pursuit of excellence. Students confront

the challenge of a conservatory education armed with the belief that with ample hard work and persistence that he or she will reap the rewards of the highest degree of artistry and mastery. Yet some musicians seem to exponentially excel with only a moderate quantity of hours spent in the practice rooms, while others practice seemingly obsessively and achieve no more fruitful of results and are bound by long periods of stagnancy. This point of diminishing return can lead to frustration and underperforming.

Clearly the answer lies not with the number of hours one invests in a practice room, but rather how effectively and efficiently the practicer utilizes his or her time spent (Duke et al., 2009; Miksza, 2007). Cognitive psychologist Dr. Gary Marcus—author of *Guitar zero: The new musician and the science of learning* (2012)—wrote the book using his own expertise to conduct research on musical skill acquisition and motor skills using himself as a test subject.

He writes, “When practice regimes aren’t selected with care, the learner may wind up automatizing bad habits and thus enshrine sloppy or inadequate procedures, in a way that impedes future progress.” (2012, p.52)

In a study conducted in 2002 (Kostka), music students and faculty members were surveyed regarding specific behaviors and time spent while conducting practice. The faculty members on average expected their students to practice for approximately 14 hours per week, while the students reported

practicing only an average of approximately 10 hours per week. If, in fact, the underlying issue is that students do not have as many hours available to devote to practice as advised by their faculty members, it is especially important to acquire a more concrete understanding of what makes practice most efficient by yielding the best results in relation to time spent.

Research has indicated that the quantity of hours spent practicing does not necessarily directly correlate to rates of performance achievement (Duke et al. 2009; Miksza, 2006; Miksza, 2007), so it is crucial to examine what the body of research has indicated can make practice most efficient. The method by which Duke conducted his study instructed the subjects to practice as long as they wished in order to determine if there was any conclusive and significant correlation between time spent and result achieved. Nonesuch correlation was observed. In his study Duke raises a particularly thought-provoking implication:

Informal reviews of private teachers' instructions for practice reveal that teachers commonly assign only what to practice and how long to practice, with little attention given to specific proximal goals to be accomplished each day. This is in stark contrast to assignments in many academic disciplines in school, where students are given sets of problems to solve, chapters to read, or essays to write, and the time devoted to homework is determined by the time required to complete the problems, read the chapters, or compose the essays. It seems readily accepted in other disciplines by teachers and students alike that all students will not devote the same amount of time to assignments, because individual learners work at different rates and different learners will not require the same amount of time to complete each assignment. How long one works

depends on how long it takes to accomplish the assigned goals. (2009, p. 311).

Informal accounts from some expert musicians also support that quite frequently they themselves do not keep track of the amount of time spent practicing.

Research Regarding Periods of Learning

Researchers have conflicting stances upon the relevance of “critical periods” in music learning—that is, the belief that acquisition of certain cognitive functions can only develop during certain windows of mental development.

Some research indicates that those who begin specialized training before the age of ten often achieve higher levels of excellence than those who begin training later in life (Ormrod, 2008). Ericsson (2003) posits that often the individuals who excel most in his or her given field are those who began learning around age six.

Dr. Marcus (2012) argues against critical periods. Many conservatory students may grapple with the idea that the only way to secure a performance at Carnegie Hall is for one to have started his or her instrument at a very young age like Mozart, Mendelssohn, or other prominent figures that have been immortalized in music history. But Marcus uses himself as a test subject to argue that this theory lacks validity in regard to music learning, and that the development and acquisition of new skills can take place at any age, thus further

necessitating a better understand of what processes are most effective for learning.

He writes: A musical mind develops only if we put in years of hard work, or at least active listening, in which parts of the brain that evolved for other purposes such as language, skill learning, and auditory analysis are gradually co-opted into doing something new. To the degree that we ultimately become musical, it is because we have the capacity to slowly and laboriously tune broad ensembles of neural circuitry over time, through deliberate practice, and not because the circuitry of music is all there from the outset (Marcus, 2012, p.33).

Research has indicated that development of senses, vision, and speech take place during critical periods, but the evidence suggesting critical periods for music learning are dubious. Ormrod even states: “[...] most theorists doubt very much that there are critical periods for all skills and knowledge domains” (2008, p.25). This may perhaps shed a bit of optimism toward those who may succumb to a defeatist attitude of “I started too late, so why bother”.

The conjectures surrounding critical periods suggest that critical periods narrow over time and certainly do not abruptly cease, after which time further acquisition of new information can take place. Older learners can still become fluent in non-native languages, and musicians can certainly develop into great artists. Ericsson—despite the implication that a practicer who begins around age six is more likely to achieve skill mastery—also (2003) posits that expertise is acquired by learning mechanisms as opposed to inherent potential. The research

argued no evidence of a “ceiling effect” due to inherent predispositions because of the mind’s high adaptability. Some of the leading guitar virtuosos including Andrés Segovia and Christopher Parkening have reported beginning around age 10. There are clearly strategies and learning mechanisms that allow for expert development even after what some may claim as critical age ranges. Expertise is not out of reach for those who got a late start.

Purpose

The purpose of this study is to understand from a scientific research base what makes practice for instrumentalists most effective and efficient. Expert tutelage is always a necessary component for effective learning and artistic development, but most institutions only advise that students meet with their private instructors for one hour—or perhaps two to three if he or she is conducting ensemble or chamber music coaching—each week. The majority of the time, students must be able to devise and execute an effective autodidactic practice routine outside their faculty members’ teaching studios. Furthermore, upon completion of the degree programs and course of study with a particular musical tutor, musicians must then adopt both roles as both the student and the teacher making the need to acquire efficient practice strategies and behaviors all the more imperative.

Methodology

This study will examine both qualitative and quantitative research regarding the effectiveness of time spent both in and outside the practice room. In order to achieve the most comprehensive sources, this study will combine narrative accounts from a number of method books and journals along with research in social cognitive theory, cognitive and metacognitive learning and behavioral psychology. Social cognitive theory pertains to the implication that we can learn by observing our peers and tutors. Cognitive psychology deals predominantly with the idea that changes take place internally in our minds that may or may not be visible in our behaviors. Metacognition is one's own understanding and engagement in the learning process itself. Behavioral psychology pertains to the observation of one's behaviors as an indication that learning has occurred, which is often effected by reinforcement.

There is an extensive collection of instructional guitar methods which incorporate foundations of technique, technical exercises, pedagogical etudes, concert repertory, and additional accounts of effective practice habits as well as guitar-specific instruction including right-hand fingernail shaping and maintenance for adequate tone production. However, many of these methods are largely narrative accounts that are based heavily on personal opinion and

testimony and often lack a scientific research base. Periodicals such as the *Journal of Research in Music Education* and *Psychology of Music* target largely academic disciplines of music education, and very few guitarists or instrumentalists have considered the idea of turning to these types of resources for tips on effective practice. Furthermore, very few researchers have examined effective practice strategies among guitarists as research subjects.

This presents a clear need to compile a literature review of documentable quantitative research to determine which practice habits have been confirmed as effective from existing music education and psychological studies and compare them with popular method books and expert testimony. The target audience of this study will be advanced conservatory students who are looking for a more detailed, scientific evidence base for effective practice techniques. Another benefit of this document will also be to provide valuable research findings for pedagogues in the application of studio instruction. Having a more solid research base behind the instruction of practice habits will enable students to achieve a higher degree of practice efficiency, and ultimately by extension, performance achievement. Each of the outlined subtopics to follow will include important findings in music research and suggestions for music learning and application to guitar pedagogy.

The following section will describe the planning and preparation of practice through metacognition. By utilizing learning strategies which research has indicated to be effective, the learner can examine and thus more effectively engage in the learning process itself. Examples include—but certainly are not limited to—time of day one chooses to practice, frequency and duration of practice sessions, etc.

After examining the research surrounding the various examples of metacognition in planning, the next section will present the research surrounding the effectiveness of specific behaviors during practice. The research base will be pooled from journal articles, pedagogical methods, and other expert testimony. Through comparing and contrasting these various types of sources, we can posit potentially effective methods of deliberate practice.

**RESEARCH-BASED APPROACHES FOR DESIGNING AN EFFICIENT
PRACTICE ROUTINE**

I. PLANNING A PRACTICE ROUTINE

Tedious repetition of arduous musical tasks provides no guarantee for further skill acquisition among advanced instrumentalists. Mundane repetition of difficult passagework and technical exercises places perhaps too great an emphasis on the physical act of executing these passages rather than the examination of the mental associations we develop during practice sessions and over periods of distributed practice.

Metacognition

Metacognition refers to an understanding of the process of skill learning. Examining elements of cognitive psychology enables the performer to take a more active role in the learning process from planning to execution.

Gabrielsson writes: Studies on planning of performance—that is, how to form mental representations of the music, devise performance plans and strategies for efficient practice—did not start until after the emergence of cognitive psychology during the latter half of the 20th century [...] (2000, p. 236).

This study of mental processes will help enable the performer to better utilize the time spent not only in the practice room, but outside as well.

Metacognition encompasses everything from the planning to the execution of practice. David Pedrick's article *Effective Practice Makes Successful Performance* (1998) is an example of metacognitive strategies and outlines and

describes five components of effective practice sessions: setup, preparation, warm-up, maintenance, and advancement.

He describes the setup component by stating: There is a great deal for students to do at the beginning of a practice session before playing a single note. First, they remove all distractions. Telephones, televisions, and other devices that can hinder their concentration on the task at hand are turned off or put at a distance. The practice room should be a quiet place, free of interruptions. (p. 33)

This can be particularly difficult when smartphones, tablet computers, and similar electronic devices serve as a nearly endless encroachment upon a quiet and focused environment. Pedrick also argues that the student should assemble all materials including scores, a metronome, pencil, etc. before initiating the execution of the practice regimen in order to keep the environment free from disruptions and to further facilitate the effectiveness of the practice session.

He describes preparation by stating: To prepare mentally, students focus intensively on the practice session at hand. Engaging their minds in the concentration and focus required for successful practice may involve their blocking out a bad day or setting aside the frustration of a personal dilemma. (p. 34)

He also argues that goal-setting should be integrated into the preparation process. There is an extensive body of research arguing the effectiveness of goal-setting toward skill acquisition which will be explored in further detail later in this essay.

Pedrick also instructs the practicer to free any excess tension from the neck, shoulders, back, and limbs in order to achieve a sense of physical relaxation necessary to maintain the foundation of proper technique. A number of other pedagogues additionally argue this point (Parkening, 1997; Shearer, 1990; Tennant, 2002). Physical relaxation will be explored in greater detail in the section that summarizes research describing factors that prevent fatigue, overuse, and injury.

The next step that Pedrick describes is the warm-up stage, the point in which the practicer implements tuning and basic technical exercises to warm up for the impending practice session.

He writes: The students' approach to these should be neither precipitate nor perfunctory. Rather students should perform these exercises in a deliberate and calculated manner, giving special attention to technique, form, and posture. (p. 34)

Pedrick describes the following step, maintenance, as the most important component of practice:

This is the area of practice that students most often neglect. This stage of the practice session provides time for students to review material that their teachers have already presented. Too often, students skip this phase, erroneously thinking that they can use their practice time more efficiently by proceeding directly to new material. The problem with this thinking is that without first maintaining the techniques already presented by the instructor, time spent working on new material is often unproductive, and progress may be hampered. Reviewing allows students to confront the new technical challenges lying in the week's assignment without suffering

the inevitable lapse in concentration that occurs when students find that they must backtrack and spend time acquiring or refining skills that they supposedly mastered in the past. During this stage of the practice session, students work to maintain technique, but this should by no means be the exclusive focus of their attention. This is also the time to practice skills in rhythm, sight-reading, theoretical analysis, and tone color and dynamics. Maintained daily, all of these skills give students the ability to proceed with new material efficiently and confidently. (pp. 34-35)

The last stage that Pedrick describes is advancement. In this stage he describes the reading and acquisition of new material.

He states: Mistakes need to be isolated and addressed immediately. Students accomplish this by taking the problematic passage out of its musical context and repeating it slowly and deliberately until they can perform it three times in a row without error [...] Finally, when students feel comfortable with a piece of music, they should perform it for the most unbiased audience available—the tape recorder. (p. 35)

More information regarding the use of recording devices will be examined in the following section.

II. KEEPING A PRACTICE JOURNAL

Effective practice is largely contingent upon problem-solving skills, and self-awareness can help better facilitate more error detection and correction resulting in more efficient practice. As a music educator, reflection and discussion of important points with students helps the student and the instructor gain a more clear understanding of what is actually taking place. The clear communication of ideas either verbally or written in a practice journal may help gain a deeper understanding of the mental representations we create during practice.

Examples of noteworthy commentary may include technical ideas such as “The scalar passagework in measure X sounds uneven, particularly at points of string crossing and needs to be practiced in isolation”, or musical ideas such as “Be particularly mindful to bring out the inner voice of the texture at measure X.” This type of critical thinking will help not only isolate problematic areas of the work, but also will help stimulate further thought regarding particular processes that will help the performer achieve the desired outcome from these problematic areas.

Gabrielsson writes: [...] most of the studies [...] used recordings (audio or video) of practice behaviour in combination with some kind of verbal report. The verbal reports come from performers instructed to ‘think aloud’ during practice and/or from interviews afterwards. For instance,

Nielsen (2001) asked performers to think aloud as if answering questions such as 'What am I thinking?' and 'What am I focusing on?'; she also interviewed the performers afterwards, asking them to look at the video recording to stimulate recall of their thinking, a procedure also used earlier by Miklaszewski (1995). The combination of recording and verbal reports is generally preferable if conditions allow. [...] Observation of practice behaviour can provide important information that does not appear in the performer's verbal reports. For instance, although observation revealed that the pianist practised dynamics right from the start, this was not mentioned in her self-reports, probably because it was unproblematic. (2000, p. 238).

Many renowned artists and pedagogues will also argue in favor of keeping a practice journal. Marcus describes his experience meeting Grammy award-winning jazz guitarist Pat Metheny. He writes that Metheny told him in conversation that he keeps a written practice diary, with each entry consisting typically of six to eight pages, describing in great detail the things that produced positive and negative results during practice (2012). Renowned classical guitarists Jason Vieaux (2009) and Scott Tennant (2002) both advocate the benefits of keeping either a mental or written log of each practice session.

III. MOTIVATION AND GOAL SETTING

A large body of research has indicated a correlation between motivation, goal setting and achievement. Oxendine (1968) writes that motivation, “is the most basic essential for learning and is a prerequisite for all other steps (of learning)” (p.17). Essentially, motivation is the necessary drive that creates a state of internal arousal. Many people possess the ability to acquire new skills required to perform new tasks, but generally only those who are motivated to do so actually will. Motivation increases cognitive engagement during the learning process, increases affective state, and spurs the learner to repeatedly engage in the task with persistence (Ormrod, 2008). Highly motivated individuals will be much more likely to engage in metacognition in order to achieve mastery at a specific task.

Extrinsic versus Intrinsic Motivation

Extrinsic motivation is aroused by an external stimulus, such as a cash prize at a music competition. Personal anecdotal experience with competitors suggests that most musicians compete to test their own abilities in pursuit of a higher goal of mastery. This desire comes from an internal state of arousal and is referred to as intrinsic motivation. Those who are intrinsically motivated generally outperform those who are motivated by an external stimulus (Ormrod,

2008; Schmidt, 2005; Schmidt, 2007). Generally, those who are extrinsically motivated will only perform the task well enough to achieve the desired outcome, such as cramming for an A on a final exam. Often times, when the external stimulus is removed, those who lack intrinsic motivation will cease performing the task. Returning to the cramming analogy, once the student has received a satisfactory grade for the course, he or she no longer continues studies in that particular subject and thus activity ceases, and the student forgets—can no longer retrieve—the information.

Ormrod writes: Intrinsic motivation has numerous advantages over extrinsic motivation. For any particular task, intrinsically motivated learners are more likely to pursue the task on their own initiative, be cognitively engaged in the task, strive for true understanding of the subject matter, undergo conceptual change when such change is warranted, show creativity in performance, persist in the face of failure, experience pleasure--sometimes even exhilaration--in what they are doing, regularly evaluate their own progress, often using their own criteria, seeking out additional opportunities to pursue the task, and achieve at high levels. (2008, p.454)

Hierarchy of Needs for Motivation

Psychologist Abraham Maslow is one of the forefathers of humanist psychology who developed a hierarchy of needs which affect motivation (1943). The two that are particularly applicable for the current discussion are esteem needs and need for self-actualization. Esteem needs pertain to the need for self-confidence.

Maslow describes self-actualization by stating: Generated by this new humanistic philosophy is also a new conception of learning, of teaching, and of education. Stated simply, such a concept holds that the function of education, the goal of education—the human goal, the humanistic goal, the goal so far as human beings are concerned—is ultimately the “self-actualization” of a person, the becoming fully human, the development of the fullest height that the human species can stand up to or that the particular individual can come to. In a less technical way, it is helping the person to become the best that he is able to become. (1968, p.74)

Ormrod provides insight on Maslow’s principal which makes the concept more approachable and easier to grasp in the context of music practice and skill acquisition.

Ormrod writes: Individuals striving towards self-actualization seek out new activities as a way of expanding their horizons and want to learn simply for the sake of learning. For example, people seeking self-actualization might be driven by their own curiosity to learn everything they can about a particular topic. (2008, p.459).

A particularly interesting question to address is whether or not motivation to participate in music competitions comes from a need for self-esteem or a need for self-actualization. Some musicians become too personally invested in the outcome of the competition and find the blow of a negative outcome difficult to handle. When the performer feels that too much is on the line, he or she may experience exacerbated symptoms of performance anxiety (which will be discussed in further detail later in this essay). Under said circumstances, one could even argue that a poor experience at a competition may elicit similar

responses as when the external stimulus is removed from extrinsic motivated behavior.

Individuals striving for self-actualization may simply be more interested in testing oneself rather than proving oneself, and will therefore be more likely to handle to a failure in a constructive way and be persistent enough to continue competing. Additionally, those who strive for self-actualization may be more inclined to continually learn new repertory and practice for the betterment of oneself. After examining and contrasting the needs for self-esteem and self-actualization, we can posit that the latter enables the performer to handle failure better, thus promoting the continuation of learning and possibility of future success, not only in performance, but in the conduct of practice itself.

Self-efficacy

Often times our expectations can be predictive of how well we are able to perform specific tasks. Self-efficacy is one's belief that he or she is capable of accomplishing the goal at hand. One of the monumental pillars of western music is Johann Sebastian Bach's Chaconne from the Partita in D minor BWV 1004. The great Maestro Segovia proclaimed "One must be at least fifty years old to perform the Chaconne well." The gravity of this bold statement places the work on a pedestal and thus many performers shy away from performing it because of

the expectation that the work is too difficult and that he or she lacks the maturity to attempt such an undertaking. If the performer believes he or she is not capable of performing a particular piece of music well, he/she will either underperform or avoid the task altogether.

As a result, self-efficacy affects a variety of behaviors including one's choice of activities, goals, effort, persistence, learning and achievement (Ormrod, 2008). For example, those who believe they can be successful at competing are much more likely to attend competitions. Furthermore, self-efficacy can also affect the choice of repertory one selects for his or her next performance. And one is certainly more likely to succeed in performance if he or she has high self-efficacy.

Individuals' sense of self-efficacy can also change and evolve over a period of time. During practice, one's ideas of his or her own capabilities may change depending on the rate of success or failure from previous practice. If a practicer is engaging in deliberate practice and utilizing effective practice behaviors, he or she may experience positive results, thus increasing his or her sense of self-efficacy. Self-efficacy and its relationship to achievement will be discussed further in the section on performance anxiety.

As previously stated, one's sense of self-efficacy can affect goal setting, a necessary part of deliberate practice. The practicer is much more likely to make noticeable improvement when he or she is keeping track in relation to a specific goal. Barry and Hallam (2002) posit that the extent of motivation also affects concentration during practice.

Other goals are more long-term. These types of goals will enable the practicer the longevity of sustained motivation. The practicer must take special care to determine goals that are small enough that they can be achieved in a single or series of practice sessions. For further discussion of goal-setting, refer to Section IX (p. 47) on deliberate practice.

IV. MASSED VERSUS DISTRIBUTED PRACTICE

A contributing factor to the efficiency of teaching and learning is the deliberate and thoughtful scheduling of individual sessions, partly in duration, but more specifically in frequency.

Massed, or concentrated, schedules are those which have little to no rest (or alternate activity) between the beginning and the completion of practice on the activity. Spaced, or distributed, schedules are those in which work periods are spread out or separated by either rest of some activity which is different from the one being practiced. (Oxendine, 1968)

A number of research studies have examined the dichotomy of massed and distributed practice. Often times due to the time constraints of a hectic and rigorous curriculum, conservatory music students may find themselves practicing in single, large blocks of time, a phenomenon known as massed practice. Research indicates that this is not generally the most effective way to store and retain information (Ericsson, 2003; Gabriellson, 2002; Oxendine, 1968; Ormrod, 2008). Many students find themselves quickly losing the ability to retrieve pieces that they had hastily scrambled to memorize in time for a recital thereafter.

Ormrod argues: Rehearsal is probably a relatively ineffective way to promote long-term memory storage. In contrast to such short-lived rehearsal, reviewing and practicing information and procedures at periodic intervals over the course of a few weeks, months, or years clearly enhances retention and performance. (Ormrod, 2008, p.219)

While learning a piece may take more time this way, it will ultimately yield better results both in performance and in long-term retention. This is known as the spacing effect. Ericsson (2003) posits the effectiveness of distributed practice due to the limited capacity of the short-term memory (which will be discussed further in Chapter X).

Ormrod and other psychologists also argue that attention is necessary for learning to take place. Naturally as products of the 21st century, we are perpetually inundated with sensory information, which is conditioning us to have shorter and shorter attention spans. In order for active learning to take place, one must be able to practice in a distraction-free environment and to practice only as long as one's attention span will naturally allow. Mindless repetition of a task is no guarantee for improvement, and many renowned concert artists will argue that sometimes "less is more" when the quality of attention and focus during deliberate practice is uncompromised. It is better to practice for shorter periods with keen attention to detail several times throughout the day than to lump all of the day's practice into one massive session where physical and mental fatigue may compromise its quality.

But when consulting the literature on motor psychology, Oxendine still poses the question: Since research has shown the short practice sessions generally have advantages over longer practices, how short should these practices be for maximum efficiency? [...] Psychology does not offer

specific answers to these problems, its contribution has been in the establishment of broad principles. (1968, p. 19)

An early study in 1935 (Snoddy) characterized a difference between primary and secondary growth. Primary growth refers to the beginning stages of skill acquisition, while secondary growth refers to the advancement of skill once the foundations have been acquired. Snoddy concluded that during primary growth, longer periods of rest proved more advantageous than during periods of secondary growth, which—contrary to popular opinion—yielded better results from massed practice.

Other researchers (Woodworth & Schlosberg, 1963) have posited that duration of practice sessions and rest periods are contingent upon several factors including the nature of the task to be performed and the relative difficulty of the task. For example, longer and more substantial pieces of music may require more practice time than shorter compositions. Tasks that are also particularly difficult may require longer sessions, and correspondingly shorter periods of rest.

V. PERFORMANCE ANXIETY

A particularly vexing problem that frequently leads to an unfilled sense of self-doubt is performance anxiety. Many conservatory students find themselves nearly debilitated by crippling anxiety during performances, particularly the higher the stakes. Nideffer and Hessler (1978) argue that the severity of performance anxiety can only be marginally controlled with extra preparation through practice. There is a point of diminishing return, after which prolonged practice bears no guarantee to ameliorate the on-stage symptoms of performance anxiety. The implication of this statement appears bleak for those seeking to overcome performance anxiety, but the answer lies not exclusively within physical practice itself, but rather in conjunction with engagement in metacognitive activities including planning, and goal-setting. This chapter will elaborate on how metacognition and self-efficacy can play an instrumental role, along with physical practice, toward ameliorating the negative effects of performance anxiety.

The aforementioned article describes several potential causes and responses to performance anxiety. "Some students react to anxiety with withdrawal and fail through avoidance and refusal or an inability to perform"

(Nideffer and Hessler, 1978, p. 149). All too often conservatory performance majors end up performing infrequently if at all in extracurricular settings.

Others react in a disorganized fashion responding almost impulsively to anything around them. Their feelings of becoming overloaded and confused keep them from responding in a local, integrated way. [...] Others become very narrowly focused in an attempt to control and reduce the overload. This excessive narrowing makes them respond in a rigid fashion, and they tend to make the same mistakes repeatedly. (149-150)

One of the most problematic aspects of performance anxiety is the heightened muscular tension induced by the fight or flight response. Previous research has also indicated that muscles in the forehead are the best single muscle indicators of total arousal induced by performance anxiety (Nideffer & Hessler, 1978).

Self-efficacy and its Effect on Performance Anxiety

Self-efficacy can also help predict one's success on the stage. Perception of stage anxiety often derives from mental associations formed by previous experiences. If an aspiring concert artist receives an ovation after a performance in smaller venues with seemingly less at stake, that success will shape his or her sense of self-efficacy for performance. However, if a student has little to no performing experience, the junior recital may be more nerve racking than what they are prepared to handle. If the student is dissatisfied with the outcome of the performance, the experience may adversely affect his or her sense of self-efficacy and the mental associations of performing.

But what determines one's sense of satisfaction with a performance? Is it simply to make it through without any derailing memory slips, or to play without a single fret buzz or missed note? In some cases, individuals' self-efficacy is contingent upon how they perform in relation to others, which can be particularly problematic at competitions, where the results are often highly subjective. Music competitions in general produce a high degree of anxiety among performers due to a high failure rate. Most prominent prize-winning musicians will have to cope with a great deal of failures before achieving success. A colleague of mine entered a particular competition six times before eventually winning. In order to develop a sense of resilient self-efficacy, one must be confident enough in his or her own abilities that even despite minor setbacks, these failures will have little effect on their overall sense of self-efficacy. Perhaps the best solution to this is to engage in musical activities where you are likely to succeed—performances at small venues, chamber music performances, etc. Given enough prior success at these types of events, a performer is not likely to be discouraged by minor setbacks.

VI. SLEEP AND MEMORY RETENTION

A particularly interesting phenomenon regarding practice is how the effects of stimulation following practice affect memory retention. Studies have indicated that general activity tends to negatively affect memory retention of newly acquired skills (Oxendine, 1968). Interestingly, studies have historically indicated that subjects retained acquired information more effectively when followed by periods of sleep than those who remained awake and engaged in general activity (Jenkins & Dallenbach, 1924).

The study (Jenkins & Dallenbach, 1924) involved the instruction of verbal syllables during two different time periods. The first period of instruction was conducted between 11:30 p.m. and 1 a.m., while the second period took place between 8 and 10 a.m. Subjects were then tested for the retention of the instructed verbal information after one hour, two hours, four hours, and eight hours. Those who slept after the instruction recalled the information 64 percent better after one hour and 69 percent better after two hours. After four hours, subjects who slept retained more than twice the amount of syllables, and approximately five times as many after eight hours.

Another study by Robert Duke and Carla Davis (2006a) examined the process of memory consolidation of a short musical excerpt following practice observation of keyboard players. The results indicated:

...consistent, significant improvements attributable to sleep-based consolidation effects, indicating that learning continued after the cessation of practice during both the first and second nights of sleep following training. When subjects briefly recalled a learned sequence 1 day after training and then immediately learned a second, similar sequence, there were no observable improvements in subjects' performance of the first sequence after the second night of sleep. (p. 111)

Another study (Duke & Davis, 2006b) not only indicated that subjects showed improvement in overall performance after a period of sleep, but determined that those who did not sleep immediately thereafter showed no significant improvement.

My anecdotal experience suggests that a large number of musicians prefer to practice in the evenings, many of whom prefer to adhere to practically nocturnal schedules in order to practice into the night. The implication based upon the research is that practice immediately before a period of sleep can be particularly beneficial for retention, and additionally emphasizes the value of rest and recovery time between practice sessions.

VII. SOCIAL COGNITIVE THEORY OF LEARNING

Examining and understanding the components of Social Cognitive Theory can provide valuable insight for this discussion regarding both behavioral and cognitive learning since it encapsulates elements of each. Ormrod outlines the general principles of social cognitive theory (2008, p.119):

- People can learn by observing the behaviors of others, as well as by observing the outcomes of those behaviors.
- Learning can occur without a change in behavior
- The consequences of behavior play a role in learning
- Cognition also plays a role in learning
- People can have considerable control over their actions and environments.

The first and last of these points are the most pertinent to the current discussion.

The most relevant component of Social Cognitive Theory for this study pertains to the processes of acquiring information from observing the behaviors of others.

One of the many benefits of a conservatory environment is the ability to acquire and develop new habits from expert instructors, but also from one's peers. If two students are performing the same work in a repertory or master class, one may discover aspects of the other's interpretation and style that shed new light on the work. Perhaps both performers in the scenario end up learning from each other in a symbiotic exchange.

We can learn a great deal from others, whether they are iconic figures or peers. We choose how frequently we interact with others, what schools we will

attend, under whose tutelage we will study, etc. Attending festivals and competitions featuring renowned artists can often inspire us and unveil new perspectives which we had not discovered prior. A renowned performer's particular phrasing or use of timbre may awaken a new and deeper understanding and approach to interpreting a work.

Modeling

Modeling can be particularly effective from the perspective of both the pedagogue and the student—that is instruction which involves the student imitating specific pedagogue-directed gestures. Models can be aural examples including audio recordings or a combination of aural and visual cues such as direct instruction from a pedagogue. One can learn a great deal by listening to audio and video recordings from accomplished virtuosos—the way Andres Segovia was capable of producing such a robust tone upon executing a rest-stroke melody, or the way John Williams performs with such remarkable ease and elegant composure.

There is certainly room for debate among pedagogues regarding the extent of using aural models for instruction. Some could argue that relying too heavily upon other performers' interpretations may impede a student's ability to cultivate independent, thoughtful performances. But a wealth of existing

research on modeling and other types of behavioral psychology have indicated that practicing with an aural model generally yields better results than without an aural model (Hewitt, 2001). It is up to the discretion of the instructor (or the performer no longer under the umbrella of an instructor) to determine to what extent modeling is appropriate. A particular problem that may ensue for the advanced conservatory student is to only use one particular source for aural models, for example the recordings of Andres Segovia. It may become habit to perform things in a fashion that merely imitates the Maestro without necessarily understanding the reasoning behind the interpretation. But evaluation of multiple sources, for example several different recordings of a widely performed work such as Fernando Sor's *Variations on a Theme by Mozart Op.9*, may provide new insight on the piece for the student undertaking the work while simultaneously enabling him or her to discern differences in musicality and thus promote more independent interpretation.

Although studies have indicated that while the use of aural models correlates to increased performance of musical gestures such as phrasing and dynamics, in some studies no significant correlation was evident between the use of aural models and increased note accuracy (Dickey, 1992). But nonetheless, those receiving modeling instruction still tend to achieve higher composite performance achievement scores than those who do not. Furthermore, anecdotal

accounts with concert artists suggests that the highest tier performers often focus on execution of musical gestures—the musical skill that research has indicated to be most effective when given modeling instruction—rather than the muscular sensations required to produce them (for further discussion see Chapter XI on motor function).

To summarize a few of Dickey's conclusions regarding modeling (p.36):

- Teacher demonstration-student imitation cycles can contribute significantly to the development of musical skills.
- Positive relationships exist between teaching modeling and student performance.
- Students learn to make increasingly complex musical discriminations through modeling, via both musically appropriate and inappropriate demonstrations and imitations.
- The models used to teach music affect the way students think music should be performed.
- Students' performance preference, sense of correctness, group performance, and individual performance are all positively influenced by musical models.
- Modeling is an effective strategy throughout a wide age distribution. Modeling has a positive influence on music learning for elementary students, junior high students, and undergraduate and graduate music majors.

Modeling can also be effective in other areas. Modeling can be an effective method of teaching and learning a physical skill such as playing a musical instrument, but it can also be used as a method of instructing proper practice habits and behaviors. Many competent models will argue that one develops a

greater understanding of which practice behaviors are most effective with experience. Miksza (2007) examined students' attitudes and self-evaluations in relation to practice behaviors and their expected outcomes.

Based on the results he posits: The results [...] suggest students may need to be trained to distinguish between efficient and inefficient practicing. For example, teachers could demonstrate characteristics of inefficient practicing, such as repetition of errors and physical and/or mental fatigue, and warn students to guard against them. Conversely, teachers could also highlight characteristics of efficient practice, such as focusing on problematic passages and taking appropriate amounts of rest. (2007, p. 372)

Perhaps one of the only limiting factors regarding the effectiveness of modeling is the necessity for the learner to be able to reproduce the task being modeled. Sometimes students simply lack the technical facility to be able to reproduce a modeled performance of a work or excerpt. But with competent verbal instruction combined with the receptiveness of a learner, he or she can still acquire a general understanding of how to execute the modeled task, even if he or she is initially unable to reproduce it. Cognitive change is necessary to influence future behaviors.

SUMMARY OF RESEARCH-BASED APPROACHES FOR DESIGNING AN EFFICIENT PRACTICE ROUTINE

The reviewed research and expert testimony quite frequently tend to support one another. To summarize the key implications from the body of research regarding the design of an efficient practice routine, one must consider the following:

- Engage in metacognition: The examination of the learning process can aid the practitioner in the planning of an efficient practice strategy.
- Deliberate practice: This pertains to the structuring of goal-directed practice. Research has indicated that deliberate practice is significantly more effective than informal practice.
- Keep a practice journal: A practice log or journal helps the learner more descriptively describe what practice activities proved most effective and helps actively engage the practitioner during the conduct of practice.
- Motivation and goal-setting play a significant role in achievement.
- Distributed practice yields more effective skill acquisition and retention and is preferable over massed practice. Distributed practice is also effective for preventing and treating symptoms of overuse syndrome.

Practicers should plan accordingly when implementing a practice regimen.

- Performance anxiety stems from previous experience and the mental associations formed from those experiences.
- Time of day at which practice is conducted may determine effectiveness and retention. Practicers may benefit from avoiding unrelated tasks following practice and planning a practice session followed by a period of sleep.
- Modeling is effective for learning. The practicer should always be receptive to learning from competent models. The instructor should always strive to give thorough demonstrations of technique, interpretation, and practice habits.

**SPECIFIC APPROACHES FOR EXECUTING EFFECTIVE SKILL
ACQUISITION AND LEARNING DURING PRACTICE**

After examining the research surrounding the various examples of metacognition in planning, the next section will observe and discuss the research surrounding the effectiveness of specific behaviors during practice. The research base will pool information from journal articles, pedagogical methods, and other expert testimony. Through comparing and contrasting these various types of sources, we can posit the potentially effective methods of deliberate practice.

VIII. HABITS THAT PREVENT FATIGUE, OVERUSE, AND INJURY

After the musician has engaged in metacognitive learning strategies regarding the planning and conduct of deliberate practice, it is important to begin each practice session by reinforcing the foundation of instrumental technique. When the practitioner adheres to pedagogue-directed foundations of proper body alignment and technique, he or she is more likely to excel and significantly less likely to develop symptoms of overuse syndrome (Fry, 1986, 1987; Shearer, 1990; Tennant, 1995).

Prevalence of Overuse Syndrome

A fairly common problem among conservatory students is the prevalence of injury due to overuse.

Fry (1987) describes overuse syndrome as: persisting pain and tenderness in the muscles and joint ligaments of the upper limb due to excessive use and in more advanced instances by weakness and loss of response and control in the affected muscle groups. (p. 35)

In a study conducted among Australian tertiary music schools (Fry 1986), 9.3 percent of students reported symptoms of overuse injury. Among these were keyboard players (8.8%), woodwind players (13%), string players (8%), brass players (14.6%), and percussionists (8.7%). The majority of the reported overuse symptoms pertained to pain in the hands and wrists.

Fry indicates: The pain originated from the affected intrinsic muscles of the hand and some joint ligaments, notably those of the carpometacarpal joint of the thumb, the radial side of the wrist, and sometimes collateral ligaments of the metacarpophalangeal and proximal interphalangeal joints. (p. 35)

In another essay, Fry (1986) argues that overuse injury among conservatory instrumentalists can lead to underperforming.

Implications for Prevention

Fry also advocates: There is no need to have practice segments longer than twenty to thirty minutes, and these should be followed by a five-minute break. During the break, physical and mental tension subsides and muscles and joint ligaments have a chance to rest and become refreshed. (p. 49)

Based upon the previously stated research implications, we can surmise that shorter practice sessions serve dual functionality—to avoid overuse injury and to better utilize the way we store and retain information through distributed practice (to be discussed in further detail in the Memory Acquisition Techniques section). Longer and more substantial works may require longer practice sessions, but incorporating short increments of rest periods into a larger practice session may effectively stave off fatigue and overuse. The hectic schedules that conservatory students maintain can often be problematic toward this principle. Nonetheless, even if a student must by necessity condense all the day's practice into one lump-sum block of several hours, regular breaks are essential for

preventing overuse and may yield additional benefits for focus and memory retention.

Avoiding Excess Physical Tension

Fry also argues that too much tension in one's technique can also exacerbate symptoms of overuse. Parkening (1999) writes: "Cultivate, from the beginning, a technique based upon relaxation. The tension required to play should be confined to the hands, with the rest of the body remaining relaxed" (p. 20). Shearer (1990) further elaborates by stating, "Counterproductive tension is any muscular exertion beyond the minimum amount needed to carry out an activity" (p.125). He continues to argue that repetitive strain injury is onset by this counterproductive tension. Repetitive strain injury generally exhibits symptoms in the hands and wrists, but Shearer advocates awareness of the amount of tension in the shoulders and upper arms, as counterproductive tension in these muscles can lead to underperformance in the fingers. Many studies (Fry 1986, 1987) often write of physical discomfort and underperforming as overuse syndrome, but Shearer distinguishes a difference between overuse and misuse, the latter being the byproduct of counterproductive tension.

Shearer also outlines Principles of Efficient Muscle Function. He outlines these principles as follows (p.10):

- Muscular Alignment: Muscles function most efficiently only when naturally aligned with their base and joint attachments. Natural alignment provides the most direct pull of the muscles which control your back, wrist, and finger joints.
- Midrange Function of Joints: Muscles function most efficiently only when the joints they control are operated within their mid range of movement. Midrange positioning and movement provides optimum leverage to the muscles involved.
- Uniform Direction of Joint Movement: Muscles function most efficiently only when all three joints of a finger or the thumb are either flexed or extended together. In contrast to flexing one joint while extending another, simultaneous extension or flexion simplifies coordination of the muscles.
- Follow-Through: Muscles function most efficiently only when there is sufficient follow-through to avoid a build-up of counterproductive tension. Sufficient follow-through means that, once a movement has been initiated, no intentional restraint is applied to the movement.

Shearer even states in the introduction that his motivation for writing and compiling his method was due to the progression of his own performing-related injury. He authored the method with the intent to offer new insight for students to acquire a relaxed, efficient technique in order to facilitate long-term skill development with the longevity of injury-free playing. Scott Tennant similarly describes the necessary state of relaxation for efficient and injury-free practice in *Pumping Nylon* (1995, pp. 6-7):

The hands should be in a constant state of dynamic relaxation. This means they should always be free of excess tension. At the same time, they should always be on stand-by; ready to play in an instant. Then they should empty, or relax, just as quickly. [...] The body should also be in a relaxed state. While seated, try stretching your neck and spine upwards

towards the ceiling, pulling your shoulders back slightly (just enough to keep them from drooping forward). Now, relax your muscles so that your body sort of freezes itself in the position. This is a good state for the body to settle into. Your shoulders should not crunch upward into your neck.

Madeline Bruser (1997) offers testimony regarding practicing free of excess tension, both physical and otherwise, in her book *The Art of Practicing*. She argues that performing-related injuries ensue after prolonged periods of practice with excess tension and avoiding the signs of fatigue. She writes:

One of the most well-known examples is pianist Leon Fleischer, whose celebrated international career came to an abrupt halt when his right hand stopped function properly. Looking back on the torturous practicing that caused this tragedy Fleischer commented, "There was something macho about practicing *through* the pain barrier. Even when my hand was exhausted, I kept going. Although I thought I was building up muscle, I was, in fact, unraveling it." (p. 16)

Warm-up Routine

In the video titled "On Preserving Enthusiasm", Grammy-award winning guitarist David Russell advocates that a daily warm-up of simple, technique-foundational exercises will not only help the practitioner acquire higher technical facility, but will additionally help stave off symptoms of performing-related injuries (2007). Scott Tennant's *Pumping Nylon* includes a section of exercises titled "Daily Warm-up Routine", suggesting the implication that technical exercises are preferred for warming up over repertory. Bruser (1997) supports another method of warm-up, which includes extracting difficult passages from

concert etudes that target specific technical difficulties, over the practice of isolated technical exercise that offer little or no aesthetic stimulation.

Bruser additionally incorporates a number of other holistic techniques into a warm-up, including full-body stretching and breathing exercises. She argues that stretching before playing helps to alleviate much of the excess physical tension accumulated throughout daily activity. Even necessary activities including transporting a heavy instrument case can create excess tension in the back, shoulder, and forearms. The breathing exercises have a similar effect and help empty the mind of clutter before engaging in deliberate practice.

IX. DELIBERATE PRACTICE

Attention plays an instrumental role in the effectiveness of practice. Many of the aforementioned authors and researchers argue that practice without a clear sense of direction bears little fruition toward skill acquisition. When one practices attentively, in an environment free of distractions, and in pursuit of specific task-oriented goals, the result is known as deliberate practice.

Miksza writes: Deliberate practice encompasses effortful, goal-directed, and intentionally structured activities. Although it exists in the larger context of music practice in general, the concept of deliberate practice requires sustained concentration and effort and is therefore somewhat distinct from unstructured activities engaged in for the sake of playing for fun. (2007, p. 360)

Miksza (2007) also actually detected a negative correlation between the subjects that reported more informal practice and overall performance achievement throughout the course of his study.

We have already discussed goal setting in the planning stages of practice, but in order for the student to engage in deliberate practice, he or she must have the necessary follow through to execute these goals. Tennant (1995, p.93) writes:

Always practice with a purpose. [...] Organize the hierarchy of items you want to improve upon. Some are long-term (such as practicing the *Concierto de Aranjuez*) and within those long-term goals are smaller goals (such as improving your tone) that can be accomplished in one or two practice sessions.

While engaging in deliberate practice may seem like an obvious solution, many conservatory music students find themselves unclear on the conduct of deliberate practice. A study (Kostka, 2002) illustrates a discrepancy between music students and faculty members regarding the instruction of deliberate practice. Among the faculty members surveyed, 94 percent reported giving detailed instruction on formulating a practice routine, while only 45 percent of students claim to exercise a specific practice routine. This leaves 55 percent of students that may be underperforming due to a lack of specific goal-directed practice.

X. MEMORY ACQUISITION

In order to understand the processes that best utilize our memory acquisition, it is important to examine how we acquire new pieces of information and how we store and encode them. Almost every aspiring musician will be asked to perform compulsory works, whether for degree recital, public concerts, or for competitions. Examining the process of learning new music will help us understand how to more effectively memorize new pieces and even understand more abstract concepts such as technique and musicianship. Perhaps the most widely accepted view of memory acquisition and retrieval is the dual-store model.

Dual-Storage Model

Learning, simply defined, can be viewed as the acquisition of new information in the form of mental representations. The ability to retrieve information after it is acquired, such as performing a work without a score, is a key feature of *memory*. *Storage* refers to the process of acquiring new memory. *Encoding* refers to the process of storage, which sometimes can involve the modification of the information in a way that makes it more meaningful and relatable to existing knowledge.

The dual-store model refers to a three-part process of acquiring new information, as first described by Atkinson and Shiffrin (1968). First the information is received through the sensory register, whether it be hearing a piece of music for the first time, or sight-reading it from the score. Information is only held in the sensory register for a split second unless it undergoes further mental processing, thus information is not actually stored, only received. This is the brain's mechanism for naturally weeding out irrelevant information that we perceive through our senses.

If we perceive something to be of particular importance and devote our attention to it, it moves to be processed in our short-term memory. Short-term memory, while having a longer rate of retention than the sensory register, still has only a limited capacity, both in how much information can be stored at one time and how long it can remain there. Researchers have estimated that the average number of bits of information one can store simultaneously in short-term memory is seven (+/-2). This perhaps explains Christopher Parkening's rationale behind the statement that a work or passage must be executed at least seven times flawlessly before it is ready for performance (1997a).

Once information in the short-term memory has undergone further processing, it then can become stored in long-term memory, which is

hypothesized to have a virtually infinite capacity. Some psychologists surmise that once fully committed to long-term memory, information can stay there forever, and that 'forgetting' the work is simply a problem of retrieval. Others posit that information can indeed be lost from long-term memory. Given the difficulty of the nature of studying the human brain, there is no way to be certain at the present time which conjecture is most accurate, but regardless, to avoid forgetting or difficulty retrieving the desired information, regular maintenance of information stored in long-term memory is essential.

Chunking for Memory Acquisition

Chunking is a process of encoding smaller units of information into larger units in order to store them in a more meaningful and efficient way. A basic example of chunking is a process which we use to memorize a telephone number. The telephone number contains 10 digits. 8-1-2-8-5-5-4-8-4-8. As stated above, the average person's short-term memory can only hold approximately seven pieces of information at once. Yet memorizing this many digits becomes much more manageable when we organize them into more meaningful groups that our brains encode in three larger units. 8-1-2 is organized into 812, the area code for domains in southern Indiana. 8-5-5 is organized in 855, the three digit code for Indiana University phone numbers. 4-8-4-8 becomes organized into

4848, which can be memorized in a number of meaningful ways. The end result of the encoding process is [812] [855] [4848], which is much easier to retain than 10 digits that by themselves contain no significant meaning or importance. When memorizing a piece of music, particularly one with a dense texture, we can perceive it in a number of ways.

⑥ =RE *Fuga*

The musical score shows the beginning of the Fuga. The first staff contains measures 1-4, and the second staff contains measures 5-8. The music is in G major and common time. The score includes various fingerings (e.g., 2, 1, 2, 2, 4, 1, 3, 1, 2, 2, 2, 1, 4, 2) and articulation marks like slurs and asterisks. Annotations include 'C II' with arrows pointing to specific notes, circled numbers (3, 4, 2) indicating fingerings or patterns, and asterisks marking specific notes or groups of notes.

Example 1.1 – Fugue from Prelude, Fugue, and Allegro BWV 998 by Johann Sebastian Bach, mm. 1-6, public domain.

For example, many guitarists are daunted by the intimidating task of learning lute transcriptions from Johann Sebastian Bach. The above excerpt (Example 1.1) is taken from the Prelude, Fugue, and Allegro BWV 998. In memorizing the opening measures of this work, it can much more easily be broken down into smaller units.



Example 1.2 – Fugue BWV 998, mm. 1-2.

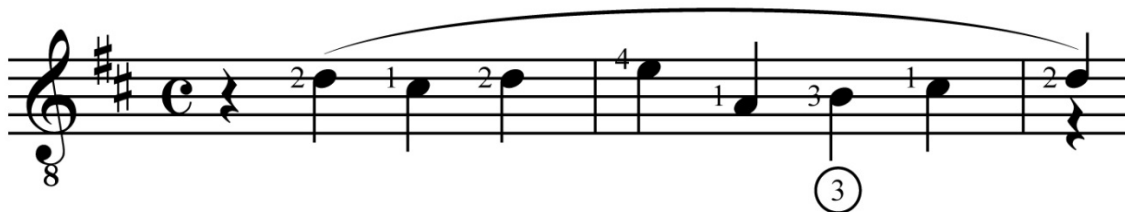
The practicer may begin by rehearsing the opening four notes (Example 1.2).

Once the practicer has achieved a satisfactory level of proficiency, he or she can rehearse the next four notes (see Example 1.3).



Example 1.3 – Fugue BWV 998, mm. 2-3.

After rehearsing these four notes, he or she can combine these two units of four notes together into the complete statement of the opening subject. Assuming the student is knowledgeable about the form of a fugue, he or she can build the association that these opening measures compose the opening subject of the fugue--the primary theme around which the composition is built and treated in imitation--and encoded as such for meaningful learning, a process that Ormrod describes as, “relating new information to knowledge already stored in their long-term memories” (2008, p. 203).



Example 1.4 – Subject from Fugue BWV 998, mm. 1-3.

After the student has memorized and rehearsed the subject (Example 1.4), he or she may repeat the process by separating out the answer and the countersubject and practicing each in isolation. Although, another suggestion would be for the student to follow the suggested fingering even in omission of the other voices in the texture. This way when the student is ready to converge the two parts of the texture for rehearsal, it will not require undoing the motor habits that he or she developed to perform the part in isolation. This approach may seem tedious, but a deeper understanding of the counterpoint will lead to a better performance of the piece, and a more thorough approach that will enable the performer to encode the information more effectively by means of meaningful learning.

Mental Practice

Previous research (Coffman, 1990; Miksza, 2005; Weinberg, 1982) has indicated the effectiveness of mental practice. Mental practice may encompass a wide variety of tasks whether in conjunction with physical performance on one's respective instrument, or perhaps even omitting the use of the instrument

altogether. Research has shown correlation between achievement and a combination of physical and mental practice approaches (Miksza, 2005; Weinberg, 1982). Physical practice, however, has been proven to be more effective than mental practice alone (Coffman, 1990).

Mental practice can be particularly useful in facilitating the memorization of a new work. Once the performer has sight-read through the score enough times to get a rough understanding of the fingerings and harmonies of the work, use of the score as a visual aid—even without the tactile sensation of physically performing the work—can facilitate memorization and a better understanding of the form and structure of the piece. Another study (Williamson & Valentine, 2002) found that expert musicians often memorize music by structural analysis rather than exclusively by kinesthetic/motor memory. This memorization of musical structure (form) is an important skill in both guiding practice and in retrieval during performance. Music history and theory pedagogy both incorporate the use of musical scores as visual aids to demonstrate principles such as counterpoint between voices, harmony and orchestration within a large symphonic texture, the development of memorable musical motives including the opening motive of Beethoven's Fifth Symphony, or Berlioz's *Symphonie Fantastique*. A guitarist studying a well-known work such as Joaquin Rodrigo's *Invocation et Danse* may also discover a new understanding of the use and

development of motivic material, making interpretive decisions about which note or notes to highlight from the texture more clear and evident.

Mental practice can also prove very effective toward reducing the number of memory slips in a given concert program. Mentally running through the work—sometimes even without the presence of the score as a visual aid—can prove very effective in reducing memory lapses on stage. Furthermore, the imagining of a work and creating an internal auralization is no easy task. It can be quite taxing for one's concentration, and thus the sharpness required to execute such a task can yield positive a relationship toward stage concentration.

Mental practice can even be useful in creating mental representations of the tactile sensations produced during physical practice. If one imagines a state of relaxation during physical practice, this technique can be directly applicable toward the execution of physical habits. More information on mental practice in regard to motor skill acquisition will be discussed later in this essay.

XI. MOTOR FUNCTION

Most of the topics covered thus far pertain specifically to cognition, the mental processes and conditions that can help learning to occur. Yet struggling conservatory students can find themselves in periods of stagnancy where there is a disconnect between conceptual knowledge and the ability to actually perform it on one's own instrument. One can study the formal structure of fugues extensively and still struggle to perform Johann Sebastian Bach's Fugue BWV 997. Our fingers need to be trained in order to execute the most intricate and virtuosic passagework. In order to acquire a better understanding of how to improve upon such a refined set of skills such as playing a musical instrument, it is necessary to examine how we acquire and develop motor functions.

There is certainly a myriad of complex processes that take place in the brain while performing complex motor functions like playing a musical instrument.

Dr. Gary Marcus describes the process of practice through repetition: The only known way to defy the speed-accuracy trade-off is through practice, using the only technique that the brain can bring to bear, a process known as automatization or proceduralization, in which the brain makes a transition from explicit or "declarative" knowledge, which can in principle be verbally articulated (albeit slowly), to implicit or "procedural" knowledge, which can be executed rapidly [...] During this process, simple steps get combined or "chunked" into more efficient, larger units. (2012, p. 52)

There are a number of factors to consider when making practice as efficient as possible to achieve automatization.

Oxendine (1968) classifies motor learning as a denomination of behavioral psychology, the belief that the learning process can be observed and studied through behavior modifications, which in this case pertains to the acquisition of physical skills necessary for the execution of a piece of music. He also states that there are different types of motor functions, and some chose to define motor learning by the physiological changes that take place in the central nervous system. We acquire many of our basic motor skills without being aware of the learning that is taking place, such as learning to stand and walk. But Oxendine states: "Learning to type, to play a musical instrument, to drive an automobile, or to perform a complex rhythmical maneuver involves both mental and physical coordination" (p. 12).

Types of Motor Skills

There are fine and gross motor skills, which indicative of the nomenclature, pertain to large and small movements. Playing a musical instrument deals primarily with fine motor skills. Discrete motor skills are functions that can be performed in a single action such as kicking a ball, and serial motor skills are comprised of several movements chained together in a

meaningful sequence. Oxendine writes: “In most motor skills, learning takes place gradually by small degrees. The ultimate goal of excellent performance is not fully realized each time progress is made” (p. 119).

Chunking/Chaining for Motor Learning

As examined early, chunking can be an effective process for memorizing a piece of music, but can also serve as an effective method for developing the motor skills necessary to perform the work. Even once a piece of music is memorized and understood on a conceptual level, chunking still can be an effective method for continued practice toward mastery. Jason Vieaux (2009a) advises that guitarists organize difficult passages into effective and sensible “chunks” that can be initially performed with ease. He describes two different chunking techniques by which executing a scalar passage can be broken into chunks of five notes. The last note of the first chunk should overlap the second chunk, a process also called chaining. Eventually, after attaining the ability to perform the two chunks with ease, the next step is to combine the two into a segment consisting of nine notes. Another method he suggests is to simply add one note at a time to the chunk. Vieaux also instructs the practitioner only to move on—either by increasing tempo or chaining—when the current excerpt can be executed with a success rate of 80 percent at minimum.

Miksza (2007) conducted a study to examine the frequency of specific behaviors during practice to determine which yielded the best results. Students conducted practice sessions on three consecutive days, each beginning with a pretest of the musical excerpt that the subjects would practice. The researcher formulated a system of scoring the quality of each performance in order to yield more reliable data collection for the study. Among the behaviors examined and studied was chaining, as Vieaux suggests (2009a). While there was a noticeable improvement each day from those who exhibited chaining, the behaviors that correlated to most significantly with improvement were repeat measure, repeat section, and slowing. While these results still provide valuable information regarding the correlation of practice behaviors and performance achievement, it is also worth mentioning that this study was conducted over the span of three practice sessions. Vieaux refers more to practice over extended periods of time (weeks, months, etc.), so the findings and implications from this study do not necessarily nullify any testimonial claims in Vieaux's instructional article.

Whole-Part-Whole

Another commonly exercised technique is the whole-part-whole approach. Jason Vieaux states that even after the student has spent days or even weeks chaining difficult passages, regular maintenance of those passages is

essential. To execute this technique, the performer runs through the work, then zooms in to fine tune and maintain difficult passages, and then zooms back out to perform the work again, hence whole-part-whole.

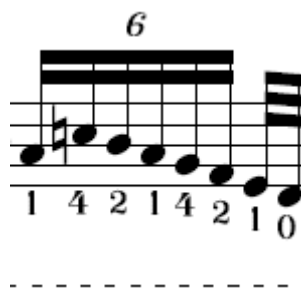
This whole-part-whole technique may also apply to sections and subsections within them. Miksza (2007) observed that the whole-part-whole technique was among the behaviors that correlated the strongest performance achievement.

The following excerpt is taken from the famous piece *Capricho Arabe* by Francisco Tárrega.

The image shows a musical score for guitar, measures 9-10 of 'Capricho Arabe' by Francisco Tárrega. The key signature has one sharp (F#) and the time signature is 2/4. The notation includes a treble clef and a key signature of one sharp. The music consists of a sequence of notes with various fingerings indicated by numbers 1, 2, 4, and 0. A circled '6' is placed below the final measure, indicating a sixteenth-note pattern. A dashed line is drawn below the first measure.

Example 2.2 – *Capricho Arabe* by Francisco Tárrega, m. 9-10, public domain.

Naturally this section poses a number of difficulties, but perhaps the most obvious is the large position shift in the middle of the passage (Example 2.2).



Example 2.2 – *Capricho Arabe* by Francisco Tárrega, m. 9.

After playing through the entire passage, the student can then zoom in to isolate the most difficult part or parts. After achieving a satisfactory level of proficiency executing the position shift, the student can then zoom back out and practice the passage in its entirety.

Repetition

Repetition during practice is, of course, a necessary part of the process of skill acquisition. But several factors must be taken into consideration in order for repetition to be productive:

- Repetition must incorporate only correct procedures. Repetition of errors in pitch, rhythm, and articulation can actually be counterproductive if the practicer does not take the necessary steps to correct these mistakes. This also demands strong sense of error detection and critical listening.
- Repetition is generally more effective for smaller units of information.

Miksza's research (2007) indicated that two of the practice behaviors that

yielded the highest correlation to performance achievement were repeat measure and repeat section. Repeating the entire etude was used infrequently and yielded non-significant positive correlation.

Transfer

When we develop particular motor processes, quite often the skills we acquire to perform these tasks can be transferred to similar tasks. For example, many of the guitar works of Mauro Giuliani contain running passagework of parallel octaves and rapid arpeggios, many of his works also contain common figuration idiomatically suited to the guitar and particularly in the key of A major. After studying works like *Grand Overture Op.61* and *Gran Sonata Eroica Op.151*, much of the figuration, harmonic language, etc. presumably will allow the performer greater ease when learning the *Concerto in A major Op.30*. A research study on practice behaviors and performance achievement (Townsend, 2012) observed that subjects may identify relevant technical exercises and practice them aside from a specific piece when troubleshooting difficult technical issues. Based upon this conclusion, when a guitarist is undertaking one of the large-scale aforementioned compositions by Mauro Giuliani, he or she may refer specifically to Giuliani's 120 right hand studies, particularly the ones most

relevant for accomplishing the desired goal. The effectiveness of transfer is largely contingent upon the similarity of the two tasks being performed.

Similarly, *Pumping Nylon* contains a number of exercises on flamenco techniques. Many recurring techniques such as florid scalar passagework, flamenco-esque rasgueados (strums) and golpes (percussive hits on the body of the guitar), and harmonic language will give the performer a certain familiarity when learning other works by Joaquin Turina or Joaquin Rodrigo.

Mental Practice in Motor Development

As stated in the previous discussion about mental practice, this technique yields benefits for more than the intellectual aspects of a piece (form, memorization, etc.). Mental practice is also effective when individuals imagine the physical sensations of playing his or her instrument (Weinberg, 1982). Mental practice can actually help facilitate the development and understanding of the motor processes acquired during practice.

Oxendine writes: The truth is that in the physical performance of a task there is usually some degree of related mental activity, while in mental practice certain neural and muscular responses are evoked. [...] The emphasis on overt performance, with a neglect of the associated mental process, does not take full advantage of man's intellectual abilities. (1968, p. 222)

Oxendine also describes several types of mental practice for motor skill development. In the first example, he describes a mental rehearsal immediately preceding the performance of a task. The second type he describes takes place between physical practice sessions. He argues that both types contribute to the overall development of specific motor tasks.

Focus of Attention in Motor Function

A particularly vexing problem for musicians is the extent to which one dedicates his or her attention to the execution of the motor skills necessary to perform a work. A recent study (Duke, Cash, & Allen, 2011) examined the nature of attention during motor learning. The study observed keyboard players who were instructed to practice under one of four different possible focuses of attention. The first group was told to focus on the movement of their fingers to make corrections and adjustments. The second group was instructed to focus on the keys of the piano. The third group was instructed to look inside the instrument and focus on the mechanism of the hammers striking the keys. And the fourth group was instructed not to focus on any visual stimulus, but rather to make all necessary adjustments aurally, based only on the sound produced. The results indicated that those who focused on the sound produced outperformed the other three groups.

One implication from this study is that focusing too much on the mechanisms taking place during motor function may actually impede the execution of these skills. But even this is dependent on the difficulty of the task at hand. Duke (2011) writes:

Learners who are first introduced to novel skills of moderate to high complexity produce more consistent and accurate performances when initial instructions focus attention on body movements (internal focus). In contrast, learners who are more skillful or who in the past have practiced skills similar to a new skill being learned tend to benefit more from instructions that focus attention on movement goals. (p. 46)

Another implication from this study is that aural cues are better for guiding responses to musical tasks than visual cues. The following section will discuss the benefits of using a metronome, and informal accounts from expert musicians indicate that following the visual cue of a metronome (flashing) is significantly more difficult than following by listening to the pulses. Some guitarists will argue the necessity of watching one's own hands during performances, particularly the left hand for smoother execution of position shifts, but based on the implication from this study, he or she would perhaps benefit more from a preemptive visual cue such as visually locating the position before shifting, rather than watching the movement of the hand itself.

Based on the implication that focusing too intently on motor processes can impede the performance of the task, this also may offer some insight to revisit the topic of performance anxiety. Why is it that performing a piece that has been so finely tuned becomes so much more difficult when others are watching? As stated in the previous section, some performers respond to anxiety on stage by excessively narrowing the point of focus, but if that focus is simply the task the hands are executing, this may impede accurate motor function. Personal anecdotal experience with professional concert guitarists suggests that they focus on the expression of the desired musical gestures rather than the movement of their fingers.

XII. TEMPO VARIATION

Use of Metronome

The metronome has become a tool frequently implemented by pedagogues and students alike. This valuable tool enables the performer to practice difficult passages precisely in rhythm while allowing for a gradual increase in speed until the performer has acquired the skill necessary to perform the excerpt at performance tempo, or perhaps even faster for an extra sense of security when placed in a high-stress performance setting. But even in my own experience, students frequently groan upon the activation of the metronome during lessons. Students then attempt to negotiate with me by proposing that if they can first perform the work with a strong pulse and no detectable errors in rhythm that I put away the instrument of their aggravation. Although I infrequently succumb to their bartering and must insist upon using a metronome. Rather than simply adhering to the customary use of the metronome, I shall examine the research surrounding the effectiveness of practicing with a metronome.

Dr. Gary Marcus writes: We are naturally endowed with circadian rhythms that allow us to keep track of the general time of day, but tracking time in milliseconds poses serious challenges. To develop that level of precision, aspiring musicians often spend hundreds or thousands of hours playing along to the steady tick-tock-tick-tock of a metronome. Their goal is not just to be able to play each beat exactly when the

metronome clicks but to master the time in between the metronome's beats—to play, for example, eighth notes exactly in between the metronome's quarter notes (or, harder still, to divide the period between quarter notes into smaller divisions like triplets or sixteenth notes). (2012, pp. 48-49)

Research has also indicated a high positive correlation among those who reported regular use of metronome and overall performance achievement (Duke, 2009; Miksza, 2007), yet metronome use is among the least frequently demonstrated behaviors (Miksza, 2007). The implication is that use of a metronome while engaging in deliberate practice helps the practicer achieve a stronger sense of rhythmic accuracy and precision.

Slowing the Tempo

Students ranging from novice to graduate conservatory level are always taught to practice slowly when mastering difficult passages. In addition to expert testimony, observational research studies on practice behaviors have indicated that instrumental musicians often practice slowly. Instructional practice methods (Artzt, 1978) emphasize the importance and effectiveness of slow practice as well.

A study by Robert Duke, et al. (2009) examined the performance improvement of advanced college-level piano students 24 hours after observing the students' practice. The researchers' findings indicated that indeed slow

practice yields effective results. Those pianists with the highest scores and greatest improvement were those that slowed the performance tempo to maintain accuracy following error correction. Two of the top ranked pianists actually preemptively made speed adjustments to prevent errors from occurring.

Previous research has indicated the effectiveness of slowing down difficult passages, as well as repeating measures or sections larger than a measure (Miksza, 2007). Efficiency of the performance speed adjustment may be contingent upon error detection. While some pedagogues still maintain the emphasis of error prevention, Ericsson (2003) stated that developing expertise requires “stretching” performance ability by attempting more difficult tasks. The increased difficulty will inevitably cause mistakes, but rather the mistakes should be used to correct and refine the cognitive associations of the task at the next performance, and the subject will continuously be engaged mentally. Research has clearly indicated a correlation between slowing during practice and achievement (Miksza, 2007), but how slow is appropriate, and is there ever a point where one is practicing the excerpt too slowly to maintain relevance to the intended task?

Techniques such as tremolo or certain arpeggios are compound movements, where the desired result is only executed with the fingers moving

quickly enough in succession. A performer may never be able to perform a tremolo work at tempo unless he or she eventually begins to push the speed.

Tennant describes this sensation in regard to the tremolo technique in *Pumping Nylon* by stating (1995, p. 56):

Instead of dividing tremolo into one + three notes (thumb plus the three fingers), [...] individuals should think of it as simply four notes played by four consecutive fingers.

Renowned guitar virtuoso Jason Vieaux advocates practicing at a variety of tempos ranging everywhere from 50 to 100 percent of the intended performance tempo in his article “Working on Difficult Passages” in *Soundboard* (2009a). He argues, “Muscle movements change from slow to medium to fast speeds, and it is good for the hands and mind to experience every step along the way” (2009a, p. 48). He also advocates that even while practicing a passage slower than performance tempo, the player should strive to be physically relaxed and to shape the passage with all the musicality (dynamics, tone color, etc.) that he or she intends to perform the final product.

Speed Bursts and Varying Rhythm and Articulation

Both expert testimony and research confirm the effectiveness of slowing difficult passages. But eventually the student must come up with a strategy to work these passages back up to performance tempo. Expert musicians also

commonly advocate the use of speed bursts—short, incremental passages of rapidly executed notes—to increase the tempo after achieving accuracy at slower tempos.

Scott Tennant advocates the use of speed bursts in *Pumping Nylon* (1995). He also describes several methods of varying the rhythm and articulation, such as performing passages of even 16th notes with dotted rhythms. Playing with dotted rhythms allows the player to play a very short speed burst followed by a longer note on which he or she may briefly rest and ‘empty’ the tension, as Tennant describes. The Miksza study (2007) observed that subjects frequently varied rhythm and articulation as a means of achieving mastery on difficult passages with positive results.

Alternating Tempo

As stated prior, Vieaux advocates practicing a piece at every tempo increment from 50 percent to performance speed. But there is little implication as to the frequency and rate at which the performer should increase the tempo. Perhaps the most common interpretation of Vieaux’s statement would be to increase the tempo as gradually as possible using the smallest increments on the metronome. However, noteworthy research has indicated that alternating

between fast and slow tempos can be more effect than the gradual and incremental approach (Henley, 2001).

Henley's study examined both the effectiveness of modeling in conjunction with several treatments for achieving performance tempo. Students were divided into six different treatment groups: steady increase, where students would gradually and incrementally increase the tempo during practice; steady increase with an instructional video model; performance speed without a model; performance speed with a model; alternating tempo with a model; and alternating tempo without a model. The post-practice tests were then judged for pitch, rhythm, and tempo improvement. The results for pitch accuracy indicated:

The largest mean percentage gain was for the alternating tempo with model group ($M = 23.08\%$). The lowest percentage gain mean came from the performance speed group ($M = 8.60\%$). (p.173)

The results for most acquired speed indicated:

The performance speed with model group had the highest mean percentage tempo gain ($M = 61.90\%$). The lowest mean gain percentage was found in the alternating tempo group ($M = 14.40\%$). (p.175)

Henley then goes on to draw the inference:

However, this particular condition [performance speed with model group] does not necessarily lend itself to accuracy. The performance speed groups produced the lowest means in pitch percentage gain and rhythm percentage gain. Thus, the performance speed with model

condition may be best suited for assimilating proper tempo after the correct pitches and rhythms have already been learned. (p. 176).

The implications of Henley's research do conflict or negate Vieaux's instruction.

The research indicates that alternating tempo technique yields the best results for achieving note accuracy. One can, for example, alternate between 50 percent and performance tempo, then alternate between 55 percent and performance tempo, continuing to increase the slower tempo in a fashion that integrates alternation and steady increase. This allows the performer the opportunity to develop the tactile sense of performing the work at a variety of incremental tempos.

SUMMARY AND DISCUSSION FOR APPROACHES FOR EXECUTING EFFECTIVE SKILL ACQUISITION AND LEARNING DURING PRACTICE

To summarize the main points regarding effective behaviors during practice sessions:

- Students can prevent and/or reduce symptoms of overuse syndrome by striving for a technique built upon relaxation.
- Shorter and more frequent practice sessions (distributed practice) more effectively utilize the limited capacity of short-term memory and help prevent fatigue and/or injury.
- During these distributed practice sessions, the learner should engage in deliberate practice, a goal-oriented and attention-focused method of practice.
- Chunking and mental practice are research-based approaches that are particularly helpful for both memory and motor skill acquisition.
- Research has indicated a positive correlation between use of a metronome and performance achievement.
- The most common tempo variation techniques include slowing, speed bursts (including varied articulation such as dotted rhythms), and tempo alternation. Slowing and tempo alternation may be most effective for

achieving note accuracy, while speed bursts may be more effective for increasing the overall performance tempo.

XIII. CONCLUSION

After compiling and examining the research surrounding practice behaviors and their relative effectiveness, the results support the large majority of the testimonial instruction compiled for this study. Researchers and practitioners alike support the fundamental concept that effective practicing is effective problem-solving. Every session of deliberate practice conducted should have clearly defined goals, a strategic approach by which to accomplish them, and keen attention during the execution of that strategy.

Implications for Future Research and Pedagogical Publications

Some of the research collected for this study provided new insight to practicing which have not been formally evaluated and/or published by expert musicians. For example, Miksza's (2007) suggestion that private instruction should incorporate modeling of effective and ineffective practice behaviors has not thoroughly been evaluated or discussed among the existing body of guitar pedagogy. This clearly highlights the need for more detailed instruction on the careful organization of practice routines and effective behaviors for skill acquisition in future pedagogical publications.

Furthermore, none of the guitar methods consulted for this study examined the correlation between sleep and memory and motor acquisition.

Based upon the observed positive correlation between memory retention (consolidation) and periods of sleep, the research has clearly opened the forum for more discussion among competent pedagogues.

Additionally, pedagogical publications argue the importance of attention for cognitive engagement in deliberate practice, creating concurrence between pedagogues and researchers. But none of the pedagogical work examined for this study described the focus of attention in regard to motor skill performance. While practicers and previous researchers alike may suggest that the most competent performers focus on more musical aspects during performance, the research reviewed in this study regarding the focus of attention in motor skill performance emphasizes the need for further research on the study. The aforementioned research did not include visual cues from a musical score as an experimental variable, and there is a lack of significant research demonstrating any correlation between score reading and motor performance. Another curious question that the Duke et al. (2011) study brings to light is whether or not the correlation between aural adjustments for error correction and performance achievement were a result of the effectiveness of aural cueing, or rather because of the lack of effectiveness of visual cues in music practice.

A potential area for future study could utilize a metronome and observe practice under three different conditions: sound only; light only; both sound and light. The results may help us better understand not only how the conditions best facilitate the effectiveness of metronome-based practice, but also provide the implication of which types of cues are most effective for instruction and learning. Other potential research could reinforce the pedagogical texts surrounding the effectiveness of practice. In the Miksza (2007) study on observed practice behaviors, among the highest achieving students' behaviors was the use of the metronome. But subjects were not instructed specifically to use a metronome, and more conclusive research can help determine the effectiveness of the frequency of use and tempo variation techniques on performance achievement.

Conservatory musicians are in pursuit of the highest level of artistic achievement and proficiency. Performing artists are constantly faced with fierce competition and adversity. After examining the research, we can posit strategies and techniques that may potentially make practice more effective toward skill acquisition. Engaging in metacognition—the examination of the learning process—can aid the practicer in the planning of an efficient practice strategy (Gabrielsson, 2002; Miksza, 2007; Pedrick, 2008). Research has indicated that deliberate practice—goal-directed and focused practice—is significantly more effective than informal practice (Miksza, 2007). Keeping a practice log or journal

helps the learner engage in deliberate practice (Marcus, 2012). Distributed practice yields more effective skill acquisition and retention and is preferable over massed practice and is effective for preventing overuse syndrome (Fry, 1986; Fry, 1987; Ormrod, 2008). Self-efficacy can affect our goals, activities, and expectations (Ormrod, 2008). Performance anxiety stems from previous experience and the mental associations formed from those experiences. Time of day at which practice is conducted may determine effectiveness and retention. Practicers may benefit from avoiding unrelated tasks following practice and planning a practice session followed by a period of sleep (Duke & Davis, 2009a; Jenkins & Dallenbach, 1924). Modeling is effective for learning (Coffman, 1990; Henley, 2001; Hewitt, 2001), and thus one should seek out competent models. Chunking and mental practice are particularly helpful for both memory and motor skill acquisition (Oxendine, 1968). Focusing one's attention on an external goal yields better results than focusing on muscle movements (Duke, 2011). Research has indicated a positive correlation between use of a metronome, tempo slowing and alternation and varying articulation with performance achievement (Miksza, 2007; Tennant, 2002; Vieaux, 2009). After reviewing the literature, conservatory musicians can better understand the benefits of cognitive and metacognitive learning strategies, and exercise the practice behaviors that suggest higher performance achievement.

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