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GRADUATE COLLEGE

MEDICAL OPINIONS REGARDING WARM-UP PROCEDURES FOR FOUR-MALLET MARIMBA PERFORMANCE

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In partial fulfillment of the requirements for the

degree of

DOCTOR OF MUSICAL ARTS

By

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Norman, Oklahoma
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MEDICAL OPINIONS REGARDING WARM-UP PROCEDURES FOR FOUR-MALLET MARIMBA PERFORMANCE

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ABSTRACT

Warming up prior to playing a musical instrument is considered by many to be a vital part of the practice session or performance. However, in the percussion field there is a surprising lack of research or opinion that involves medical professionals in this area. This is alarming when one considers how common injuries are among percussionists. The purpose of this study is to make available the informed opinions of medical professionals regarding warm-up procedures for four-mallet marimba performance.

Playing any percussion instrument requires much repetitive motion. The many hours spent practicing and perfecting a performance can be harsh on the body and may lead to injury. Some of the more common repetitive motion injuries experienced by percussionists are carpal tunnel syndrome, tendonitis, tenosynovitis, tennis elbow, arthritis, bursitis, and back pain of all different sorts. One of the best ways to avoid these injuries is to incorporate some sort of warm-up procedure into the practice routine.

Many percussion sources discuss different ways to warm up prior to practice or performance, but most contain only the opinions of musicians. This study seeks to bring knowledge from the medical community into the warm-up process. To achieve this goal, four medical professionals representing different areas of the field were interviewed. Each was shown both videotaped and live demonstrations of marimba performance and asked a series of questions regarding warm-up procedures.

Although the responses varied, all emphasized the same fact--warming up before playing is not only smart, but essential to avoid injury. All of the consultants agreed that the repetitive motions used in marimba performance can, and often do, lead to various injuries. To avoid injury, the consensus of the medical professionals stressed the need to

prepare the body by stretching those muscles to be used during performance. This could be achieved in a two-step process, away from and at the instrument. Other important conclusions drawn from the interviews included preparing the mind for performance, taking adequate breaks to rest the muscles, and cooling down after playing. The most important conclusion drawn from this study is the need for further investigation into the warm-up process together with utilizing various resources from the medical profession to make informed decisions about warm-up and injury prevention.

MEDICAL OPINIONS REGARDING WARM-UP PROCEDURES FOR FOUR-MALLET MARIMBA PERFORMANCE

CHAPTER I

INTRODUCTION

Early in his playing career, the author had experiences with performance-related injuries. First with back pain and then with pain in the wrists, these injuries started the author thinking about ways to minimize performance-related injuries. Ever since, he has been interested in the various injuries musicians experience and the possibilities for minimizing these injuries. This study is the beginning of what the author hopes to be a long sequence of research involving medical professionals and musicians' injuries.

Many opinions exist on how to warm up properly before playing any musical instrument. Although these opinions vary from person to person and from instrument to instrument, most agree that warming up before playing is important to not only prepare the body physically, but also to prepare the mind. Preparing the body physically before playing an instrument has often been compared to warming up before physical exercise. Professional athletes typically warm up their muscles before engaging in their particular sport or activity. This is seen as a crucial step in most exercise programs in order to prepare the muscles and the body for a workout. When performing music, a period of warm-up is also considered by most to be important. Warming up prepares the muscles for exercise whether that exercise is pressing the keys of a piano, brass, or woodwind instrument, manipulating drumsticks or mallets, bowing a violin string, or singing.

One reason adequate warm-up is so important to musicians is the prevention of injury. Unfortunately, much more thought and effort is placed on creating and performing music than is placed on the prevention and treatment of injuries associated with improper physical preparation. Performers of all different types of music and on all instruments have reported injuries of varying kinds. In the past twenty years, musicians, physicians, and others have begun to address performing arts injuries. Most of these opinions are presented by professional music educators and performers while fewer come from medical professionals. According to Darin Workman, a doctor of chiropractic, a percussionist, and the chairman of the Percussive Arts Society's Health and Wellness Committee, "Health and wellness has historically stood low on musicians' priority lists until they become unable to play" (Workman 1998, 33).

Over the past twenty years, a new medical field entitled "Performing Arts Medicine" has developed to serve artists and their medical concerns and questions. This new field focuses on the study and treatment of injuries and illnesses affecting performers and is viewed equivalently to the athlete's "sports medicine." Physicians believe that injuries among percussionists and athletes are similar, for both must develop qualities of strength, flexibility, agility, coordination, and endurance to perform at their best. Physicians find that physical fitness correlates highly with musical health, and balancing performance, exercise, diet, and sleep helps build resistance to performance-related injuries (Allen, B. 1997, 45).

Although disease and disability are common among musicians, many performers tend to ignore troublesome symptoms and warning signs from the body. Percussionists especially are notorious for ignoring symptoms of injury because they believe aches and

pains simply are a part of playing percussion instruments. The notion of "playing through the pain" is common. Some of the factors that contribute to performance-related injuries in percussionists are poor posture, overuse and misuse of the fingers, wrists, hands, arms, shoulders, and back, and the repetitive stress involved in prolonged practice. Poor posture can often be corrected by adjusting one's instrument to the correct height, thereby helping maintain good posture and avoid fatigue. Poor time management skills can often lead to overuse and injury. Practicing for short periods of time on a regular basis is better than engaging in long practice sessions before the performance. Long practice sessions, especially without prior conditioning, puts abnormal stress on the body and may lead to injury (Ibid.).

Given the injuries that many percussionists sustain, ideally a variety of research that addresses these injuries would be available to the student. This is not the case. Apart from a few published articles and comments made at clinics and master classes regarding warming up to prevent injury, there is an alarming lack of research involving the opinions and suggestions of medical professionals. Most of the information comes from the musicians themselves and not from those doctors and other medical professionals trained in the physiology of the body. This study addresses this lack of research by seeking input from medical professionals regarding warm-up procedures. Properly warming up to prevent injury should be the first concern of any musician. "Your true instrument--the body--cannot be replaced" (Ibid., 46).

Purpose of the Study

The purpose of this study is to provide percussionists with the opinions of medical professionals regarding appropriate warm-up procedures for playing four-mallet marimba. Many articles have been written and many views presented in the percussion community regarding warm-up and its importance; however, the musicians themselves have authored most of this information rather than professionals with medical expertise and training.

This study surveyed a variety of medical professionals and presents their opinions regarding warm-up procedures. Each consultant was shown a live demonstration of two of the basic motions used during four-mallet marimba performance: the double vertical and the single alternating strokes. A set of written questions was presented to each consultant who was then asked to express an opinion on the best or most proper way to prepare the muscles for the given activity (warm-up).

The author hopes that this study will not only encourage more percussionists to warm up actively before playing any type of percussion instrument or style of music, but also aid the percussionist in choosing the particular warm-up regimen that works best for a given style of music or performance medium. The primary purpose of warming up before playing an instrument is to prepare the body properly for the physical activity that follows. This preparation should decrease the chance of injury during performance. This study hopes to make injury prevention a more common goal for all percussionists rather than a concern after an injury has occurred.

Need for the Study

Very little research has addressed performing arts injuries in the past, with significant progress made only within the last twenty years. This history of research is very brief considering the level of progress of modern medicine. According to Darin Workman, "many experts believe that the 1977 book *Music And The Brain: Studies in the Neurology of Music* was the first foothold for studying performing arts medicine" (Workman 1998, 33).

Many musicians have begun to realize the importance of performing arts medicine and research, and the field is beginning to grow. In 1980, *The International Trumpet Guild Newsletter* began a regular column discussing trumpet playing injuries and prevention. Many pianists have realized the importance of performing arts medicine. The *Piano Quarterly* has conducted interviews with physicians, polled readers, and published much information about performance related injuries while playing piano. In 1985, the International Flute Association created a committee of flutists and physician musicians to study injuries incurred while playing the flute. In the flute community, clinics, conferences, and articles on injury and injury prevention are common. The rock magazine *Guitar Player* has published many articles covering medical problems facing guitarists. One group of instruments that has not received much attention or research until recently is the percussion family. According to Workman, "when one seeks to learn more about injuries to the drummer/percussionist specifically, there is little available" (Ibid., 34).

Numerous texts deal with the technical aspects of playing percussion instruments; however, most of these books do not deal with the physiology of how one's body works

when performing percussion music. This author agrees with Workman in his statement, "I saw a need for more information that gave a broader knowledge of why we do what we do" (Workman 2002, 1). The Percussive Arts Society has recently created a committee to specifically deal with health and wellness issues. Each publication of "Percussive Notes", the official journal of the Percussive Arts Society, now contains an article dealing with health and wellness. This is a great step toward informing percussionists about important issues such as warm-up and injury prevention. Although the percussion community has now started to address health and wellness issues, no study has surveyed medical professionals regarding warm-up procedure.

Limitations

Percussionists perform on many different instruments which require different and varied techniques. This study focuses on one instrument only, the marimba. Narrowing down the study to one instrument still leaves many variables to consider. Issues such as how many mallets are being held and which grip is being used are two important items to address. The author chose to focus on four-mallet marimba performance using the Leigh Howard Stevens grip (see figure 1). Once narrowed down to this grip and number of mallets, many stroke types still are used in contemporary marimba performance. For the purposes of this study, the two most commonly used motions will be addressed, up-and-down and side-to-side. In marimba pedagogy, these two motions are commonly referred to as the double vertical and the single independent/single alternating strokes, respectively (see figures 2 and 3).

The following photographs are used with permission of Leigh Howard Stevens from his *Method of Movement for Marimba* copyright 1979.

Figure 1. Leigh Howard Stevens grip (Stevens 1993, 11).

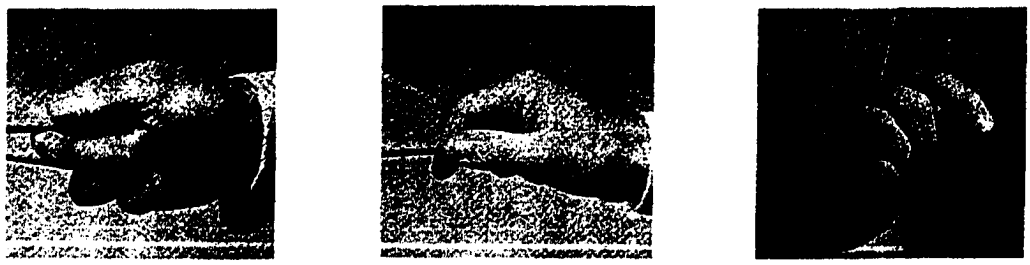


Figure 2. Double vertical stroke (Stevens 1993, 34).

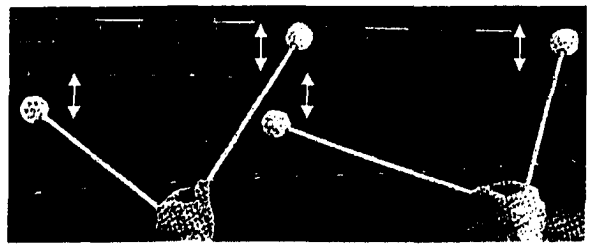
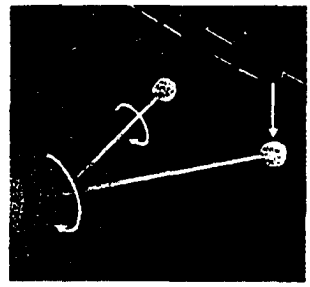


Figure 3. Single independent stoke (Stevens 1993, 28).



Many different types of medical professionals could have appropriately participated in this study. In an effort to provide a varied yet thorough survey of opinions to best inform the reader, professionals from four different areas of the medical field were chosen to be included: Dr. Darin Workman (chiropractor), Dr. Bernard R. Rubin

(osteopathic physician specializing in rheumatology), G. Jane Alfier (physical therapist), and Dr. Kris Chesky (doctor who has devoted his career to researching musicians' injuries). These professionals were chosen to represent a variety of opinions because of their individual expertise and experience with musicians' injuries.

Organization

This study is comprised of five chapters, a bibliography, and appendices. Chapter One introduces the reader to the problem of the lack of understanding involving medical opinions regarding warm-up, explains the purpose and need for the study, summarizes its limitations, and outlines its organization. Chapter Two reviews related literature on the subject including muscular activity, motor control, common injuries, warm-up, stretching, and medical issues on other instruments. Chapter Three addresses the methods and procedures by which the study was constructed and distributed. Chapter Four presents the results of the study. Chapter Five provides a summary of the study and its findings, presents possible conclusions, and gives suggestions for further research.

CHAPTER II

RELATED LITERATURE

Injury

In his *Drummer's Injury Book,* Dr. Darin Workman states "In my many years of treating drumming/percussion injuries, I have discovered that by the time the patient came to me for treatment, the injury had been there so long that it was extremely difficult (if not impossible) to fully cure" (Workman 2002, ii). Workman explains that most injuries can be healed if treated early. Problems arise when the injury is ignored or when the attitude "it will go away" prevails. The adage "an ounce of prevention is worth a pound of cure" is very true when it comes to musicians and injuries.

The body communicates in many ways. Hunger is an excellent example of this; it is the body's way of communicating that nourishment is needed and it is time to eat. Pain is also a good example of the body trying to communicate. Pain is the body's way of saying something is wrong. However, once pain is experienced, a serious problem may already exist. To help increase an understanding of how the body communicates, Workman recommends practices such as "Yoga, marshal arts, Alexander Technique, meditation, etc." (Ibid., 8). According to David Warren May, a percussionist who researches injury prevention, "the challenge is to become aware of injury prevention before an injury occurs. The risk involved in ignoring or being unaware of simple injury prevention techniques can be career-threatening" (May, 73). The idea of losing your job due to an injury is severe, but unfortunately it may be one of the last events to focus one's attention to injuries. Learning how the body communicates and some basic injury

prevention techniques could make the difference between being employed and unemployed.

Even with normal use, the body breaks down with age. When parts of the body are misused by raising the duration and/or intensity of a given activity, the "breakdown of the body" happens quicker. This is especially true when the body is not given adequate time to adapt to the increased activity. According to Workman, "As you ignore the initial signs and things begin to break down, the body begins to lose its lines of defense and a snowball effect occurs until the problem cannot be ignored anymore." Swelling, compensation (avoiding further injury by changing the way the body moves thus using improper technique), spasms, and the formation of scar tissue are just some of the initial problems of not addressing injuries at an early stage (Workman 2002, 11-12).

In music, performers are notorious for delaying the treatment of injuries. The assumption that the injury will disappear on its own, coupled with a fear of possibly having to stop playing, delays many musicians from seeking medical treatment early. If detected early by a physician or other medical professional experienced in performing arts medicine, most injuries can be treated without the performer having to interrupt regular playing (Ibid., 12).

Cumulative Trauma Disorders

According to the Bureau of Labor Statistics, employers spend approximately $20 billion dollars annually on insurance claims related to cumulative trauma disorders or CTDs (Catanese 2000, 26). These disorders, also commonly referred to as musculoskeletal disorders, repetitive motion disorders, or repetitive stress injuries, place

individuals from many different industries at risk. "CTDs are a result of continued stress on tendons, muscles and nerves of the hand, wrist, forearm, elbow and shoulder, and include conditions such as carpal tunnel syndrome, tendonitis, bursitis and backache" (Ibid.). In the 1980s, CTDs began receiving attention when computers became common in the workplace and cases of carpal tunnel syndrome rose drastically. Due to the high cost of CTDs, many industries have implemented special employee training programs in hopes of minimizing costs resulting from these injuries, and many insurance companies offer ergonomics loss control services to reduce the risk of claims. Rotating jobs, taking frequent breaks, or changing an employee's duties can help decrease exposure to CTDs (Ibid.). Changing the amount of time a person is exposed to repetitive tasks is often one of the most beneficial remedies.

Common Injuries (CTDs) to Percussionists

Playing any percussion instrument requires much repetitive motion. The many hours spent practicing and perfecting a performance can be harsh on the body. Some of the more common CTDs experienced by percussionists include carpal tunnel syndrome, tendonitis, tenosynovitis, tennis elbow, arthritis, bursitis, and back pain of all different sorts. The following is a brief discussion of these CTDs.

Workman describes carpal tunnel syndrome as a "numb, tingling or achy feeling in the hand and/or wrist (usually thumb and first finger) worse over weeks or months and during or shortly after repeated stressful motions of the hand or wrist" (Workman 2002). According to McCann and Sulzer-Azaroff, "carpal tunnel syndrome, the most widely reported CTD, is a specific, chronic nerve entrapment disorder that results from

compression and irritation of the median nerve in the wrist" (McCann and Sulzer-Azaroff 1996, 2). Although carpal tunnel syndrome can be caused by an array of predisposing biological factors (it is five times more common in women), its roots are biomechanical. Because repetitive motions of the wrist and hand directly irritate the median nerve, task repetition is the most commonly cited biomechanical cause for this syndrome. McCann and Sulzer-Azaroff state that "other occupational practices have also been reliably correlated with the incidence of carpal tunnel syndrome: forceful exertion, pinching motions, deviations from a neutral wrist alignment, rapid work pace, increased muscular tension, exposure to vibration, and constrained or inefficient posture" (Ibid.). Many of these occupational practices can be seen at one time or another in percussion performance. For example, during four-mallet marimba performance the wrists often deviate from a neutral wrist alignment to strike the bars on both rows of keys at the same time with one hand. When playing many types of percussion instruments, the wrists are exposed to vibrations of the sticks or mallets, muscular tension is increased, pinching motions are used to hold the sticks or mallets or to produce certain sounds, and forceful exertion is necessary to reach loud dynamics levels or to execute fast rhythms. All of these practices could make the percussionist particularly susceptible to carpal tunnel syndrome.

According to the Mayo Clinic website, "tendonitis is inflammation or irritation of a tendon--the thick fibrous cords that attach muscles to bone. The condition, which causes pain and tenderness just outside a joint, is most common around the shoulders, elbows (tennis elbow) and knees, but it can also occur in the hips and wrists" (MayoClinic.com 2002, 1). The pain associated with tendonitis is usually caused by

inflammation or a small tear of the tendon that links muscles to bone and is most commonly caused by overuse, aging, or injury. Tendonitis can also be linked with inflammatory diseases found in many other areas of the body, a common example being rheumatoid arthritis. The Mayo Clinic website states "you have a greater risk of developing tendonitis if you perform excessive repetitive motions of the arms or legs" (MayoClinic.com 2002, Tendonitis, 2). When performing on various instruments, percussionists often execute repetitive motions in their arms and when playing the drumset, also in their legs. If untreated, tendonitis could lead to the rupture of a tendon, requiring surgery.

Tenosynovitis is closely related to tendonitis. It occurs when the synovium (the lining of the sheath that surrounds a tendon) becomes inflamed. It can also be accompanied by inflammation of the tendon itself. Although tenosynovitis can be found at any tendon site, the wrists, hands, and shoulders are common sites for this CTD. When found in the wrists, it can lead to carpal tunnel syndrome. Like tendonitis and carpal tunnel syndrome, tenosynovitis is most often caused by overuse or injury (Roye 2001, Tynosynovitis, 1).

According to DiLuigi, one of most common complaints seen and treated by hand centers is deQuervain's Disease (DiLuigi 2000, 99). This condition is characterized by pain on the side of the wrist and forearm just above the thumb. DiLuigi describes it as a "tendonitis/tenosynovitis caused by inflammation of the abductor pollicus longus (APL) and extensor pollicus brevis (EPB) within the tunnel of the first dorsal compartment. This can arise from increased stress on the APL and the EPB from writing, typing, sewing and other activities requiring hand, thumb and wrist motion" (Ibid, 100). This

condition is characterized by pain at the base of the thumb and can be confused with arthritis found in this same location. However, an x-ray may help distinguish between the two due to the presence of degenerative changes of the joint found with arthritis (Ibid).

Lateral epicondylitis (known to the layperson as tennis elbow) is defined as "inflammation of the muscles of the forearm, or their tendons near their origin on the humerus (the bone of the upper arm)" (Roye 2001, Lateral Epicondylitis, 1). This CTD is often caused by repetitive twisting of the wrist or forearm, hence the association with tennis playing. It is important to note that any activity that involves repetitive twisting of the wrist (like using a screwdriver) can lead to lateral epicondylitis (Ibid). With the amount of wrist and forearm twisting used in percussion performance, it is not surprising that tennis elbow is one of the common CTDs found among percussionists.

Bursitis is defined as "an acute or chronic inflammation of the fluid-filled sac (bursa) that lies between tendon and skin, or between tendon and bone" (Roye 2001, Bursitis, 1). Bursae are small fluid-filled sacs that cushion the pressure points between the bones and the tendons and muscles found near the joints. These bursae facilitate movement without pain unless they become inflamed. Bursitis is commonly found in the shoulder, elbow, hip, or knee and is usually caused by overuse, trauma, rheumatoid arthritis, gout, infection, or unknown causes. Bursitis caused by repetitive motion is often named after the profession associated with certain joints or motions. For example, "miner's elbow" results from swinging a pick and "housemaid's knee" from long periods of kneeling. Bursitis usually goes away within a week or two following simple self-care and home treatment (MayoClinic.com 2002, Bursitis, 1-3).

Arthritis

On the Mayo Clinic website, one shocking statistic that could affect percussionists stands out: "More than one in seven Americans experience the nagging pains and physical limitations of arthritis" (MayoClinic.com 2002, Rheumatoid Arthritis, 1). The term arthritis derives from the Greek words "arthron," meaning joint, and "itis," meaning inflammation. Therefore, arthritis literally means joint inflammation. Although neither osteoarthritis nor rheumatoid arthritis is considered a cumulative trauma disorder, they can be mistaken for one and thus are important to mention in this document.

Osteoarthritis, often referred to as degenerative arthritis, degenerative joint disease, or osteoarthrosis, includes approximately half of the more than 100 types of arthritis and affects twenty million Americans. Most often seen in women and adults over forty-five, osteoarthritis is caused by normal wear and tear on the joints and is most commonly found in the fingers, spine, and weight-bearing joints such as the knees, hips, and feet. Because of these natural causes, osteoarthritis may not be considered a disorder or an injury. Although there is no cure for osteoarthritis, the various treatments available today coupled with an actively managed lifestyle can help arthritis sufferers gain control of the pain (MayoClinic.com 2002, Osteoarthritis, 1-2).

"Rheumatoid arthritis is among the most debilitating of them all, causing joints to ache and throb and eventually become deformed" states the Mayo Clinic's webpage (MayoClinic.com 2002, Rheumatoid Arthritis, 1). Unlike osteoarthritis, the exact cause of rheumatoid arthritis is unknown. It is thought that the body's own immune system

attacks the synovium (the tissue that lines the joints), causing rheumatoid arthritis. An inflammatory condition usually found in adults between the ages of twenty and fifty, rheumatoid arthritis can occur in children and older adults. Women are three times more likely to have rheumatoid arthritis than are men. The joints most commonly affected are those in the hands, wrist, ankles, and feet, but the jaw, neck, shoulders, elbows, hips, and knees can also be affected. Even though rheumatoid arthritis is often a chronic disease, its severity may come and go. Like osteoarthritis, there is no cure for rheumatoid arthritis (Ibid., 1-2).

Warm-up, Stretching, and Cool Down

"Warming up and stretching are an integral part of our ability to perform at peak. It allows the body to prepare for activity, and is one of the most effective things you can do to prevent injury" (Workman 2002, 8). This quote sums up an important part of this study, an effort to educate percussionists in the avoidance of injury. In his *Drummer's Injury Book,* Workman distinguishes the difference between warming up and stretching. His discussion of warming up focuses on increasing the body's activity to promote the circulation of blood towards the muscles. Physical activities such as walking or jogging are recommended to increase the heart rate and prepare the body for performance. Once a feeling of warmth is felt in the muscles, the actual stretching can begin. Manually stretching a muscle gives it flexibility and prepares it for exercise. The following illustration given by Workman describes this process well:

> Mentally, it may help to compare muscle fibers to strands of spaghetti – brittle until warm and moist. This image may help illustrate the fact that as we get colder, we become less flexible and more apt to break (injure). Conversely, the warmer we get, the more flexible we become. It is obviously best to stretch

> something when it is soft and flexible, rather than brittle and cold. The body responds in this way as well. (Ibid., 9)

Many people may think of warming up as playing certain technical exercises on the instrument before performance. Distinguishing the differences between warming up and stretching is important, and incorporating these practices into a daily performance routine is vital in the effort to avoid injury.

A much-overlooked part of any exercise program is the cool down stage. Cooling down after exercise involves maintaining motion in the muscles and continuing good circulation while reducing the actual frequency of occurrence. This process helps flush out lactic acid, the substance remaining in the muscles following longer and more intense periods of use than the muscles are normally worked. Cooling down can be viewed similarly to warm up/stretching, only in reverse. Exercising and performing mild stretches at a pace slow enough that the body stops perspiring is essential. Cooling down also will help decrease the chances of soreness or stiffness the day following exercise. According to Workman, "After significant activity, you must cool the body down, allowing the blood to replenish the muscles with supplies, and cool them down–pulling the blood out of them. It is bad to leave the muscle pumped up with blood and lactic acid. Allow the body to flush itself out via the cool down" (Ibid., 10-11).

Ergonomics

Ergonomics is defined as "an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely" (Merriam-Webster OnLine, s.v. "ergonomics"). In addition to warm-up, proper consideration of ergonomics is crucially important for those who encounter repetitive

motions in their daily activities. With the prevalence of computers in modern society, ergonomic awareness is becoming a necessity. Those who spend many hours working on a computer experience injuries similar to percussionists. According to Dr. Benjamin Lesin, "The personal computer has multiplied productivity, but it has also increased the incidence of carpal tunnel syndrome, tendonitis, and tennis elbow--disorders caused by the stress of repetitive motion" (Lesin 1994, 52). Due to the common occurrence of computer-related injuries, many employers are starting to address ergonomic issues before problems arise. According to Lesin, "Ergonomics is not just new furniture and accessories, but tailoring the workspace to fit each employee to assure comfort, reduce strain and avoid injury" (Ibid.). In practice and performance, musicians should consider ergonomic factors and view their workspace in a similar manner.

Lesin states "The capability to adjust the workspace is particularly important when a workstation is shared; for example, if an individual who is 5'6'' tall is replaced by someone who is 6'2'', an adjustment is essential" (Ibid.). Percussionists also need to adhere to this advice and adjust each instrument to a height or position that fits the individual performer. Because many keyboard percussion instruments have traditionally not been height-adjustable, performers of all different heights have played on the same instrument without changing its height. Today there are many height-adjustable instruments made that will accommodate performers of all different sizes. If no such instrument is available, then the instrument can be adjusted to place the individual in an optimum performing position (placing it on blocks for taller students). According to May, instruments should be "set-up to make certain that they are positioned in such a way that the area of impact is directly in front of the performer and at the proper height (May

1994, 74). When discussing injury prevention, Workman suggests that educating students on proper instrument set-up and adjustment should be taught in the first lesson. To avoid injuries, taking ergonomic considerations into account is vital to computer-users and musicians.

Alexander Technique

The opening statement on the website entitled *The Complete Guide to The Alexander Technique* states, "The Alexander Technique is a way of learning how you can get rid of harmful tension in your body" (Rickover 2002). F.M. Alexander (1869-1955) was an actor who developed chronic laryngitis while performing. After examining himself speaking, he found that undue muscular tension had created his injury. Through working on himself and others, "he evolved a hands-on teaching method that encourages all the body's processes to work more efficiently--as an integrated, dynamic whole" (Ibid.). A more detailed explanation of his technique follows:

> The Alexander Technique is a method that works to change (movement) habits in our everyday activities. It is a simple and practical method for improving ease and freedom of movement, balance, support and coordination. The technique teaches the use of the appropriate amount of effort for a particular activity, giving you more energy for all your activities. It is not a series of treatments or exercises, but rather a reeducation of the mind and body. The Alexander Technique is a method which helps a person discover a new balance in the body by releasing unnecessary tension. It can be applied to sitting, lying down, standing, walking, lifting, and other daily activities... (Ibid.)

In the music field, The Alexander Technique is often used to help improve the quality of physical movements used while performing. By learning how to release tension and stress while performing, many musicians have benefited from this technique. It is taught at the Juilliard School of Performing Arts in New York, The Royal College of Music in

London, The Royal Conservatory of Music in Toronto, and at many other schools of music, universities, and colleges (Ibid.).

The Feldenkrais Method

The Feldenkrais Method is named after its originator, Dr. Moshe Feldenkrais, D.Sc. (1904-1984), a Russian born physicist, judo expert, mechanical engineer, and educator (Feldenkrais 2002). According to the Feldenkrais Guild of North America

> The Feldenkrais Method is a form of Somatic Education that uses gentle movement and directed attention to improve movement and enhance human functioning. Through this Method, you can increase your ease and range of motion, improve your flexibility and coordination, and rediscover your innate capacity for graceful, efficient movement. These improvements will often generalize to enhance functioning in other aspects of your life. The Feldenkrais Method is based on principles of physics, biomechanics and an empirical understanding of learning and human development. By expanding the self-image through movement sequences that bring attention to the parts of the self that are out of awareness, the Method enables you to include more of yourself in your functioning movements. Students become more aware of their habitual neuromuscular patterns and rigidities and expand options for new ways of moving. By increasing sensitivity the Feldenkrais Method assists you to live your life more fully, efficiently and comfortably. (Ibid.)

Similar to The Alexander Technique, the Feldenkrais Method is used by musicians to help improve the quality of physical movements used while performing. Commonly musicians will focus all of their attention on the parts of the body used most while they create music. For singers, this might be the mouth and throat; for pianists, the fingers; and for percussionists, the wrists, hands, and fingers. Although this can produce a high technical prowess, it often creates musicians who do not use their bodies as efficiently as they could (Rubin 1995). The Feldenkrais Method is used to increase mental awareness of motion and to maximize the effectiveness of movements while

performing music. Famous musicians such as violinist Yehudi Menuhin and cellist Yo Yo Ma have used this method (Feldenkrais 2002).

Pilates

Joseph Hubertus Pilates (1880-1967) created a method of exercise that was considered by many to be innovative and ahead of its time. Today many people use these exercises and the principles of Joseph Pilates in their daily workout (Pilates 2001). According to the Pilates.com website, this method "teaches body awareness, good posture and easy, graceful movement. Pilates improves flexibility, agility and economy of motion" (Ibid.). Pilates exercises work to strengthen all the muscle groups creating a body with balanced flexibility and strength. Creating this type of musculature helps decrease the chance for injury. The Pilates.com website stresses the importance of the mind-body connection:

> Pilates gets your mind in tune with your body. By emphasizing proper breathing, correct spinal and pelvic alignment, and complete concentration on smooth, flowing movement, you become acutely aware of how your body feels, where it is in space, and how to control its movement. The quality of movement is valued over quantity of repetitions. Proper breathing is essential. Correct breathing helps you execute movements with maximum power and efficiency. Last but not least, learning to breathe properly can reduce stress. (Ibid.)

Many dancers, athletes, and musicians have used Pilates and benefited from this system of exercise. Pilates is frequently used in many forms of rehabilitation from injury.

References to Warm-up

As previously stated, many journal and magazine articles written by percussionists reference warm-up and its importance. Unfortunately, most all of these

articles simply express the opinions of these musicians without the benefit of research and/or opinion from the medical field. This situation is best described by Workman's statement, "Although no conclusive evidence of the benefits of warming up have ever been documented, seasoned musicians are well aware of its many great advantages, both physically and mentally" (Workman 1999, 57). Unfortunately, Workman's articles are an exception to those normally found in percussion journals and magazines. Because he is a medical professional and a musician, his articles synthesize knowledge from the medical field with his experience as a musician.

In his article, "Top Ten Tips for Productive Practicing," Michael Burritt suggests percussionists "Develop a comprehensive warm-up regimen, both physically and mentally" (Burritt 2000, 42). He continues, "A good practice session hinges on the effectiveness of your warm-up time" (Ibid.). These and other statements suggest how strongly Burritt feels about warm-up. He even states that ignoring warm-up "can result in serious muscle and tendon problems, and even long-term damage" (Ibid.). Burritt is not only an Associate Professor and the Director of Percussion Studies at Northwestern University, but one of the leading marimba performers, composers, and clinicians active today. However, there is no medical research referenced in his article; the information is all the opinion of the musician.

Peter Erskine is another well-respected percussionist who advocates warming up. Erskine is a highly sought-after drumset performer and clinician well-known throughout the world. In his article, "Practice Makes Perfect," Erskine discusses specific warm-up routines he has used since 1965. He says they "help loosen up and exercise the mechanical part of my music-making apparatus--in this case, my drumsticks and hands"

(Erskine 1998, 26). Although Erskine has used these routines since 1965, there is no mention of any research or opinion from the medical field.

When discussing practicing, former Chairman of Percussion at Millikin University, Dr. James Moyer, recommends, "at least ten percent of your total practice time should be devoted to warm-ups" (Moyer 1996, 53). In similar journal articles, percussionists Britt Allen and David Warren May also discuss the importance of warm-up with regard to injury prevention. Stephen J. Howard states, "Beginning each practice session with appropriate warm-up exercises can physically prepare the performer as well as expand the possibilities of practice time" (Howard 1997, 54). All of these individuals stress the importance of warm-up and some even touch on the possibilities of injury, but again, no medical research or opinion is included in support of their ideas.

Although his articles contain information regarding performance related injuries and mentions some of the work being done in the medical field, Glenn Steele's suggestion to "perform physical warm-up/flexibility exercises before and after playing" lacks specific research or opinion from the medical community (Steele 1991, 27). In another article, Steele stresses the importance of warm-up, but again without mention of medical support of the ideas. Steele has done great work researching the subject of percussionists' injuries, but there is still much work to be done regarding the acquisition of specific research and opinion from the medical community.

Dan Lidster, a freelance percussionist and owner of Encore Mallets, Inc., has undertaken research into injury prevention for marimba players. His ideas stem from his study with Dorothy Taubman, "a pianist who has developed a system of coordinate movement that heals injuries while at the same time facilitating technical abilities"

(Lidster 1999, 52). His research and writing focuses on medical issues such as muscle groups and how they work, certain injuries, location of pain and what might be causing it, and how what Taubman calls "coordinate movement" can prevent injuries. Concepts regarding warm-up are only slightly mentioned in his article. Lidster states that his "warm-up is more mental than physical," and later says that "Taubman teaches that when coordinate movement is utilized, very little warm-up is needed" (Ibid., 55). Although Lidster's article presents good information and is helpful to the marimbist who is experiencing pain, there is little discussion regarding warm-up and no opinion or research from medical professionals.

Some research focuses on issues regarding general fitness, fitness conditioning for percussionists, and health precautions for percussionists. Articles found in *Percussive Notes* by Wright and Mikula deal with preparing the body for practice and performance through concepts like stretching and strength building, but no research from medical professionals was found regarding specifically warming up the muscles of the hand, wrist, and arm. Other articles mention the concept of mental practice (using your mind to practice away from the instrument) to help prevent overuse of certain muscle groups, and one by Shaffer even suggests using mental practice when recovering from an injury (Shaffer 2000, 65). General fitness and mental practice concepts are helpful when working to avoid injuries. However, there is still a lack of research and opinion from professionals in the medical field specifically regarding warming up to prevent injury.

Summary

A list of all possible injuries percussionists could incur would be enormous. In this chapter, the author has tried to identify some of the more commonly found injuries, define them, and review literature regarding some of the best ways possible to avoid them, primarily by utilizing some sort of warm-up and stretching routine. Although many percussionists have expressed their own opinions on what a proper warm-up routine should be, there is a lack of physiological research from the medical profession to support these opinions.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study is to provide percussionists with the opinions of medical professionals regarding warm-up procedures for four-mallet marimba performance. The author hopes to add knowledge from the medical profession to the many percussion sources available that address warm-up procedures. This chapter will address the methods and procedures by which the study was constructed and distributed.

Medical Professionals Surveyed

Medical professionals were selected from different areas of the profession in order to obtain a wide variety of opinions and perspectives. The professionals' specialties were chiropractic, rheumatology, physical therapy, and research involving musicians and their injuries. The differences in these professionals' backgrounds, training, current practices, and areas of expertise should provide a wide variety of viewpoints.

Dr. Darin Workman, Doctor of Chiropractic, was chosen for the study because of his experience in treating musician's injuries. A percussionist himself, Workman has extensively researched the injuries commonly experienced by percussionist and treated many of them. In addition to his chiropractic practice, Workman is the Health and Wellness Committee chairman for the Percussive Arts Society, writes many articles for this Society's journal, and currently is writing a series of books focusing on percussionists and their injuries, entitled the *Drummers Standard Reference.*

Dr. Bernard R. Rubin holds a degree in osteopathic medicine and specializes in rheumatology. He received his degree from the Chicago College of Osteopathic Medicine. After completing most of his training in Philadelphia at the Albert Einstein Medical Center and the Thomas Jefferson University School of Medicine, Dr. Rubin joined the faculty of the University of North Texas Health Science Center at Fort Worth. Currently, Dr. Rubin holds the positions of Professor of Medicine; Chief, Division of Rheumatology, and Medical Director of the Texas Center for Music and Medicine. He is also a former president of the Texas Rheumatism Association. Dr. Rubin's past and present area of research centers on testing novel treatments for osteoarthritis, rheumatoid arthritis, and performance injuries in musicians.

G. Jane Alfier is an Occupational, Physical, and Certified Hand Therapist. She graduated with a Bachelor of Science in Child Development in 1976 and a Masters degree in Occupational Therapy in 1979 from Texas Woman's University. In 1983 she graduated from the University of Texas Health Science Center at Dallas with a Bachelor of Science in physical therapy. Alfier was certified in hand rehabilitation in 1991, and is a member of the American Society of Hand Therapists. Hers was among the first hand certifications offered in the United States. Her practice of physical and occupational therapy has centered on upper extremity/hand rehabilitation since 1986, and treating musicians has been part of her experience.

Dr. Kris Chesky holds a Ph.D. in Music and was chosen for his extensive research and experience in the area of treating musician's injuries. He is the director of research and education for the Texas Center for Music and Medicine. He co-directs the center and has written numerous research articles and book chapters related to medical problems of

musicians, as well as articles related to the applications of music in medicine, i.e., music therapy. He has a half-time appointment in the University of North Texas College of Music and half-time appointment in the College of Medicine within the department of Internal Medicine. Currently, he serves on the editorial board of the Medical Problems of Performing Artists Journal and on the Board of Directors for the Performing Arts Medical Association. In addition, over the past ten years, he has presented at most major national and international performing arts medicine conferences. He states:

> My primary area of specialty is research and my primary focus is related to the integration of people, ideas, and resources between those in the medical profession and those in the music profession. My research agendas include investigations related to epidemiology, biomechanics of performance, hearing loss, psychological and mental health issues, and interdisciplinary perspectives on musician's health. (Chesky 2002, 1)

Information Presented

The author met with each medical professional, showed them videotaped and live demonstrations of marimba performance, and interviewed them. Each consultant was asked a series of questions regarding their background, degrees, years in practice, treatment of musicians, and specifically treatment of percussionists with injuries. The performance demonstration contained excerpts of the contemporary marimba literature with four mallets. The demonstration was presented to each consultant on videotape and in person so they could get a closer look and view the performance from any angle they wished. Each demonstration session was audio and videotaped by the author with the permission of the consultants in order to document responses.

Materials Used

All of the performances were presented on a five-octave Marimba One rosewood marimba. The marimba was set at a height of thirty-six and one-half inches above the floor with the performer standing at a height of five feet, eleven inches tall. Each consultant viewed a videotape of the author performing *Merlin* by Andrew Thomas and a live performance of the *Four Rotations Pour Marimba* by Erik Sammut. The Stevens grip was used, and each selection utilized many contemporary four-mallet techniques. Mallets made by Innovative Percussion were used on all of the works.

Questions Asked

After the consultants viewed both the videotape and live performance, the following questions were presented.

1. Describe what injuries you think could come from this sort of repetitive motion?
2. What factors do you think could contribute to these injuries?
3. Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm-up)?
4. What interval of time do you recommend the performer spend preparing the body by warming up?
5. Should any of this preparation occur away from the instrument?
6. After the body is warmed up and ready for performance (or practice), what are your recommendations for taking breaks to avoid injury?
7. Do you recommend a "cool down" period after performance?
8. Describe your recommendation for this cool down.

9. Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

CHAPTER IV

RESULTS OF THE INTERVIEWS

This chapter discusses the results of the interviews. Transcription of each interview is presented in Appendix A. Although differences in opinions do exist, many of the answers were similar in nature.

Question #1

Describe what injuries you think could come from this sort of repetitive motion?

The first injury Alfier mentioned was deQuervain's tendonitis, "a type of tendonitis that occurs in the first dorsal compartment of the wrist" (Alfier 2002). Another type of tendonitis she thought could occur was extensor tendonitis with the second dorsal compartment. The second dorsal compartment is the point where the wrist extensors attach to the metacarpal bone. She commented, "The prolonged gripping and pinching would contribute to flexor tendonitis or carpal tunnel syndrome, especially in the carpal tunnel" (Ibid.). Due to the repetitive use of the wrist extensors, she thought players would be prone to tennis elbow. Alfier also saw the potential for trouble with the neck due to the standing position while looking over the instrument for long periods of time (Ibid.).

Rubin's first statement regarding injuries was, "Well, I think the injuries would be anywhere in the upper extremities. You could have injuries to the fingers, the wrists, elbows, shoulders, neck, and upper back" (Rubin 2002). The possible finger injuries Rubin described are tendon problems, flexor tendon problems, cramping, and the development of nodules due to how tightly the mallets are being held. In the wrists,

Rubin (and Alfier) mentioned deQuervain's tenosynovitis as a main problem. He mentioned tenosynovitis and said that carpal tunnel could be a problem, but felt the deQuervain's would be a more common complaint. Rubin felt that in all the areas of the arm, the elbow would be the area most prone to injury. Due to the elbow's rotating and flexing motions, the elbow could develop lateral epicondylitis (tennis elbow) or arthritis. Rubin saw the shoulders as a possible sight for injury with tendonitis being the main concern. Because of using the shoulders for additional force, standing for long periods of time, posture problems, and the position with the head slightly bent down, Rubin felt that pain between the shoulders, in the upper back, and in the neck could also be a concern. He stressed the need for good posture and an awareness of the position of the shoulders, neck, and back (Ibid.).

Chesky's comments regarding possible injuries focused more on the mental aspects of performing. Although he agreed the movements could contribute to pains and problems, he stated, "I don't think the injuries themselves are related just to the biomechanics of the movement. My definition of occupational injury is broader than that" (Chesky 2002). Factors such as stress, heightened anxiety, genetics, and body size were all mentioned as possible contributors to injuries. Chesky also stressed the difference in perception regarding pain. He stated, "Pain, by definition, is a perception, and being a perception, has a psychological component to it" (Ibid.). Because people tolerate and perceive pain in different ways, it is often hard to diagnose a problem or injury. Chesky also mentioned that individuals with a prior history of pain or an injury would react differently in the future if the pain returns. Because of past experiences, they have an idea of what they may be dealing with. Regarding pain, Chesky stated "If you'd

never had it before you wouldn't know any different. Say if someone had a pain in their side, they may think they have indigestion. Or, if somebody has a history of cancer, or has had a tumor in their lung, the pain could be a lot less but boy the meaning is a lot different" (Ibid.).

Workman's comments regarding possible injuries began with the shoulders. He stressed the need for relaxation in the shoulders and upper body. Otherwise, breathing will be affected and tension will move down the arms and force all of the movement to come from the elbow downward. Workman discussed various muscle motions such as flexion/extension and rotation/pronation; tendonitis can occur if these motions are not balanced. In terms of carpal tunnel, he felt the height of the instrument, which affects the angle of the wrists, is the greatest factor in combating this common injury. When asked if he sees much tennis elbow in the percussionists he treats, Workman stated, "Not really. What I usually see is the precursors to tennis elbow, which is the tightening of the muscles of the forearm. That's a problem with the extension muscles...where they don't put enough pressure to cause the tendonitis part of it, but they put enough pressure to actually cause a muscle problem" (Workman 2002, Interview).

Question #2

What factors do you think could contribute to these injuries?

Alfier's comments regarding contributing factors included the repetitive motion, the position, the striking, and the vibration. When asked to elaborate on her comment "the position," she emphasized all of the various positions involved in marimba performance. The position of the arms, hands, and body were stressed. Alfier also felt

that long amounts of performance time could contribute to possible injury. She felt "the prolonged grip, the constant grip, and constant pinch" could lead to problems (Alfier 2002).

The factors Rubin felt could contribute to injury were "bad technique and not modifying the work environment to fit the individual" (Rubin 2002). Elaborating, he stressed that the height of the instrument must be appropriate to the individual. Mallet weight was another form of modifying the work environment Rubin felt was important. Comparing the author to a beginner, he stated "if she's playing it compared to you, she may not be able to get the same sound when she uses a heavier mallet, and this puts more stress on her" (Ibid.).

Chesky discussed the biomechanical nature of any occupational injury and the three risk factors that are most important--repetition, duration, and force. He described how any one of these risk factors can lead to injury, but when they are combined the chances of injury increase. Posture was another factor Chesky felt could contribute to injury. He mentioned wrist posture (position) as a possible problem, and felt upper extremity posture was a major risk factor. Chesky also considered physical stature to be a risk factor, citing someone with less upper extremity strength or smaller hands as examples (Chesky 2002).

Workman also felt that posture was a risk factor and could lead to pain and possibly injury. When people lean over the instrument as they play, pain will probably occur in the shoulders and lower back. He saw the grip itself as a possible risk factor, citing the constant spreading and contracting of the fingers. Workman discussed his feelings on the term used to describe many of the injuries seen in marimba performance,

"overuse syndrome." He stated, "It's like running. People say you shouldn't do it because that's too many steps for one day. Well that's not true if you're running correctly and efficiently. People can run for long periods of time, but if you don't do it right you can also get hurt" (Workman 2002 Interview).

Question #3

Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm-up)?

In preparation for playing, Alfier stressed the need for some specific stretches. Shoulder exercises, such as the posterior shoulder stretch (pulling the elbow across the chest), were recommended for the upper back area. For the wrist and hand, Alfier mentioned stretching the wrist extensors, a thumb stretch, abduction stretch, and a metacarpal-carpal tunnel glide stretch. Due to the position of the arms and hands when playing, Alfier stated, "I would think you would want to make sure the extensors were completely stretched and limber before you started" (Alfier 2002). She then demonstrated by pulling the hand downward and to the outside of the body. Generally maneuvering the hands, wrist, and forearms prior to playing should help prepare the muscles for warm-up (Ibid.).

Similar to Alfier's views, Rubin also stressed the importance of stretching. He mentioned stretching the upper back, shoulders, neck, elbows, forearms, hands, and fingers. In order to be better prepared for warm-up, Rubin considered building up strength in the finger muscles to be very important, and recommended squeezing silly putty or a similar substance repeatedly to strengthen the fingers. He mentioned using

light weights to build strength in the extensor muscles, wrists, and elbows. To develop a full range of motion in the shoulders, Rubin suggested holding a broomstick or yardstick in both hands (shoulder width apart) and raising it up over one's head, then moving the stick from one side to the other. He also recommended a stretch called "walking the wall" to help stretch the four rotator cuff muscles in the shoulders. This is done in two separate ways; first, facing the wall and walking up the wall with one's fingers until the arm is fully extended and second, by standing next to the wall and repeating the same motion. Rubin also stressed the importance of body awareness and knowing if you are standing correctly and feeling comfortable. He stated, "I'm a firm believer in Pilates and Feldenkrais and this whole postural breathing and standing" (Rubin 2002). Studying different methods that focus on the mental aspect of performing and teaching body awareness such as the Alexander Technique, Pilates, and Feldenkrais can help any musician prepare for performance.

Chesky also felt that stretching to "increase the blood flow to the involved muscles" would help prepare for warm-up (Chesky 2002). In addition, he suggested that part of the preparation should include being "psychologically relaxed and focused," and knowing what it feels like to be warmed up. He stated:

> So when you are warmed up and are playing well, and it feels real natural, what are those senses; what are those ranges of motion like; what are the overall perceptual attributes in that state of being? I don't think there's a general, standard, or specific set of things that get you there that are the same for everyone. So, for an individual, once you sort of feel like you know what that is, you'll know if you are there or not, and what it would take to get there again. It's almost like using the existing knowledge drawn from experience and using it as a feedback mechanism because you want to get back to that, and then trying different things to efficiently, quickly, and effectively get back to that state. (Ibid.)

Similar to Rubin, Chesky not only stressed the importance of stretching, but also saw great potential in increasing mental awareness to aid the warm-up procedure.

Workman also recommended increasing movement in the areas to be used prior to warm-up. He stressed that the body needs to be forewarned before executing repetitive motions. To accomplish this, Workman uses a two-step procedure. First, increase the blood flow to the extremities by walking, running, or using calisthenics to elevate the heart rate. Second, start moving the areas and muscles that will be used during the activity. A good general stretch Workman recommended was holding a stick or mallet in one hand and rotating it from left to right to help loosen the muscles. This motion is similar to turning a doorknob. In addition, Workman suggested playing in the air to get the wrists moving and general motion going (Workman 2002 Interview). Executing these stretches before (and during) performance will aid in preparing the muscles for the activity and also stretch them out during practice.

Question #4

What interval of time do you recommend the performer spend preparing the body by warming up?

Alfier said she did not know of anything written that says how much time one needs to spend warming up. However, she stated five to ten minutes as an approximate amount of time (Alfier 2002). Rubin felt the amount of preparation time was related to the amount of time to be spent practicing or performing. He stated, "If you're going to play for hours I think you need to spend at least thirty or forty-five minutes warming up" (Rubin 2002). Chesky felt that the length of time needed to warm up was a very

individualized thing. Depending on the person, it could take anywhere from ten to thirty minutes (Chesky 2002).

Workman began his comments to this question by stating, "It's not a time sort of thing. A warm-up has to do with the actual sequence of events and knowing it's actually happening" (Workman 2002 Interview). He continued by saying the amount of time was relative to the time of day and the level of activity that has happened earlier in the day. A longer process is needed in the morning, but after a regular day consisting of routine activities such as walking and typing, the time needed is shorter. If the warm-up is going to take place at night, Workman suggested an hour to complete the process. This includes a walk or jog to get the heart rate up and the blood flowing to the extremities, followed by a gradual process of increasing movements related to the activity about to be undertaken. He also recommended a short period of time away from the instrument at the end of this hour to clear the mind (Workman 2002 Interview).

Question #5

Should any of this preparation occur away from the instrument?

Alfier's answer to this question was a simple "yes" (Alfier 2002). Rubin stated that this "has nothing to do with the instrument," and that all of the preparation should occur away from the instrument (Rubin 2002). The author believes he is referring to all of the stretching and mental preparation referenced in question number three. Rubin added that he does believe in warming up at the instrument also, "playing very, very light pieces, at a very modest tempo so we are not hammering away, and not playing something that's intellectually, emotionally, or physically complex. And we do this for

very brief periods of time" (Ibid.). Chesky felt that the preparation could take place either at or away from the instrument, depending on the individual. He discussed how the movements and stretching in the shoulders, elbows, and wrists are easily done away from the instrument, but that a set of musical exercises at the instrument would aid warm-up (Chesky 2002).

Workman described the warm-up procedure as involving mental, emotional, and physical preparations prior to performance. He believes the mental part of the process can be done away from the instrument, but that the physical part should be done on the instrument (after some walking or calisthenics to get the blood flowing). Workman supported this idea stating, "Because there is a mind-muscle memory thing where you have to have the distance right and the rebound correct and the weight of the sticks or mallets proper. So your body must get accustomed to the environment, and it can't do that on a pillow or somewhere else; you really have to do that on the instrument to be most effective" (Workman 2002 Interview).

Question #6

After the body is warmed up and ready for performance (or practice), what are your recommendations for taking breaks to avoid injury?

Similar to the advice she would give someone involved in highly repetitive manual labor, Alfier suggested no more than fifteen to twenty minutes of constant playing before taking a break. The length of the break she recommended was at least one to two minutes (Alfier 2002). Rubin suggested people play no more than forty-five

minutes at a time without a break (Rubin 2002). With regard to taking breaks Chesky stated:

> The recommendation I have, based on my knowledge and literature, is that there is no set time-frame which is generalized for all conditions or for this instrument or any instrument. It should be a very individualized concept. You should be aware of changes in the body. The body is extremely versatile and able to tell us when things are going wrong. That's probably the best way to tell when you need to take a break. The perceptual ability gives a sense of what to do. (Chesky 2002)

If the performer is playing well (not injured), Workman suggested a one hour practice session with a ten minute break each hour. He related this to the fifty-minute class schedule found in many schools. It is good for the mind to take a ten-minute break every hour. For an injured performer, Workman recommended breaking the practice session up into shorter parts and spreading them out throughout the day. He stated, "I feel its more effective to take a number of practices during the day that are shorter rather than take one long one, because you do fatigue emotionally as well as physically" (Workman 2002 Interview).

Questions #7 and 8

Do you recommend a "cool down" period after performance?

Describe your recommendation for this cool down.

Alfier said she generally does not recommend a cool down (Alfier 2002). Rubin, however, does recommend a lengthy cool down. He suggested forty-five minutes for the cool down with constant monitoring to ensure that no new aches or pains are occurring. Because the same muscles have been engaged in the same repetitive motions for a long period of time, Rubin suggested working opposing muscle groups during the cool down. He suggested doing something completely different to stretch the muscles out in new and

different ways. Due to the amount of standing and the stresses put on the back, Rubin also mentioned stretching both the upper and lower back during the cool down (Rubin 2002).

Chesky felt a cool down is important and should include mental aspects as well as physical. He talked about "getting your mind into a good positive attitude and not leaving frustrated" (Chesky 2002). If worried about an upcoming performance or repeated mistakes made during the practice session, Chesky felt it is important for the player not to dwell on those things during the cool down but rather to leave the practice session with a positive attitude. If the heart rate and breathing are elevated, he suggested some slow walking or continued movement, as opposed to sitting to rest. He also mentioned stretching and continued movement, but to a lesser degree than that used during the performance.

According to Workman, like athletes, musicians must cool down after exerting themselves. He stated, "You have exerted the muscles, and blood is pumping freely through to get as much nutrition as possible when all of a sudden the muscles stop, and everything backs up. You get the flow of blood in there, you get swelling, and you get lactic acid built up where you have not flushed the lactic acid or the exhausted byproducts of muscle use. So instead of stopping, you slow down" (Workman 2002 Interview). Workman used the analogy of an athlete who, having just run a race, jogs for a while and then slows down to a walk, rather than just stopping and sitting. He recommended decreasing one's physical action and motion over a period of thirty minutes (Ibid.).

Question #9

Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

Alfier's main recommendation dealt with beginners and strength development. She felt that people just starting to play the instrument "need to be very specific on strengthening" (Alfier 2002). Areas mentioned include the intrinsic muscles of the hand, the wrist extensors, the upper shoulders, and the middle back. These areas are heavily used, require much strength, and must be strengthened in the beginning performer in order to avoid injury. To strengthen these areas, Alfier recommended using weight exercises or isometrics. In a more advanced performer, she suggested looking for areas and muscle groups that may be over-conditioned and working to correct imbalances. Her final thought was to be sure to rest when it seems one might be having trouble that could lead to an injury (Ibid.).

Rubin's thoughts on this question dealt mainly with the entire mental state of performance. He stressed the importance of general conditioning and again recommended techniques such as Pilates, Feldenkrais, and the Alexander Technique to help increase mental awareness of the body, how it is working, and if it might be heading toward an injury. Constantly monitoring and being aware of how one should stand and move, as well as the specific motions of the desired techniques, is very important. Rubin stated, "I think too many people focus on the warm-up, and everything is task specific. I think it really has to do with the mind" (Rubin 2002).

Other than what the performer tells us, Chesky stressed the fact that we really don't know much about the biomechanical risks involved with performing on any instrument. He stated:

> The greater need is perhaps investigation into the true biomechanical dynamics involved and the true physical requirements involved. What are the ranges of motion involved in this? How much are they influenced by the physical stature of the person? Some people have smaller arms or legs, different hand sizes, and are going to be taxed differently. And do those physical features or those differences require different types of warm-ups or cool downs? We need that information, but we don't have it. So, it's all speculative. In fact, anything I can say is speculative regarding this instrument. So, what we do need is further research. (Chesky 2002)

Workman spoke of the possible benefit of shaking one's hands out, or holding the sticks/mallets in the hand and rotating from side to side. He also added that playing in the air generates motion in the wrists and the consequent general movement could help the warm-up process. Another issue touched on was recurring injury. Workman stated, "If you don't deal with an injury, each time it comes back you have to deal with the problems it causes as a recurring injury. If it keeps recurring, you haven't solved the technical problem that caused it in the first place (Workman 2002 Interview). Finally, Workman stressed that the majority of players do not need to stop playing to recover from an injury. He believes it is important to keep playing moderately as recovery progresses. Performing the activity that caused the injury is important in building endurance and stamina during the recovery period. Stopping all playing when injured, as recommended by some medical professionals, may have a negative effect when returning to the instrument. Workman emphasized allowing recuperation, but doing so while continuing a moderate amount of playing (Ibid.).

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Many musicians from different age groups, musical backgrounds, and instrument families have experienced some level of pain, discomfort, or injury at one time or another. Although different opinions exist, many performers, teachers, and other experts agree that one of the best ways to avoid pain and injury is to warm up prior to practicing or performing. Warming up prior to playing a musical instrument is similar to warming up before exercising. Most professional athletes prepare their bodies for the given activity by executing some sort of warm-up regimen. Although this warm-up differs greatly from sport to sport and person to person, the general goals are the same, to alert the muscles physically and prepare them for action. Most athletes and musicians tend to agree that preparing the mind for exercise or musical performance is also an important part of the warm-up procedure. The question then becomes, Is there an ideal way to warm up for any given musical activity? There may be no one correct answer to this question, but the potential benefit in researching the issue is tremendous.

A relatively new field entitled "Performing Arts Medicine" (similar to sports medicine) has made great strides towards informing musicians about the importance of physical well-being in relation to their ability to perform well. However, few musicians pay as much attention to their physical health as they do the creation of their art. Often the only time musicians worry about health and wellness issues is after they have sustained an injury. Ignoring early warning signs and an attitude of "playing through the

pain" is prevalent among many musicians from different instrument families and genres of music.

Like many other musicians, percussionists are guilty of abusing their bodies and not considering the consequences. The physical nature of playing percussion instruments involves many repetitive motions often executed at loud volumes and over long periods of time. The stresses placed on the body of a percussionist are high, and the chance for injury is great. Percussionists need to spend a great deal of time educating themselves on the importance of physical well-being before an injury occurs.

The abuse the body takes while executing the repetitive motions used in percussion performance is closely related to other professions with similar repetitive motion stress. Percussionists, like typists, often encounter various cumulative trauma disorders (CTDs) from the many hours spent using repetitive motions in practicing and performing. Some of the more common CTDs experienced by percussionists include carpal tunnel syndrome, tendonitis, tenosynovitis, tennis elbow, arthritis, bursitis, and back pain of all different sorts. These CTDs can affect musicians in many different ways, from slight pain to loss of work, or even the feeling by some that a change in profession is needed.

In the primary literature available to percussionists, many references concern warming up before playing. However, most of these references are opinions of performers. These performers themselves typically present their opinions without conducting research or gathering the opinions of actual medical professionals. Medical doctors, physical therapists, and others with specific medical training know much more about the physical and biomechanical nature of the body and what specific things might

lead to injury than does the average musician. The purpose of this study is to provide percussionists with the informed opinions of medical professionals regarding warm-up procedures for four-mallet marimba performance. The author hopes to add knowledge from the medical profession to the many percussion sources available that address warm-up procedures in an effort to make injury prevention more commonly understood by all percussionists.

In order to provide a varied yet thorough survey of opinions, the author interviewed professionals from four different areas of the medical field. A physical therapist, a Doctor of Osteopathic Medicine specializing in rheumatology, a Doctor who has devoted his career to researching musicians injuries, and a chiropractor (who also happens to be a percussionist) were interviewed. Each consultant was shown a videotape and a live demonstration of contemporary marimba literature and then asked a series of questions dealing with warm-up and injury prevention. The goal of the interviews was to gain insight into each individual's thoughts regarding appropriate warm-up procedure for four-mallet marimba performance.

Conclusions

The main conclusion to be drawn from this study is that there is no one right way to warm-up prior to performance; however, the benefits of adhering to some sort of warm-up routine are tremendous. Although some of the medical professionals' answers differ, they all emphasized the same fact--warming up before playing is not only smart, but essential to avoid injury. All of the consultants agree that the repetitive motions used in marimba performance can, and often do, lead to various injuries. When these

repetitive motions are coupled with long hours of practice, the chance for injury increases.

For the beginning marimbist, learning a warm-up routine is vital to the development of good life-long musical and physical health. As suggested by two of the consultants, beginners to the instrument need to spend ample time conditioning and strengthening the muscles used in marimba performance. These areas include the lower back, upper back, shoulders, neck, elbows, forearms, wrists, and hands. Although two consultants suggested using light hand-held weights, the primary way to strengthen these areas is through stretching and through playing the instrument. Stretching builds flexibility, increases range of motion and muscle tone, and helps prepare the body for the activity to follow. The author recommends the following specific steps when developing a personal warm-up regimen.

The Mental Warm-up

First, focus on the many aspects of the mental warm-up prior to beginning any other part of the practice or warm-up process. Before entering the practice room or performance venue, it is important to begin to focus the mind on the task at hand. Knowing the specific goals to be accomplished during the practice session, or focusing on how the performance should go, are critical aspects of the mental warm-up. With all of the daily distractions facing students and professional performers alike, it is important to filter out of all of the non-essential "noise" going on in the mind. Problems and worries should be left behind so one can focus on making music. All too often musicians spend hours in the practice room when they could have done more in less time had they

been focused on the task. Letting the mind wander to other concerns when playing not only wastes time during practice, but also can lead to less desirable results when performing.

Once the warm-up process and practice session begins, it is important to monitor one's activities constantly. This includes being aware of the slightest variances in the normal routine. Slight feelings of awkwardness, discomfort, or days when things just don't seem to be going right, may be signs of a bigger problem on the horizon: injury. These feelings can be the body's way of telling the player that things are not going well and an injury could be on the way. Paying specific attention to any pain is crucial. Pain must not be ignored, as it is usually the final signal before injury occurs. Knowing the body and being aware of how much one can handle in a given practice session is important. This awareness comes from keen mental concentration and careful attention to aspects other than notes and rhythms.

Stretching

Before beginning the physical activities involved with warming up, the body must be physically alerted that something is about to happen. Initially, this can be accomplished by slowly increasing physical activity to start blood flowing to the extremities and elevating the heart rate. Walking, jogging, or other moderate physical activity can help in this process. Once the heart rate has increased and the body is alert, stretching the muscles to be used during the activity is vital. Stretching was strongly recommended by all of the consultants interviewed. Workman suggested moving the specific areas and muscles that will be used during performance, and then slowly

increasing the speed and types of movements so the body is not alarmed when playing begins (Workman 2002 Interview). Preparing the areas and muscles through stretching is considered by all of the consultants, and the author, to be one of the best ways to help avoid injury. As previously mentioned, the main areas used in marimba performance include the lower back, upper back, shoulders, neck, elbows, forearms, wrists, and hands.

In preparing the back for practice or performance, the author recommends executing a series of stretches to prepare this critical area. A chiropractor recommended the following series of stretches to the author who was seeking treatment for back pain. If the back is not properly strengthened and stretched prior to performance, pain can occur. Back pain is a common problem for percussionists and can impede the music making process. With all streches, it is important to go slowly, remembering to stretch the muscles and not to tear them. The author recommends starting with a low number of repetitions of each stretch and gradually building up the repetitions to help strengthen the muscles.

To stretch the lower back, one should lie supine (on one's back), bend the knees so the feet are flat on the floor, and slowly pull one knee up to the chest and then return to the floor. Repeat the procedure with the other knee and then with both knees together. These stretches will aid in stretching the lower back. Another series of stretches for the lower back include twisting the torso slightly to stretch the muscles in a different way. One should lie supine on the floor and bend one knee slightly up in the air. Using the opposite hand, gradually pull the knee across the body and towards the floor on the opposite side. Repeat the process with the other knee and opposite hand to rotate in the other direction.

Another group of recommended stretches helps strengthen the abdominal muscles as well as the back muscles. Strong muscles in the abdominal area of the torso are just as important in building good posture and back strength as the previously mentioned stretches. One should lie supine on the floor; bend the knees so the feet are flat on the floor, and practice flattening out the entire back onto the floor. Flattening out the natural curve of the back by pushing the pelvis forward works both the abdominal and back muscles. Executing sit-ups or crunches (similar to a sit-ups but only lifting the head and shoulders slightly off the ground) will also help strengthen the abdominal muscles, thus aiding the back muscles in developing good posture. Another stretch that will have similar results is accomplished by standing with one's back flat to a wall. With the feet slightly apart and away from the wall and knees flexed, use the legs to slowly move the entire upper body up and down the wall. This exercise not only stretches the back and abdominal muscles, but aids in strengthening the quadriceps muscles in the legs.

A final group of stretches to aid with both the lower, mid, and upper back is executed sitting on the floor. Completely extend one leg to the side, bend the other leg slightly and allow it to rest comfortably on the floor, then slowly bend the torso over and straighten the arms as both hands move down the straightened leg towards the foot. Then repeat with the other leg. This stretches all of the parts of the back and the shoulders. The last stretch executed while sitting begins with the soles of the feet together and the knees bent out to the side. Slowly bend over moving the head towards the feet. In order to keep the proper hip and spine alignment, try to keep the back as straight as possible when performing this stretch.

Executing a group of stretches to strengthen the upper back, shoulders, and neck is also helpful when preparing for marimba performance. All of the following stretches are performed standing up. The first exercise stretches the shoulders and chest muscles. Start with the arms in front of the chest, bent at the elbow, and positioned parallel with the floor. Pull the arms (from the elbow) back and outwards until the elbows are next to the body's sides then move back inward until the arms cross in front of the chest and repeat. Another upper-back stretch begins with the arms resting naturally at the sides. Rotate the palms outward and raise the arms until the hands touch, palms together, over the head. Return to resting position with the arms at the sides. A similar stretch begins with the arms at the sides, palms facing back. The arms are raised in front of the torso until they are straight above the shoulders and then returned to the sides. Do not bend the elbows as these stretches are executed.

A description of two other stretches that work the shoulders and upper back follows. The first begins with one hand placed behind the head (palm touching) and the other hand in the small of the back (back of the hand touching the back). Then the hands switch positions and repeat. A final upper-back stretch also works the shoulders and neck. Begin with the arms extended straight out to the side and parallel with the floor; then, rotate the arms forward making small circles. While keeping the arms straight, gradually make the circles larger until a full rotation is reached. Then reverse the direction of the circles gradually making them smaller.

As mentioned in chapter four, Alfier recommended a posterior shoulder stretch, which is executed by gently pulling the elbow across the chest (Alfier 2002). Rubin suggested holding a broomstick or yardstick in both hands (shoulder width apart) and

raising it up over one's head, then slowly moving the stick from one side to the other. He also recommended a stretch called "walking the wall" to help stretch the four rotator cuff muscles in the shoulders. Using one arm at a time: first, face the wall and walk up the wall with one's fingers until the arm is fully extended. Second, stand next to the wall and repeat the same "walking" motion (Rubin 2002). The author has used this stretch in conjunction with those mentioned previously with good success.

Stretching the arms, wrists, and hands is equally as important as stretching the back. The author strongly recommends beginning this part of the stretching process with warm hands. If coming inside on a cold day, the hands will be cold. Even if a slow jog or walking has been executed, the hands could still be cold. Rubbing the hands together under running warm water is a good way to heat the hands before beginning this portion of the stretching process. Once the hands feel warm to the touch, begin rolling the wrists slowly from side to side while also in a rotating motion to begin the stretching process in these areas. These and other similar movements help stimulate the flow of blood to the arms, wrists, hands, and fingers, preparing them for practice or performance.

A good general arm/wrist stretch Workman recommended was holding a stick or mallet in one hand and rotating it from left to right to help loosen the muscles. This motion is similar to turning a doorknob or screwdriver. The author also recommends doing this without the sticks or mallets in the hand. In addition, Workman also suggests playing in the air to get the wrists moving and general motion going (Workman 2002 Interview). Executing these stretches before (and during) performance will aid in preparing the muscles for the activity and also stretch them out during practice.

Alfier and Rubin both emphasized the importance of stretching the wrist extensor muscles. Alfier suggested accomplishing this by pulling the hand downward (after starting in a palm-down position) and to the outside of the body (Alfier 2002). The author suggests placing the forearms on the thighs and moving the wrists up and down to work the wrist extensors. Rubin mentioned executing the same motion but adding light hand-held weights to further develop and stretch the muscles (Rubin 2002).

Alfier recommended a thumb stretch using abduction and stretching the median nerve. This stretch would begin by rotating the hand outward from palm-down to palm-up and then gently abducting the thumb outward to glide the median nerve through the carpal tunnel (Alfier 2002). Due to the role of the fingers in holding two mallets in one hand, Rubin felt strongly about the importance of building up strength in the fingers. He suggested squeezing silly putty or a similar substance repeatedly to strengthen the fingers (Rubin 2002). The author also recommends working the fingers during the stretching process. Holding the thumb and index finger together and moving all of the other fingers in a "waving" motion or to repeatedly touching one finger at a time to the thumb will help strengthen and stretch the finger muscles.

The author also recommends trying to remain physically warm during the stretching process and throughout the practice session or performance. If playing in a cold room, it is important to keep the arms warm by wearing a long sleeved shirt or light jacket. The colder the arms get, the less blood flows through the muscles and the more difficult it is to get, or stay, warmed up. Analogous to the baseball pitcher, who regardless of the temperature outside, puts on a jacket in between innings, the percussionist should strive to keep the muscles warmed up and limber.

There is no one correct way to stretch each of the areas used during marimba performance. Many different methods and stretches exist that all have the same goal in mind, limbering the areas/muscles used. The important point is to incorporate some type of stretching process before one begins playing at the instrument. This will better prepare the body for the activity to follow and will also aid in preventing injuries.

Warm-up At The Instrument

Thus far all the preparation for practice/performance has taken place away from the instrument. Once the blood is flowing and a thorough stretching routine has been executed, warming up at the instrument may proceed. The author recommends initially the slow execution of the various types of strokes and motions used in four-mallet marimba performance. Referencing a text such as *Method of Movement for Marimba* by Leigh Howard Stevens would be invaluable to this process. Included in this text is an extensive discussion of the strokes and motions used while playing the marimba together with many exercises to aid in technical development (Stevens 1993). The author recommends spending a great deal of time executing the two most commonly used motions in marimba performance, the double vertical (up-and-down) and the single independent/single alternating strokes (side-to-side). Once each of these strokes has been isolated and worked on, starting to combine them together in various ways is the next logical step. Other stroke types that can then be executed include the double lateral and triple lateral strokes, followed by the independent roll. It is important to work on each of these stroke types using different pitch intervals to ensure the muscles are properly stretched and prepared for the performance of contemporary literature.

The author also suggests stretching the muscles in different ways during the warm-up process both by playing exercises with two mallets, and also on different instruments, like the snare drum. The muscles and the motions used while playing with two mallets and while playing snare drum are very similar. However, playing on a snare drum (or practice pad) allows the performer to use the natural rebound of the drum in his/her stroke. Taking a break from executing various four-mallet techniques and working with two mallets or sticks helps to stretch the muscles in different ways and increases the usefulness of the warm-up process. Slowly executing a series of four-mallet and two-mallet technical exercises will aid the marimbist by not only continuing the stretching process, but also by building muscle tone, technical prowess, and learning certain motions needed to perform today's contemporary marimba literature.

In his interview, Chesky mentioned the importance of using a set of exercises to help get everything warmed up and working (Chesky 2002). Rubin recommended "Playing very light pieces at a very modest tempo" (Rubin 2002). During this part of the warm-up, he also stressed "Not playing something that's intellectually, emotionally, or physically complex" (Ibid.). Workman felt that executing a slow warm-up that did not tax the brain was very important. After getting the heart rate up and hands in motion, he suggested slowly working phrases, transitions, tempo changes, and meter changes found in the piece to be performed. This will help the brain key into these areas during performance (Workman 2002 Interview). The strategy of starting slowly with technical exercises, easier pieces, and certain passages found in the music will be very helpful in the warm-up process.

The total amount of time needed for the warm-up process differs from person to person. Variables such as the level of ability or experience, strength, personal needs and goals, and the repertoire being studied can increase or decrease the amount of time devoted to the warm-up process. One consultant stressed that the amount of warm-up was relative to the amount of time that was going to be spent playing. The author also believes the intensity of the performance medium (solo playing versus performing with a large ensemble where louder dynamics are required) and literature should be considered when deciding the proper length of time to spend in warming up. The one fact that stays constant is that warm-up can help the performer in many ways. Younger performers and students often disregard the warm-up process or rationalize not warming up by using the excuse "I don't have enough time". While it is true that all musicians are eager to begin making music the minute they enter the practice room, spending time preparing the body through warm-up will ultimately save time in the future. Time will be saved through improved technique and quicker learning, but most importantly by preventing injuries.

Taking Breaks

After completing the warm-up process and beginning practice, it is important to occasionally rest the muscles. All of the consultants and the author agree that taking breaks is very important to maintaining good health. Although each consultant had a slightly different idea of when to take breaks, the author has incorporated their opinions with his own to suggest no more than fifty minutes of playing followed by a ten-minute break. Playing for forty-five or fifty minutes then leaving the room for a break not only rests the muscles but gives the mind an opportunity to relax for a brief period of time.

This also aids in the processing of information learned during the practice session. Depending on the intensity of the material being played, more frequent breaks may be needed, even if only for a few seconds or minutes.

It is important to note that this break routine only applies if the performer is in good health. If recovering from an injury, taking more frequent breaks will be necessary. Workman states, "If somebody is injured I definitely encourage them to do five practices at half an hour rather than a two-and-a-half hour stint" (Workman 2002 Interview). The author strongly agrees with Chesky's comments regarding taking breaks: "It should be a very individualized concept. You should be aware of changes in the body. The body is extremely versatile and able to tell us when things are going wrong. That's probably the best way to tell when you need to take a break" (Chesky 2002).

Cool Down

Perhaps the only process more neglected by musicians than warm-up is the cool down process. Three of the four consultants strongly recommended a cool down period after the practice session or performance. The actual components of this cool down can vary greatly, but it should include a gradual slowing of the strokes and motions used during practice. It also could include some totally different strokes and motions, working the muscles in new and different ways. The cool down enables the muscles to wind down, the heart rate to decrease, and the mind to slowly emerge from its heightened state of concentration. Workman referenced an expression used in horse racing, "rode hard and put up wet" (Workman 2002 Interview). This refers to the practice of not letting the horse cool down after strenuous exercise, but rather putting the animal immediately into a

stall where it cannot move. When a musician immediately sits down to rest for a long period of time following practice, it could be analogous to the horse being put up in the barn. Although he did suggest using a cool down process, Chesky did allude to the correlation between the level of activity used and the amount of cool down needed. From the marimba literature he witnessed during the presentation, he felt the cool down needed would not be as great as that needed by a basketball player for example (Chesky 2002). Slowly decreasing motion over a period of time after performance will greatly aid the body and help prevent injury.

Additional Considerations

Although not discussed with the consultants, the author believes age to be an important factor when determining the appropriate amount of warm-up. Musicians must consider the possibility that more warm-up time may be needed as the body ages, together with normal wear-and-tear of its various systems (including conditions such as osteoarthritis). Given this normally diminished ability, it is likely that the amount of warm-up time needed will increase and likely vary from performer to performer.

The author believes the subject of warm-up and injury prevention is important and relevant to all musicians and music educators, and as such should be included in as many areas of music education as possible. In addition to the private lesson and ensemble settings, strategic opportunities exist for inclusion in the curriculum of such discussion within the music techniques curricula. When future music educators study the various instrument families, they should be made aware of the possibilities for injury found in

each area. Warm-up procedures should be included in the various techniques courses to increase awareness and better inform prospective music educators.

Recommendations For Further Research

In addition to emphasizing the importance of the warm-up process, the primary conclusion drawn from this study is the distinct need for further research. As Chesky states, "We really don't know much about the biomechanical risks involved in playing the instrument" (Chesky 2002). Further research into how the body works and the exact physical requirements involved in playing the marimba is desperately needed. Additional study into the specific muscle groups used during four-mallet marimba performance, other percussion performance mediums, and other instruments can greatly add to an understanding of why warm-up is so important. More documentation and study of different warm-up procedures could also help in determining precisely what is important to a given individual's warm-up routine.

This study documents the importance of utilizing a warm-up regimen when performing four-mallet marimba techniques and literature. By interviewing consultants from the medical profession, the author has endeavored to add the substance of medical opinion to the existing advice, "always warm-up," given by many musicians and teachers. Identifying possible injuries and the subsequent problems associated with them is one way to motivate students, teachers, and professional musicians to embrace the concept of warm-up. The true benefit of utilizing a warm-up routine is simple--making better music. Hopefully, additional research about warming up will aid musicians in achieving this ultimate goal.

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APPENDIX A

TRANSCRIPTION OF INTERVIEWS

Interview With Jane Alfier, OTR, PT, CHT

July 9, 2002

West: Describe what injuries you think could come from this sort of repetitive motion.

Ms. Alfier: deQuervain's would be my very first guess, particularly on the right. I think the prolonged gripping and pinching would contribute to flexor tendonitis or carpal tunnel syndrome, especially in the carpal tunnel. I think people would be a bit prone to lateral epicondylitis, or tennis elbow, because of the repetitive use of the wrist extensors and the banging. You might be getting into a little bit of trouble further up the neck, just because of the position you're hold your arms in, a slightly abducted position, for such a long time, and the forward head position, looking over the instrument. Those were the first ones I thought of.

West: Just for my clarification--the first one you thought of was deQuervain's? Is that a type of tendonitis?

Ms. Alfier: It is a type of tendonitis that occurs in the first dorsal compartment in the wrist. There are other types of tendonitis you could definitely get such as extensor tendonitis. In the second dorsal compartment, where the wrist extensors attach to the metacarpal bone, would be a place where you could be prone to tendonitis.

West: What factors do you think could contribute to these injuries?

Ms. Alfier: Well, first of all, the repetitive motion, the position, the striking, and the vibration. Those would be things that would contribute.

West: You said the position?

Ms. Alfier: Yes, the arms, the body, the whole thing. The prolonged grip, you know, the constant grip, constant pinch.

West: Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm-up)?

Ms. Alfier: Right off the bat, I would think you would definitely need some specific stretches. The wrist extensors, thumb stretch, abduction, maybe the metacarpal-carpal tunnel glide. You would start by basically taking the hand from here to here (demonstration of starting with the hand palm down and then rotating it outwards until the hand is palm up) and then abduct the thumb a little further to glide the median nerve through the carpal tunnel and through the finar eminence which is a small carpal tunnel glide. Any of the upper shoulder exercises, such as the posterior shoulder stretch (demonstration of pulling the elbow across the chest) any of those would be good. The elbow looked like it would move pretty freely. Just because of the way you hold your

arm in pronation, I would think you would want to make sure the extensors were completely stretched and limber before you started (demonstration of pulling the hand downward and to the outside of the body). So I would start with stretches. Maneuvering the hands, wrists, and forearms.

West: What interval of time do you recommend the performer spend preparing the body by warming up?

Ms. Alfier: Maybe five to ten minutes. I don't know that if there's anything written, or that I've ever read that says how much you need to warm up before you start.

West: Should any of this preparation occur away from the instrument?

Ms. Alfier: Yes.

West: After the body is warmed up and ready for performance (or practice), what are your recommendations for taking breaks to avoid injury?

Ms. Alfier: I would say no more than fifteen or twenty minutes of constant playing before you take a break. That's what I would recommend. That's what we would recommend if it were a highly repetitive manual labor.

West: Do you have a specific time interval for that break?

Ms. Alfier: I usually say at least 1-2 minutes.

West: Do you recommend a "cool down" period after performance?

Ms. Alfier: Generally, I do not.

West: Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

Ms. Alfier: I think if it were a new person--I don't know if you're talking about a new person learning or an experienced person, where the muscle tone is there. I would think for a person that was just starting, they would need to be very specific on strengthening. You can see that the intrinsic muscles of the hand seem to be very strong, so you know, that can get people in trouble if they started, you know, practice, practice, practice without strengthening those muscles first. The wrist extensors would definitely need to be much stronger. The upper shoulder and middle back, too. So I would think, for a new player, those key muscle groups that require a lot of strength and a lot of use would need to be very strong or they're going to lend themselves, particularly because they're all tendon down here except for the intrinsics, to a lot of injury if they're not.

West: Do you have any recommendations as far as this strength development? Do you recommend doing this through playing, or?

Ms. Alfier: You could, but you might need to have some sort of weight exercises. Some sort of extra thing, or even isometrics, particularly for the pinch. Isometrics means that you have a muscle contraction, but it's not moving. So if I were to hold the pinch--like this--I would be doing an isometric contraction for the finar muscles and other intrinsics in the hand versus taking a piece of putty or a gripper or something like that and moving it back and forth, back and forth. So I think specific things like that would be beneficial for a new player who could be injured.

West: What about the more advanced player?

Ms. Alfier: They are probably conditioned. You may need to look for muscles imbalances because there are parts that could be over-conditioned more so than other parts, but I would think they would be conditioned.

West: So, do you have any recommendations for someone who's been playing for a while?

Ms. Alfier: No. I would think the main recommendation would be if you look like you're starting to get tendonitis, not to work it too much. If a tendon is inflamed, you don't want to keep that repetitious movement while it's inflamed. You've got to rest it.

West: Describe what injuries you think could come from this sort of repetitive motion.

Dr. Rubin: Well, I think the injuries would be anywhere in the upper extremities. You could have injuries to the fingers, the wrists, elbows, shoulders, neck, and upper back. The finger, would be a problem because, depending on how tight you are gripping and the way you're moving, you could develop nodules because of the constant irritation. You're using the very small muscles, the intrinsic muscles of the hands, to make these fine movements. So, you could certainly develop tendon problems, flexor tendon problems, and I guess you could even have cramping in the fingers.

Extending on that, you could get what's called tenosynovitis, which is an inflammation of the tendon, sheath if, in fact, you're not warmed up. It's obvious you could get some problems in the wrist. I think you could get carpal tunnel, but I would think that would not be the major problem, because carpal tunnel is a nerve impingement usually from pressure on the nerve. What people might complain of more, I believe, would be what's called deQuervain's tenosynovitis, inflammation of the extensor tendon right across the thumb, because they are doing this motion (demonstrating the wrists moving up and down in a thumbs-up position), and that's going to cause pain. There are two tendons across here, one goes right down the thumb, and you can usually make it worse by putting your thumb in and pulling it like that, causing severe pain right here. They'll say

it's the wrist, but it's actually the extensor tendon. I would say that, of all the areas in the arm it would be the elbow that would be affected most severely, because the elbow both flexes and also rotates. So, watching you over there, you're not only doing this (demonstrating movements used while playing the instrument), but you're doing this (demonstrating rotation of the entire forearm side-to-side), and that's not only coming from the wrist. The wrist is fixed. It's really the elbow. So I would say there would be tendonitis of the elbow developing. Out here it's the lateral epicondyle. So, usually, when you do this type of motion, it's called tennis elbow, bending the elbow here (demonstrating). This is golfer's elbow, from this motion (demonstrating). This could be easily treated. You could actually develop arthritis of the elbow simply because you're constantly rotating it. This is not a real normal motion to be doing repetitively.

The shoulders could be a problem. This looks like a standard height. I don't know if people stand on platforms, if they have to compensate, or if it's one size fits all. So, depending on how much you have to use force you're going to develop tendonitis or problems in the shoulders. The most common problems I see with people are the neck and upper back because you're standing all the time, and you're not moving that much.

You want good posture, but you're focusing on your hands and the sound and not paying any attention to whether you're standing crooked or not, if your neck is tilted, or whatever. I can see people bending over more, causing more upper back problems, and so I would think people would complain of pain between their shoulder blades and maybe in their neck.

West: What factors do you think could contribute to these injuries?

Dr. Rubin: Well, I think what would happen would be bad technique and not modifying the work environment to fit the individual.

West: Such as instrument height?

Dr. Rubin: Yes, absolutely. And the weight of the mallet. The weight of the mallet depends on the instrument. It also depends on the person. I mean if she's playing it compared to you (pointing to a young, non- percussionist), she may not be able to get the same sound when she uses a heavier mallet, and this puts more stress on her.

West: Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm up)?

Dr. Rubin: Stretching. Stretching in general is important. I don't do that with weights or anything like that. Flexibility is important. Stretching the finger muscles, the hands, the forearms, and be sure to stretch the elbows and neck and upper back. I'm a firm believer in Pilates and Feldenkrais postural breathing and standing. Understanding where I am in relationship to my body. Where's my neck and back in relation to my arms and hands? Am I standing correctly? Do I feel comfortable? Is the instrument the

right height for me? You know, all that, I think is real critical. So, general stretching, but specifically to the arms, neck and back.

West: Do you have any specific stretches you can recommend?

Dr. Rubin: Yes, I think what's important is building up the muscles in the fingers to hold the mallets; this is something you obviously have to do. Exercises like squeezing silly putty will help with this. That would be very, very important. But for the exercises to build up the wrists and elbows, what you want is very, very light weights and to do this kind of a motion (demonstration of holding the arms parallel to the floor with the palms down and moving the wrists up and down) to build up the extensor muscles here. For shoulder range of motion, just take a broomstick or a yardstick and raise it up with both hands over your head and go from one side to another. Also do what's called "walking the wall," where you raise it and come all the way up, sort of extending it beyond what you think your limits may be to get full range of motion. In the neck and upper back it's the posture.

West: I'm just curious. When you say "walking the wall," is that facing the wall or putting your side to the wall?

Dr. Rubin: Both. Because, this way you're stretching the rotator cuff muscles, four separate muscles.

West: What interval of time do you recommend the performer spend preparing the body by warming up?

Dr. Rubin: What's the amount of time you're going to play? Are you going to play for a couple of hours?

West: With percussion, you can play for many, many hours. Normally, I personally try to practice for 45 minutes then take a break. But, I've played for two, three, four, and in some cases will play for a day, off and on with breaks.

Dr. Rubin: Right. So if you're going to play for hours I think you need to spend at least 30 or 45 minutes warming up. Then maybe cool down at the end. You have to spend the adequate amount of time. I would also recommend people play no more than 45 minutes at a time, then take a break, then go back to it.

West: Should any of this preparation occur away from the instrument?

Dr. Rubin: Oh yeah, all of it. This has nothing to do with the instrument. When it comes to warming up with any instrument, I believe in that too. When I want to warm anyone up at an instrument, it's usually playing very, very light pieces, at a very modest tempo so we are not hammering away, and not playing something that's intellectually, emotionally, or physically complex. And we do this for very brief periods of time. So it's really smoother.

West: So after the body is warmed up and ready for a performance (or practice), what are your recommendations for taking breaks to avoid injury?

Dr. Rubin: I would say no more than once every hour--don't go longer than an hour.

West: You touched on this, but do you recommend a "cool down" period after a performance?

Dr. Rubin: Yes. I think that's probably another forty-five minutes or so. I think that, again, you're monitoring yourself the entire time you're playing. Do I have a pain or an ache that I didn't have before? Do I need to address it, or just keep playing? The cool down is, now I'm playing and my muscles are tight and they are tight because you've been in the same position for X amount of time. So, what I would do is work opposing muscle groups. You know, I've been doing this all day, so now I need to stretch and do something completely different to stretch out in a completely different way. I would also stretch the low back before and after as well as the upper, because you're standing and putting more stress on the low back.

West: Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

Dr. Rubin: Mainly, I would say general conditioning. Like I said, I believe in Pilates, Feldenkrais, and the Alexander Technique. These techniques describe postural, deep breathing, and the sense of "where am I," and were developed for people who were trying to be singers but couldn't project. When they stood better and took deep breaths, they were able to project better. So I can see somebody smoking, getting tired, leaning over, OK? They are using their shoulder more than the elbow or wrist, and may not realize that when they shift their weight from one side or the other and how they are standing. So I think it's real important to have this fluid motion you probably want, but you have to be aware of where your body is and know that. I think too many people focus on the warm-up, and everything is task specific. I think it really has to do with the mind.

Interview With Kris Chesky, Ph.D.

July 29, 2002

West: Describe what injuries you think could come from this sort of repetitive motion?

Dr. Chesky: How general or specific are you with that question?

West: I'm looking into all areas. How can we prepare as far as warm up for this activity? What injuries are out there? When you see this, what do you think could happen?

Dr. Chesky: Well I don't think the injuries themselves are related just to the biomechanics of the movement. My definition of occupational injury is broader than that. But partially I think this movement could contribute to some pains and problems.

West: Could you be more specific about, not just related to music, but broader things?

Dr. Chesky: The World Health Organization's definition of occupational injury includes the biomechanical nature of the injury as a risk factor for the injury. But it also includes psychosocial factors and includes factors that could be related to changes in your body due to something else, or genetic factors. You could be predisposed to a condition based on your general size, different tolerances, and things like that. Clearly it's a broader perspective. Maybe motion like this could be the origin to something, but it

certainly develops in the context of all these other factors. The overall risk factors, like stress for instance. People that engage in repetitive motion and are stressed are, therefore, more at risk than the one who's not. Whether that changes their biomechanical variables in a performance or not is something of interest. If they have heightened anxiety while they're playing or if they play with more tension--it may be something that is observable or it may not. But it clearly could influence the onset of a problem. Pain tolerance itself or pain perception as a pain syndrome can be pretty broad. Most of overuse syndromes have a pain component. Pain, by definition, is a perception, and being a perception, has a psychological component to it. Some people can tolerate immense amounts of nociceptive or neurologic activity related to the pain and maybe register it as not being very painful or perceiving it as not being very painful but for somebody else it may be extremely painful even though it's a neurologic activity. And then the meaning of the pain has a lot to do with the total injury. I always use the example of why we use pain scales and do a pain questionnaire which helps people describe their pain using verbal descriptors to categorize in groups and then rank in terms of intensity. One of them could be the sensory aspect of the pain experience--I sense this, its lacerating, its cutting, its pinching, its burning; different pain sensations may have different meanings and intensities to different people. There is also another category of evaluating pain. You can evaluate it as annoying or troublesome.

So somebody who's playing an instrument like this may be fearful due to a prior injury. If he has a shooting pain up the forearm, he may think, "Uh oh, my tendonitis is back." That means something different to them because they think, based on prior experience of

what that means. Somebody who's playing a lot of sports uses his hands a lot. For instance, I had a shooting pain in the thumb up to the elbow from playing a lot of softball this summer. So the meaning is different because I understand what it is. I had this experience before, and it made me play not so well. Right? If you'd never had it before you wouldn't know any different. Say if someone had a pain in their side, they may think they have indigestion.

Or, if somebody has a history of cancer, or has had a tumor in their lung, the pain could be a lot less but, boy, the meaning is a lot different.

West: What factors do you think could contribute to these injuries?

Dr. Chesky: From a biomechanical standpoint, I would recognize posture, and in this case maybe your wrist posture, left or right, and certainly your upper extremity strain plays a role. That's a major risk variable. Then, the other thing is the major risk variable of repetition. So, the duration of how long you play can increase your risk of injury. The force used is another major risk factor. Any occupational injury has a biomechanical nature to it. These three risk factors are the most important. Any combination of the two or three is bound to increase the risk also. So if you're playing with your wrist extended or something like that, and playing with a lot of force, and playing for a long time you would be more at risk. Another risk factor may be your physical stature. Maybe your vocational supination strength isn't as great as somebody else's. You may be therefore

more at risk by doing some of this rolling activity. Tolerance for that kind of thing makes a difference. You may have small hands and not be as strong in the upper extremities.

West: Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm-up)?

Dr. Chesky: I would say increase the blood flow to the involved muscles. Go through the range of motions involved in this and stretching. To prepare might also include being psychologically relaxed and focused. I think to be aware of what it feels like to be relaxed and warmed up is a good end-point to keep in mind in terms of a benchmark you might strive to get to. So when you are warmed up and are playing well, and it feels real natural, what are those senses; what are those ranges of motion like; what are the overall perceptual attributes in that state of being? I don't think there's a general, standard, or specific set of things that get you there that are the same for everyone. So, for an individual, once you sort of feel like you know what that is, you'll know if you are there or not, and what it would take to get there again. It's almost like using the existing knowledge drawn from experience and using it as a feedback mechanism because you want to get back to that, and then trying different things to efficiently, quickly, and effectively get back to that state. That may be various stretching or isometric exercises perhaps.

West: What interval of time do you recommend the performer spend preparing the body by warming up?

Dr. Chesky: From my point of view, I would ask someone to individualize the necessity. Everybody is going to require something different. The degree of difference is something we are not sure of– I don't think. It may take someone a good half-hour to do that, or it may take someone 10 minutes. Some people don't need it apparently. There is a famous trombone player who says he doesn't warm up at all. He just vibrates his lips a little bit before he plays. This is just contrary to what everybody else says to do, but this guy plays all the time and is an extremely versatile musician who's highly successful. So, who's to say?

West: Should any of this preparation occur away from the instrument?

Dr. Chesky: Should it? It can. It may be effective for some people to do it away from the instrument and may be effective for some to do it with the instrument. For the shoulders and the elbows and wrists, these kinds of movements are mimicked, both in terms of stretching and also just getting the muscles involved, are doable without the instrument. They are doable with the instrument also. There could be a set of musical exercises to help warm up, and in fact there are, right? Maybe not specifically designed for that goal, but certainly to get everything warmed up and working.

West: After the body is warmed up and ready for performance (or practice), what are your recommendations for taking breaks to avoid injury?

Dr. Chesky: The recommendation I have, based on my knowledge and literature, is that there is no set time-frame which is generalized for all conditions or for this instrument or any instrument. It should be a very individualized concept. You should be aware of changes in the body. The body's is extremely versatile and able to tell us when things are going wrong. That's probably the best way to tell when you need to take a break. The perceptual ability gives a sense of what to do. Like the trombone player again, I often play beyond what I should be playing, and my lips are definitely telling me I should stop. Whether I can stop is another issue. There are a lot of times when the musical performance doesn't allow me to stop, so I don't do that kind of gig. I don't play that piece. So, I'm sure your'e familiar with that kind of thing. You get out there and do a recital or a performance, and you don't have the luxury of stopping. In terms of getting ready for some extended performance like that, a person should consider practicing the full length of the performance to find out what it takes to be able to do that without any physical symptoms that seem to be indicative of some kind of problem.

West: Do you recommend a "cool down" period after performance?

Dr. Chesky: It depends. I don't think, from my point of view, and from what I saw here and what I saw on the videotape, that that type of performance would require that much elevated physical activity which would require a cool down period. To stretch and continue moving would be good. A cool down period as if you were ending a basketball game or something like that is probably not needed. I don't think you heart rate would be that elevated. But, again, judging from what I saw you do. I'm sure there is some music

where at the end of it you are panting a little bit. It depends on the piece, depends on the person, the tolerance to be able to get through that repertoire.

West: Describe your recommendation for this cool down.

Dr. Chesky: A cool down in terms of taking a break or an intermission is different from, oh, you're done.

West: So I think we are thinking more in terms of done with the session for the day than just getting away from it for awhile.

Dr. Chesky: I think, yes, a cool down should be regarded as including all these other attributes that could pose potential risk, including state of mind, thinking about what the body is telling us. Therefore, it may be needed from the point of view of tension or if you feel a little stiff. So stretching and continued movement to a lesser degree than was involved there if your breathing and heart rate are elevated and, if so, maybe some walking or something like that, slowly, and not just sitting.

Probably more important, is the whole mental set. Where are you? Are you frustrated that your practice didn't go like you hoped it would? Maybe you made mistakes repeatedly, or were concerned for what you were preparing for. Getting your mind into a good positive attitude.

West: Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

Dr. Chesky: This is probably not the answer you're looking for, but, we really don't know much about the biomechanical risks involved in playing an instrument. Other than the perception of the performer, there may be some insight into techniques, but I don't think there's any in the literature that discusses this. So we are just looking. Because of that limited insight, I'd say that, yeah, we could probably speculate that some things are worthwhile. But the greater need is perhaps investigation into the true biomechanical dynamics involved and the true physical requirements involved. What are the ranges of motion involved in this? How much are they influenced by the physical stature of the person? Some people have smaller arms or legs, different hand sizes, and are going to be taxed differently. And do those physical features or those differences require different types of warm-ups or cool downs? We need that information, but we don't have it. So, it's all speculative. In fact, anything I can say is speculative regarding this instrument. So, what we do need is further research.

West: Maybe this could be a kick off or starting point. The biggest thing we talk about regarding percussion is that there's little research like this out there.

Dr. Chesky: You probably are hearing some people say there are answers, and to the degree that we respect those is to the degree that we accept most advice from

professionals. And the fact is that some people do get good help, and a lot of people don't. It causes some questions to come up, and that's OK.

Interview With Darin Workman, D.C.

July 30, 2002

West: Describe what injuries you think could come from this sort of repetitive motion?

Dr. Workman: The first thing that comes to mind is the shoulders. If there is a little bit of rolling forward of the shoulders and closing up of the chest area, it contracts the peck muscles. This may be due to nervousness or intensity. When the pecks contract, they bring the shoulders around. If you are playing like this, it is going to affect your breathing because your lungs can't fully expand. But most importantly, it's going to tighten everything up in the upper areas. So your sitting like a tightened ball up in the chest area and then you force all the movement to come from the elbow down because the shoulders and upper areas aren't moving. A lot of time when you bring the tension out, you will get a lot more natural movement with the shoulders and that helps.

The other thing is there is a rotation (with single strokes especially). There are two actions of the wrist, flexion and extension. In repetitive motion of wrist flexion, these muscles pull on the bottom (demonstrating), and those on top are relaxed. In extension, the top muscles contract. If they don't relax, then this fatigues the muscles. In flexion/extension, you have a big bulk of muscles for power and endurance. In rotation and pronation of the wrists (demonstrating), pronation causes more fatigue. The pronator quadratus protracts in rotation, you find yourself tired and you have a stinging feeling. Contractions make the muscles work harder and the tendons pull tighter. If you fatigue it

over and over again you have tendonitis. In the up and down motion, you use the large muscle groups to accommodate. In terms of carpal tunnel, I found that when typing if I change the position of the wrists and put them up on the counter and using my shoulders, taking the dynamics out of the wrists, it was much more fatiguing to my hands. I can feel the carpal tunnel starting to get swollen. It's the positioning of it; it's not actually the movement. It's the position of the wrists more, I believe, and that is what the research has shown. In terms of marimba, the height of the instrument is what makes the difference. I think one of the best things that has happened is the adjustable height frame. A high instrument is generally not the problem for most people. When playing the marimba with your hands lower and keeping your arms straight, you make the tendons go around that corner and rub, causing friction and swelling. More selling causes more friction because it tightens up the tunnel.

West: What about tennis elbow? Do you see this a lot?

Dr. Workman: Not really. What I usually see is the precursors to tennis elbow, which is the tightening of the muscles of the forearm. That's a problem with the extension muscles. When a tendon starts to pull (demonstrating flexion/extension of the elbow), you get tennis elbow. I'm treating one now--a true tennis elbow that comes from a backhand. Usually I'll get the precursors to that where they don't put enough pressure to cause the tendonitis part of it, but they put enough pressure to actually cause a muscle problem.

West: What factors do you think could contribute to these injuries?

Dr. Workman: We talked about the upper body. That's going to be tension and the fact that you are leaning over the instrument and that's going to affect the lower back. But a lot of times people have told me that leaning over the instrument with the upper body also causes more pain in the shoulders than it does in the lower back. Now from the shoulders down, the main problems are going to be with the wrist and hand. We talked about carpal tunnel, its an overuse or misuse syndrome. They call it an overuse syndrome, but I think the body is meant to be used. It's like running. People say you shouldn't do it because that's too many steps for one day. Well that's not true if your running correctly and efficiently people can run for long periods of time. But if you do it right you can also get hurt. Also the grip and the spreading and contracting of the fingers can also be a problem. I really don't see many thumb problems with marimba players--that usually is with the drum players.

West: Before executing these repetitive motions, what do you think the performer should do to prepare the muscles for the given activity (warm-up)?

Dr. Workman: The body needs to somehow be forewarned and get geared up before going through the repetitive motion. In doing that, the body gets the blood flowing and can work more efficiently. The second thing would be to get some movement of that area happening. So first general body warming up like walking, running, calisthenics, to get the heart rate up and get the blood flowing to the extremities. This is good since as

percussionists we use all of our extremities. Once the blood is flowing to all of the areas, you want to start moving the specific areas and muscles you will be using. After that, start increasing the speed and the types of movements you'll be doing, so it's no surprise to the body because it's already gone through them. You've already rehearsed.

West: What interval of time do you recommend the performer spend preparing the body by warming up?

Dr. Workman: There are two preparations. One is the preparation to get to the concert or performance. So how much time do you need to learn and prepare for this piece – to be mentally and emotionally ready. The second part is how much time do you need to warm up on that specific day. It's not a time sort of thing. A warm-up has to do with the actual sequence of events and knowing it's actually happening. When you warm up, the first thing you want to do is get the blood flowing. If I warm up in the mornings, it's going to be a longer process than later in the day. Later on, I've been typing, walking, getting the blood flowing. In the morning I've got to prepare the brain to get everything moving. At night, if I'm going to perform, I usually start warming up an hour before. So I address the instrument and make sure everything is set up properly; chat with everyone; do some swinging of the sticks and mallets just to get the hands kind of warm.

West: Just so I am clear, does this hour include the walking or jogging to get the body going?

Dr. Workman: Yes that is when I start that. You walk or jog just until you feel a warmth but you don't sweat. Warm up until you can feel a slight clamminess on the skin but there is no drips or beads of perspiration; there is a warmth under the skin. Then you start doing general movement of the hands or feet depending on what instrument you are going to be playing. But just general slow movements just to get the brain to wake up and to see here are the movements that are going to be happening and this is what's going on. As the brain wakes up to that, then you start gradually to increase speed. This is not just to develop speed it is for coordination. You want to be sure the strokes are equal, and the bounces are right, the to see if the hands feel comfortable doing it. And if they don't, just continue those movements until the hands feel like it's not a problem. Then speed up and slow down until your hands are comfortable with it and get the speed well beyond where you are going to be playing in the performance. After that happens and your feeling comfortable and not feeling like you are binding up--if you are binding up then you are going too fast. You are trying to warm up too fast. Then you want to do some phrases, some transitions where you know you will be changing tempos or time signatures, so the brain can catch onto that and the movements become natural to you. They should always be natural. You are trying to bring it back to the surface, you have already practiced it so you are just trying to refresh the brain as to what's going on. The longer you have practice the less time it's going to take you on that section. Those movements and phrases will go along probably a little quicker than you usually do in the piece until they are comfortable. So when you play the piece your brain is keyed in; its been playing it physically faster so that when you do play it will feel like its in slow motion. And the piece will feel easy which builds the confidence, which gives you the

dynamics and you can actually get into the piece now. That's the warm-up process. One of the most important things that I do before the end is fifteen minutes before a performance I won't touch my instrument. I go for a walk or chat. It's to clear the brain. If you don't allow the brain to clear, you're still concentrating. You need to give it a chance to file it all away. So for the last15 minutes, I'll do something different, just to keep my mind off of what I'm doing. For some reason that clears my mind. Then when I go out on stage, I'm not preoccupied with still trying to organize the piece. Its had fifteen minutes of rest.

West: Should any of this preparation occur away from the instrument?

Dr. Workman: A lot of people say preparing for a performance involves mental, emotional and physical preparations prior to the performance. Mentally go through the performance; situate it in your mind in sections. Organize it so that when you do approach the instrument, everything is in a nice, blocked fashion, i.e., this section has so many measures; this section has so many measures...you get into the dynamics and the flow of it. You then transition into the second cubicle, then the third cubicle. That's all mental.

As far as the physical, after calisthenics there are a lot of things you can do, most of the warm-up exercises are best done in my opinion on the instrument you going to be playing. Because there is a mind-muscle memory thing where you have to have the distance right and the rebound correct and the weight of the sticks or mallets proper. So

your body must get accustomed to the environment, and it can't do that on a pillow or somewhere else; you really have to do that on the instrument to be most effective.

West: After the body is warmed up and ready for performance (or practice), what are your recommendations for taking breaks to avoid injury?

Dr. Workman: It's an endurance type of thing because you obviously can't take a break during a performance. So you want to build your endurance so you can go beyond the performance length of time. That's a given. During a practice session, I feel its more effective to take a number of practices during the day that are shorter rather than take one long one, because you do fatigue emotionally as well as physically. You don't want to push yourself into frustration. And that's what going to happen and you don't play well. We all have been there--been in the practice room when the walls get smaller, the room gets littler, and the roof comes in. It's a difficulty situation. Now if somebody is injured I definitely encourage them to do five practices at half an hour rather than a two and half hour stint; because it's really hard on the body. So five half hour practices during the day is a little easier and it keeps them emotionally feeling like they are still practicing towards being able to play the piece better or well. So if you are playing well, I would encourage a one hour session with a ten minute break each hour. There is a reason that classes are fifty minutes with a ten minute break. The reason they say to take breaks in school is because the brain can't handle it. I consider that good advice that schooling has taught us.

West: Do you recommend a "cool down" period after a performance?

Dr. Workman: When you take horse out to run, there's an expression, "rode hard and put up wet". That means you take a horse out to run and then you put it right into the barn where it sits in a little stall and can't run or jog or anything. It's really hard on the muscles to do that. You have exerted the muscles, and blood is pumping freely through to get as much nutrition as possible when all of a sudden the muscles stop, and everything backs up. You get the flow of blood in there, you get swelling, and you get lactic acid build up where you have not flushed the lactic acid or the exhausted byproducts of muscle use. So instead of stopping, you slow down. You let it kind of flow out. It's the same thing in music as in athletics. They have a warm down or a cool down. And that consists of say you run a cross-country meet running four and a half minutes a mile and you finish a three-mile race rather than sit, you walk. And then when you do your cool down, within fifteen minutes of finishing your race after you have caught your breath you go and cool down. You jog and then you do spurts of speed that are as fast as you went in the race for about five or ten seconds. And then you slow down your jog a little more. Then you do another burst of five or ten seconds just a little slower than the first one. And what your doing is flushing out the muscles. Gradually flushing out the lactic acid and the byproducts of muscle use. In percussion we do the same thing. Once you play the piece that is really taxing, you really don't want to put your hands in your pockets and just sit. Because there is still blood pumping; when you finish a piece your heart rate doesn't go back down to sixty, it continues to decrease with time--and you should do the

same. Your actual physical action and motion should continue to decrease over about half an hour.

West: Are there any other recommendations you have that would be helpful to marimbists regarding their warm-up prior to playing these types of strokes and/or literature?

Dr. Workman: A couple of things that I have heard--that don't have to do with the marimba--but when you have mallets there have been a number of people and patients that have told me that this does work; I have used it, but I've never really done any research. They have told me that if you will just do this kind of thing with rotation (demonstration of holding a stick in your hand and rotating it side to side like turning a door knob) that it loosens up the muscles and I can see how it does. That may be something that we didn't mention yet that may be of some merit to discuss. Or just playing in the air, just to get the movement and motion in the wrists. Let them flow.

West: What about occurring/recurring injury?

Dr. Workman: If you don't deal with an injury, each time it comes back you have to deal with the problems it causes as a recurring injury. If it keeps recurring, you haven't solved the technical problem that caused it in the first place.

West: What about healing as you play.

Dr. Workman: Number one is that you don't have to stop playing. The majority of people don't actually have to stop playing. You can put the hours in every single day. The other thing is that, when you recover, one thing that's important is that you can rehabilitate an injury by playing and using that part of the body. When you recover, you should continue playing the marimba; otherwise, when you get back on the marimba, you haven't recovered from the original injury. During the recovery process, it's very important to perform the activity that caused the injury in the first place. It helps build stamina and endurance. As far as stopping, it can have a negative effect on taking it to a certain level. If you drop the level down; say you have ten levels, you don't have to go down to level zero just because you're injured. Drop maybe to four and one-half, then play. Allow yourself to recuperate. You don't have to stop completely, just take it down to a level you're comfortable with while you recover.

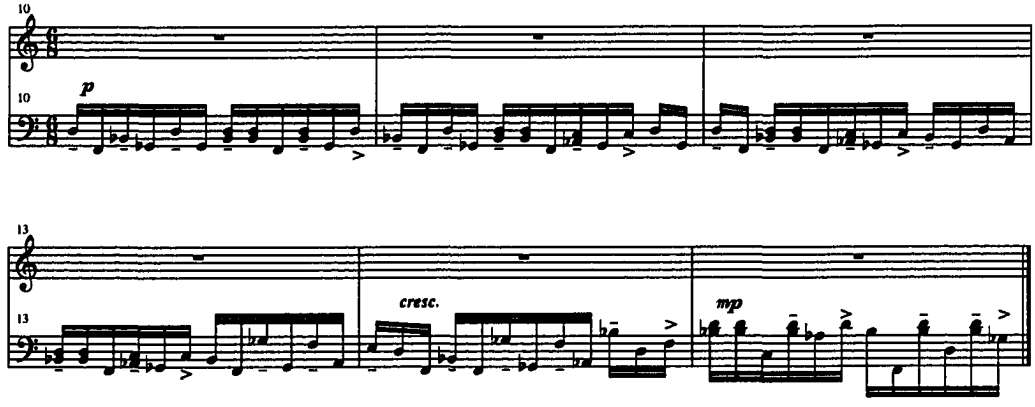
APPENDIX B

EXCERPTS OF MUSIC PERFORMED FOR CONSULTANTS

The following excerpts demonstrate the double vertical, single independent, and single alternating strokes discussed in chapter one.

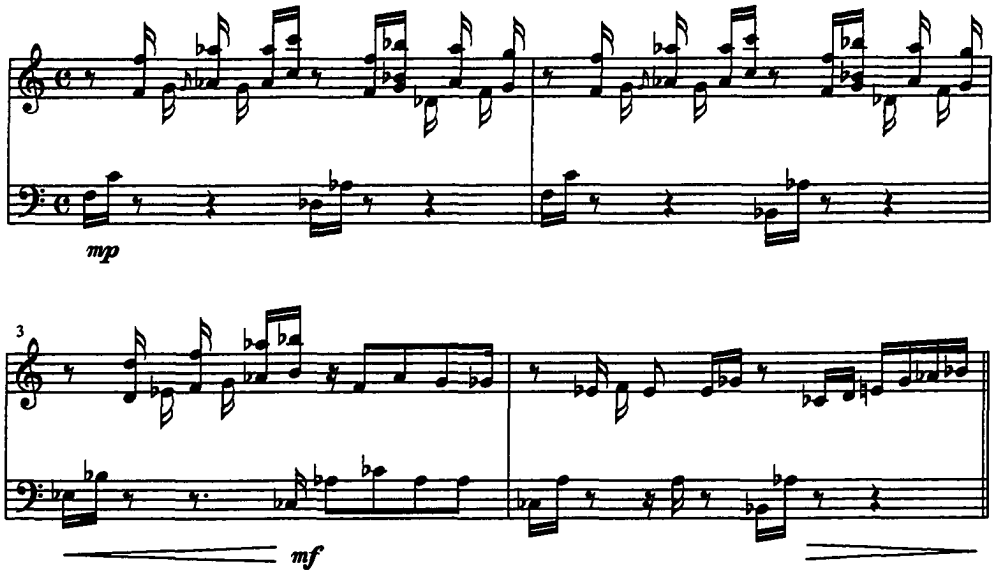
Merlin by Andrew Thomas

II. Times Way



Four Rotations Pour Marimba by Eric Sammut

Rotation IV



APPENDIX C

PERMISSION TO USE PHOTOGRAPHS LETTER

To: Leigh Howard Stevens
From: Brian A. West
Date: 4/14/2003
Subject: Permission to use photographs

Leigh,

I would like to request permission to use some photographs from your book *Method of Movement for Marimba* in my doctoral document entitled "Medical Opinions Regarding Warm-up Procedures For Four-mallet Marimba Performance." Specifically, I would like to use photographs from pages 11, 28 and 34. I would also like permission to add some white, double-headed arrows to indicate the motion going up and down on page 34 (showing the double vertical strokes) similar to those found on page 28.

As you requested, the following will be printed with the photos, "used with permission of Leigh Howard Stevens from his *Method of Movement for Marimba* copyright 1979."

Please indicate your willingness to give permission to use the photographs listed above by signing below and returning to:

Brian A. West
4816 Rincon Way
Fort Worth, Texas
76137

Leigh Howard Stevens

Date 4/16/3

Your consideration to this request is appreciated,

Brian A. West