FOCAL DYSTONIA IN PIANISTS:

THE ROLE OF MUSICAL INSTITUTIONS

BY

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A dissertation submitted to the Graduate Faculty in Music in partial fulfillment of the requirements for the degree of Doctor of Musical Arts, The City University of New York

2011

This manuscript has been read and accepted for the

Graduate Faculty in Music in satisfaction of the

dissertation requirement for the degree of Doctor of Musical Arts.

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Abstract

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This dissertation examines the role of musical institutions in the prevention and possible cure for focal dystonia through the possible collaboration between the medical, pedagogical, and performance professions. The first chapter will outline the medical profession's role in musicians' health, including the diagnosis and current treatment of focal dystonia. The second chapter outlines the pedagogical profession's role in the prevention of focal dystonia and includes an analysis of several pedagogical retraining programs seen through the eyes of the medical, pedagogical and performance professions. The final chapter covers the performance profession's role in focal dystonia, and includes interviews with the celebrated pianists Gary Graffman and Leon Fleisher.

Acknowledgements

I first heard the term “focal dystonia” at the World Piano Pedagogy Conference in Las Vegas, 2004, where Leon Fleisher was the keynote speaker. Dr. Eckart Altenmüller and Dr. Hans Christian Jabusch were also featured speakers that year, and I found their descriptions of focal dystonia to be both intriguing and horrifying. I left the conference wanting to write about the condition, but wasn’t sure how to frame it. A few years later, I stumbled on an article written by the late CUNY professor Robert Alford and his assistant Andras Szanto, entitled “Orpheus Wounded: The Experience of Pain in the Professional Worlds of Piano” which subsequently gave me the impetus to write about focal dystonia; by describing it through the eyes of their aforementioned worlds (the medical, pedagogical and professional), I was able to comprehend the subject. I am indebted to them for providing the inspiration for this dissertation.

I am grateful to the DAAD for their generous dissertation grant which covered my living and travel expenses to Germany; the grant gave me an opportunity to visit the Institute for Music Physiology and Music Medicine in Hanover and observe first-hand the work of Dr. Altenmüller and Dr. Jabusch; I was also able to visit Laurent Boullet in Berlin, which was a large part of this dissertation. The interviews would not be possible without the instrumental work of Robert Perlstein, LLQ, who convinced Leon Fleisher to accept yet another interview, which subsequently led to my interview with Gary Graffman. Their words have meant much more beyond the confines of this dissertation.

I wish to thank my advisor, Sylvia Kahan, for her thoroughness and expertise in seeing this project to completion. I thank my readers Joe Straus, Norman Carey, Ilya Itin

and Alice Brandfonbrener for their feedback and encouragement, and the entire department for their open-mindedness in allowing me to take on this topic. I thank my countless family and friends for their patience during this process – they were there when things were difficult, and celebrated when things were great. And with great appreciation to my first teacher, my late Uncle Mann, who said, “Always finish what you start.”

None of this would have been possible without the love and support of my husband, Bernhard: every accomplishment of mine is equally his.

In memory of cousin Dennet Kuan

(May 23, 1956 – December 10, 2009)

CONTENTS

INTRODUCTION

Institution: the structure or mechanism of social order and cooperation governing the behavior of a set of individuals, within a given human collectivity. They are defined with a social purpose and permanence, transcending individual human lives and intentions, and with the making and enforcing of rules governing cooperative human behavior.[1]

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Focal dystonia in musicians is a task-specific, painless movement disorder, which appears as incoordination or loss of voluntary motor control, and is perceived while the musician is playing. It is highly disabling, and for some musicians, it may mean the end of their careers. There is still no known cause or cure. Because the origin of the condition is probably multifaceted, it is also difficult to treat.

The condition can manifest itself in virtually any instrument: in pianists, focal dystonia could manifest in the curling of the fingers; in string players and guitarists, it also manifests in the hand requiring the finest motor control; in brass and woodwind players, it manifests itself in the hands or in the embouchure. Focal dystonia is most prevalent in pianists and guitarists, and occurs usually in the dominant hand.

Doctors have found the pathophysiology of focal dystonia to be unclear. There is growing evidence for abnormal cortical processing of sensory information, as well as degraded representation of the motor function in musicians with focal dystonia – doctors

[1] Stanford Encyclopedia of Philosophy: <http://plato.stanford.edu/entries/social-institutions> [accessed June 25, 2010]

have found that dystonia could be acquired simply from practicing. Furthermore, other triggering factors include physical disorders resulting from pain (trauma, nerve entrapment or overuse injury) as well as psychological conditions such as perfectionism and anxiety. A genetic pre-disposition has also been found among some with focal dystonia.

A musical institution is responsible not only for developing and informing young musicians; it also is for serving the community at large by establishing criteria and standards within the music world. It has the power to bring together the medical, pedagogical and performance professions to find preventative solutions as well as a possible cure for focal dystonia. Its potential for collectivity could promote a healthier environment for music and musicians in which to flourish.

The first chapter of this dissertation gives an overview of the role of the medical profession in developing the field of music medicine; because focal dystonia is considered a relatively new diagnosis, the chapter also describes current ways of diagnosis by the most respected physicians in the field, as well as the current available treatments. The second chapter discusses the role of pedagogy in a musician's health, and includes a description and analysis of retraining methods designed by the medical profession, the pedagogical profession, and testimonies of two professional pianists. The final chapter discusses the role of the performance profession itself, and includes interviews with the celebrated pianists Gary Graffman and Leon Fleisher.

CHAPTER ONE

The Medical Profession

The medical profession is responsible for diagnosing, treating and researching focal dystonia. However, medical professionals do not dictate how a musician learns, practices or performs. The limits of this field are clearly evident in the treatment of focal dystonia, because the disorder is both neurological and behavioral. The medical profession needs the collaboration of the pedagogical and performance professions to create a holistic approach, one that is inclusive of all facets of a musician's life, in the understanding, treating and possibly curing of focal dystonia.

I. The Role of the Medical Profession in Focal Dystonia

Unlike the pedagogical and performance professions, the medical profession usually plays a role after pain has already appeared.[2] Most general doctors, uninformed of the specific needs of musicians, may make wrong diagnoses and prescribe ineffective treatments. Gary Graffman expresses his frustration with doctors in an article published in 1986, complaining that doctors are "trained not to listen."[3] It is only recently that a new area of expertise has come to exist, that of music medicine or performing arts medicine. Doctors who wanted to use their expertise to treat pianists and other musicians initiated this specialty. However, at the time of writing this dissertation, only a few medical schools offer a performing arts medicine specialty.

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[2] Robert and Andras Szanto Alford, "Orpheus Wounded: The Experience of Pain in the Professional Worlds of Piano," *Theory and Society* 25, no. 1 (1996). 1-44.

[3] Gary Graffman, "Doctor, Can You Lend an Ear?," *Medical Problems of Performing Artists* 1, no. 1 (1986).

According to Alford, the medical profession differs from the pedagogical and performance professions as it has already established legitimacy and power within its medical schools, hospitals, insurance companies, clinics and physician partnerships and solo practices.[4] The power of the profession also gives medical professionals more immediate ability to address the medical needs of the performing musicians. The establishment of performing arts medical profession could potentially lessen the stigma that prevents musicians going to medical professions for help.

Alford believes that to establish the profession, several steps are needed. First, there needs to be cognitive requirements to properly diagnose the disorders, including clearly defined vocabulary for each of the symptoms. The catalogues of treatments (rest, surgery, physical therapy, psychotherapy, drugs, etc.) need to be rationally connected to the diagnoses. Secondly, there needs to be an accumulative clinical experience that can be described in a specialized language. Research based on clinical studies must have academic and professional credibility. The organizational requirements include a minimum number of doctors potentially committed to the specialty; they must come from other established specialties in order to legitimatize the new subfield. An establishment of a visible set of institutionalized expressions of the specialty is also needed; for example, a professional association, a journal, a textbook, and research conferences. There also needs to be a course in medical schools that is recognized as specialty training, which use the textbook, and teach the catalog of treatments. Finally, the clinics need to be established where the specialty can be advertised, learned and practiced.

[4] Alford, "Orpheus Wounded," 1-44.

We can see what some of Alford promotes in the United States. The music medical professional association "Performing Arts Medicine Association" (PAMA) exists, which was founded in 1989.[5] This organization grew out of first Symposium on the Medical Problems of Musicians in Aspen, Colorado in 1983. Their scientific journal, *Medical Problems of Performing Artists*, was established in 1986. Both the symposium and the journal began under the leadership of Dr. Alice Brandfonbrener of Chicago, who was the journal's first editor-in-chief and the founding president of PAMA. She is also the co-author of the medical textbook, *A Textbook of Performing Arts Medicine* (1991), now in its second printing.

PAMA was initially an organization limited to physicians, but now includes all types of health professionals, as well as performers, educators, and administrators in both music and dance genres. Their mission statement includes "developing educational programs designed to enhance the understanding and prevention of medical problems related to the performing arts" (see Appendix 1). They continue to hold their annual meetings in conjunction with the Symposium in Colorado each summer.

In the past, doctors have generally paid little attention to the potential faulty ways of moving that could cause pain; however, treatment of focal dystonia should include retraining instead of just surgery or other medical interventions. In these ways, doctors are dependent on the pedagogical profession: "input from music teachers is crucial…so

[5] Information on PAMA was found on their website: http://www.artsmed.org/ [accessed July 15, 2010]

much evidence points to faulty technique as a cause of injury."[6] This is probably the weakness of the medical profession. Even if there was a strategy for prevention to be established, their limited jurisdiction of the medical profession does not extend into the pedagogical and performance professions.

The medical profession is not adept as it could be in recognizing symptoms that could ultimately lead to musicians' injuries: such symptoms may include lack of physical coordination, awareness of pain, sensitivity to movement, posture, breathing, and general tensions in the body. Consequently, injured musicians have turned to popularized non-traditional treatments to pain, including Alexander Technique, the Feldenkrais method, acupuncture, chiropractic, physical therapy and Rolfing. According to Alford, when medical treatments have failed, musicians have even sought out psychology and religion to alleviate pain.

Alford also claims that pain cannot be treated simply as a physiological condition as there are broad cultural and historic variations in defining and experiencing pain. For example, there are pedagogues and pianists who still believe pain is part of the training in becoming a professional musician. The issues of performance and pedagogy, therefore, must play an equal role in resolving injuries related to leading to focal dystonia, and possibly challenge traditional notions of both fields.

In dealing specifically with focal dystonia, doctors need to understand the psychological cost that accrues to musicians who are injured. Musicians strongly identify with their careers, and a diagnosis of focal dystonia could be difficult to accept. As

[6] Alford, "Orpheus Wounded: The Experience of Pain in the Professional Worlds of Piano." 1-44.

having pain or injury could mean a temporary or permanent break from performing, the financial and career costs could be enormous. The medical profession still needs to work collaboratively with music pedagogues and performers to find solutions that would prevent and rehabilitate focal dystonia.

II. Medical Diagnosis of Focal Dystonia

One of the challenges of curing focal dystonia is creating a diagnosis based on established medical terms, one that is comprehensible among the medical, performance and pedagogical communities. Physicians who are unaware of the existence of focal dystonia, or are lacking in experience of observing how healthy instrumentalists play, may be confused by what they see and hear from patients, especially because the symptoms usually appear *only* during a performance or a task. Often a disorder may be misdiagnosed as a psychological rather than a neurological condition. The unfortunate frequent errors of diagnosis and treatments can cause further confusion and anxiety in patients. This chapter will examine some of the current approaches to diagnosing focal dystonia.

There are three established medical clinics that have taken an interest in focal dystonia, and each has its own way of diagnosing it; Dr. Brandfonbrener at the Feinberg School of Medicine at Northwestern University in Chicago; Dr. Eckart Altenmüller and Dr. Hans Christian Jabusch at the Institute for Music Physiology and Music Medicine at the Hanover University of Music and Drama[7] and Dr. Raoul Tubiana, from Institut de la Main in Paris, France. The clinics have contributed to the ongoing research of focal

[7] Dr. Jabusch has recently moved to the Dresden University of Music in 2009.

dystonia; they also observe the musician during practice and consider the emotional aspect of a musician's life as well.

A. Alice Brandfonbrener, M.D.

According to Brandfonbrener, there is still no definitive test for focal dystonia, and the diagnosis must be based on an examination.[8] The examination should consist of a musculoskeletal and routine neurological evaluation, including cranial nerve tests, tests for coordination, observation for tremors and muscle fasciculations[9] or other irritability; deep, tendon reflexes, sensory examination, observation of gait, and mental status examination. Because the symptoms are most evident during a performance, the doctor should also observe the patient while playing. Patients also have electrodiagnostic testing, which should be normal to eliminate other possible diagnoses. One other criterion for focal dystonia is having a negative neurological exam with no evidence or history of any pathology that would explain the isolated loss of muscular control.

Of the fifty-eight patients with focal dystonia that Brandfonbrener saw between the years of 1985 and 1995, there were no cellists and there was a high percentage of flutists, which may suggest that the underlying risk factor was in the number and type of repetitions, the hand and wrist positions, the required independence of finger activity, the force applied by the player or other undetermined or combination of factors. She found

[8] Alice G. Brandfonbrener, "Musicians with Focal Dystonia: A Report of 58 Cases Seen During a Ten-Year Period at a Performing Arts Medicine Clinic," *Medical Problems of Performing Artists* (1995).121-127. (All information regarding Brandfonbrener in the following paragraphs is from the same publication).

[9] Fasciculations are muscle twitches that are visible under the skin arising from the spontaneous discharge of a bundle of skeletal muscle fibers.

that in eight of her patients, the onset of dystonia came after the deliberate attempt to change hand or wrist position; one guitarist, recovering from an unrelated surgery, used his idle time to work compulsively for hours daily using just two fingers repeatedly for six weeks; two others had to accommodate to new instruments with stiffer action by making a variety of technical compromises. Most patients reported periods of especially high levels of stress, including one patient who performed for the funeral of a parent shortly prior to the onset of dystonia. Of the fifty-eight musicians studied, forty were full-time professionals, and considered themselves primarily as performers.

The clinical diagnosis of focal dystonia was based on the history and the presentation, and the absence of any findings suggesting another diagnosis. She found women tend to suffer more from overuse syndrome than men, whereas in focal dystonia, more men tend to suffer than women.[10] There is a link between overuse and focal dystonia; based on clinical observation, researchers identified a number of circumstances where dystonia appears in a body region that had been traumatized. However, overuse syndrome is different from dystonia as there are no overt difficulties in making specific movements.

B. Eckart Altenmüller, M.D. and Hans Christian Jabusch, M.D.

Dr. Eckart Altenmüller and Dr. Hans Christian Jabusch are the leading music medical doctors at the Institute of Music Physiology and Music Medicine in Hanover, and are both classically trained musicians. In addition to a full history background and physiological and neurological exam, they have found that focal dystonia is most evident

[10] Brandfonbrener, "Musicians with Focal Dystonia: A Report of 58 Cases Seen During a Ten-Year Period at a Performing Arts Medicine Clinic." 121-27.

in pianists when playing scales. Responding to this fact, they have developed a device of analysis comparing dystonic patients to healthy pianists using a MIDI-based analysis of musical scale performance.[11] The evenness observed in the MIDI analysis is used in conjunction with an observational tool they call the Art Dystonia Disability Scale (ADDS (see Appendix 3).

The MIDI-based technique was developed to measure the extent of the disorder while patients are playing the piano. The potential problems of dystonic pianists in the scale-playing analysis would be irregularities in volume and durations between each note. Scale playing is usually affected even in the early stages of dystonia, and the symptoms would include difficulties in playing rapid passages and movements requiring the turning under or over of fingers. The key of C major, considered the most difficult scale (there are no black keys to facilitate the turns) was used as the easiest way to detect the early stages of focal dystonia.

Altenmüller and Jabusch studied eight healthy pianists who were compared to eight pianists with focal dystonia. The two groups were matched by age, gender and handedness. The scales were performed on a digital piano (Kawai MP 9000) connected to a computer. For the recording and generating of MIDI files, commercially available music editing software was used (Musicator Wing, v. 2. 12; Music Interactive Technology). Pianists were asked to play ten to fifteen C major scales over two octaves consecutively in both directions, each hand separately legato and *mezzo forte*, with standard fingering. Scales were played in sixteenth notes with a quarter note at 120 beats

[11] Hans Christian Jabusch, Henning Vauth, Eckart Altenmueller, "Quanitification of Focal Dystonia in Pianists Using Scale Analysis," *Movement Disorders* 19, no. 2 (2003).

per minute; the newly developed MIDI-based scale analysis software was used to analyze the key velocities and tone durations for all individual notes. Standard deviations of four different parameters (velocities, tone durations, inter-onset intervals and overlaps) were calculated for each scale, and all the scales were also studio recorded.

Their study found significant differences between the groups in two parameters only: the irregularities of tone durations and of inter-onset intervals (spaces between each note played). In addition, the study was able to compare dystonic hands to hands treated with botulinum toxin (Botox), which, after treatment, measured inside the inter-onset interval range of healthy hands. The use of the MIDI was also able to detect the gradual decrease of the effects of Botox after a period of time post-injection.

While the Hanover study gives scientific, measurable results, it is limited as it only applies to pianists with focal dystonia and does not consider the other facets of dystonic movements (trills, repeated notes, octaves) that could appear in different repertoire. However, it does serve as a good standardized test to compare the results of various treatments for focal dystonia, and it is duplicable at other institutions independently.

C. Raoul Tubiana, M.D.

Raoul Tubiana, an orthopedist surgeon in France, has developed his own system of rating dystonia, known as the Tubiana scale (see Appendix 3). He agrees that the diagnosis rests essentially on the description of the problem and can be extremely difficult to make when motor control disorders are slight. He states, “One must begin by

eliminating other disorders that interfere with movement of the digits, such as trigger finger[12] or ganglion cysts[13].”[14]

In Tubiana’s article of his study, he similarly conducts his diagnoses in two parts: a thorough history, followed by a physical and neurological exam. He has found focal dystonia to be a condition that develops gradually, and is sometimes associated with a precipitating factor: it may follow a painful episode or a traumatic incident; a history of chronic pain may be found; certain mechanical factors, such as poor posture, reduced passive abduction of the fingers and muscle and tendon anomalies may also predispose to developing focal dystonia. Sometimes the onset coincides with a period of intense musical activity and overuse, obsessive practice in an attempt to increase the speed of a difficult passage, or during extensive travel.

In some cases, he found the predominant feature to be a spasm,[15] while in others there is a development of involuntary movements, sometimes accompanied by tremor. Although some patients complain of pain, in theory dystonia is painless; pain was not the initial manifestation of the disorder and appeared only after repeated episodes of muscle spasm. Dystonia differs from muscle and tendon disorders in that pain is not a dominant phenomenon; in some cases, dystonia can also be triggered by other activities, including

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[12] Trigger finger is a condition in which one of the fingers or thumb catches in a bent position.

[13] Ganglion cysts are swellings that often appear on or around the joints and tendons in the hand or foot.

[14] Raoul Tubiana, "Musician's Focal Dystonia," *Hand Clinics* 19, no. 2 (2003).303-08. (All information regarding Tubiana’s diagnosis in the following paragraphs is from the same publication).

[15] Spasm is a sudden, involuntary contraction of a muscle.

writing and typing. There is no paralysis,[16] no sensory disturbances of the skin, and reflexes are normal, with normal electromyography (EMG) in the majority of cases.

Tubiana also found that musicians suffering from dystonia had major postural disorders involving not only the upper limbs, but also the shoulder girdle, and in many cases, the spine. In many cases the ulnar metacarpal heads[17] of the hand have collapsed, indicating a weakening of the corresponding intrinsic muscles, while the forearm muscles were well developed, probably from compensation. The finger spread was often reduced as well. The shoulders were often asymmetrical, with the arm on the affected side in an internal rotation, indicating a weakening of the external rotators; the shoulder blades often stuck out. When the patient was asked to play his or her instrument, the non-physiological positioning is seen at once, with the wrist flexed and the hand abducted, and one shoulder lifted. The head was often no longer in line with the spine, the pelvis was tilted and there was a lack of balance between the agonist and antagonist muscle groups. All patients with postural disorders also adopted non-physiological positions in handling their instruments, such as having the hand in hyperpronation, the wrist excessively flexed and the arm in internal rotation.

In the experience of Tubiana and his partner, physiotherapist Philippe Chamagne, the higher the functional grade at the beginning of treatment correlated with the higher results after rehabilitation. Other factors that they found to influence the results included the quality of treatment, unfavorable psychological or morphologic conditions, and a

[16] Paralysis is the complete loss of muscle function in one or more muscles.

[17] Metacarpal heads make up the “knuckles” of the hand. The base lies proximal and the head lies distal.

delay between the onset of problems and treatment. Age also seemed to influence the results: the prospect of a long and uncertain rehabilitation may be more difficult to tolerate for elderly musicians. They do acknowledge that the results of their prolonged rehabilitation treatment are far from satisfactory in all cases, but they have shown that focal dystonia is not incurable.

Tubiana believes the onset of dystonia often coincides with a period of especially intense musical activity or change in musical behavior (where both biomechanical and psychological changes were made to long established musical habits). Some patients had chronic pain due to overuse or misuse, and others had nerve compression or trauma. He also found that the same individual or a family member might occasionally have other types of dystonia, such as writer's cramp, torticollis, or blepharospasm. However, the most common inciting factors were biomechanical and psychological.

Tubiana asserts that focal dystonia cannot be attributed just to psychological origins, although it is well known that stress can cause muscular tension, particularly in the trapezius[18] and neck areas. A complete physical examination is necessary to evaluate the mechanical disturbances; he found that even an examination *without* the instrument will show muscular imbalances or deficiencies that are not specific to focal dystonia but are nonetheless common in musicians with focal dystonia. For example, he finds frequently extremely frequently the dropped level of the scapulothoracic girdle,[19] the muscles that are responsible for the positioning of the shoulder axis. The disturbance of

[18] Trapezius is a large superficial muscle that extends longitudinally from the occipital bone to the lower thoracic vertebrae and laterally to the spine of the scapula (shoulder blade).

[19] Scapulothoracic girdle: the shoulder girdle.

this region causes internal rotation of the arm and affects the dynamics of the upper limb. Tubiana found that without the proper support and positioning of the shoulder girdle, fine control of hand movements could become problematic.

Although a neurological examination may not reveal any abnormalities in focal dystonia patients, he finds that proprioception[20] is often altered. As a test, he asks patients to touch fingertips of opposite hands with eyes closed.

Tubiana believes it is vital to assess a musician while playing his or her instrument. This not only reveals involuntary abnormal movements but also identifies non-physiological postures and movement compensations. During a performance, it is impossible for instrumentalists to avoid momentary lapses from an ideal posture; furthermore, the numerous repetitions of a complex movement in a non-physiological position can cause overworking of certain muscles that may lead to serious disorders. Because the majority of musicians with non-physiological positions are able to maintain the accuracy of their movements, additional risk factors must exist to disturb the fine motor control movements to cause focal dystonia. According to Tubiana's opinion, these additional risk factors include excessive emotional susceptibility and/or a genetically determined predisposition.

Most of Tubiana's patients showed muscular disequilibrium between the strong peripheral muscles of the limb used for fine movement and often insufficiently used proximal stabilizing muscles. He also found functional imbalance between the radial and ulnar parts of the hand. Typically, such imbalance involves the collapses of the fourth

[20] Proprioception: one's own sense of the relative positioning of the neighboring parts of the body.

and fifth metacarpal heads of the hand. There is occasionally a limitation of abduction between the third and fourth fingers as well.

Most musicians tend to be intense perfectionists and have great artistic ambition. In most patients, Tubiana found an interdependence between biomechanical and these psychological factors. He finds that an extensive examination is necessary for designing a therapeutic program that is based on how and when the instrumentalist uses movements as compensation during a musical performance.

Tubiana's diagnosis differs from that of Brandfonbrener, Altenmüller and Jabusch as he considers the entire physiological aspect of the body in his assessment of focal dystonia, and not just on the hand or the affected part. His thorough analysis demands considerable time investment by both the doctor and patient, utilizing the collaboration of a multi-disciplinary team. This emphasizes the need and uniqueness of collaboration *within* the medical community to establish clear diagnoses of this multi-faceted disorder.

D. Conclusion

Although the aforementioned medical institutions diagnose focal dystonia distinctively, they all acknowledge that it is indeed a multi-faceted condition. Because focal dystonia is a task-specific disorder, it is necessary for the doctors to have some knowledge of the performance skills needed in playing a specific instrument. Both visual and aural analysis of the performance task is necessary to give a complete diagnosis. Brandfonbrener's study is significant as she eliminates all other possible diagnosis after a thorough historical and medical examination. Altenmüller and Jabusch's study is significant as it provides the basis of a method to test for the early stages of dystonia; the

test requires little time (seven to ten minutes per pianist), is inexpensive and quite simple to monitor. June T. Spector and Brandfonbrener find the MIDI-Based Scale analysis to be the only reliable, valid and responsive method in measuring focal dystonia[21] as all other testing measurements are based on human visual and aural observations. Tubiana's diagnosis is unique, as it includes a thorough analysis of the body posture and position of dystonia patients, which is often overlooked when the focus is on the affected part. He gives a holistic analysis, which is also reflected in his treatment of focal dystonia.

The difficulty of focal dystonia is that it is not always task-specific and not always technique specific; some dystonic movements may also be subtle and difficult for objective observers to identify. The complexity of this disorder demands a better method of evaluation than what exists today – one that is reliable, valid, responsive to change, can be applied to different instruments and does not require the use of specialized equipment. This further emphasizes the necessity of collaboration between the medical, performance and pedagogy fields in finding an effective diagnostic tool for focal dystonia.

III. Current Medical Treatments for Focal Dystonia

Because focal dystonia is considered to be a multifaceted complex disorder, there is still no cure and it is difficult to treat. This section will describe a few of the medical treatments available with both advantages and disadvantages of each method, beginning with the least invasive treatment. Pedagogical retraining, which requires extended

[21] June T. and Alice G. Brandfonbrener. Spector, "Methods of Evaluation of Musician's Dystonia: Critque of Measurement Tools," *Movement Disorders* 22, no. 3 (2006).

observation and commitment, will be covered in the next chapter, the Pedagogical Profession.

A. Splinting

Using a non-invasive neuro-imaging technique (magnetic source imaging), Victor Candia and his colleagues found that musicians with focal dystonia exhibit an overlap or smearing of representational zones of the digits of the dystonic hand in the somatosensory cortex.[22] Because behavioral mechanisms underlie both the cortical disorder and the involuntary incoordination of movement, it is thought that a behavioral intervention, such as splinting, could reduce or eliminate some of the focal dystonic movements.

In constraint-induced therapy, one or more of the fingers (excluding the dystonic finger) is immobilized by splinting. The focal-dystonic finger is required to do repetitive exercises in coordination with one or more of the other fingers for one and a half to two and a half hours (depending on patient fatigue) per day, over a course of eight consecutive days under therapist supervision. The patients continue practicing the exercises with the splint for an hour each day at home in combination with progressively longer periods of repertoire practice without the splint. In Candia et al.'s study, two measurement groups were used to mark improvement: a dexterity/displacement device which continuously recorded digital displacement during metronome-paced movements

[22] Victor Candia, Thomas Elbert, Eckart Altenmüller, Harald Rau, Thomas Schaefer, Edward Taub, "Constraint-Induced Movement Therapy for Focal Hand Dystonia in Musicians," *The Lancet* 353, no. 9146 (1999). (All subsequent information on splinting is derived from this same article).

of two fingers; and a dystonia evaluation scale (DES)[23] in which patients rated how well (without the splint) they performed the movement sequences and passages that had generated dystonic movements in the past.

Of the five professional musicians (three pianists and two guitarists), all patients showed improvement without the splint at the end of the treatment. After treatment, one patient who was non-compliant regressed after nine months; three patients showed additional improvement into the normal or almost normal range; and one showed no reduction in a substantial therapeutic effect. Two of the musicians resumed concert performances.

Splinting is a cost-effective, non-invasive treatment for focal dystonia. The treatment requires observation from a doctor who understands healthy performance technique and is also possible to do with keen self-observation. However, there needs to be more definitive tests to see how much improvement is possible for all patients with focal dystonia, as Candia's study only included five musicians, with two resuming concert performances. Although splinting could possibly repair the cortical representations of the fingers in the somatosensory cortex, it does not address the other facets of focal dystonia, including compensatory physiological structure of other body parts, instrumental technique, and the emotional/psychological aspects of the disorder. Splinting would probably be most effective when combined with pedagogical retraining.

[23] For the Dystonia Evaluation Scale, see Appendix 3.

B. Sensory Motor Integration

Sensory motor integration is the process by which the sensory and motor systems communicate and coordinate with each other. It involves stimulus reception and transmission to the central nervous system (CNS) where the stimulus is interpreted. The CNS then determines which response to make and transmits its instructions as nerve impulses along a motor neurone to the appropriate effector (e.g. a group of muscle fibers), which carries out the response.

Some studies have shown that the ability to perceive two stimuli as temporally or spatially separate is impaired in musicians with focal dystonia. Often, a "sensory trick" can induce improvement in some musicians with focal dystonia. For example, some musicians saw an improvement when playing while wearing a latex glove, or when holding an object, such as a rubber eraser, between the fingers, thus changing the somatosensory input.[24]

The objective of learning-based sensorimotor training (LBST)[25] is to redefine spatial and temporal processing capacities in the sensory and motor cortices in order to restore task-specific skills, such as writing. The patients initially make relatively simple distinctions about relatively large objects, with the task difficulty increasing as each is mastered, and progresses to more difficult distinctions. One set of tasks includes reading Braille or embossed letters, making roughness estimations, and performing grating

[24] Eckart Altenmüller, "Focal Dystonia: Advances in Brain Imaging and Understanding of Fine Motor Control in Musicians," *Hand Clinics* 19, no. 3 (2003).523-38.

[25] Eckart Altenmüller, Mario Wiesendanger, Jurg Kesselring, ed. *Epidemiology, Phenomenology, and Therapy of Musician's Cramp*, Music, Motor Control and the Brain (New York: Oxford University Press,2006).

orientation discriminations.[26] A series of haptic tasks (using the sense of touch) required the subjects to manipulate and identify surface features and shapes of three-dimensional objects held in their hands. In a test of twelve musicians with focal dystonia, all showed improvements in performance ability on a variety of tests of sensory discrimination, fine motor accuracy, and speed, strength, flexibility and functional independence. Motor control improved to an average of 70% to 94% of normal and all but three patients returned to their usual work.

Sensory motor retraining is one aspect of focal dystonia that is often overlooked in the treatment process. For some pianists, it can simply mean playing on either ivory or plastic keys, or performing while wearing a latex glove to identify if this part of the sensory motor system is impaired. Although this type of retraining is not a cure for focal dystonia, it can contribute to any of the treatments without side effects or difficulty. Furthermore, sensory motor retraining does not necessarily need the guidance or observation of a skilled medical doctor. As with splinting, a larger testing pool is needed to determine the effectiveness of the various methods of sensory motor retraining.

C. Pharmacological Treatments

Doctors have experimented treating focal dystonia with pharmacological treatments prescribed for Parkinson's disease. These medications include anticholinergics, which are substances that block the neurotransmitter acetycholine. Trihexyphenidyl, which is one type of anticholinergic, works by providing an inhibiting

[26] Ibid.

effect on the parasympathetic nervous system and a relaxing effect on smooth musculature. It has had various effects on focal dystonia.

At the Hanover University of Music and Drama, Trihexyphenidyl is offered as the first-line medical treatment for patients without contraindication (increased risks). In the study at Hanover, 69 of the 144 musicians with dystonia were given an average dosage of 11mg per day.[27] Twenty patients had side affects or unsatisfying responses during the first two months, and treatment was halted. The other 49 patients received Trihexiphenidyl on an average of 16 months. The most frequent side effects were dry mouth, fatigue, dizziness, agitation, memory impairment, drowsiness, depression, loss of concentration, nausea, hyperkinesia, impaired visual accommodation, and tremor. The average minimum dosage that induced side effects was 9 mg per day. In 16 other patients, Trihexiphenidyl was stopped due to its side effects. Twenty-three of the patients had improvement with limb dystonia, and nineteen of those had Trihexiphenidyl for more than two months. The doctors found no correlation between side effects and improvement rate. The average maximum dosage was 11 mg per day in both patients with and without improvement.

Although the side effects of Trihexiphenidyl may be a deterrent for the affected musicians, this drug requires no extended observations and time commitment. Despite the side effects taking a drug, it is considered to be low risk and cost effective compared to other extended treatments, such as Botox injections and pedagogical retraining, but not

[27] Eckart Altenmüller, Hans Christian Jabusch, "Focal Dystonia in Musicians: Phenomenology, Pathophysiology, Triggering Factors, and Treatment," *Medical Problems of Performing Artists* 25, no. 1 (2010).3-9.

as effective: only 23 of the 144 musicians showed improvement, and the study does not specify how much improvement was made. For some musicians, the necessity of taking a drug daily in order to perform may be a deterrent for this type of treatment.

D. Botulinum Toxin Injections

The use of botulinum toxin, otherwise known as Botox, is a popular choice of treatment because it is easy to administer and provides immediate effects on the affected body part. It works by weakening the involved muscles and can last for about three months, depending on the dosage. This treatment uses fine wire electrodes to localize bursts of muscle activation during a task (such as writing), and the toxin is then injected through a hollow electromyography (EMG) needle into the belly of the most active muscle. After the injection, the activity of the injected muscle is reduced by blocking the release of acetylcholine at the neuromuscular junction. Botox injections in hand muscles is usually recommended only in instrumentalists with limited demand on lateral finger motion, such as in woodwind players and the right hand in guitarists. Keyboard players may benefit from this option if they avoid repertoire requiring a wide hand span and extreme lateral finger motion.

In a study by Jankovic, 46 patients with hand dystonia were injected with the toxin in the forearm muscles over a period of 130 treatment sessions.[28] The patients were observed after careful examination based on the palpation of forearm muscles during a writing activity, and the toxin was injected into the wrist flexors or the wrist extensors.

[28] Joseph Jankovic, "Botulinum Toxin Therapy for Focal Dystonia," *Medical Problems of Performing Artists* 6, no. 4 (1991).122-27. (All information in the following paragraphs is derived from the same publication).

The average baseline of severity of dystonia was 3.5 on a 4.0 severity rating scale. The average peak-effect response for all the treatment sessions was 2.3, with 4.0 being the beneficial maximum.

The latency from the injection to the onset of the effect averaged 5.6 days and the benefit lasted an average of 9.2 weeks. The main complaint of this treatment was temporary hand weakness, which occurred in 54% of the patients and in 34% of all the treatment sessions. Most patients, however, preferred to have the temporary weakness, which was usually mild, to the disabling focal dystonia. Based on the longitudinal experience, the study concluded Botox injections improved disability from hand dystonia in patients who had not benefited from other forms of therapy.

After treating over 1000 patients since 1984, Jankovic determined that there was no evidence of waning benefit; in fact, the results continued to improve. However, a small percentage of patients developed blocking antibodies, and they required immunologically distinct Botox preparations. For these and other reasons, Jankovic found it important to continue searching for new and more effective neuromuscular blocking agents.

In another study conducted at the Hanover Institute, 71 patients were given Botox injections.[29] The target muscles were identified by visual inspection of the dystonic movements while the patients were playing their instruments. In patients with flexion or extension dystonia of individual fingers, injections in the forearm muscles were preferred. Additional injections in hand muscles were performed in patients with

[29] Altenmüller, "Focal Dystonia in Musicians: Phenomenology, Pathophysiology, Triggering Factors, and Treatment." 3-9.

dystonic flexion in metacarpal joints and the extension component in the proximal interphalangeal joints[30] and the distal interphalangeal joints.[31]

After Botox treatment, 35 of the 71 patients reported improvement, 30 of which received more than one injection. The positive rating of the Botox effects was correlated to the number of Botox treatment sessions and the duration of the Botox treatment. According to the results, Botox treatment was successful in patients in which primary dystonic movements were clearly distinguished from secondary compensatory movements (the dystonic finger usually curls under and the compensatory usually sticks straight). It was difficult to administer when compensatory movements were more pronounced than primary dystonic movements. The study found electromyography (EMG) guidance was necessarily applied and mandatory; with the absence of EMG, only 37% of needle placements reached desired muscles.

As in the study by Jankovic, the study at Hanover also found that keyboard players might benefit from the option of Botox if they avoid repertoire requiring a wide hand span and extreme lateral finger motion. No improvement was seen in the affected left hands of one guitarist and two string players who needed to perform lateral finger movements. None of the two patients with injections in the upper arm/shoulder muscles experienced an improvement and none of three patients with embouchure dystonia experienced an improvement.

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[30] Proximal interphalangeal joints are joints between the first and second phalanges.

[31] Distal interphalangeal joints are the joints between the second the third phalanges.

The Hanover study found that time investment seemed to influence the choice of treatment for focal dystonia: older patients who desired a quick improvement preferred Botox injections. In contrast, several patients found the injection therapy to be "unnatural" and preferred an alternative therapy, and some found it difficult to have "control" over their instruments when playing with weakened muscles. Because Botox is not a cure, results can be unpredictable, especially during a performance (loss of control or weakness of certain muscles). As Botox does not address the technical aspect of music performance or the other facets of focal dystonia, the effectiveness of this treatment is also limited. In studies by both Jabusch and Altenmüller[32] and Tubiana and Chamagne[33] treatment of patients with Botox or Trihexiphenidal was also found to be most effective when combined with pedagogical retraining.

[32] Altenmüller, "Focal Dystonia in Musicians: Phenomenology, Pathophysiology, Triggering Factors, and Treatment."3-9.

[33] Raoul Tubiana, "Prolonged Neuromuscular Rehabilitation for Musician's Focal Dystonia," *Medical Problems of Performing Artists* 18, no. 4 (2003).

CHAPTER TWO

The Music Pedagogical Profession

The pedagogical profession has the responsibility of providing the technical responses to solving musical problems, as well as guidance in the careers of young musicians. The profession is authoritative by nature, although the role of the teacher is to serve the students and music. Traditionally, pedagogy is based on knowledge that is handed down from previous teachers; this can be an ineffective means of solving technical and physical problems leading to pain, and subsequently, focal dystonia.

I. The Role of the Music Pedagogical Profession in Focal Dystonia

To understand the causes of focal dystonia, we must first understand how technique is taught and how pain or injury is managed at a musical institution. Today, there is a divide in American universities between "performance" and "pedagogical" majors – we expect piano teachers to have a certain capability as performers, yet pedagogy is not required for all performers.[34] There is also a large divide within the pedagogical world – most concert pianists who teach are rarely involved with pedagogy; even more rarely do they speak at pedagogical conferences (although this is slowly changing).[35] It is ironic that pedagogy seems to have a lower status than performance, as consequently most teaching positions still go to the accomplished performers. Being a great performer certainly does not necessarily qualify a person to teach.

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[34] Alford, "Orpheus Wounded: The Experience of Pain in the Professional Worlds of Piano." 1-44.

[35] Leon Fleisher spoke at the 2004 World Piano Pedagogy Conference in Las Vegas where he addressed the audience about his focal dystonia.

Until recently, pedagogical curricula did not deal with pain – teachers could avoid the issue of pain by dealing with technical, esthetic or interpretative issues. There is still no single, coherent and widely accepted body of pedagogical knowledge about the causes and remedies of pain. Many piano exercises seem to entail an element of pain: for example, in the *Keyboard Classics* Magazine of June-July 1987, the composer/pianist Robert Starer gives a music example of five fingers holding down widely dispersed notes that end in the "most painfully stretched position."[36] Recent neurophysiological theories of muscular tension hold that such painful stretches, while endured by the body for perhaps a long time, ultimately cause a rebellion of the body in the form of pain or stiffness that inhibit playing,[37] which can be a pre-cursor for focal dystonia.

Pain is usually individualized, rationalized, and denied which makes it difficult for the pedagogical profession to recognize.[38] Even ideas of piano posture vary from school to school, and teacher to teacher. The acknowledgement of contradictory ideas is rare and even less discussed. Many pedagogues still believe that pain is a necessary attribute in building stronger hands and technique. In a personal interview between Alford and Joseph Rezits at Indiana University, Rezits said, "there is a prevalent belief among teachers and students that pain is necessary."[39] The divide between teachers, even within the same institution, can contribute to confusion and possible injuries to susceptible music students.

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[36] Starer, Robert. "Victor Ebenstein's Exercises." Keyboard Classics, 7/4 (June-July 1987): 11.

[37] Alford, "Orpheus Wounded: The Experience of Pain in the Professional Worlds of Piano." 1-44.

[38] Ibid.

[39] Ibid.

The emotional aspect of studying and performing music is not always acknowledged in pedagogical traditions. In a 1990 article Julie Jaffee Nagel writes, "Talented performers must not only compete with other musicians but they also must *beat the system* – the society that paradoxically claims to appreciate the performing arts yet does not adequately support it."[40] In another study at the University of Freiburg, Spahn, Strukely and Lehmann found that music students compared with all other freshmen had a higher prevalence of health problems (including anxiety) even at the start of their studies.[41] These authors believe that these problems are caused by the music students' strong identification with their work, and by their high professional ambitions and commitment to music, which began long before their entry into university. Like others in her profession, Nagel believes that anxiety is not an isolated symptom, but a combination of attitudes, traits and unconscious conflicts that become activated in a specific circumstance, such as performing in a concert.[42] Anxiety also affects people who are performing in situations where failure is a possibility, such as a juried recital or an audition. Because anxiety and perfectionism have been suggested causes for focal dystonia by Jabusch and Altenmüller,[43] it is essential that pedagogues acknowledge the

[40] Julie Jaffee Nagel, "Performance Anxiety and the Performing Musician: Fear of Failure or Fear of Success?," *Medical Problems of Performing Artists* 5, no. 1 (1990).

[41] Claudia Spahn, Sandra Strukely, Andreas Lehmann, "Health Conditions, Attitudes toward Study, and Attitudes toward Health at the Beginning of University Study: Music Students in Comparison with Other Student Populations," *Medical Problems of Performing Artists* 19, no. 1 (2004).24-31.

[42] Nagel, "Performance Anxiety and the Performing Musician: Fear of Failure or Fear of Success?."140-45.

[43] Hans Christian and Eckart Altenmüller Jabusch, "Anxiety as an Aggravating Factor During Onset of Focal Dystonia in Musicians," *Medical Problems of Performing Artists* (2004). 75-81.

negative affects of these behavioral patterns as a part of the prevention and treatment of this condition.

In an investigation of injury prevention among university piano students at a Washington State university, it was found that musicians have a reluctance to seek out medical assistance for injuries for three primary reasons: their belief that health care professionals were insensitive to and ill-informed of the physical and emotional demands of music performance; the threat to their employability if the disability becomes known; and the acceptance of pain as a part of the price of performing music.[44] Musicians will often alter their technique to adapt to the pain, while others learn to simply play through it. When pain is ignored or adapted to, it could lead to compensation (protecting the painful areas by using other muscles to execute the movements), which could cause more severe injuries, including focal dystonia.

A study by Nicholas Quarrier found that treatments often focusing only on physical dysfunction yielded a low percentage of success, while a treatment that addresses the holistic view of the individual had higher degrees of efficacy: "successful management of treatment requires a holistic approach, including local treatment, and correction of contributing factors."[45] By approaching the patient as a whole person, health care professionals are not limited to treating only the physical aspects of injuries – they must also be informed to address the psychosocial and emotional aspects as well.

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[44] Heidi Blackie, Ronald Stone, and Anne Tiernan, "An Investigation of Injury Prevention among University Piano Students," *Medical Problems of Performing Artists* 14, no. 3 (1999).141-49.

[45] Nicholas F. Quarrier, "Survey of Music Teachers: Perceptions About Music Related Injuries," *Medical Problems of Performing Artists* 10, no. 3 (1995).106-10.

The high incidence of injury among music professionals and students warrants a need for extensive injury prevention education early in their careers, before problematic habits develop. Although many studies have proclaimed the importance and benefits of injury prevention education for musicians, very few studies have actually examined the musician's education background and extent to which it is employed in practice. In a study by Blackie, Stone and Tiernan (all occupational therapists), they found injury prevention education for musicians should include:

1) Understanding of ergonomics of healthful playing
2) Regulating difficulty of pieces played to maintain endurance
3) Incorporating warm-up into practice
4) Maintaining physical fitness
5) Increasing awareness of and correcting high-risk behaviors such as sudden increase in playing time, not taking breaks, significantly heightened intensity of pieces played, and lengthy, demanding practice schedules
6) Study of anatomy, kinesiology and physiology[46]

The study also found that although many respondents reported they didn't accept the notion of playing through pain, they frequently were obliged to play with pain in order to perform at the expected level. The study also found that musicians generally tended to rely on themselves for solutions rather than consulting a medical practitioner – again, this could be due to physical, psychological or financial risks of admitting an injury.

[46] Blackie, "An Investigation of Injury Prevention among University Piano Students." 141-49.

The same study included a discussion with Duane Hulbert, a university piano professor. Hulbert acknowledged his difficulties in presenting important injury prevention principles in the context of a weekly thirty or sixty minute lesson. It was difficult, if not possible, to identify and correct all high-risk behaviors while improving the performance of repertoire.[47] If time was the issue, then perhaps adding a course to the curriculum for all music students that taught low-risk behaviors would help decrease injury. The study also found that a collaborative effort between instructors and medical professionals might be most beneficial in teaching these principles and techniques.[48]

A survey of one hundred and seventeen music teachers about their perceptions of music-related injuries found that music teachers attribute ninety-eight percent of injuries to improper technique (although there was no definition of what constituted proper technique).[49] Yet, courses for the recognition and understanding of music-related injuries are not required in the curriculum of music-educators. The survey found that music teachers who have experienced injuries themselves may have preconceived ideas about the principles of prevention and management; these ideas may or may not be consistent with the current information from the music medical profession. If the music teacher has played injury-free for his or her entire career, he or she may not believe in the existence of music-related injuries and may assume that the complaints are psychosomatic.[50] The experienced teacher may know that proper playing posture is

[47] Ibid.

[48] For examples of schools, refer to Appendix 2.

[49] Quarrier, "Survey of Music Teachers: Perceptions About Music Related Injuries." 106-10.

[50] Ibid.

required to prevent injuries, but he or she may not be aware of what the best posture is for anatomic efficiency.

Eighty-four percent of the teachers in the study also rated emotional stress to be a moderate- to high- degree risk factor for an individual's predisposition to music-related injuries. In a similar study of relation of stress to athletic injuries,[51] researchers found that stressful situations causes the body to experience physiological changes, including increased muscle tension and decreased fine-motor muscle control, which may reduce the ability to perform intricate and complicated motor movements. Like athletes, musicians may also have abnormal muscle tension and inattentiveness when practicing, resulting in injury.

Although the music teachers surveyed seemed to know about the different treatments available to injured musicians, they did not seem to know the apparent effectiveness of each treatment. It seems that the teachers themselves could potentially lead the path for a more pedagogical understanding of what could cause and treat focal dystonia.

At the Winterthur Zürich Musikhochschule, twenty-six instrumental teachers and sixty-six of their students participated in a study to determine if providing training in musicophysiology to instrumental teachers would benefit their students.[52] The

[51] M. B. Andersen, and J. M. Williams "A Model of Stress and Athletic Injury: Prediction and Prevention," *Journal of Sports and Exercise Psychology* 10 (1988): 294-306.

[52] Horst Hildebrant, Matthias Nuebling, "Providing Further Training in Musicophysiology to Instrumental Teachers: Do Their Professional and Preprofessional Students Derive Any Benefit?," *Medical Problems of Performing Artists* 19, no. 2 (2004).62-69.

pedagogical course took place two hours weekly, during the seventeen weeks of summer, and focused on sensory and psychomotor systems of musicians. After the training, participating students were asked to assess their teachers to determine if there were any changes in teaching style.

The results of the study found that the teachers who elected to participate in the advanced training were convinced that it changed their teaching style and had begun paying careful attention to the functional dynamics of the sensorimotor and psychomotor systems. Their students also perceived changes in their teaching style, even though the study was both limited with time and methodology. It was also noted that teachers who elected to participate were perhaps more self-critical of their own teaching styles and were also open to learning new ways to benefit their teaching.

The study is important because it shows the possibility of modifying and influencing the instructional style of teachers, which could ultimately benefit students to use preventative strategies of performing. Although this was a brief experiment, it did lay the groundwork for further possibilities of enrichment for both teachers and students.

A similar study was undertaken in the United States in 2004, under the banner Health Promotion in Schools of Music (HPSM). The study hosted a national conference made by a collaborate effort between the University of North Texas System and the Performing Arts Medical Association (PAMA). In their study published in 2006, they concur that faculty within the schools of music represent the primary channels for

reducing performance injuries.[53] They suggest that music faculty, more than any other group, embody the critical determinants for establishing social and cultural values and beliefs that are so important for influencing students. Although they acknowledge that interdisciplinary and collaborative strategies need to be initiated with groups and individuals outside of music, the reliance on outside professions without the involvement of the music faculty would ultimately fail.

Not only did the study propose that all undergraduate problems have an "occupational health" course for all music majors, it also propose that all directors of student health resources be up to date with all the resources and performing arts medical experts in the field. They found preventive education to be effective only if it goes beyond "delivering" instruction, as it must address issues that affect music students' values, beliefs and motivations.

In an interview survey of the three major conservatories in New York City,[54] the directors and heads of piano departments were asked: 1. What are the procedures set forth by your school if a student sustains a playing-related injury? 2. Are there any courses offered at your institution that deal with physiology and/or health issues as they pertain to performance? 3. Are there any members of the faculty who currently work in collaboration with medical doctors or hospitals? Only one school responded, with the director stating that they do not offer any such type of courses; any situations are handled on a one-to-one basis; and, as they are part of a university, they must abide by their

[53] Kris S. Chesky, William J. Dawson, Ralph Manchester, "Health Promotion in Schools of Music: Initial Recommendations for Schools of Music," *Medical Problems of Performing Artists* 21, no. 3 (2006).

[54] Author conducted survey via email in December 2010.

privacy policies and cannot disclose any additional information. In an interview with the head of the piano department from the same school, she stated that there has never been a case of focal dystonia in her years as tenure, and based on that fact, there is no immediate need for such a course.

Although the results from this interview survey were limited, one can assume it is still possible for students who develop focal dystonia to go undetected, and help within the institution is limited. For those who have already developed focal dystonia, the most effective treatment today seems to be pedagogical retraining, as this is a long-term solution unlike repeated Botox injections or oral medication. Focal dystonia is still a relatively new field in music medicine; there are very few published studies on the available methods, making it difficult to discern between what is effective or not. This section will analyze different pedagogical retraining methods by the medical, pedagogical and performance professions. There has yet to be a single established method in this new field - perhaps through the multiple lenses of these professions, such a method for recovery could also lead the path to an agreeable pedagogical method of what constitutes proper technique.

II. Retraining from a Medical Perspective

Dr. Brandfonbrener, Dr. Tubiana, Dr. Altenmüller and Dr. Jabusch agree that retraining is perhaps the least intrusive therapy for focal dystonia, and has the potential for lasting benefits. The disadvantage of this treatment is the time commitment and patience required for those affected. Also, it is also expensive and difficult to access doctors who have had successfully treated focal dystonia; this section outlines two studies performed by doctors who have published their retraining methods.

The first study outlined is by Dr. Naotaka Sakai (Professor and Director of the Biomechanics Laboratory, Faculty of Engineering at Utsunomiya University and the Department of Orthopedic Surgery, Yokohama City University Hospital). His method, "Slow-Down Exercise for the Treatment of Focal Hand Dystonia in Patients"[55] describes a two-week study with twenty pianists, reducing the level of performance to a speed where dystonic movement is no longer present. The second study, "Prolonged Neuromuscular Rehabilitation for Musician's Focal Dystonia"[56] was written by Dr. Raoul Tubiana, Associate Professor of Orthopedic Surgery at the University of Paris, and founder of the Institut de la Main. His article is based on one hundred and forty-five case studies of musician's focal dystonia that he and his partner Philippe Chamagne treated from 1992-1999.

A. Naotaka Sakai, M.D.

Sakai found that his program "slow down exercise" (SDE) had dramatic results when patients with focal dystonia performed basic movement training at a decreased speed of movement.[57] In his experiment, twenty pianists with focal dystonia were selected based on showing no symptoms of dystonic movement while performing at a slow tempo. Ten were male, ten were female; eight were right-handed and twelve were left-handed, and the average age among them was thirty years. The average onset age

[55] Naotaka Sakai, "Slow-Down Exercise for the Treatment of Focal Hand Dystonia in Pianists," *Medical Problems of Performing Artists* 21, no. 1 (2006).25-28.

[56] Tubiana, "Prolonged Neuromuscular Rehabilitation for Musician's Focal Dystonia." 166-69.

[57] Sakai, "Slow-Down Exercise for the Treatment of Focal Hand Dystonia in Pianists." 25-28. (All information in the following paragraphs is derived from the same publication).

was twenty-eight years, with the period between onset and the first visit to a clinic averaging three years. The subjects all had no abnormalities in their neurologic and psychiatric examinations, including radiography of cervical spine and brain MRI. The symptoms included involuntary, task-related abnormal hand movements that interrupted their professional activity.

The Slow Down Exercise (SDE) program comprises five steps:

1. Subjects chose musical pieces that triggered dystonic hand movement;
2. Subjects reduced speed of movement during performing until dystonic hand movement disappeared (rate was recorded by metronome);
3. At the recorded speed, subjects repetitively rehearsed a piece for a half-hour per day for two weeks; subjects were freely permitted to perform other piano practice in addition to SDE; except for SDE pieces, they could practice any musical pieces including those at normal speed, and could include additional hand movements to avoid or relieve focal dystonia;
4. After two weeks, subjects tried to increase their speed in the SDE pieces from 10% to 20%; if symptoms did not reappear at the increased speed, patients increased the speed for another two weeks; if dystonia reappeared during increased rate of movement, patients returned to rehearsing at the former, slower speed;
5. After another two weeks, step four was repeated and the performance speed was gradually increased.

The clinical results were evaluated by two grading systems, the ADDS and the TCS (see Appendix 3). The symptoms of focal dystonia included abnormal involuntary movements that appeared in all subjects at a specific point during the performance. Of the twenty pianists, the abnormal movements included a flexion (curling in) in seventeen pianists' fingers and extension in three pianists' fingers. The movements were observed in the middle and ring fingers most frequently (seven pianists) followed by the index finger (seen in six pianists). The performance techniques during which abnormal movements appeared included scales (nine pianists), arpeggios (five), octaves (three) and trills (one). In SDE protocol, pianists repeated practice at slower speeds, with the treatment period ranging from one to six years, with an overall average of two years.

One example of a success story was a thirty-one year old pianist, who had a right hand ring finger involuntary flexion movement while playing, especially in repeated scalar passages. In that situation, SDE was performed with scale technique. Initially, the difficulty of controlling the speed of the ring finger appeared at 20 metronomic beats per minute, with abnormalities at 40 beats per minute. The pianist used the SDE protocol and was able to play without any involuntary movements at 90 beats per minutes, and the pianist returned to the concert stage after 36 months of therapy.

In this study of twenty pianists, SDE initially decreased the speed of their exercises by an average of 12.4% from the rate of normal performance; all patients also expressed a "desire to discontinue SDE as soon as possible" and reported disliking performing SDE. However, after SDE, the speed of performance increased to a rate of 88.6% of a normal performance. Prior to SDE, four subjects had ADDS=2, sixteen had ADDS=3; after SDE, twelve had ADDS=0 and eight had ADDS=1. In the TCS scale, the

improvement ranged from 2.2+/-0.41 to 5.6+/-0.50 following SDE. All patients did report satisfaction with the results and eight patients with mild difficulties continued with the exercise.

The idea behind SDE is that it could reduce the level of neural memories of physical movements to repair those memories associated with dystonia. This goal is achieved by reducing the speed of movement to a level below those associated with dystonia. The results from this study indicated that SDE therapy is effective in all participants and enabled them to return to the speed of movement in performances prior to the manifestation of dystonia. However, patients did express an extreme dislike for SDE, even when performed for as little as ten minutes a day: some experienced such dislike to the point of experiencing a cold sweat while performing the exercises. According to Sakai, the reaction likely occurred because performing at a level in which memories are missing can induce some type of subconscious rejection. Sakai noted the likely reason for the success of this method is the use of the metronome as a tool for the exercises, which can be used to accurately record the controlled speed of movement.

The advantages of the SDE program is that it seems simple and requires only self-monitoring and a disciplined use of the metronome. It also allows affected pianists to continue practicing other musical works where the dystonia movements may not be present. Furthermore, the SDE program is not limited to just scales – it can be applied to trills, arpeggios, and octaves as well, which will broaden the scope of rehabilitation. The use of measurement scales ADDS and TCS both show consistent improvement in all the pianists within the short time frame of two weeks.

However, the emotional and psychological aspects of performing music is not addressed in the SDE program, and seems to detach the "sound" from the "mechanical" action. The "dislike" that many of the patients experienced in this method may discourage musicians from continuing on the program independently, and does not address the psycho-emotional aspects of focal dystonia. Furthermore, the method does not address either physical posture or hand position, both which are usually distorted among musicians with focal dystonia. More collaboration with the pedagogical, physiological and psychological professions seems necessary for this method to create long-term reliable rehabilitation.

B. Raoul Tubiana, M.D. and Philippe Chamagne

Raoul Tubiana is one of the key figures in hand surgery in France; he is also still actively involved in research. In 1975 he began working with Philip Chamagne, a physiotherapist at the Musician's Clinic of the Institut de la Main. Between 1992 and 1999, they diagnosed and worked with 145 musicians with focal dystonia.[58] They found focal dystonia to be predominant in men (105 men, 40 women) and the average age of onset to be 33 years.

For examination purposes, they developed the Tubiana and Chamagne score (TCS) (see Appendix 3) and used this as an assessment for diagnosis and evaluation of results after treatment. From the 145 musicians with focal dystonia, 35 failed to complete

[58] Tubiana, "Prolonged Neuromuscular Rehabilitation for Musician's Focal Dystonia." 166-69. (All information about the study in the following paragraphs is derived from the same publication).

the rehabilitation. Of the 110 that completed, 25 showed no improvement, 85 showed more or less improvement, and 39 returned to performing.

The goal of the treatment program was to establish a new sensory motor program through a complete rehabilitation of the neuromuscular system. Tubiana and Chamagne treated musicians both physically and the psychologically. In addition to a thorough history of the affected musician, they taught the musician to be aware of any poor posture, deprogrammed non-physiological movements and then taught movements that respect normal physiologic function. Their re-education was not restricted just to the hand, but included the entire body.

Tubiana and Chamagne found that a prolonged rehabilitation tended to re-establish a physiological posture that supports the freedom of movement necessary for musicians to use at a minimal expense of energy. Once the neuromuscular program was prescribed, it was communicated to the patient in simple, understandable terms in order for the musician to recognize not only what is being done but why - they found this approach to maximize the rehabilitation potential.

According to the study, the prospect of a long period of rehabilitation may in itself produce anxiety in a musician, not only for economic reasons but also by fear of being cut-off from the musical community. The study also concluded that the support therapy from a psychotherapist could potentially help the musician adhere to a long rehabilitation program. They found it necessary for the instrumentalist to maintain some type of musical activity, whether playing with the other hand when possible or teaching at a music school.

Chamagne developed a four-phase progressive therapeutic program:

Phase 1: Restructuring the Body Image

In the preliminary phase, the musician develops an appreciation of the proprioceptive[59] elements and learns the techniques of stereognosis.[60] The musician is placed in front of a mirror to become aware of posture and of the effect of gravity. The required posture involves having the transverse axis, the shoulder joints and the pelvis placed squarely at the feet; the musician must also create a straight spine and balanced position of the head with his/her eyes closed.

Chamagne notes that the physiotherapist must maintain a close relationship with the musician throughout the process of recovery; the physiotherapist also has a psychological effect in his/her relationship with the patient. The physiotherapist is responsible for teaching the patient the basics of normal anatomy and physiology, describing any of the deformed mechanisms of the body, prescribing corrections for any of the inappropriate gestures or movements. They found that without this knowledge, it was impossible to modify the patterns of movement that lead to the disorder.

Phase 2: Independence of Limb Movement

Once the balanced posture was achieved, the musician's next task was to achieve complete independence of the functioning limbs, without altering the basic posture previously attained. These two first phases are directed at eliminating bad habits and

[59] Proprioceptive is the ability to sense the relative position of the neighboring parts of the body.

[60] Stereognosis is the ability to perceive the form of an object by using the sense of touch.

they are generally difficult for the musician. They found that the rehabilitation sometimes ended at this stage if there were no signs of collaboration on the part of the patient after several months; if there was improvement, the rehabilitation is continues.

Phase 3: Re-teaching Movement or Posture

This phase focuses on specific areas of movement or posture to be corrected or developed. This could include a lack of proximal support of the limb, strengthening of the wrist and digital extensors or strengthening of the interosseous muscles.[61] The rehabilitation included the function of each digit on the instrument. They have found quite often that the strong proximal muscles of the shoulder girdle in dystonic musicians were neglected at the expense of the distal muscles[62] and there was an increased force of contact of the digits on the keys. The force of the digit on the instrument was re-taught first on foam using different resistances.

Phase 4: Return to the Instrument

The final phase emphasized the integration of the new posture and a muscular balance into the movements used at the instrument, and was done while the musician faced a mirror. The use of orthotic devices was sometimes helpful in this phase. They found it was also important to develop the exteroceptive[63] and proprioceptive senses, first by simulation play without the instrument (shadow playing) and then by actual playing

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[61] Interosseous muscles: pertaining to the area between the bones.

[62] Distal muscles are the muscles furthest from the center of the body; in this case, author is referring to the fingers.

[63] Exteroceptive: pertaining to stimuli that originate from outside the body or to the sensory receptors that they activate.

on/with the instrument. They found the return to playing to be particularly important – the activity needed to be progressive, with a gradual increase in time spent playing, the technical difficulty and the tempo of the music. This phase also required an avoidance of positions and activities that provoked any of the dystonic symptoms.

Tubiana and Chamagne state that the progression to recovery is never linear; rather, it is a series of successive levels. The rehabilitation as a prolonged treatment may take several years (their average was two years in this series). The aim of the treatment was to give the instrumentalist an opportunity to play musical passages using physiological movements at a normal speed, as well as regain the instrumental sound that he or she had attained prior to dystonia. They acknowledge that the duration of the rehabilitation depends mainly on the patient's motivation.

The thirty-nine instrumentalists who recovered, some of international renown, were able to return to performing. After treatment, some musicians felt fatigued when concerts were scheduled too closely, and a periodic re-assessment of posture of movement was mandatory to avoid recurrences.

Although the authors recognize the use of botulinum A toxin (Botox) for treatment, they do not believe it is the treatment of choice for musicians with focal dystonia. They found that although Botox alleviates the spasms of the disorder, it does not address the motor coordination component. The authors believe that Botox, in conjunction with a rehabilitation treatment, is much more effective.

C. Conclusion

Tubiana and Chamagne found that the basis of therapy for musician's focal dystonia was a long rehabilitation program, and having a multidisciplinary approach was the most effective way to treat this condition. Currently at the Institut de la Main, there are several doctors who work in collaboration: a hand surgeon (Dr. Tubiana), a neurologist (P. Rondot), a pediatrician (R. Malek), a rheumatologist (J. Dehais) and a physiotherapist (Chamagne). The physician would typically make the diagnosis, prescribe the therapy and control the evolution of the treatment. An experienced physiotherapist then institutes the de-programming and re-programming of the musician's sensorimotor system. Finally, psychologists, who are trained in the musicians' problems, help lessen the frustrations and assist the musicians in developing a new perspective. Tubiana and Chamagne also acknowledge that the collaboration of instrumental teachers would be desirable and could be of great help. Because the rehabilitation required a long-term investment, they found that the personalities of the musicians could also influence the results. They found those musicians who had re-evaluated the basic aspects of their playing and some aspects of their professional behavior had the best chance for recovery.

Although Tubiana and Chamagne's program has had some success, the lack of motivation that keeps some of their patients from completing the curriculum is a setback for both the affected and the complete success of the program. Their team of doctors is limited to the physical and psychological aspects of retraining; however, musicians are most motivated when they are actively involved in the act of music making. Their study

does not take into account the ease or difficulty of adapting the new postures to performance and correcting the quality of sound of the affected musicians.

Because their positive results seemed to be influenced by motivation, and musicians are most motivated when they are able to perform, the collaboration with music pedagogues and performers might benefit their results. Even though a balanced body is essential in music making, the practical aspects of performance need to be the central goal of rehabilitation for musicians with focal dystonia.

III. Retraining from a Pedagogical Perspective

The pedagogical profession has the most direct access and influence in retraining musicians with focal dystonia; however, there is still not one universally-accepted idea of good technique, and the different ideas of pedagogy are also reflected in the different approaches to retraining. Nonetheless, the pedagogical profession would still benefit from the scientific approaches used in the medical profession, and also the realization of that technique in the performance profession. The following section analyzes the Taubman Approach, Laurent Boullet's method, and a study by Rae de Lisle and her colleagues.

A. The Taubman Approach

Dorothy Taubman has spent more than fifty years of study and research in the field of piano pedagogy. She was a faculty member of the Aaron Copland School of Music of Queens College in New York, and also taught privately from her studio in Brooklyn. She has given lectures and masterclasses in institutions across the country, and her students include faculty members of prestigious music schools including the

Juilliard School and Oberlin College. Although there is yet to be a published study on the effectiveness of the Taubman Approach, it is important here because there are public testimonials from her disciples indicating the success of the approach, including recovery from focal dystonia.[64]

There are no publications on the Taubman Approach; however, information on Taubman's work can be found on the website of Dr. Teresa Dybvig, a Taubman Approach teacher who studied with Edna Golandsky.[65] Dybvig identifies three components to the technique: alignment, balance and movement. "Alignment" refers to how the hand should be on the keyboard, which is demonstrated by the natural fall of the hand on the side of the body. "Balance" is defined as not pushing or holding up, the equivalent of how a person stands on the floor. This is applied to the fingers on the keyboard and also how the pianist sits on the bench. "Movement" is maintaining the alignment between the balanced positions – there is the walking hand and arm, forearm rotation, forearm movements in and out of the black key area, and shaping. In addition, she describes how the piano can help a pianist play: by aiming to feel the "bump" (where the hammer hits the string, halfway between the top of the keys and the keybed) and by using the keybed to follow through, rather than being the aim. In addition, by using the

[64] The six testimonials regarding focal dystonia recovery can be found at the website of The Golandsky Institute, www.golandskyinstitute.org/about/dystonia [accessed July 12, 2010]

[65] Edna Golandsky received her Bachelor and Master of Music from Juilliard, and studied with Dorothy Taubman after graduation. She directs the Golandsky Institute and is also a faculty member of City University of New York.

natural “staccato” feeling of playing the piano, this will allow the pianist to move from note to note with ease.[66]

One can only assume that these same principles, of alignment, balance and movement, are used in focal dystonia retraining. We don’t know based on the six testimonies how many pianists have fully recovered using the approach, or how many of these pianists are fully recovered to concert playing level, or how many months of retraining were needed on average. As the digital cortical representations are smeared in the somatosensory cortex in focal dystonia patients, the Taubman Approach does not address this as it de-emphasizes the individual movement of fingers in rehabilitation, and rather focuses on the larger body movements of the arm and hand rotation. Although the Taubman Approach includes physiological principles based on the Alexander Technique and the Feldenkrais Method, one must also discern how these principles are taught as the approach may vary from each one of her disciples. Furthermore, the Taubman Approach believes that one must learn only new repertoire when utilizing the method. This is severely restrictive. Until this approach is confirmed in the research lab, this and other aspects are open to question.

Edna Golandsky is a leading exponent of the Taubman Approach. In an interview on November 12, 2010, she expresses a view somewhat different than other Taubman teachers on the question of old repertoire. She said in that interview that pianists can, in fact, return to former repertoire, but many choose not to, because of their memory of playing with the former technique. Her students took on average two years for full

[66] Teresa Dybvig, The Well Balanced Pianist: The Integrated Approach. www.wellbalancedpianist.com/bptaubman.htm [accessed July 12, 2010]

recovery from focal dystonia; she based the reasoning of their recovery on how often they took lessons and how committed they were to her instructions. She is also open in collaborating with neurologists but has yet to find one that is interested and open-minded in working with her on the Taubman Approach.

B. Laurent Boullet

Laurent Boullet is a Belgian pianist living in Berlin who had also suffered from focal dystonia for many years, beginning in 1994; through collaboration with specialized physiotherapists he was able to re-train himself. Since 2003, he has joined the faculty of the International Piano Academy in Lake Como, Italy, and continues to collaborate with Dr. Eckart Altenmüller and Dr. Hans Christian Jabusch at the Hanover University of Music and Drama. Patients are generally diagnosed by Altenmüller and Jabusch, and then referred to Boullet for retraining at his studio in Berlin.

The method used by Boullet, reflecting the methodology as outlined in a study by Altenmüller and Jabusch, is as follows:

1. Movements of affected body parts were limited to a level of tempo and force at which the dystonic movement could not occur;

2. Compensatory movements (e.g. of adjacent fingers) were avoided, particularly under the application of splints;

3. Instant visual feedback with mirrors or monitors helped patients to recognize dystonic and non-dystonic movements;

4. Body awareness techniques (e.g. Feldenkrais) were applied to increase the patient's perception of non-dystonic movements. [67]

At the time of publication of this article in 2010, this treatment was applied to twenty-four patients, and twelve patients (50%) experienced improvement (although the study did not signify what was considered improvement). The patients who reported improvement had an average of twenty-eight months of treatment.

Boullet begins the first session,[68] the "deprogramming phase", by identifying any incorrect movement patterns and signs of muscular imbalance. He used real time digital video analysis of the subject performing a section of repertoire in which the dystonia is apparent; the video is played back to the subject, sometimes in slow motion, to analyze the dystonic and compensatory movements. He then used simple finger movements of individually adapted exercises, played in a slow tempo with little force, where the dystonic movements would not be visible. These exercises (e.g. a simple five-finger exercise, from C5 to G5) focused on the fine motor movements of fingers, avoiding movements of arm and shoulder. When needed, he increased the perception of the dystonic finger with taping (splints), mirror technique or instant video monitoring. The goal was to establish the correct posture of the hand, which he accomplished through an analysis of the different functions of the hand anatomy, and also through the pedagogical

[67] Altenmüller, "Focal Dystonia in Musicians: Phenomenology, Pathophysiology, Triggering Factors, and Treatment." 3-9.

[68] Because Boullet's method has yet to be published, the following account is based on the author's own observations from July 2008 in Berlin.

methods of Leschetizky.[69] This first phase usually took four to six months, including four to six sessions[70] of private lessons with Boullet.

During the sessions, Boullet emphasized a good quality of sound production created by non-extraneous movements played with a good hand position at a slow tempo. In the five-finger ascending and descending exercise, the fingers were required to drop to the bottom of the key and the transfer between the fingers had to create a clean release (the key had to come all the way to the top to match the surface of the other keys). During the performance of the exercises, Boullet constantly checked the forearm and shoulder girdle for any extraneous movements. During this process, he also taught the subject to "check" himself/herself. Boullet intermittently talked about other related and unrelated topics to give the subject a "break" from the exercise when it becomes too difficult. These topics may include the quality of instruments, the ideal weight of a finely adjusted keyboard (he suggests that each key should be adapted to 50 grams), and body awareness. Depending on each subject, Boullet also assigned individual physical daily exercises to be done away from the piano.

The second phase focuses on "strengthening of weak muscle-groups and acquisition of an internal representation of simple movements" uses special physiotherapeutic exercises, which he learned through work with physiotherapists. This part of the training included that of the dorsal interossei muscles,[71] an exercise in the

[69] More details can be found in Malwine Brée's *The Leschetizky Method*. New York: Dover Publications, 1997.

[70] Each session was two hours in length.

[71] Dorsal interrossei muscles are the muscles that occupy the space between the metacarpals.

wide hand position (e.g. diminished seventh chord). These exercises combined the fine motor movements of the fingers with the larger motor movements of the hand, arm and shoulder (e.g. lateral movements of forearm in broken chords). He also used techniques to "fool the brain," such as unusual fingering, variation of movements, and gradual increase of either force or speed. This phase usually took on average four to six months.

Like Tubiana and Chamagne, Boullet encouraged subjects to continue performing repertoire when possible, but avoid pieces that could aggravate the dystonia. In the third part of his retraining program, the "reprogramming phase," pianists revise their whole instrumental technique. Repertoire was used in this phase, with the same strategies learned from phase one and two: physiological finger movements, creative fingering, and mental practice. The strategies also included mental simulation of passages using all of the sensory modalities. Boullet would suggest suitable repertoire based on the progress of the pianist; a post-training video is made to compare the results with the first session. This phase generally took up to twelve months.

Affected pianists could return to the Hanover Institute for a follow-up "C major scale analysis," which would give an accurately scientific comparison to the original results. Boullet's method is unique, as he adapts the exercises to every individual. Moreover, he trains pianists to check themselves, which serves as a good ongoing tool in the recovery period. His usage of video recording and mirror imaging technique also allows the affected pianist to see the diagnosis from his perspective. As a pianist who has recovered from dystonia, Boullet is able to share his own frustrations and successes, which is encouraging to any pianist going through the rehabilitation.

Although half of the pianists showed improvement, there is no indication regarding how much they improved or any explanation of the lack of improvement in the other half. It may be that reducing musical performance to retraining of a simple five-finger exercise provide insufficient motivation for some. A similar problem arises, as we have seen, in Sakai's SDE program. Most musicians are anxious to return to performing, and the possibility of a long-term rehabilitation may also be discouraging for some. Although Boullet seems knowledgeable about physiotherapy and the psychology, he is not a trained medical specialist in either field. It would be beneficial to have specialists in these areas available to collaborate fully during the retraining period, as in Tubiana and Chamagne's program.

B. Rae de Lisle

Rae de Lisle is a Senior Piano Lecturer at the University of Auckland where she is also enrolled as a PhD student. Her teaching has produced many outstanding students, and during the last thirty years, she has developed a retraining method that has helped pianists overcome overuse injuries.[72] In the last five years, she has been researching focal dystonia. She has presented her research at the Aspen Symposium (PAMA), the Guildhall School of Music, the Royal Northern College of Music, the Australasian Piano Pedagogy Conference, the International Symposium on Performance Science, and at Hacettepe University in Turkey.[73] Her findings, published jointly with her colleagues Dr. Dale Speedy (sports physician and research fellow in the Department of General Practice

[72] Biography found on website of 10th Australasian Piano Pedagogy Conference, www.appca.com.au/keynote_rae.php [accessed July 12, 2010]

[73] Ibid.

and Primary Care, University of Auckland), Dr. John Thompson (epidemiologist/biostatistician in Department of Pediatrics, University of Auckland) and Dr. Donald Maurice (Professor of Music, New Zealand School of Music),[74] indicate that retraining methods differ from other treatments, as they require motivation and persistence from the musician; they have also found that the return to the previous level of playing is also possible when retraining is closely monitored. Although the pathophysiology of focal dystonia involves the cerebral cortex, their hypothesis is that the physiological aspect of playing the instrument is pivotal in the development of this condition.

The issue addressed by de Lisle is how to play correctly again. Many pedagogues stress the need to relax when playing the instrument but without giving specific instruction on how to play with minimum tension, which can be misunderstood. Pianists who undergo treatments that require rest who return too soon to the instrument will often experience reoccurrence of injury, because the body may "remember" the movement pattern that caused the initial injury. The neurologic pathways that have always been used may no longer be functional in focal dystonia, and new pathways may need to be established.

Because piano playing at the concert level utilizes highly repetitive movements, the body must work in the most biomechanically efficient way possible. De Lisle found that if the initial technique was biomechanically faulty, then repetitive motions executed

[74] Rae de Lisle, Dale B. Speedy, John M. D. Thompson, Donald G. Maurice, "Effects of Pianism Retraining on Three Pianists with Focal Dystonia," *Medical Problems of Performing Artists* 21, no. 3 (2006). (All information about the study in the following paragraphs is derived from the same publication).

over time might lead to injury. The aim of their study was to determine whether a specific pianistic retraining program resulted in physical improvement in pianists with focal dystonia.

De Lisle studied three pianists (one professional, two graduate level students) with medically confirmed diagnoses of focal dystonia. The medical diagnosis was made by a specialist neurologist or a sports physician with experience in focal dystonia. The subjects were asked to play repertoire that demonstrated their dystonia. Two subjective grading systems were used to evaluate the severity of the condition, taken before and after the study: the dystonia evaluation rating (DER) used to provide information about the smoothness of movement and evenness of transfer from one finger to the other; and the pianist evaluation rating (PER), which is used to assess rhythm, tone and freedom of expression (see Appendix 3).

The dystonic movements usually occurred in rapid passages, such as scales, arpeggios, and movements requiring crossing of fingers. The assessment of a pianist was based on one author's (de Lisle) opinion of balanced technique:

> The author believes that ideal pianist posture involves a four-point balance between ischial tuberosities[75] and the feet, enabling free movement of the body; active abdominal muscles that support the body, enabling the back to remain straight; shoulders dropped and relaxed; elbows and wrist floating and free of tension. Forearm is used for transferring weight from shoulder to hand without pressure; shoulders open freely without excessive ulnar or radial deviation of the

[75] Ischial tuberosities: rounded protuberances of the lower part of the ischium. They form the bony area on which the human body rests when in sitting position.

wrist; fingers should be close aligned to axes of keys as possible; metacarpophalangeal joints (MCP)[76] and interphalangeal joints (IP)[77] should be softly flexed and each finger should be released immediately after playing.

The subjects were asked to play and record on video three two-octave scales and diminished-seventh arpeggios with separate hands in the same keyboard location at a range of speeds (quarter=48 to 168). The subjects also recorded several repertoire segments that demonstrated their dystonia, and the subjects attended a minimum of ten one-hour retraining sessions over a period of two weeks.

The primary goal of de Lisle's retraining method was to eliminate unnecessary tension and optimize biomechanics (the movement of the limbs, and the mechanical properties of soft tissue and bones). The subjects were encouraged to become aware of their posture and to understand how to release each finger immediately after playing. Posture and unnecessary tension in arms and wrists were corrected at the beginning of the retraining and frequently during sessions. The session began by having the pianist become aware of how to play a single note with a mezzo-forte tone, using the weight from the arm. Each finger was aligned with the key, lifted from the metacarpophalangeal joint (the hand knuckle), and allowed to fall to the key. Following that, the first five notes of a whole tone scale beginning on E were played consecutively, legato, at a very slow tempo. Each finger was aligned with the center of the key prior to playing. The

[76] The metacarpophalangeal joint is formed by the reception of the metacarpal head in the shallow cavity of the first phalange.

[77] Interphalangeal joints: any of the joints between the fingers.

procedure was, “turn, lift, drop, release, listen and evaluate the tone, then turn for the next note.”

Their retraining sequence proceeded through the following steps:

1. Dropping of a single note (with a single finger)
2. Five note whole tone scale
3. Complete major scale
4. Wrist exercise
5. Slurred notes
6. Brahms Exercises (Appendix IV)
7. Diminished seventh arpeggios
8. Test Repertoire

When lifting, there had to be no tension in the hand – a relaxed opening of the hand at the metacarpal joint aided this. The tone also had to be resonant and full at a dynamic of mezzo forte. When the retraining exercise was too difficult for the dystonic hand, the technique was mastered by a non-dystonic hand. When difficulty arose from passing the dystonic finger to the compensating finger, unrelated conversation was offered as a mental distraction, which eventually removed the blockage and allowed the transfer between the fingers. A swing of the wrist was also recommended to overcome blockage.

After the five-note sequence was mastered, the retraining of scale work was begun, beginning with a slow B major scale in the right hand, ascending and descending three times in two four-note sections, finishing on the thumb before progressing to a

complete scale. D flat major was used for the left hand. The choice of these keys offered the easiest turns for either hand, because the longer fingers were on the black keys, and the thumb was below on the white keys (these same principles were applied to the initial E whole tone scale). The principles of playing a scale included: free movement of the hand when crossing under the thumb; a consistent hand level with the descending part of the scale moving in mirror image of the ascending; a supported ulnar border of the hand without the collapse of the metacarpophalangeal joints; release of the thumb immediately after playing; and the thumb crossing under the hand just before playing without unnecessary preparation.

An exercise to help free the wrist was also introduced: with the third finger anchored on a white key, the wrist then traced large circles in the air, clockwise and counter-clockwise with the non-dystonic hand followed by the dystonic hand. Another exercise was the dropping of single fingers from a height of about four centimeters (about one and a half inches) above the keyboard: the wrist was raised slightly above the level of the hand, falling to the base level of the key and then immediately released upward. All of the arm weight was dropped onto the finger, and the finger only left the key after the wrist had been released. The subject was also made aware of the quality of the sound, especially if it became harsh. The dystonic finger was only used after all the other fingers in each hand had achieved the routine easily. Following this, the subject was taught to drop two, three and four notes (fingers) simultaneously.

The slur was introduced next: the subject dropped each finger and lifted off the next consecutive key, with the wrist leading the movement. The wrist began above the level of the hand and then moved forward and up until the fingers naturally left the

keyboard. The number of notes within the slur was increased to include three, four and five notes. Minor thirds were then played with consecutive fingers; the subject moved the wrist with a convex downward swing to align the finger with the key, before lifting freely and dropping on to the key. Each movement between consecutive minor thirds was repeated three times, with the digits swinging side to side. The subject repeated the exercise chromatically, ascending with the right hand and descending with the left hand; this proved useful for separating the dystonic finger from the compensating finger. Following this, Brahms' Exercise No. 7 was used for practicing releasing each finger after playing, and the subject was encouraged to open the hand from the chromatic position after playing each note (see Appendix 4). Brahms' Exercise No. 8 was used to separate fingers and give awareness of alignment (see Appendix 4). Diminished seventh arpeggios played at a slow tempo were also introduced.

The principles of technique included: alignment of each finger with the key before playing; release of each finger after playing (with the hand closing after each note); a supported fourth digit metacarpophalangeal joint to allow the thumb to pass under freely without lifting the wrist; immediate relaxation of the thumb after playing (especially when the crossing the fourth digit); and a convex downward swinging movement of the wrist after crossing over the thumb. The support of the metacarpophalangeal joint, when necessary, was reinforced by having the hand rock forward on the key without raising the wrist. When the above techniques were mastered, the scale tempi were gradually increased.

The work on the original test repertoire began at very slow speeds, and new techniques were applied to these passages, working one hand at a time. The progression

to faster tempi was only allowed after the techniques were perfected at the slower tempi. The study also found that reading a score reduced the quality of the movement, and the authors encouraged the use of memorized repertoire before the exercises were attempted. The methods used to increase the tempi in test repertoire included stopping on different notes within the phrase to check hand alignment and release, actively moving the dystonic finger away from the compensating finger, playing groups of notes at the speed of one arm fall, and beginning with three or four notes and adding notes one at a time until the passage was complete.

The three scales, the diminished-seventh arpeggio, and the test repertoire were re-recorded after the tenth session of training and after further sessions when needed. The original scales of evaluation and the dystonic hand identification evaluation scale were used to measure the results by a blinded pianist. All subjects showed improvement, and subjects also reported an improvement using the DER and PER self-rating systems. Although there are other retraining methods available, the authors claim this study to be significant as it uses a scientific method to record the results.

In all of the subjects, they found a lack of support at the metacarpophalangeal joints, and they believe this is where the dystonic cramping begins. The authors also believe in beginning the rehabilitation with sound, as this allows the pianist to monitor his or her own sense of postural balance (assuming a good balance would produce a good sound). They found that all three pianists were more aware of their sound than their posture, which made it easier to self-check. Although in the approaches by Chamagne and Taubman and Taubman recommend not playing the piece that stimulated the

dystonic movement, the authors of this study found that the old repertoire served as a good measurement tool.

Because all studies have found that motivation was important for full rehabilitation, the authors found the subjects needed to have a minimum of ten consecutive days of retraining to notice the subtle changes in fine motor coordination. They found that within ten days the subjects were able to achieve noticeable improvements, which was highly encouraging. It was essential for each subject to see progress in order to make a full recovery.

De Lisle also found that the scale playing improved in the dystonic hand to a level greater than the non-dystonic hand prior to retraining. The implication is that the overall pianism was improved in each subject through the retraining process. They hypothesize that the retraining improved scale pianism by establishing a balanced posture, refining the movement patterns so that the fingers were aligned with the keys, removing the tension in the wrist and forearm, maintaining freedom of movement in the elbow and shoulder, enabling the fingers to carry the weight of the arm, and releasing each note immediately after playing.

De Lisle asserts that although focal dystonia is a neurological disease, the muscular level is also crucial in the development of the condition. The stress of the previous movement patterns causes the enlargement of finger representations in the cortex, and the only way to recover is to establish new connections by retraining the technique. The authors acknowledge that the exact mechanisms by which pianism

retraining corrects the focal dystonia is unknown and requires more research, but they think that it is possible that new neural pathways can be established.

The study of de Lisle is most promising as it is a collaborative work between a piano pedagogue, a sports physician, a biostatiscian, and a performance/music therapy professor. It uses scientific data to measure the results, although the results are limited as only one pianist measured them aurally. The study also provides detailed description of hand positions and exercises used; perhaps what is most difficult to document is sound quality and the actual sensation of playing (movements may appear to look correct but may still be uncomfortable or painful to execute). Although they found it essential for subjects to see progress in order to make a full recovery, a complete recovery was not indicated in this study. The strength of this study lies in its expounding of the technique of learning from the "healthy" hand, using a slower tempo for recovery (as in Sakai's study), and careful monitoring and observation. This program, however, is difficult to duplicate without trained professionals working in collaboration. Furthermore, only three subjects were used in a span of ten days; a more diverse spectrum of pianists with focal dystonia for the results to be more conclusive.

C. Comparing Approaches

The Taubman Approach and de Lisle's study are based on the same principles of balance and alignment, but how they differ is their approach to movement. The Taubman Approach supports a more detached, staccato-like movement while de Lisle et al. uses a more traditional, legato movement in rehabilitation. Both employ that the thumb should be released immediately after playing. Because the Taubman Approach uses only new

repertoire, it is difficult to compare the improvement rate of focal dystonia without a scientific method based on before and after retraining. The Taubman Approach does not emphasize the support of the metacarpophalangeal joint (which de Lisle, Tubiana and Chamagne acknowledge to be weakened in focal dystonic hands); rather, it emphasizes rotation, using the supernator and the pronator. Boullet's method is comparable to de Lisle's as it emphasizes the drop and release of individual fingers, repairing the finger representations in the cortex, and uses the C major scale analysis to measure scientifically the results. Both de Lisle's approach and Boullet's method utilizes collaboration with the medical community, and scientific evaluation to measure results. The Taubman Approach would also benefit from collaboration and scientific evaluation; currently the effectiveness of recovery from focal dystonia is based on the veracity of the testimonies.

IV. Pedagogical Retraining from a Performer's Perspective

Prior to the full acknowledgement and treatment of focal dystonia by the medical community, two different pianists sought to solve their problems individually through disciplined self-retraining. Catherine Merena Baird wrote in 1986 about her personal experience as a pianist with a "devastating organic neurologic disease of the peripheral nervous system, involving recurrent sensory and motor impairment of the upper and lower extremities": her experiences are published in the *Medical Problems of Performing Artists*.[78] Hung Kuan Chen, a celebrated concert pianist, developed focal dystonia

[78] Catherine Merena Baird, "A Pianist's Techniques of Rehabilitation," *Medical Problems of Performing Artists* (1986). 128-30.

following a right hand injury in 1992. In an online article,[79] he identifies the careful steps he took for his full recovery from focal dystonia. Despite the lack of help from the medical community, it is interesting to see how both pianists were able to find similar retraining methods during their self-recovery.

A. Catherine Merena Baird

Catherine Merena Baird was an American pianist and teacher (1944 -1999).[80] Although there is little information to be found about her, her story of self-retraining is worth reviewing in light of the retraining methods used today. In 1974, Baird began experiencing numbness ascending from her feet to neck, which eventually reached her fingers, forearms and upper arms.[81] After numerous tests a clear diagnosis could not be established, and she returned home unable to do simple daily activities, such as holding or dialing a touch-tone phone, eating, brushing her teeth, or even writing her name. She closed her piano studio of twenty-five students and cancelled all upcoming performances, and dedicated herself to self-retraining through a keyboard practice schedule.

Baird owned a clavichord, and chose this as the instrument to begin practice sessions. The clavichord had a light and even action, a key depth of 3/8 of an inch, delicate expressive tonal qualities and dynamic range, and a direct relationship between

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[79] Hung Kuan Chen. "My FD Story." Musicians with Dystonia Bulletin Board. http://www.dystonia-bb.org/forums/mwd/uploads/My_FD_story.doc (accessed July 1, 2010).

[80] Found at: <http://library.wustl.edu/units/music/necro/1999.html> [accessed June 29, 2010]

[81] Baird, "A Pianist's Techniques of Rehabilitation." 128-30. (All information about Baird in the following paragraphs is from the same publication).

the finger, key, tangent and string. Baird found the physical power needed to depress a single key on a triad was minimal, and that gave the chance to reawaken the "musical impulse" in retraining the muscles of the shoulder, arm, and hand by playing lightly without the strength that is needed to depress keys on a grand piano.

She was extremely disciplined: the first practice sessions lasted three to ten minutes in duration, and after four to six weeks of gradually increased time on the clavichord, she was able to move to an upright piano, and then eventually, to the grand piano. The entire process took approximately three months. Her entire recovery took about two years.

Her routine began with a practice in the morning, following a light breakfast. She acknowledged that the return to the keyboard was both a challenging and emotional experience, and found it important to have a supportive person be with her for encouragement, especially during the first several weeks. She began by sitting quietly at the instrument, touching the surface of the keys with her fingertips in all areas of the keyboard. She did not have a full awareness through the sense of touch, and therefore, could not feel the keys very well. She played up and down on the white keys, first with the right thumb, then with each consecutive finger, much as a child would discovering the keyboard for the first time. Slowly and gently, each finger produced a sound as the brass tangent met the corresponding string. After re-exploring the keyboard in this way, she tried to form each hand in the shape of a fifth, because this interval seemed to be the easiest and most comfortable. The approach was to drop into the keys from the surface, lowering the wrist slightly, and then raising the wrist while striking the third finger. She attempted this exercise slowly five or six times ascending to higher notes in each hand,

and then rested. When the exercise became difficult, she would grasp two softer rubber or knit balls about the size of an orange, and this helped her regain a feeling for the hand position. She found that holding the balls encouraged the muscles to produce a curved arch in each hand. She acknowledged that the progress was slow in the beginning, and much patience was needed.

Baird kept the upper body as free from tension as possible, with the forearm remaining quiet, wrist supple and fingers poised. The objective was to invigorate and recall the coordination of hands separately and together by playing beginner pieces that were so well known that they could be played a moment's notice. The author used beginning music pieces that she could recall by memory, but made sure she did not try immediately to play them in a musically sophisticated performance because failure could bring a relearning block.

Baird used a relaxed tempo and employed a firm touch and straightforward, non-interpretative style. She paid careful attention to the use of correct fingerings, and then added strong contrasts of tempo, dynamics and articulations as simple musical goals. After several repetitions, the flow of performance returned in the coordination between her hands. Sometimes this only occurred in the easier sections. She tried to find parts of several pieces that could be played through in this manner, rather than be tempted to learn all the notes of one complete piece before going on to another.

As soon as each selection could be played through more or less steadily, even if not quite up to tempo, Baird would alter the execution of the sections by arbitrary dynamic changes not found in the score, and vary the tempo from each section or at its

repeat. She also used contrasting articulations in touch, first playing with a rather loud, overly articulated assertive tone, then in the repeat using less loud, bland but very legato approach. When one piece would go rather well using various basic approaches, she tried to play the whole section or piece as musically and stylistically correct as possible, using the best touch that she could. She would then stop practicing that section or piece, accepting musical synthesis as the best achievement for the day.

Using music from the beginner and intermediate repertoire during the early part of her recovery period was beneficial to Baird, as it freed her from the technical demands of more difficult works. She avoided over-exercising what she considered to be her musical intellect in more complex music because both of these demands would tend to block the reawakening flow of coordination that had become instinctive during the previous earlier training. She also found that a more passive mood or attitude maintained during daily practice in the early stages of rehabilitation produced a more effective recovery in the long run.

Even though the practice sessions were kept short, they were intense, and she found that regular exercise at the swimming pool, employing large and small muscle groups in a relaxed way, seemed to soothe her physically and emotionally and left her feeling refreshed for the next day's practice. In particular, she spent many months of daily swimming on her back with a light "Frisbee" in each hand. Using a gentle scooping motion, she slowly traversed the pool to help build the upper body strength and coordination. She acknowledged other types of exercise could probably have been used to achieve a similar effect.

After four to six weeks on the clavichord, she "graduated" to a studio upright piano action of light to medium weight for one-half hour or more playing per day. She reviewed the entire process as described on the clavichord over a period of two weeks, then selected a more advanced memorized piece from her repertoire, such as the first movement of the Beethoven's Sonata in C sharp minor, Op. 27, No. 2. This piece demanded the use of motoric material with constant repetitive patterns, and she found that she was able to increase her practice time to forty-five minutes, with rests taken when fatigue was evident. She would then add four-octave scales in comfortable keys, a selection of Hanon's Exercises from Books 1 and 2 became important for daily use. She never pushed beyond the first signs of fatigue but rather rested for several minutes and then resumed practicing. Pieces from lower advanced repertoire were also played during this stage, and on every third day, she found it useful to practice the repertoire that had been relearned on the clavichord.

When Baird seemed ready to read new or old repertoire from a score, she found this to be the appropriate time to approach the grand piano and resume a more normal practice schedule of about one hour duration, with rest periods. The grand piano action took some time to get used to again and required patience during the process of re-acquaintance. This was the time that she spent concentrating on problematic areas of technique that did not feel completely normal. For example, the right thumb had not regained complete sensation and seemed awkward and inarticulate. To correct this, Baird encouraged the right thumb to "learn" from the left thumb, which was functioning normally. In particular, she used Hanon's Exercise No. 32 in which thumbs and second fingers alternate in a similar motion up and down the keyboard. The small amount of

work produced encouraging results, and she followed this exercise with Hanon's No. 33-36 Exercises. She practiced chromatic scales in contrary motion, with the left thumb beginning on middle C and the right thumb on the E above, so that each played black or white keys together, and major and minor scales in contrary motion. She also constructed chordal studies that worked well to restore fluent and graceful lateral motion of the forearms and upper arms, and the suppleness of the wrists. Another example of exercises she used was the first exercise from Joan Last's *Freedom Technique,* Book 2.[82]

Baird found that playing unsophisticated music literature learned during childhood thoroughly reawakened the musical impulse in the performer's mind. The musical impulse allowed sufficient time to reassert itself through physical mechanism by playing simple melodies and harmonic structures, allowing the performer to be ready to exercise talent and training again on previously learned advanced musical literature. Although Baird did not have a physiotherapist, her own initiative to swim and use objects (such as a ball) to help regain her hand position were effective ways in regaining her physiological sense; her careful self-monitoring and learning from her healthy hand (as in de Lisle's study) aided her retraining when exercises became difficult; mostly, her emphasis on keeping a positive mind and letting go of her perfectionist attitude was most likely influential in her self-recovery.

B. Hung Kuan Chen

Hung Kuan Chen is a pianist born in 1958 in Taiwan and raised in Germany, who concertizes today. He was a prizewinner in the Arthur Rubenstein, Busoni, Queen

[82] Joan Last, *Freedom Technique, Exercises and Studies,* Book 2 (New York: Oxford University Press, 1971).

Elizabeth, Van Cliburn and Chopin competitions and in 1991 was a recipient of the Avery Fisher Career Grant. He is currently the chair of the piano department at the Shanghai Conservatory of Music and was also on the faculty of Boston University, New England Conservatory Preparatory Division, and Distinguished Artist in Residence at the Mount Royal Conservatory in Canada. In his autobiography, Hung Kuan Chen recounts his recovery from focal dystonia in 2003 by his performing of the following repertoire: Tchaikovsky's First Concerto, Op. 23; Brahms' Second Concerto, Op. 83; Bartok's Second Concerto, Sz. 95, BB 101; and Rachmaninoff's Third Concerto, Op. 30. He also recorded two solo recordings post-recovery: Beethoven's *Hammerklavier* Sonata, Op. 106, and Rachmaninoff's Second Piano Sonata, Op. 36.

As with Baird, Chen found little help from the medical profession when he was first injured in 1992. He did not have health insurance or the income to support the high cost of doctors' visits, and according to Chen, the medical profession at the time was still confused and puzzled by focal dystonia, and so he decided instead to initiate his own research, his rationale being that no one would know his hands as well as he did.[83]

In his approach, instead of learning new techniques to compensate for the injury, and he chose to "unpeel the onion," of uncovering the layers to get back to the original state of playing. He realized that in order to recover from focal dystonia, he needed to access the original memories of performing, those prior to the onset of focal dystonia. He credits his experiments to the influence of Professor Regina Seidlhofer of the Vienna Musikhochschule, who worked in collaboration with researchers on memory retention.

[83] Hung Kuan Chen, "My Fd Story." (All information about the Chen in the following paragraphs is from the same publication).

According to the studies of Seidlhofer et al., the muscular memory cannot be erased easily. Therefore, Chen assumed focal dystonia to emanate from a newer set of memories and for the process of retraining, he needed to uncover an older set of memories.

Chen began his experiments by waking up in the middle of the night and playing the piano half awake. The first minute or two, the hands were fine, but as soon as the mind and body woke up, the focal dystonia would set in and he could see how his fingers would start to curl up one by one, and eventually Chen could no longer play. By observing the onset of the dystonia, he noticed a progressive process: his fingers curled up one at a time.

From an anatomical point of view, Chen learned that there are two general types of nerves: the sensory nerves and the motor nerves. The motor nerves move the fingers, and the sensory nerves are responsible to relay the information back to the brain for location, touch, etc. at the same time. The simplest movements required complete coordination between all the muscles and sensory nerves to be effective. He found different levels of thresholds (the points where he could play without dystonic movements) within his sensory information that were sent to other muscles at different thresholds. He found it to be possible to detect each threshold using "focused concentration and strong mind power" to clear away the newly formed dysfunctional set of memory. For example, he did this: while pressing the third finger down, this caused the fourth finger to twist and climb over the third. As a result, he found the threshold where he could press the third finger down with minimal force without the other fourth finger twisting or climbing, and used visualization techniques to relax the other muscles.

Chen consulted a book on anatomy and figured out which muscles were responsible for which movements. Part of his visualization was aided by using colors (for example, red for tension and green for relaxation). With repeated exercise, his third finger eventually would travel without the participation of the fourth finger, and gradually built up strength.

The difficulty was to never go beyond the threshold. He even practiced on different kinds of buttons before moving on to the keyboard – an old remote control, for example - and then slowly increased the pressure. He began in the upper register of the keyboard (where the weight is slightly lighter than the lower register) and sometimes, without looking. An additional difficulty was not getting emotionally involved, as he feared this would make the recovery more complicated. Chen would walk away from the piano at the slightest anxiety and relaxed himself before going back. Before long, he was able to play all five fingers cleanly, and then practiced various positions and combinations, allowing the brain to recognize and register the different movements. After four months of not playing at all, he performed Shostakovich's First Piano Concerto, Op. 35, at Boston Symphony Hall in 1995.

Chen also used a few difficult etudes to measure his ability and recovery: Chopin's "Chromatic" Etude in A minor, Op. 10, No. 2 and Liszt's *Feux follets* (Transcendental Etude No. 5). He used the metronome mark as a guide to measure against his prior performance speed, and he decided that he had arrived at complete recovery when he reached the metronome marking of 138 for both etudes, which was approximately the speed he was playing before he had focal dystonia.

Chen believes in the role of the medical community plays in helping musicians, and hopes that with more data the doctors will be able to resolve cases of focal dystonia more successfully. According to Chen, until there is a medical cure for focal dystonia, one's own observation and willpower is vital in the search for answers.

Chen doesn't believe in a "miracle cure", but there are two treatments that helped him: cupping[84] (a technique used widely in Asia, Latin Americas and Greece, which gives instant relief to the muscles and tendons in the areas that are tense) and cetyl myristoleate, a fatty acid sold mostly as an arthritis treatment at natural food stores. Although he did not have arthritis, after taking this he found he was able to triple his playing time. He took this supplement for five years and is still not sure what the role it played in his recovery, but it did help his morale and gave him extended time to retrain.

Chen found that soft touch practice was just as effective in retraining his fingers than traditional loud and hard playing of mechanical exercises. He found that healthy movement at the keyboard could be regained: the key was to perform the movements extremely slowly with full concentration, and if necessary, to work at a troubling spot with minimum pressure for a long time, so that the brain can register the movements properly. He now uses visualization to learn music.

His current repertoire is extensive. He received a standing ovation at his Carnegie début concert in 2008[85] where he performed Messiaen's "Le baisser de L'Enfant-Jesus"

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[84] Cupping refers to an ancient Chinese practice in which a cup is applied to the skin and the pressure in the cup is reduced (by using change in heat or by suctioning out air), so that the skin and superficial muscle layer is drawn into and held in the cup. www.itmonline.org/arts/cupping.htm [accessed July 12, 2010]

[85] The author was present at the concert.

from *Vingt regards sur L'Enfant Jesus*, Schubert's Sonata in B flat major, D. 960, and Beethoven's "Hammerklavier" Sonata in B flat major, Op. 106. His encores included "Ondine" from *Gaspard de la Nuit* by Ravel. It was evident that he had no technical difficulties performing the demanding repertoire, and the audience showed its appreciation with a full house standing ovation.

C. Conclusion

Both Baird and Chen had similar approaches to their retraining: they started playing with the lightest touches possible (for Baird it was the clavichord and for Chen it was the upper register of the piano); they both immediately stopped as soon as they felt fatigued or when they were "pushing the threshold"; they both used their own old, familiar repertoire as "testing ground" to monitor their progress and improvement, and recognized a "musical impulse," "performance flow" or coordination which had disappeared during their injury. Both acknowledged the re-exploration of playing (rethinking of all movements used), and the slow, sensory awakening process of simply depressing a key. What both found to be essential in the recovery were extreme patience, will power and suppression of negative emotion during the retraining period – this seemed to reduce any blockages between the hands and the brain. And both, in their own way, acknowledge that anxiety and perfectionism were obstacles in their way to recovery.

The differences were few: although both simplified and reduced their practicing, Baird decided to go back to elementary and intermediate repertoire, while Chen worked on sections of concert repertoire, but at a slow tempo. Baird graduated her physical recovery progress with change of instruments: from clavichord to upright to grand piano,

whereas Chen used the tempo of the Chopin's "Chromatic" Etude and Liszt's *Feux Follets* as his guide. Baird practiced swimming to strengthen her upper body, and used a rubber ball to regain the shape of her hand position. Chen used cupping and the possible placebo effects of a natural arthritis drug in his recovery. Baird tried to recapture the enjoyment of "playing" the piano, and Chen devised a clear visualization tool to help him overcome difficult passages. Chen's experiment of "uncovering the original set of memory" is similar to that of Sakai's method, where he reduced the speed of performance to a level below those memories associated with focal dystonia.

Although Baird and Chen seem to be exceptional in achieving results through self-discipline, one wonders how many musicians with focal dystonia were left frustrated after trying numerous self-recovery methods. The personal stories of Baird and Chen provide insight on how self-motivation and monitoring could help overcome the difficulties of the condition, thus providing insights that are insurmountable to the medical and pedagogical communities. Finding a source of motivation and utilizing it fully seems to be the common thread in all the pedagogical retraining methods, as well as a willingness to learn or re-learn a new technique.

CHAPTER THREE

The Performance Profession

The performance profession consists of the artists currently performing in the world today. They are expected to perform flawlessly, which makes them just as susceptible to injury or pain as students in music institutions. They are bound by contract and personal integrity to give audiences their best performance; when there is an injury, cancellations are necessary which could lead to loss of both income and reputation. Although this stigma is still very much evident today, we are fortunate that artists like Gary Graffman and Leon Fleisher are willing to talk candidly about their experiences with focal dystonia.

I. The Role of The Performance Profession

The performance profession has a difficult role among the medical and pedagogical professions in contributing to the cure of focal dystonia. Musical institutions typically train future virtuosos, competitions single out the winners, and agents strive to recruit them for the business of music. Recordings, likewise, have also pushed our expectations of perfection to such a degree that wrong notes are simply no longer acceptable. The performer is under pressure to succeed, to compete in an already difficult market, and to make superhuman accomplishments seem effortless in every performance. Pain and disability are, by necessity, downplayed or ignored.

The musical institution breeds competition among all the young performers, beginning with the entry audition: within minutes, a performer has to prove his or her virtuosity, musicianship and other abilities to a jury of faculty members, many of whom

may have conflicting ideas on what constitutes a good audition. The audition does not allow for holistic understanding of a work; rather just a snapshot of excerpts, which the performer may or may not perform successfully within the limited timeframe. The demands of the entry audition are replicated throughout the period of study: one must audition for more performance opportunities, scholarships, master classes and studies with a specific teacher; then one must audition all over again at the year-end juries. The stresses of these auditions, in addition to the self-perfectionist attitudes of many musicians, lead to unnecessary anxiety. This structure of a musical institution may lead to unnecessary cases of focal dystonia. A successful audition does not necessarily equate having a successful career in music.

Within the musical institutions, however, performers do have a potential advantage over the medical and pedagogical profession: their public voice. Until recently, most performers would not publicly acknowledge their struggle with pain or injury in fear that it could impend their career. Leon Fleisher was one of the first pianists to acknowledge publicly his inability to perform with his right hand, simultaneously alleviating the stigma of seeking professional help for an injury and challenging the medical profession for answers. Musical institutions seem to be slowest to respond, with only a small percentage of schools offering health courses for musicians (taught by qualified teachers) and even fewer with direct access to qualified musicians' medical doctors (see Appendix 2). The performance profession, with its visibility and fame, could potentially demand more research coupled with physiological and psychological training in all the worlds' finest institutions, and expect the public to do the same.

The first documented case of a performer with focal dystonia is most likely found in Robert Schumann's (1810 – 1856) own diary entries from around the period of 1831 to 1832.[86] During this period, Schumann was under considerable stress after leaving law school to pursue a career as a pianist. Schumann's teacher, Friedrich Wieck was on tour with his daughter Clara Wieck, and Schumann was left to his own devices to strengthen noticeably weak second and third fingers of the right hand with his "cigar mechanics" creation (an apparatus for his finger).[87] Schumann's experiments with this contraption lead to a "completely stiff third finger" and his piano composition from this period, the Toccata Op. 7, reflects the absence of the third finger in the right hand, despite the virtuosic style (see Appendix 4).[88] During this period, Schumann, the pianist, turned to improvisation at the keyboard, and the German conductor, composer and music writer Hironymus Truhn (1811-1886) describes Schumann's performance from 1837: "He moved his fingers with an almost frightening speed, as if ants were crawling around on the piano; he played his own things – I honestly never heard anything else from him – with only very little accentuation, but with lots of usage of both pedals. In the last instance, one naturally must not find a lacking of taste; he only played with as much pedal as needed to help a not so grand piano."[89]

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[86] Eckart Altenmüller, Mario Wiesendanger, Jurg Kesselring, ed. *The End of the Song? Robert Schumann's Focal Dystonia*, Music, Motor Control and the Brain (New York: Oxford University Press, 2006). (All information regarding Schumann in the following paragraphs is from the same publication).

[87] Ibid.

[88] Ibid.

[89] Ibid.

It is apparent from Truhn's description that Schumann was compensating for his injury: by performing his own works and improvising, he could accommodate to his injured hand and the over-pedaling would accommodate his lack of sound. As in the case in modern diagnoses of focal dystonia, physical pain is never mentioned in any of these entries. And not unlike most pianists who are misdiagnosed today, Schumann tried numerous medical treatments including rest, diet, electricity, even bathing the hand in animal blood and homeopathy[90] – as we know, none of these treatments worked.

Today, focal dystonia has been brought to awareness of the public by the celebrated pianists Gary Graffman and Leon Fleisher. It is interesting to note that both pianists continued fulfilling musical careers despite having focal dystonia: Graffman began teaching, directing, and performing works for the left hand alone, and Fleisher, likewise, taught, conducted and learned left hand repertoire.

Graffman's injury dates from the spring of 1967, when he was performing the Tchaikovsky Piano Concerto No. 2 with the Berlin Philharmonic. The piano was particularly dull and he remembers "whacking" the keyboard with his fourth finger in his right hand. He ended up spraining the fourth finger, and had to re-finger his octaves with the thumb and third finger for subsequent performances. That was where the problems began.[91] The new re-fingering was effective and loud for octaves, and became a norm for Graffman; once, Eugene Ormandy even jokingly said, "You're drowning out my

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[90] Ibid.

[91] Jennifer Dunning, "When a Pianist's Fingers Fail to Obey," *The New York Times*, June 14 1981.

orchestra!"[92] It wasn't until much later, when Graffman showed his new fingering to his friend, Eugene Istomin, that he realized he had been compensating all along.[93]

Graffman admitted the existence of his injury in a *New York Times* article in 1981[94]that became a catalyst for musicians all over to seek treatment for their injuries. Although Graffman chose to discontinue treatment at one point, he has continued to live a full musical life. In addition, he enrolled in post-graduate classes in Asian art at Columbia University, and pursued a second career in studying and collecting Asian art. In the interview with Graffman that follows, he explains his frustration and his reasons for discontinuing treatment, but nevertheless, living a fulfilling life in music.

According to Rick Schultz, Graffman's one hand often sounds better than most pianists with two.[95] In addition to the Ravel's Concerto for the Left Hand, he has found a career performing Max Reger's Four Special Studies; Carl Reineke's Sonata Op. 179; the Brahms Chaconne from the Bach's D minor Partita; Leon Kirchner's "L.H." (1995, commissioned by Fleisher); Alexander Scriabin's Prelude in C sharp minor, Op. 9 No. 1, Nocturne in D flat, Op. 9, No. 2, and Etude in C sharp minor, Op. 2, No. 1 (arranged by Jay Reise); Felix Blumenfeld's Etude in A flat; Chopin-Godowsky Etudes No. 13 in E flat minor and No. 41 in B minor; John Corigliano's Etude No. 1 from *Etude Fantasy*; and Federico Mompou's Prelude No. 6.

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[92] Gary Graffman, interview with the author, July 7, 2010.

[93] Dunning, "When a Pianist's Fingers Fail to Obey."

[94] Ibid.

[95]Rick Schultz, "For Gary Graffman, One Hand Is Enough," *Los Angeles Times*, October 9 2007.

Fleisher made his Carnegie Hall revival performing with both hands in 2003, after nearly forty years of playing with the left hand alone due to dystonia of the right hand. His story begins long before Graffman's diagnosis in 1981; it was in 1963 when he first noticed the curling of the fourth and fifth fingers of his right hand while practicing Schubert's Fantasy ("Wanderer") in C major, D. 760. He tried to play through the initial pain. Eventually the entire hand curled uncontrollably, and then there was no pain. Doctors were equally confounded by his hand, and could offer no solution to the problem. Like Schumann, he tried everything "from A to Z: acupuncture to Zen meditation."[96]

Fleisher was not diagnosed correctly until 1991, when he consulted with Dr. Mark Hallett of the National Institutes of Health. During this time he had weekly treatment of a deep tissue massage called Rolfing,[97] before Botox could be injected into his forearms. In 1995 he returned to the concert stage playing with both hands, followed by a Carnegie Hall concert in 2003 and the release of the recording *Leon Fleisher: Both Hands* (Artemis Classics, 2004). He is an advocate on the issue of focal dystonia and is currently a member of the Musicians with Dystonia Advisory Board, founded in 2000 under the auspices of the Dystonia Medical Research Foundation, and has made a personal mission to tell his story at medical and pedagogical conferences; the proceeds of his 2004 recording are dedicated to dystonia research.

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[96] Holly Brubach, "The Pianist Leon Fleisher: A Life-Altering Disability, Reconsidered," *The New York Times*, June 12, 2007.

[97] Rolfing is a form of hands-on manipulation and movement education developed by Ida P. Rolf over fifty years ago and works on the connective tissues to release, realign and balance the whole body. Information found at: http://www.rolf.org/

As of today, Fleisher also performs widely. Critics show respect and admiration for his comeback, although occasionally they still criticize him for missed notes in fast passages. Many agree that his performances have taken on a more spiritual quality, but his performances are still unpredictable, as he is not fully cured. Although he acknowledges his limits, his return to the stage has raised consciousness of focal dystonia research.

His repertoire choices have also changed due to focal dystonia. He avoids anything too "scaly" and tends toward repertoire that is more "chordal." His signature piece is J. S. Bach's *Sheep May Safely Grace* (Cantata No. 208) arranged by Egon Petri. He also performs Brahms' Piano Quintet, Op. 34, various piano duets and solo works that demand less virtuosity, including Debussy's *Claire de Lune*, Chopin's Nocturne in D flat major, Op. 27, No. 2, Schubert's B flat major Sonata, D. 960, Beethoven's *Für Elise*, and Scarlatti's sonatas.

Pedagogically, Fleisher has had to develop a finer ability to communicate verbally, rather than through demonstration; he also refuses to teach a method of "mindless repetition." He says, "Whatever you do with your fingers and your hands must be in the service of an idea and an ideal that you hear in your head before you play. If before you put the key down for a single note, unless you have a goal for that note, it's an accident." In his own words, he has become more serious, more precise, and more specific. He had to learn how to put into words things that are very ephemeral.[98]

[98] Holly Brubach, "The Pianist Leon Fleisher: A Life-Altering Debility, Reconsidered," *The New York Times*, June 12 2007.

In the interview with Fleisher, he talks more in depth about his views of competitions, recordings, teaching, practicing, instruments, the role of the performer and the institution - and how all this could lead to focal dystonia but also a possible cure. I was pleasantly surprised that many of his opinions were in accord with my own conclusions, but what I found most fascinating was how all this was summed up by his philosophical view of music. The change needed, essentially is a larger, societal change in the way we perceive music – one that is focused more on the business of music and less on the music business. This change in attitude could ultimately prevent cases of musicians' injuries, especially of focal dystonia.

II. A Performer's Perspective: Interview with Gary Graffman

New York City, July 7, 2010, 5.30PM

JW: I read your book.[99] I learned a lot about you from it.

GG: Although I wrote that book before I started having any problems. In fact, writing the book was the beginning of the problems, but at that point I never heard of focal dystonia. I knew I was having problems, but I had no idea I wouldn't be playing again. I was just in the midst of seeing doctors while that book was being written.

JW: From what I read, there were two major things that I think you did that changed the lives of musicians today: one was in the '60s, when you made a stand to not perform for

[99] Gary Graffman, *I Really Should Be Practicing* (New York: Doubleday & Company, Inc., 1981).

segregated audiences, and the other was your "coming out" in the *New York Times* article from 1981,[100] and announced that you had this injury.

GG: Well, coming out was necessary – I had cancelled two hundred concerts, about a hundred concerts per year, and they were booked far ahead of time, so I couldn't say I had the flu!

JW: I think that moment changed many people's lives.

GG: Well, that's true. If it weren't me, it would be someone else six months later. But I was sort of the catalyst - but I wasn't helped by the way. [It was] thanks to the doctors at Mass[achusetts] General [Hospital]: Fred Hochberg, Robert Leffert, Bhagan Shahani…Bhagan Shahani (who was Indian obviously) was the head of the neurophysiology department of Mass. General. He didn't have patients of his own, he worked with animals mostly (chimpanzees), but he was in charge of interpreting the electrical tests that the other doctors did. So the three of them made me into an experiment to study. Hochberg is a specialist in brain cancer, who was also very interested in music. So they made me a special case: I got an apartment there, at the back of Mass. General, for about a year, where I spent two days a week. They gave me a piano and they put a biofeedback machine in the piano, and the three doctors came and worked with me and I got to know them very well. I wasn't charged anything for this either. That was one of the first times anything was done for so-called "music medicine" as opposed to sports medicine. And then when the article appeared, they got an ocean-flood of patients within a few months – they got calls from all over the world because of

[100] Dunning, "When a Pianist's Fingers Fail to Obey."

that article[101] and at that time [Massachusetts General] was the only hospital working on this type of thing. Now it's still incurable, on the other hand, perhaps if you get it early, you can maybe not get worse, possibly better.

In my case, it was too far-gone. I was older, about fifty, and the first twenty doctors all gave me opinions, which had to do with their specialties. A very famous doctor who was involved in Parkinson's – he told me I had Parkinson's. I [asked] him "Shouldn't my left hand have it too then?" and he said, "Well, it has to start somewhere." He wasn't at all interested, except to prove that he was right. He said *because* I played the piano, I was able to discern these really small things before a normal person would. So he gave me Sinemet, which is what they prescribe for Parkinson's. And he said, "That will probably keep it under control, and maybe you'll be able to play, but it won't cure it, and it'll get worse eventually. So take it for eight weeks and then come to see me, and call me if there are any side effects." So I called after four weeks and told him I didn't have any side effects whatsoever, but it has absolutely no affect, better or worse. He said, "Well, in that case, it's not an emergency, so I'll see you in four weeks." So he saw me again, and said, "Well I guess you don't have Parkinson's." So he had absolutely no interest at that point [in] recommending anything else. Now most of the other doctors were not that cold-blooded, but they did not help me.

With Leon [Fleisher], his problem started at [age] thirty-five, rather than fifty. So of course, they thought musicians were all a little crazy, and it must be a mental thing.

[101] Ibid.

So they sent him to a psychiatrist and so forth, and then he gave up on doctors at that point.

When these people (the doctors at Mass. General) were so desperately wanting to help, I called Leon, and he joined me up there. There's a big difference: Leon is one of my closest friends, I've known him since we were sixteen years old – but we're very different in certain ways. A slight exaggeration: if Leon hears there's a witch doctor in Congo, who helps people, he'll be on the next plane out there. I'm sort of leery of all doctors at this point, and I don't believe in all of those hand therapists, including Dorothy Taubman.

My wife wrote an article on Leon for the *New York Times*,[102] so she had to interview Dorothy Taubman, because at that time Leon was seeing her. And of course, she was famous, so I came along with her to Brooklyn. And Dorothy said, "Well I know all about you, because of your records, and you can't play anymore. Do you mind if I ask you some questions?" So I thought maybe she could help. She said, "To start with, where does it hurt?" and I said, "No, no, no – there's no pain anywhere, whatsoever, not even a little bit. No tingling, no nothing. But my fourth and fifth fingers [of my right hand] start to curl in when I play. Or when I'm shampooing my head, I feel my forth and fifth fingers pressing on my scalp. Other than that, it doesn't bother me the slightest - I can open wine bottles just like before." And she said, "Okay, but where does it hurt?" And she wouldn't listen. She did help people, clarinetists, flutists, so fourth, because they were sitting awkwardly and had pain. And what she was really helping was

[102] Naomi Graffman, "Leon Fleisher's Long Journey Back to the Keyboard," *New York Times*, September 12 1982.

tendonitis. Everybody gets tendonitis at a certain point, and she had her correct positions. Well Horowitz sat very low, and Rubinstein sat very high, and both of them played the piano pretty well, and neither seemed to have problems. Horowitz played with flat fingers, we're all taught to play with curved fingers.

So Leon tried everything, and what's helping him are the injections [Botox], and I didn't want to do that. Part of the problem is that he started having problems when he was about thirty-five, and I was fifty. So he was really cheated out of a career, much more than I was. Because from [ages] twenty to fifty – in those thirty years, I played about one hundred concerts a year, made many records, and it wasn't so terrible. Also, I think unlike Leon, I'm interested in other things besides music, and as you see [pointing to his display of Chinese art], I've been to China thirty-three times, and only the ten of them, most recently, had anything to do with music. It was just to see things, meet curators at provincial museums, and so forth. So not only China – Burma, Vietnam, Laos – I've been everywhere in Asia except Mongolia and Butan so far. I went back to Columbia University when this thing started [referring to hand] and took post-graduate courses in Chinese, Japanese and Indian art history. I went on many trips then, sometimes alone, sometimes with people who are also interested in that. And when I saw that nothing was helping me, I thought, why waste time in going to massage or poking around? Because I tried everything, acupuncture and so forth, and started to learn some left hand repertoire, and started to teach, because at that point I had not taught until I was fifty, except for one student – you may have heard of her, Lydia Artymiw. She played lots of concerts, and she is married to a musicologist who teaches in Minnesota and lives over there in Minneapolis. When she was ten years old, her father would take her here

from Philadelphia to have lessons, and then she'd follow me sometimes. If I played with the Boston Symphony, I'd be there for a week and a half, so she stayed there and [would] have three lessons at that time. Except for her, I didn't have any students at that time.

Curtis and Manhattan [Schools] phoned me when they read that same article in the newspaper[103] and asked if I'd be interested in teaching, and that's when I started teaching. For twenty years I was head of Curtis, until about four years ago, and I still teach – all Chinese students as a matter of fact: Lang Lang, Yuja Wang, Haochen Zhang, Di Wu. So that was all new for me, at the age of fifty.

I haven't really done anything. I was told by one of the doctors at Philadelphia about fifteen years ago about Botox injections. I had a long talk with him about it. He says if it works, you never know how long it lasts; it could last ten months or two months. But it brings you eighty-five percent of what you could do, not one hundred percent. At that point, I thought, when I was one hundred percent, and I walked out on stage, I didn't necessarily play one hundred percent - you're lucky if you could play ninety percent. That means it was eighty-five percent if you had a terrific day, but if you have just a normal day, it'd only be seventy-five. So I didn't have anything to prove. I didn't care. I didn't want to go through that. Also, every time you have the shot, your muscle gets imperceptibly weaker: so if you start at your age, in twenty years, your muscles would be perceptively weaker. At our age, it doesn't really matter. So anyway, I didn't get involved with it, I just learned some left hand repertoire, and I just had a good time in China playing the Ravel *Left Hand Concerto* – that's what I played in those three cities:

[103] Dunning, "When a Pianist's Fingers Fail to Obey."

Beijing, Guangzhou and Hangzhou. In October, I'll be playing it in Hong Kong and in April, I'll be playing it in Shanghai, Taiwan, maybe Singapore. I played recitals in the Beijing Festival recently, and all over the [United] States. So sure, I wish it didn't happen, but I am still playing. But also, the fact that I was fifty made a huge difference. Well I can say [that] at age thirty-five, there were so many things that I hadn't done, that I did between thirty-five and fifty, with repertoire that I learned and records that I made. I can understand Leon wanted to take more chances and more avenues to explore things.

III. A Performer's Perceptive: Interview with Leon Fleisher

Peabody Conservatory, May 24, 2010, 2PM

JW: The reason I wanted to interview you [was] because I heard you speak and perform, and it was very inspiring; I think you also opened this door which gave pianists the courage to speak about their injuries instead of hiding from them, which in many cases makes the injury much worse, instead of finding help.

LF: Well, for the longest time there was no help.

JW: Yes, that's true too. And doctors, they actually need the help and participation of performers to find solutions. So my entire thesis is based on how the medical, performance and pedagogical professions should collaborate to find solutions that would avoid future cases of focal dystonia and possibly [find] a cure.

LF: Focal dystonia doesn't just happen to pianists; also to wind players in the lip. There's no help for them, not even Botox. So to expect help from teachers might be overly optimistic.

Teaching is a very strange type of activity because it's so anecdotal: the way we learn is how we teach. And since they don't know what really causes focal dystonia – or [do] they?

JW: There's a possible genetic component which is difficult to prove unless everyone in your family studied and played music at the same level; there's a correlation [with] high anxiety, perfectionism. [Researchers] also found that most people with focal dystonia at one point had trauma or injury to that one part of their hand, and had to adjust or work around the injury without recovering fully.

LF: I think not only do most musicians practice their instruments too much, I think there is much too much mindless work. In other words, the approach that is taken is that they think it's a physical activity, so they have to train their muscles, even the little muscles of the fingers and in the hand. They feel they have to train them and strengthen to make them as strong as their biceps, triceps and quads – that would be the ideal thing. That's all wrong.

What trains your muscles, what trains your technique is your brain. …Let's say you practice an etude, purely physically, so that the fingers become really strong and reliable, I can virtually guarantee you that the moment you add the burden of a musical intention, all that practicing training will collapse, like a castle in the sand. If you practice your musical intention at the same time that you train your hands physically, then it's like putting a spine or a steel structure in the castle, then it will [be] supported because of your musical intention. There's this false separation, this false dichotomy that, on one hand, there is the physical, and the other hand you have the music. First you

have to get the physical and then you add the musical. I think that's totally wrong. Completely backwards.

JW: And that's something that can be taught from the very first lesson.

LF: I think so, if the teacher is convinced by it. And then you can find musical ways of practicing rather than purely physical ways of practicing. The weight or burden of the musical intention is heavier than just training your fingers.

JW: I read a bit about your teachers Schnabel and William Kapell…

LF: No, Kapell was not my teacher – he was older than I by about half a dozen years. Willy [Kapell] started out as a phenomenally gifted young American pianist, probably the best one ever produced – he would now be about eighty-eight. He started out with an appreciation of the brilliance, the virtuoso, the physical, the technical, and that repertoire – that Russian repertoire. He was an intensely musical boy and…Schnabel was one of his heroes. So you can't equate them. He began to appreciate Schubert, Schnabel's repertoire [as well as] Mozart, Brahms, Beethoven. So he started out playing Khachaturian and Rachmaninoff and when he died in an airplane crash flying into San Francisco from Australia, he was playing Schubert sonatas, which was quite different. I think that's why he had an interest in me, as I was the only Schnabel student that he knew and [he] wanted to learn more about him.

JW: Then do think if we all taught in the same lineage of Schnabel, would we perhaps avoid injury?

LF: I think there was one student of Schnabel's from his Berlin teaching time, meaning it was in the '20s and '30s, a Canadian who was living in Los Angeles, who's name was Tzerko, Aube Tzerko. He developed something, but never called it focal dystonia, but it possibly had to do with nerves in front of the public. He gave up playing and became an important teacher. I think that Schnabel is the only person that…didn't contribute to Tzerko's problem.

As I understand it from Altenmüller and Jabusch, the brain receives so many messages that at one point it becomes confused which is why it seems to send the same messages to contract, to opposing muscles, which is what I think focal dystonia is.

JW: One scientist explained it like an old-fashioned telephone wire board, where all the wires are confused and not going to the right circuit.

LF: And I think this comes from "mindless" practicing. Young people seem to think that if they just sit at the piano and work mechanically – that first of all, they're not harming anything out in nature, nothing bad for the environment – they feel quite righteous that they're sitting there for eight, nine, ten hours a day. But it's without thought. It's totally mechanical. And I think that's maybe where the brain possibly – although you would ask yourself what kinds of messages does the brain receive if it's only mechanical, if you're not even thinking of what you are doing.

JW: What do you think of the [Dorothy] Taubman technique? [104] Some teachers have claimed to help students with focal dystonia.

[104] More information on the Dorothy Taubman and her technique can be found on the website: http://www.taubman-institute.com/html/home.html

LF: Is she still alive?

JW: Yes, but she's no longer teaching as she suffered from a stroke.

LF: She must be in her mid-nineties. She was an exceedingly intuitive woman. And she understood what you might call the "biomechanics" of playing. But she wanted, in my opinion, to be treated as a serious musician, like a female Schnabel or something, but she wasn't. Her musical taste in my opinion was quite ordinary. I did work with her awhile. I went and saw her, and she really understood how the hand moves, what is healthy for the hand, what is not healthy for the hand. What I found not healthy for the healthy hand as she also found not healthy for the hand is what you might call "Russian technique", which is treating the fingers like little hammers and to develop them to be as strong as they could possibly be. That has nothing to do with music making. Eventually it might take you to the circus, and you can show how strong you are. Maybe you can play a note and the thing could go up and hit a bell.

JW: (laughing)

LF: But she had a much more sane and similar approach physically, similar to Schnabel. Her power came not from the individual [finger] because there's a limit. These are really tiny muscles. You can work on them twelve hours a day for twenty years; they will only get so strong, because they are so small. Someone like Dorothy [Taubman] understood that the power, the real power, comes from rotation. These two muscles, the supernator and the pronator, are very powerful muscles, and you get the power from those, not from the individual fingers, and the weight from the upper part of the body.

JW: So if someone was injured do you think it would be effective to at least hear about that?

LF: Absolutely. But she has a son, who is a doctor. And he told her that very possibly the brain has been trained incorrectly in those pieces where the focal dystonia manifests itself, and so he told her that if she wants to cure anybody, she should first insist that they would never play any of the old repertoire as the brain is wired that way, [and should play] only new pieces.

JW: Which is a problem for many pianists.

LF: It was too much of a problem for me. I had studied and taught so much. That would have left me with very little repertoire. So I didn't believe that. We had our first big disagreement.

JW: And there is Laurent Boullet, whom you might know? He also does retraining in Berlin. He has a different approach: he reduces everything to the five-finger motion. Again, he is working specifically with pianists with focal dystonia, not necessarily teaching repertoire, and he's trying to retrain the brain to feel the individual fingers. It's a very slow process.

LF: I felt I didn't have enough time.

JW: Yes, it is time consuming.

LF: Which is why I went the chemical way, with Botox.

JW: I guess the issue is, if a student was in a situation where he/she was injured, but could not afford to fly to Berlin to take lessons, or had access to any of Taubman's

students, [he/she would] need to find a way that could give them treatment or access to treatment at their institution. And that's quite challenging to do.

LF: Well, it's quite challenging to do because we don't quite know what causes focal dystonia. And if you don't know what causes it, how can we find a cure? Botox just alleviates symptoms; it's not a cure. I guess someone like Boullet, if he's consistently successful in retraining these people – does it take about the same amount of time for everybody?

JW: It's different for each person.

LF: It's very difficult to find an answer that fits everybody. It's a real one-on-one, and I'm not sure what an institution can do except to make people aware that this is a potential danger and not to over-practice the instrument.

Think about it as much as you want. Sit down on a comfortable chair and read your score, and from reading it, get a very clear idea on what you want it to sound like. That was one of the things that Schnabel said. You have to hear before you play. And that wasn't a mistake. His command of English was extraordinary. But if you don't have it in your inner ear, exactly what you're going for, what your goal is, what you want it to sound like, then when you put down the key, it's an accident. Then your performance is built on accident after accident. You must have a very specific and clear idea before you put down any key, what you want it to sound like, what you want it to say, how it connects to the next note, which connects to the next, to the next, to the next.

I think, I've said this before: I think we are three people in one. Person A, Person B and Person C. Person A hears in their inner ear before they play a note. They have

their goal, their ideal, in their inner ear so they have something to work towards. Person B is the person who actually puts down the key so that Person C who sits over here some place, and hears what comes out of the instrument, and if what comes out the instrument is not what Person A intended, Person C tells Person B what to change, what to adjust, so as to get closer to the ideal of Person A.

JW: I completely agree with that. The problem, I think, is what happens in some schools: we have the ideal sound, we try to execute it, it doesn't come out, and we keep "going back and back" and we start to feel pain.

LF: Why would "going back and back" produce pain?

JW: Let's say there's a technical passage we just can't get, and we just go over it again, and again.

LF: Well, that's stupid. You have to find another way of approaching it.

JW: And then the problem comes when the teacher can't help in finding the solution.

LF: That's the other thing I wanted to say: the institution essentially is meaningless – it's your teacher who's important - who you study with. The institution might make a nurse, for some kind of emergency. Maybe you have somebody on the faculty who is particularly acutely aware, or who understands the way Leschetitzky, the way Dorothy Taubman, or the way of other people understand the biomechanics of playing an instrument.

JW: In Hanover, they have an ideal situation where Altenmüller runs the medical music institute, and the faculty collaborates with them. They teach a mandatory class for all

freshmen called “Physiology of Playing,” and they found that with the inception of the course, the number of injuries has dropped.

LF: Well there’s your answer. Why are you talking to me? (Chuckling) That’s wonderful.

JW: Because it’s done there and it’s not done here. I’m not sure how to make it happen here.

LF: It’s not taken seriously enough here. It isn’t that prevalent. I don’t know how many cases of focal dystonia do you get in a year? Is it worthwhile to have a medical institution on board or next door that can work simultaneously [with the school]? That’s wonderful in Hanover.

JW: The problem, even in New York, there is the Musician’s Clinic at St. Luke’s Hospital, but it’s separated from the pedagogical side. So many times, at least from what I’ve heard, the common treatment is rest and to stop playing – but this doesn’t solve the problem.

LF: That’s useless in a sense.

JW: So I don’t know what the solution is – how do we join them together?

LF: Well, you’ve seen what happens in Hanover - recreate that? Altenmüller himself is a flutist you know.

JW: Yes, and Jabusch is a pianist. And they seem to be a position where there is funding.

LF: Well, that's called socialism.

JW: (laughs) I guess there's a bigger change that we need.

There's also been a big increase of competitions in the past hundred years –

LF: Yes, that certainly contributes to the problem in the sense that all these young people want to be able to play faster and louder than any of their contemporaries. That seems to be one of their main goals. That, plus somehow, demonstrating by physical gestures of the body, how much the music means to them, how much they are affected. They will go this way and that way, and their hands will fly. "Look at how affected I am by this wonderful music!" [Fleisher leans back in his chair and swings his head and arms in the air.]

That's a lot of nonsense. First of call, it's a distraction for the listener. The listener sits there and doesn't hear the music but just sees all this nonsensical activity up there. "Isn't that nice how much this young boy or girl is affected by the music?" You don't hear the music because you are watching this show there. I think the main culprit in this whole interchange is probably Horowitz.

JW: And they suspect that he had dystonia too. No one can prove it, but the fact that he had such a light keyboard and had a flat hand position.

LF: Well that's very smart. No one teaches to play with flat fingers. There were two great pianists amongst many, but two [come] to mind that stand out: Horowitz and Glenn Gould. If you see the videotapes of Gould playing, he also had very long fingers. The key became an extension of the fingers. The key was not a foreign object that [he] hit,

like a little monkey hitting the little key – the key became an extension of the finger, became one with the finger. The same suppleness you have in the finger is almost induced in the key.

The point I want to make with Horowitz is not only did he have an exceedingly light action, but, he, to put it very bluntly, doped the hammerheads. He had his piano technician – there is a mixture of lacquer and lacquer thinner that you apply with an eyedropper, and that makes the hammerhead very hard, and that produces an enormous brilliant sound. Clangorous. That was one of the things that whenever you went to hear Horowitz, the first thing when he started to play, it sounded like a fire engine, this kind of extraordinary brilliance. But he was a great artist, he could control it and make it pretty soft also. But that combined with a very light action, gave his playing a brilliance that everyone wanted to have, and it was supported when he made recordings. So these kids would hear the recordings, and they [would] come into the studio, playing a dead piano in a dead studio, and work more muscles, more strength, and they would work eight, nine, ten hours. You cannot work more than four, maybe five hours a day of concentrated work. It's just too difficult. So they would injure themselves trying to get this abnormal sound of Horowitz.

JW: But do you think audiences are expecting it also? Or demanding it? They hear the recordings too.

LF: That's the way they produce the records.

JW: So how do we create that cultural shift?

LF: You don't. They've done their damage.

JW: Do you think we could ever revert back to recordings where there are mistakes? Where they are not perfect?

LF: Well, recordings are so against the nature of art. It's just a frozen moment, always exactly the same thing – there's nothing artistic about that. After the second time you've heard it, you know what's exactly going to happen. So that has nothing to do with art. It only has to do with business.

You have two things: you have the business of music, and you have music business. I'm involved with the business of music: teaching, performing, conducting. And RCA Victor, EMI, Deutsche Gramophone – that is the music business and their management. They're trying to make money out of it. That has nothing to do [with music]. Mozart, Beethoven, Bach – they didn't write this music for somebody to become rich on. So there are two different creatures involved here.

JW: I agree. But if a young student wants to aspire to become a concert artist, getting a record contract [or] an agent or winning a competition is one of the venues to do that.

LF: When I first started out in the '40s, there were four or five major competitions in the world. There was a great competition here in America called the Levintritt Competition. Then you had Chopin Competition in Poland, the Queen Elizabeth Competition in Belgium. I don't think the Tchaikovsky Competition started until the '40s or '50s. Leeds hadn't started in the '40s. That was it.

Today, you go into the office here at Peabody, every other street corner has its "international competition." It's like an airport. In Missoula, Montana, they have an airport, and it goes across the Canadian line, to Kamloops – it's an international airport!

It goes from the States to Canada. First problem. There are many too many. And the only real barometer of a competition is its jury. So many of these international competitions now…first of all, the jury is always the same, virtually the same, from Moscow to Warsaw, to Belgium, to wherever – the same names. Ari Vardi from Israel, Kämmerling from Germany, John O'Conor from Ireland – they want to make it as all-inclusive, as catholic as possible. So they get you one juror from Germany, one from America, one from Zimbabwe, one from Cyprus, one from Tasmania. You're not going to get these people to agree on what an ideal performance is. So the winner is always the one who least offends the greatest numbers of jurors. And that invariably is the one who makes the fewest mistakes. The juries hate to be embarrassed by making a choice that is not as reliable, as humanly as possible. So they pick the player who plays most cleanly, and it's usually very uninteresting, unimaginative - somebody who is good for the circus. Competitions are terrible for young musicians.

JW: That is good to hear, especially from you. And recordings?

LF: Recordings are interesting to hear once. It shows how on that one day what that artist thought of that piece. It might give you some ideas. Some people develop their interpretations from different recordings. They'll take the first bar from this pianist, second bar from the next pianist, third bar from another pianist – but there is no continuity, there's no inevitability.

JW: Back to the instruments: some people have hypothesized the way pianos are manufactured today, with a heavier action – and also in the '70s Steinway experimented with adding Teflon to their action – that this may produce more injured musicians?

LF: Of course, that - plus the auditoriums are much larger than in the eighteenth and nineteenth centuries. So you have to fill much more space. Now in the last ten years or so, twenty years, maybe they've become more concise somehow.

JW: Perhaps with acoustic technology – but the piano is still the same.

LF: You know the Bechstein was a wonderful instrument. The action was so even, every key was exactly like every other key, and it was a very light action. Schnabel did his recordings of all his Beethoven sonatas on Bechstein. Steinway – again, it's a business, and German Steinways, I think are much better – they're smarter people.

JW: And Bechstein's made a comeback, with a store on West Fifty-Eighth Street. But Steinway still has the monopoly – that's the problem: they have Carnegie Hall, ads in the New York Times, etc.

LF: Well, that's a money thing.

JW: That affects all students too. If our instrument in the practice rooms is what it is, and we have a different sound in our ear, we may want to push to find that sound.

LF: The great technicians – Ron O'Connor – he's the big technician at Steinway now, they send him out all over the country, they send him out to five or ten major cities and keeps the pianos in the orchestra in the best shape he can. It's like if you have a Rolls Royce, are you going to take it to Jiffy Lube? You need someone who knows what he's doing. Most of the tuner technicians, with the exception of Chicago, Boston, some of the big cities, New York – they don't know what they're doing.

JW: So how do you think we can install a course like they [have] in Hanover? Do you think it should come from the piano teachers?

LF: Piano teachers are notoriously jealous of their territory. One of the great things about Curtis as a school is that the teachers, who all travel and perform - because they do travel and perform, they're not always regularly once a week available for their students. But they have no problem telling the students to play for someone else on the faculty. That doesn't happen anywhere.

JW: That's true.

LF: If you have somebody that's good, you don't play for anybody else – "you do or I'll kick you out" – so they're very jealous in a way. Even though it would probably be very helpful for the students just to get another point of view.

But I think it probably should be an all scholarship school like Curtis that would make available, make a partnership with one of the hospitals, let's say in Philadelphia. Or even suggest [to] the hospitals that they should have a performer's wing. And introduce the same type of set-up as they have in Hanover. But I don't think your state schools – I don't think they're that interested in it.

JW: One ideal aspect of a state school is that it already has its own medical campus.

LF: Yes, if they can be talked into having a performer's wing. And this certainly is one of the leading complaints of performers. Recommend them to investigate what this is all about. Let them use the scientific method in developing an understanding focal dystonia.

JW: I think the biggest problem is funding. I met Alice Brandfonbrener –

LF: Yes, in Chicago.

JW: And she started the Medical Musician's Institute there. Even though she is technically retired, she is still an active participant, and annually applies for medical grants for more experiments. But AIDS and diabetes obviously have precedence, and musician's injuries seem to be on the bottom of the list.

LF: She's actually the editor of a medical magazine –

JW: Yes, *Medical Problems of Performing Artists*.

LF: That's right. Well there! But I don't think that every music department in every institution of the country subscribes to that. Well somebody should make a gift of something and make sure every music school of the country subscribes to that.

JW: That would be a start.

LF: That's a beginning. The problem is that whoever gets [focal dystonia], they're never quite sure, to what extent, that they themselves are responsible. They always feel a little bit guilty, that they may have brought it upon themselves. That's a very big problem. That's why I talk about this "mindless work" – they think they're supposed to be building these muscles for a marathon, but they're working with art, they're working with concepts…they're working with trying to sensitize their ears. The ears are the most important organ, I think, in musical performance.

The performer is in a very difficult position, because the performer is not the center of that dynamic. It's a triad: composer, performer and public. The performer – his responsibility is to communicate the music of the composer to the public, to the

listener. But the performer is not the focal point, the performer is not the center – the music is the center. But the public always wants a star, a celebrity – and that's very tempting. Until that time comes when you can walk into Carnegie Hall and instead of a program of all the pieces, they give you the music, and you take the music to your seat, and you open the music and you read the music, and you derive as much pleasure from reading and understanding from reading the music – until that time comes, the performer is indispensible. Because the performer brings the music – all those black dots – to life. But he is not the center of attention. The music is the center of attention. And that's where the whole mix-up begins.

Schnabel described it as: you go climbing in the mountains. You go on a big mountain, and you take a guide, a mountain guide, because he *knows*. The mountain guide's purpose is to get you to the top of the mountain so that you can enjoy the view. So he's indispensable, but he's not the focal point, he's not the point of interest – it's the view. And that's our job. We bring you the music for your enjoyment. But everybody wants to be the star – the music just serves: "look how wonderful I am! Look how much this means to me!"

JW: That makes a lot of sense. That's difficult to adopt in every institution in the world, but it makes a lot of sense.

Thank you; thank you for your time. This was really educational.

LF: I'm not so sure to what extent that your thesis will ever be realized.

JW: But I do hope that if one person starts to ask questions…

LF: There are a couple of places – Marlboro. It is where music is the focus of all the activity, not the performer. That's a difficult thing for young people to latch on to as a concept. Because everybody wants to be a star, everybody wants to be a celebrity – well, most people.

JW: You've definitely steered another angle into my dissertation – how we have to think about music socially. And perhaps this could lead to fewer cases of focal dystonia, if we let go of driving to perfection and being stars in our field.

LF: There's a wonderful book by Schnabel that will open your eyes: it's called *Music, Wit and Wisdom*.[105] It just came out this year. It's a reworking of a series of lectures that Schnabel gave at the University of Chicago. It includes the lectures and a question-and-answer period after each lecture. I think it was a series of twenty lectures. Maybe it was the Schnabel Foundation that published it. But it would bring you a new awareness that is very stimulating to thought.

JW: And this collaborative ideal – that is something that can be changed in every institution, first from the inside, and then from the outside.

LF: Yes, because no teacher is going to admit "Well, the way I teach technique maybe brings on focal dystonia." They won't say that.

JW: But perhaps if a teacher could admit, "I don't know everything…"

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[105] Fleisher makes reference to Artur Schnabel, *Music, Wit and Wisdom - the Autobiography of Artur Schnabel*, ed. Werner Grunzweig and Lynn Matheson (Hofheim, Germany: Wolke Verlag, 2009).

LF: That would even be difficult for a teacher to admit, because they can play everything. They don't consider how badly or how well, but they can play, so their physical approach is *the* approach – so if it works for them, why shouldn't it work for everyone else?

JW: So how can one change this attitude, especially for the new generation of teachers?

LF: Well, I do what I can with my students. And since not each one of them is going to wind up with a big solo career, I think most of them will end up doing some teaching. And maybe they will pass along to their students – so I guess that's the only way. I don't think there is any mass production involved in that. I think it's very labor intensive.

CONCLUSION

One can understand Graffman's frustration with the medical community. Having tried almost every method to no avail, he instead was able to find a fulfilling career in teaching, performing left-hand works, and collecting Asian art. We are fortunate that he is an outspoken pianist that has caught the attention of the media, and acknowledges a cure for focal dystonia is still needed. He believes that Botox treatment or any other medical treatment alone is not enough to return to his former stature – there are still missing pieces needed for a full recovery from focal dystonia.

Fleisher, recognizing that Botox is only a treatment and not a cure, further argues that the roles of the pedagogical and performance professions can play a useful part in the possible prevention of focal dystonia. He cites the broader cultural and social problems of studying music that contribute to the injury: firstly, the separation of musical intention and technique, causing musicians to over-practice and practice mindlessly; the artificial standards of competitions and recordings that affect aspiring pianists today; and finally, to quote his teacher Schnabel, replacing the music with the performer as the center. He attests that his frustrations with the pedagogical and performance professions could be alleviated individually, from teacher to student.

The medical profession is able to share with the pedagogical and performance professions the standards of optimal health. It is able to discern, without prejudice, what constitutes healthy physiological and psychological aspects from a scientific perspective. Without their contributions, pedagogues may demand results that are not biomechanically efficient, and performers would continue to push themselves beyond their capabilities.

The medical profession is essential for providing the boundaries of human capacity but also providing the solutions when those boundaries are broken. It relies on the pedagogical profession for its technical input, and the performance profession for its establishment and trust.

The pedagogical profession is responsible for establishing the standards of performance and being the liaison between the medical and performance professions. Its role is to decipher the various traditions of pedagogy and explain the most effective approach in playing an instrument. The pedagogical profession still lacks the openness for new research and possibilities that come from performance – it must still rely on the medical profession for the scientific research and the performance profession to provide the forum for the research to be proven.

The performance profession, as we have seen in the interviews with Graffman and Fleisher, gives public attention to the medical needs of the musical community. It is necessary for the profession to be willing to collaborate, as it can contribute to necessary medical research while setting pedagogical standards for the educational institutions. It must rely on the medical profession for the scientific explanations of focal dystonia and the pedagogical profession to carry that research through. The performance profession, by raising awareness through various forums, is essential in helping the medical and pedagogical professions in finding new solutions.

If the social order and the cooperation of musical institutions are to teach, train and provide research and performance opportunities for the faculty, students and community, it would also serve as the ideal catalyst to initiate collaboration among the

three professions. Musical institutions have the ability to transcend the work of one individual and create a broader societal change at large. This makes them the ideal forum for medical research, pedagogical training, and public awareness – a dichotomy that can be unified. Therefore, musical institutions, composed by their faculty, must embrace its role as collaborator, within the institutions and outside of the institutions, in an endeavor to find a cure for focal dystonia.

APPENDIX I

Musician's Medical Institutions

1. Performing Arts Medicine Association (PAMA) (http://www.artsmed.org)

Initially a medical organization limited to physicians, PAMA quickly grew to include all types of health professionals, as well as performers, educators, and administrators in both music and dance genres. The specialty is international in scope, with 20% of its members from outside the United States. With this expansion has come an increasing diversity of activities that support PAMA's mission-dealing with the health of musicians, dancers, and actors. Collaboration with artistic organizations of many varieties has enabled us to spread our message to wider populations of performers and students who can benefit from this information. Several PAMA members serve as medical consultants to musical and dance organizations, while others work directly with orchestras and dance companies.

PAMA traditionally has held its annual meetings in conjunction with the Symposium in Colorado each summer. Through its committee structure, the organization's business-education, research, outreach, and much more – continues throughout the year. The MPPA publication has become the official journal of our organization, as well as that of our sister performing arts medicine group in the Netherlands. PAMA will continue to expand as increasing numbers of performers avail themselves of our knowledge and experience in care and prevention of their medical problems, and more health professionals become actively involved in this endeavor.

The PAMA Mission Statement: Promoting the highest quality of care to all performing artists and bringing to that care an appreciation of the special needs of performing artists; developing educational programs designed to enhance the understanding and prevention of medical problems related to the performing arts; promoting communication among all those involved in the health care and well being of performing artists; fostering research into the etiology, prevention, treatment, and rehabilitation of medical problems of performing artists.

2. American Physical Therapy Association (APTA) Performing Artists Special Interest Group (http://www.orthopt.org/sig_pa.php)

The mission of this group is to be the leading resource for physical therapy as it relates to the performing arts. The special interest group serves its members and represent the interests the interests of orthopedic physical therapy by fostering high quality patient care and promoting professional growth through advancement of education and clinical practice, facilitation of quality research, professional development of its members, and encouraging an interaction between the physical therapy and performing arts communities.

3. Arts Medicine Aotearoa NZ (New Zealand) (http://www.converge.org.nz/amanz)

The mission is to encourage arts and health practitioners to work together towards prevention and management of health issues.

4. Arts Medicine Europe (http://www.arts-medicine-europe.org/public/e_ame_frmset.html)

Arts Medicine Europe was founded in early 1999. This organization emerged from a longstanding collaboration between the Munich- and Salzburg-based Medical Society for Artists (Musical Orthopedics and Arts Medicine) and five other organizations: the Swiss Association for Musicians' Health (Berne, Switzerland), the FBL Research Project in Musicians' Health (Basle, Switzerland), the Studi Arte e Musica (Florence, Italy), the Hellenic Association for the Medicine and Science of Dance and the Performing Arts (Athens, Greece), and the Richter Herf Institute for Basic Musical Research at the Mozarteum University (Salzburg, Austria).

Arts Medicine Europe is a meeting place for physicians in various areas of specialization, all of who have completed a degree in music or dance, and for physiotherapists, hand therapists, and educators. Their work focuses on the prevention, interdisciplinary diagnosis, and treatment of strain injuries and work-related illnesses suffered by musicians, dancers and athletes. They develop joint preventive programs for use in music schools, conservatories, institutes of higher musical education, and orchestras. They train music students, educators, physicians, and interested physiotherapists in the basic principles of musicians' health. They employ and develop programs for promoting bodily awareness among musicians. Among these programs are the FBL Klein-Vogelbach basic training method, the Feldenkrais method, and the Alexander technique. They hold lectures and seminars on these and related topics. They offer special office hours for musicians in conjunction with international institutes of higher musical education. Their headquarters are located at the European Institute of

Kinetic Physiology, “Medicine for Musicians, Dances and Athletes” in Munich, Germany. They also have cooperation centers in Salzburg, Linz, Basle, Zurich, Florence and Athens.

5. The Australian Society for Performing Arts Healthcare (http://www.aspah.org.au/public)

This group formed in November 2006. The mission statement: this organization recognizes that all performers, young and old, amateur and professional, have unique needs that may not be met by standard models of health care. Therefore it promotes: accessible high quality holistic health care for all performing artists; education for health workers, teachers, performers and students to improve health and well-being; research across disciplines relevant to this field; a culture of lifelong preventative health care and safety practices; multidisciplinary discourse among health professionals, educators and performing artists; and increased community awareness of performing arts health care.

6. Austrian Society for Music and Medicine (Medicine for musicians, Music Physiology and Psychology) (http://www.oegfmm.at)

This group was founded by Prof. Dr. Matthias Bertsch, Dr. med Bernhard Riebl (University of Music and Arts Vienna) and Dr. med. Michael Peschka University for Medicine Vienna) in 2009. They are all members of the German Society of Music Medicine and Music Physiology. The organization hopes to organize a “Help finder” which would give advice on all genres of problems and questions that confront musicians. The society supports research, knowledge, theory, and various techniques in context with interdisciplinary studies of music, medicine, physiology and psychology.

Their focus is especially on the physical and psychological diseases of musicians, which include improvement of prevention, diagnoses and therapies. The emphasis is put on cooperation of those who are responsible for education of musicians like teachers skilled in playing musical instruments, singing, scientists, producers of instruments, doctors, dentists, physiotherapists, sports and music psychologists, Alexander technique teachers, Feldenkrais practitioners, music therapists, ergonomic therapists, etc. The society hopes to improve cooperation with orchestras, professionals, and institutions like music schools, conservatories, universities, etc. and also consider individual artists of similar institutions as well. The society aims to publish works of specialized knowledge for musicians, hold specialty meetings based on the different genres, and also research meetings.

7. British Association for Performing Arts Medicine (BAPAM)
(http://www.bapam.org.uk)

This is a unique charity delivering specialist health support to performing artists. They run free, confidential health assessment clinics for professional, semi-pro and student performing artists. The leading specialists volunteer their time to provide clinics in Performing Arts Medicine. Patients can be referred from their clinics to the best medical, surgical and therapeutic help available. They hold an online directory of medical doctors, physiotherapists and other healthcare practitioners including counselors, who have special expertise in treating performing artists. They have a library of health information resources for performers. Through their health-promotion work, they help artist and those who train to understand what it means to be a healthy performer.

8. German Association for Music Physiology and Musicians' Medicine (Deutsche Gesellschaft für Musikphysiologie und Musikermedizin)
(http://p56270.typo3server.info/17.html)

This is based in Mainz, works exclusively and directly as a non-profit association. The association co-operates closely with international organizations dedicated to Musicians' Medicine. Unlike PAMA it concentrates on instrumentalists and singers only, because dancers in Germany already have quite good medical support. The mission: promoting science, research and teaching concerning the physiology and pathophysiology of music performance as well as pathological and clinical aspects of physical and psychological diseases in musicians. The association is set on improving preventative, diagnostic and therapeutic measures. They emphasize and interdisciplinary cooperation of those, who participate in training and professional company of musicians, like instrumental and vocal teachers, occupational scientists, manufacturers of musical instruments, physicians, dentists, psychotherapists, physical therapists, Alexander teachers, Feldenkrais teachers and mediators of other similar therapies. They are extending the close cooperation with performing arts centers, professional orchestras and musical trainee-institutions (music schools, conservatories, music universities) as well as with other performing artists and their institutions. The organization holds scientific conferences and symposia on a regular basis, and publishes the practice-orientated scientific journal "Musikphysiologie und Musikermedizin".

9. Médecine des Arts (http://www.medecine-des-arts.com/?lang=en)

This was created in 1991, promotes the health of artists, musicians, singers, dancers, plasticiens, circassiens, etc. The organization publishes a journal "Médicine des Arts" which studies: the aspects of functional anatomy, physiology, behavioral and cognitive psychology, etc.; to promote research on risk factors and professional pathologies of artists (toxicology, rheumatology, ORL, dermatology, traumatology, etc.); to determine the most suitable forms of therapy; to study the specific functional rehabilitation programs; to diffuse a broadly based information about nutrition, health care and prevention in general; to discuss aspects of pedagogy, ergonomics, work methods, etc.. The multidisciplinary nature of the journal makes it a vehicle for interchange of knowledge and experiences between clinicians, therapists, teachers and artists. The first issue appeared in September 1992, making it the first journal in Europe dedicated to Arts Medicine, a new discipline dedicated to the medical and scientific study of artistic practices. The journal is published quarterly and features articles by current international specialists.

10. Musicians' Health Scotland (http://www.musicianshealth.co.uk)

This is a website for musicians, performing artists, dancers, throughout Scotland. It gives information on clinics held in Glasgow for the management and prevention of playing-related health problems. Patrice Berque, a chartered physiotherapist who specializes in the diagnosis and treatment of musculoskeletal disorders and injuries affecting performing artists, set up this site. He is also involved in health promotion and prevention of playing-related musculoskeletal disorders. Patrice set up a Musicians'

Clinic in 2002 in Glasgow, initially with the help of the Musicians Union Scotland (MU) and in 2004, the British Association for Performing Arts Medicine.

11. Schweizerische Gesellschaft für Musik-Medizin (Swiss Association for Music Medicine) (http://ijm.sagepub.com/content/os-35/1/46.full.pdf+html?ck=nck)

This was founded in Berne on September 1, 1997. The goals of the association are: work with selected doctors and therapists who have years of experience in this field, because they have knowledge of both medicine and music; create good interdisciplinary cooperation between doctors and therapists to view patients in a comprehensive holistic manner.

APPENDIX II:

Institutions with Health Promotion Courses for Music Students:[106]

Institutions in the United States:

1. Ohio State University School of Music in Athens, Ohio (http://music.osu.edu)

Performance Preparation taught by Gail Berenson, Professor of Piano

The Performance Preparation class began in 1991, outgrowth of workshops co-presented with Dr. Gary Chleboun, and Ohio University (OU) physical therapy colleague. The ten week class is offered every spring in odd-numbered years and is available to all music majors at undergraduate and graduate level. This is a two-credit hour elective, meets once a week for two hours.

The course description: practical course aimed at assisting music students in developing strategies for preparing themselves physically and psychologically to achieve their maximal performance potential. Includes basic anatomy, physical fitness, healthy body alignment, injury prevention, pilates, yoga, stress management and intervention strategies for coping with performance anxiety. OU faculty and guest faculty with special training in various disciplines will teach individual course components.

A thirty- to forty-student limitation is necessary in order to provide pre-and post-class physical fitness testing to each student. Students from theater, dance and engineering were also enrolled. Students are asked to keep personal journal, write

[106] Ralph Manchester, ed. "Health Promotion Courses for Music Students: Part I, II and III." *Medical Problems of Performing Artists,* March 2007, June 2007 and September 2007.

personal assessment of public performance and select an article from the Medical Problems of Performing Artists to reflect and report on what they gained as a musician.

2. University of Indianapolis at Indianapolis, Indiana (http://music.uindy.edu)

Health Promotion and Prevention of Injury for Musicians taught by Rebecca Baron, MS, OTR, Assistant Professor of Occupational Therapy and Dr. Kathleen Hacker, Chair, department of Music and Director of Vocal Studies

This course is a collaboration between School of Occupational Therapy and Music Department. It is an eight week instructional module, as part of an orientation seminar for freshman music majors in first semester. The instructor is an occupation therapist with twenty-six years of experience working with performing artists with injury and is also a musician. There are eight hours of lectures with opportunities for small group discussion and other active learning strategies. This provides opportunity for students to acquire knowledge about common health problems that musicians may encounter, and how to assess risk for potential injury for themselves and future students. Some of the specific strategies include physical conditioning, role of nutrition, rest and other restorative behaviors; dealing with stress and anxiety, and modifying instrument or environment to facilitate optimal occupational performance. Students complete pre- and post-course assessment of current knowledge as well as self-assessment of current use of strategies. As of March 2007, the first time module was offered to 28 freshmen students.

3. University of North Texas in Denton, Texas (http://music.unt.edu)

Occupations Health: Lessons from Music taught by Kris Chesky, Ph.D., Director, Texas Center for Music and Medicine

This is a new course, approved by various curriculum committees at UNT and was designated as a university core wellness course. This is applied to all students regardless of major and taught through the lens of a musical experience to address multi-dimensional nature of wellness and impact on quality of life. The hybrid approach for teaching was selected to meet diverse learning needs of students and to help with difficult scheduling demands, with both e-learning and instructor led education.

The weekly class of one hour, with the other two-thirds of class taught online, which was available 24/7 and includes text-like content, computer-based learning objects, virtual reality videos showcasing clinical experiences and opportunities, links to outside resources, surveys and exams and discussion platforms. The face-to-face activities designed to supplement and extend on-line instruction and involve live demonstrations, hands-on experiences, student-to-student dialogues and other activities that promote student interactions. The four modules presented over a fifteen-week semester. The modules cover musculoskeletal health, hearing health, mental health, and vocal health. Each module includes six lessons based on a parallel processing theory of health education. The lessons are designed to increase students appreciation for being healthy, awareness of what can go wrong, belief that problems can and do occur, knowledge of specific factors associated with specific problems and understanding the role of prevention and what to do if and when certain symptoms arise and sense of personal responsibility. This was offered for the first time in Fall 06 semester with an enrollment of 320 students, who were divided into three separate sections. Four students were recruited and hired from UNT music and Medicine graduate program to work as teaching assistants. The research data were routinely collected over the course of semester

according to IRB approved protocol and the data sets were used to reinforce learning objectives and are being developed for publication.

4. Northwestern University in Chicago, Illinois (http://www.music.northwestern.edu)

Health Issues for Instrumentalists taught by Alice Brandfonbrener, MD

This is taught to undergraduate music students and in seminar format to graduate students both in performance and music education. The students do a project during the quarter and present it to the class. There are ten classes, covering anatomy and posture, musicians with medical problems, less common diagnoses, psychological factors, focal dystonias, prevention of medical problems, good teaching, EMG as a clinical and research too, and back-up videos of famous violinists and pianists (to examine techniques with new eyes).

5. Eastman School of Music/University of Rochester in Rochester, New York (http://www.esm.rochester.edu)

Keys to Healthy Music taught by Susanne Callan-Harris, MS, PT, LLCC

This is offered in both fall and spring semesters to undergraduate and graduate students and meets weekly; this is highly experiential and students are encouraged to bring instruments if possible. The assignments are given weekly and compiled to form personal journal. Students are strongly encouraged to meet with instructor early in course to set goals. The fourteen classes, covering research done at Eastman and Eastman Wellness Initiative, includes posture, physiology of movement, anatomy, stress management, self-treatment, performance anxiety, ergonomics of music-making,

stretching, strengthening, lifestyle, performance related injuries, and treatment options for performance-related injuries.

6. Shepherd University in Shepherdstown, West Virginia (http://www.shepherd.edu/musicweb)

The Complete Musician taught by Stephanie Bruning, DMA, professor of piano[107]

This course focuses on performance anxiety, including practice techniques, relaxation techniques, and injury prevention. The course requires weekly attendance and class participation, weekly assessment papers, and two presentations. The weekly papers are one to two pages in length and serve as a journal to document any changes noted by students. Student performs twice, once at the beginning of the semester and another at end to note changes. The performances are not evaluated as personal growth is emphasized; guest speakers in yoga, Alexander, Feldenkrais, and biofeedback are invited. Texts used include: the *Inner Game of Music* (Barry Green) and *My Lessons with Kumi* (Michael Colgrass).

7. University of Southern Maine in Portland, Maine (http://www.usm.maine.edu/mus)

Dynamic Posture and Alignment taught by Craig Williamsom, MSOT Adjunct Faculty

This course covers fundamentals of body movement, alignment, and muscular retraining using movement exploration and exercise. The students learn anatomy, kinesthetically and conceptually. This course has been in the music curriculum for three

[107] Stephanie Bruning is no longer on the faculty of Shepherd University; she now teaches at Morgan University (updated November 30, 2010).

years, and is taught every spring semester. The elective is open to the university at large; it came out of an eight-week course started by Laura Kargul, director of piano studies at USM for the piano students (1993-2003).

8. Michigan State University at East Lansing, Michigan (http://www.music.msu.edu)

Healthy Musicianship, taught by Judy Palac, DMA

This is offered every two years as a two-credit, two-contact hour elective to all undergraduate music majors. It is intended to promote healthy musical and lifestyle habits through knowledge of physical and psychological aspects of music performance. It covers bodymapping and Alexander technique, in addition to the four target areas identified by Health Promotion in Schools of Music Conference: neuromusculoskeletal issues, hearing issues, voice care, and psychological issues. The instructor is a music education faculty member specializing in neuromusculoskeletal health and brings in speakers from the Musicians' Wellness Team in which she chairs. The course includes journaling, research and reading. The books include "*What Every Musician Needs to Know About the Body* by Barbara Conable and a coursepack of relevant material. A similar course is offered at the graduate level; for DMA students, it is paired with teaching seminar. The text includes *Performing Arts Medicine* by Sastaloff, Brandfonbrener, and Lederman.

9. George Mason University in Fairfax, Virginia (http://music.gmu.edu)

Art of Teaching Music: Wellness Practices for Musicians, taught by David J. Sternbach, MM, MSW, Adjunct Research Professor and Director, Center for Arts and Wellness

This course began in 2001 when William Reeder, Dean of the College of Visual and Performing Arts, invited Sternback to develop wellness program for music students (Sternbach is a psychotherapist specializing in working with performers and was a former professional horn player). He proposed wellness to be made a required course, and has been taught since 2001 through a grant from the Dunard Foundation. In addition, the Wellness Center supports master classes, clinics and workshops on campus, and individual counseling with students, and presentations at other campuses. There is also a musicians' health day with presentations by Alexander Technique, Feldenkrais and yoga teachers, physical therapists and psychologists. He also maintains list of local area performing arts medicine specialists.

The course is offered every semester, and covers the principles and practices of injury prevention, stretching, meditation and relaxation, healthy practicing and peak performance skills with focus on performance psychology. The enrollment is limited to thirty-six students each semester, divided into two sections to facilitate class interventions. The students are first introduced to systemic study of ego types and social styles to identify their own negative and dysfunctional internal dialogue, which can be contributing factors to negative experiences on stage. Over the course of the semester students are trained through the combination of cognitive and experiential exercises to gain better control over performance anxieties and to identify inefficient practice behaviors that risk overuse injuries.

Students work from a textbook written for the course, with weekly assignments, exercises and journal reports based on readings from two books by sport psychologist James Loehr – they learn to manage the "mental game". The supplementary elective

course in Alexander technique was added in 2006. In total, over three-hundred and fifty students (as of September 2007) have taken the course, but making it a requirement has posed challenges.

Listed below is the class syllabus:

Class 1. Introduction to transactional analysis ego types

Class 2. Social styles and life styles of different cultures

Class 3. Social styles and empathy communication

Class 4. Performance anxiety 1 – stress response

Class 5. Performance anxiety 2 – mental attitudes as risk factors in practicing and performing

Class 6. Performance anxiety 3 – synectics and other skills for regulating stage fright – relaxation techniques

Classes 7 and 8. Overuse injuries 1 and 2: causes, prevention practices, when to self-treat, when to see a doctor; posture and movement re-training to avoid re-injury.

Classes 9 and 10. Health issues to young students: physical and emotional risk factors, noise, hazardous practice styles; learning disabilities, cognitive problems, mental health issues.

Class 11 – Beyond the injured performer – imagery skills for peak performance, re-envisioning practice styles and relaxation techniques

Class 12 – The zone – creating conditions for achieving and maintaining high level performing. Sports psychology models of ideal performing states

Class 13 – Integrating wellness principles into teaching

Class 14 – Wellness model – self maintenance, finding balance between work life and personal life.

Institutions Outside United States:

1. Royal College of Music in London, UK (http://www.rcm.ac.uk)

Professional Skills (Level 1) taught by Dr. Aaron Williamon, BA, Bsc, PhD, Head, Centre for Performance Science, and Peter Buckoke, ARCM, HonRCM, Professor of Doublebass and Alexander Technique

The school was founded in 1882, but the Centre for Performance Science (CPS) was only established in 2000 to promote collaborative research and teaching initiatives among musicians and scientists at the college. Since 2003, the course is a compulsory part of first year undergraduate Bachelor of Music Honors program, and is in two parts: ten thirty-minute Alexander Technique classes held over ten weeks in either the autumn or spring term; eight seminars comprising the series Healthy Body, Healthy Mind, Healthy Music, which run during the autumn term in collaboration with Royal College of Music's Student Welfare Services and Students Association.

This course aims to help students gain insights into the kinaesthetic model, Alexander technique, and understand some principles of physical and psychological health that are fundamental part of performance. The Alexander Technique classes are

taught by Peter Buckoke in ten classes, with discussion and hands-on work on "everyday" activity – assessment is made on basis of quality of diary and written question submitted in Week Ten.

The seminar under Dr. Williamon, introduces students to fundamental principles of physical and psychological health that are integral to performance success. The series lies in assembled team of international experts, who give presentations on musically relevant topics drawn from fields of medicine and psychology:

Seminar 1 – Introduction to musicians' health and well-being

Seminar 2 – Physical nature of performance

Seminar 3 – The voice and its care

Seminar 4 – The psychology of performance

Seminar 5 – The ear and hearing

Seminar 6 – Physical fitness for the musician

Seminar 7 – Nutrition for the musician

Seminar 8 – Review of medical and psychological resources for musician

Assessment is based on a short group presentation focusing on one of 8 seminars.

2. Hanover University of Music and Drama – Hannover, Germany (http://www.hmt-hannover.de/en)

Health Courses and Training Program in Music Physiology taught by University Professor Eckart Altenmüller, MD, MA, PhD, Director and Chair and Hans-Christian Jabusch, MD, Dipl.mus, Institute for Music Physiology and Musicians' Medicine

This is one of the largest institutions in Germany to offer professional training for performing musicians and music educators. There are twelve hundred students from fifty-five nations in music performance, music education, musicology, drama, and communication sciences studies. Since 1978 one can confer master, doctoral and habilitation (postdoctoral lecture qualification) degrees.

The Institute of Music Physiology and Musicians' Medicine (IMPMM) was founded in 1974 as a part of the Hanover University of Music and Drama. The scope of institute is: teaching basics of music physiology and musicians' medicine for music students with particular aim of prevention; research into physiological and neurobiological principles of professional music making and music perception; research into the causes of occupational injuries in musicians' and prevention, diagnosis and treatment of such injuries.

The Institute operates in three formats:

I. Principle lecture: This is obligatory for all students of orchestra instruments and music education (including keyboard) for the first two years of study. It takes place once a week as a forty-five minute course and gives a broad overview of various music physiological topics within one semester. The lecture covers basic issues of human anatomy, physiology and psychology required for the understanding of physiological and psychological processes in music-making. The neurophysiological background of music-

making, consequences for optimized practice strategies and causes and mechanisms of musicians' health problems are explained in a positive manner with practical prevention strategies.

The syllabus:

1. Introduction to subject: anatomical and physiological aspects of music making
2. Function of muscles and nerves; tendon sheath problems and options for prevention
3. Muscle physiology and effects of training and musical practicing
4. Principles of sensorimotor learning in musicians
5. Neurobiological processes during practice; consequences for practice strategies
6. Mental practice; neurobiological background and practical approach
7. Pain syndromes in musicians: causes, mechanisms, prevention and treatment
8. Musicians' ear: anatomy and physiology of the auditory system
9. Hearing loss and other hearing problems in musicians; causes and prevention
10. Stage fright and performance anxiety: causes, mechanism and effects
11. Stage fright and performance anxiety: prevention and treatment, stress management
12. Conclusions – musician's influence on his/her health conditions

Practical exercises pertaining to performance anxiety and stress management (video feedback, relaxation techniques) mental practice (practical approach: mental rehearsal of new pieces) and injury prevention (warm-up exercises, stretching) are also offered. Students are graded on regular participation and written examination at end of semester.

II. Voluntary seminars (electives)

These are offered each semester with one special topic, which is addressed extensively throughout the semester – e.g. performance anxiety, physiology of keyboard instruments, physiology of string instrumentalists, physiology of wind instrumentalist, or similar topics. The scientific results from different fields relevant to musicians, such as physiology and other medical subjects, psychology, pedagogy, movement science, biomechanics and neuroscience, are presented and discussed in these seminars. Content is adjusted continuously to most current international research, including findings from the IMPMM.

III. Individual consultations

The opportunity for individual consultation is available to any student or faculty member with questions related to playing, music physiology and psychological topics. A physical examination by a medical doctor and an examination at the instrument is also offered free of charge.

The program also shares interdisciplinary collaboration with instrumental teachers and courses in Feldenkrais technique (twice a week for four hours). Students are also encouraged to participate in the research program of the Institute, which can be a part of a diploma or master's thesis: a typical topic includes three months of data collection and writing. Some topics include motor learning, expertise theory, practice strategies, influence of left- or right-handedness on instrumental technique, assessment of fine motor functions in different types of musicians, assessment of sensory functions in musicians. Students are encouraged to publish their research work.

The principle lectures and voluntary seminars are evaluated by participating students each semester; the results are made accessible to all teaching faculty. Overall, the quality of the HMTH program by anonymous evaluation of three hundred forty music students is as follows: 83% important or very important; 81% judged individual consultations as important or very important and 75% stated general health condition was good or excellent. However, controlled study on health programs versus non-health programs has not yet been conducted.

APPENDIX III:

Dystonia Grading Systems

1) Dystonia Evaluation Scale (DES):

    0 = Dystonia is bad at its worst

    1 = Slightly improved

    2 = Moderately improved

    3 = Almost normal

    4 = Normal

2) Arm Dystonia Disability Scale (ADDS):

    0 = normal

    1 = mild difficulty

    2 = moderate difficulty

    3 = marked difficulty

3) Tubiana and Chamagne score (TCS):

    0 = unable to play

    1 = plays several notes but stops because of pain or lack of facility

    2 = plays in short sequences without speed and with unsteady fingerings

    3 = plays easy pieces but is unable to perform more technically challenging pieces

    4 = plays almost normally but avoids difficult passages for fear of motor problems

    5 = returns to concert performances

4) Scale Quality Evaluation (SQE):

1 = scale very uneven in tone and rhythm

2 = scale almost rhythmically accurate but tone not even

3 = scale rhythmically accurate but not quite even in tone

4 = scale rhythmically accurate and even in tone

5) Test Repertoire Evaluation (TRE):

1 = blockage evident and playing rhythmically and/or tonally inaccurate

2 = playing restricted in tempo and/or rhythmic inaccuracies or unsteady fingering

3 = playing rhythmically accurate but not full tempo

4 = playing in required tempo, even in tone and rhythm but without freedom of expression

5 = playing even in tone and rhythm and showed freedom of expression

6) Visual Evaluation Rating (VER):

1 = severe problems passing from one note to the next

2 = involuntary movements visible

3 = hand noticeably stiff and cramped

4 = hand adjusted to alignment with the keys

5 = hand appeared relaxed and able to move with ease

APPENDIX IV:

V. Table of Analysis of Retraining Methods

Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**De Lisle et al.**	**Baird**	**Chen**
Location	Yokohama, Japan	Paris, France	New York City, United States	Berlin, Germany	Auckland, New Zealand	Deceased	Shanghai, China
Profession	Medical	Medical	Pedagogical	Pedagogical	Pedagogical	Performance	Performance
Institutional Affiliation	Utsunomiya University and Yokohama City University Hospital	Institut de la Main	Queens College, City University of New York	International Piano Academy in Lake Como and Hannover Institute	University of Auckland	None	Shanghai Conservatory of Music
Collaborative	No	Yes – various medical doctors from different fields	No	Yes – with music medical doctors at Hanover Institute	Yes – with medical colleagues at University of Auckland	No	No
Time Commitment	30 min. per day for 2 weeks; avg 2 yrs	Varies; average two years	Varies; average two years	3 phases, with 4 to 6 sessions in each phase; avg 28 months	10 one-hour sessions over two weeks	2 Years	11 years for concert level recovery

Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**de Lisle et al.**	**Baird**	**Chen**
Structure of Method	Reduced speed to rate of non-dystonic movement; increased gradually with metronome	New Sensory Motor Program: Four phases beginning with body posture and ending at return to instrument	Varies; can begin with scales or repertoire, depending on stage of the subject	Three phases: De-programming, Strengthening and Re-programming	Eight sequences, from dropping of single note to test repertoire	Gradual process of beginner's repertoire at clavichord to concert repertoire at grand piano	Used "threshold"; also measured metronomic speed of Chopin and Liszt etudes
Advantages of Method	Transfer-able and easy to monitor with metronome	Addresses physiological and psychological aspects	Various teachers trained to teach the method	Collaboration with medical doctors; teacher is experienced from own recovery	Specific and measurable; priority is on sound production	Transferable; self-regulatory	Transferable; self-regulatory
Disadvantages of Method	Patients found process unpleasant; only addressed physio-logical aspects	Non-transferable; also sound and pianistic technique not addressed	Quality of method dependent on teacher; not all are experienced with focal dystonia	Non-transferable; physiological and psychological aspects need more collaboration	Non-transferable; not enough subjects used to make a definitive recovery	Need access to clavichord, upright and grand piano; recovery is subjective to self-motivation	Requires extreme self-motivation and monitoring

Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**de Lisle et al.**	**Baird**	**Chen**
Number of Subjects Used	20	110	Unspecified	24	3	1	1
Improvement	12 (60%)	85 (77%)	Unspecified	12 (50%)	3 (100%)	1 (100%)	1 (100%)
Reason for Recovery	Motivation	Motivation	Unspecified	Motivation	Motivation	Motivation	Motivation
Diagnosis Method	ADDS and TCS (App. 3)	Postural disorders and TCS (App. 3)	Teachers and medical doctors	Hanover Institute and digital video	DER and PER(App. 3)	Self	Self
Hypothesis for Focal Dystonia	Unspecified	Neuro-muscular; can develop gradually from various traumatic or stress-related situations	Technique	Overuse, anxiety and perfectionism, genetic predisposition	Poor Physiological movements of body at instrument	Numbness from feet to neck including fingers, forearms and upper arms	Physical injury to hand while renovating home
Evaluation Method	ADDS and TCS	TCS	Testimonials; return to performance	Video; scale analysis	Blinded evaluation by professional pianist	Return to performance	Return to performance

Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**de Lisle et al.**	**Baird**	**Chen**
Use of Metronome	Yes – basis of method	No	Unspecified	No	Yes – used to monitor range of speeds of exercises	Unspecified	Yes – measured speed of etudes
Addressed Posture	Unspecified	Yes – specific work with trained physiotherapist	Yes – balanced; not holding or pushing	Yes – based on body awareness techniques	Yes – "four-point balance"	Yes – upper body free from tension	Unspecified
Addressed Sound Quality	Unspecified	Unspecified	Unspecified	Yes – monitored good tone	Yes – mezzo forte tone; not harsh sounding	Unspecified	Unspecified
Addressed Keybed Touch	No	Unspecified	Yes – aim for "bump" rather than keybed	Yes – "sink" to the bottom of keybed	Unspecified	Clavichord gave direct relationship between finger, key, tangent and string	Unspecified

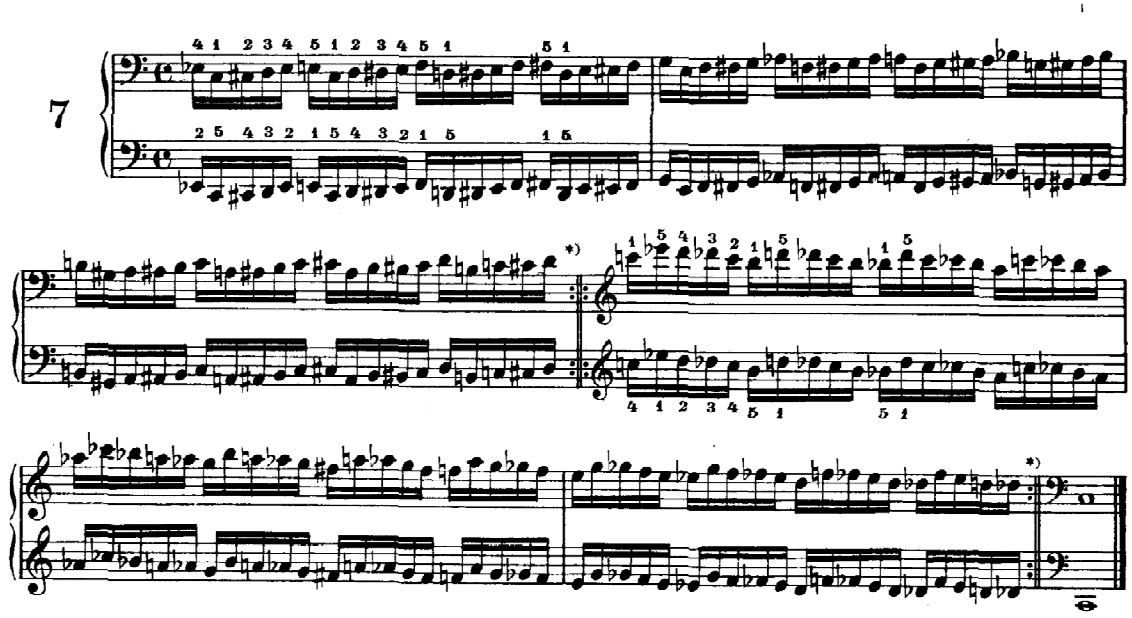
Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**de Lisle et al.**	**Baird**	**Chen**
Addressed keyboard weight	No	Yes - used different resistances before return to keyboard	Unspecified	Yes – even keyboard weight of 50 grams	Unspecified	Yes – used clavichord and upright before return	Yes – used buttons of remote control and upper register
Addressed Hand Position	No	Unspecified	Yes – fingers aligned to keyboard	Yes, based on Leschetizky Method	Yes – fingers aligned, flexible wrist	"Wrist supple and fingers poised"	No
Addressed Physiological Explanations	No	Yes – basis of method; used understandable terms	Yes – alignment and balance	Yes – monitored physical tension	Yes – new biomechanic technique needed	Unspecified	Unspecified
Addressed Neurological Issues	Reduced stratum of neural memories for repair	Used proprioceptive and stereognosis techniques	Establishing a new technique	Explained brain function in focal dystonia	Established new neurologic pathways	Avoided over-exercising musical intellect	"Unpeel the onion" to recover original set of memory

Method	**Sakai**	**Tubiana-Chamagne**	**Taubman**	**Boullet**	**de Lisle et al.**	**Baird**	**Chen**
Initial Scales used	No	Unspecified	Scales with black keys	C pentascale	E wholetone scale	No	Unspecified
Repertoire used	Subject's own	Unspecified	Only new repertoire	Subject's own	Subject's own	Began with Elementary level	Chopin and Liszt Etudes
Piano Exercises	No	Unspecified	No	Various, based on needs	Brahms Exercises No. 7 and 8	Exercises by Hanon and Joan Last	Not specified
Other Methods Used	No	Mirror for body alignment	Video-recording	Splinting and instant visual feedback; use of fingering	"Transfer learning" of non-dystonic hand	Rubber balls for hand shape	Visualization (red and green for tension)
Self-monitoring possible	Yes – with use of metronome	Yes, after initial retraining	Unspecified	Yes, after initial retraining	Yes, after initial retraining	Dependent for recovery; used comparison	Dependent for recovery
Continue other musical activities during retraining	Unspecified	Yes – performing with other hand or teaching	Unspecified	Yes – performing appropriate repertoire	Unspecified	Unspecified	Yes – gave concerts of less demanding repertoire
Alternative Treatments	None specified	Physical Therapy	Alexander & Feldenkrais	Alexander & Feldenkrais	Unspecified	Swimming	Cupping

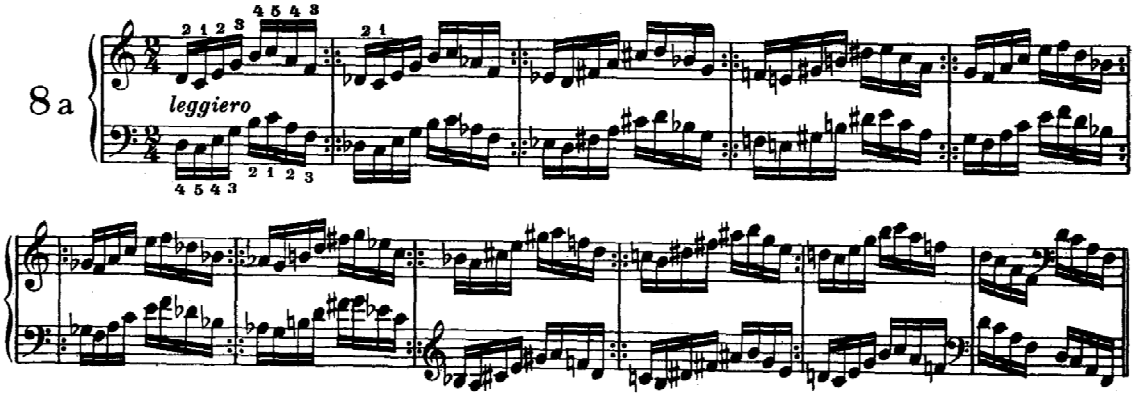
APPENDIX V:

Musical Examples

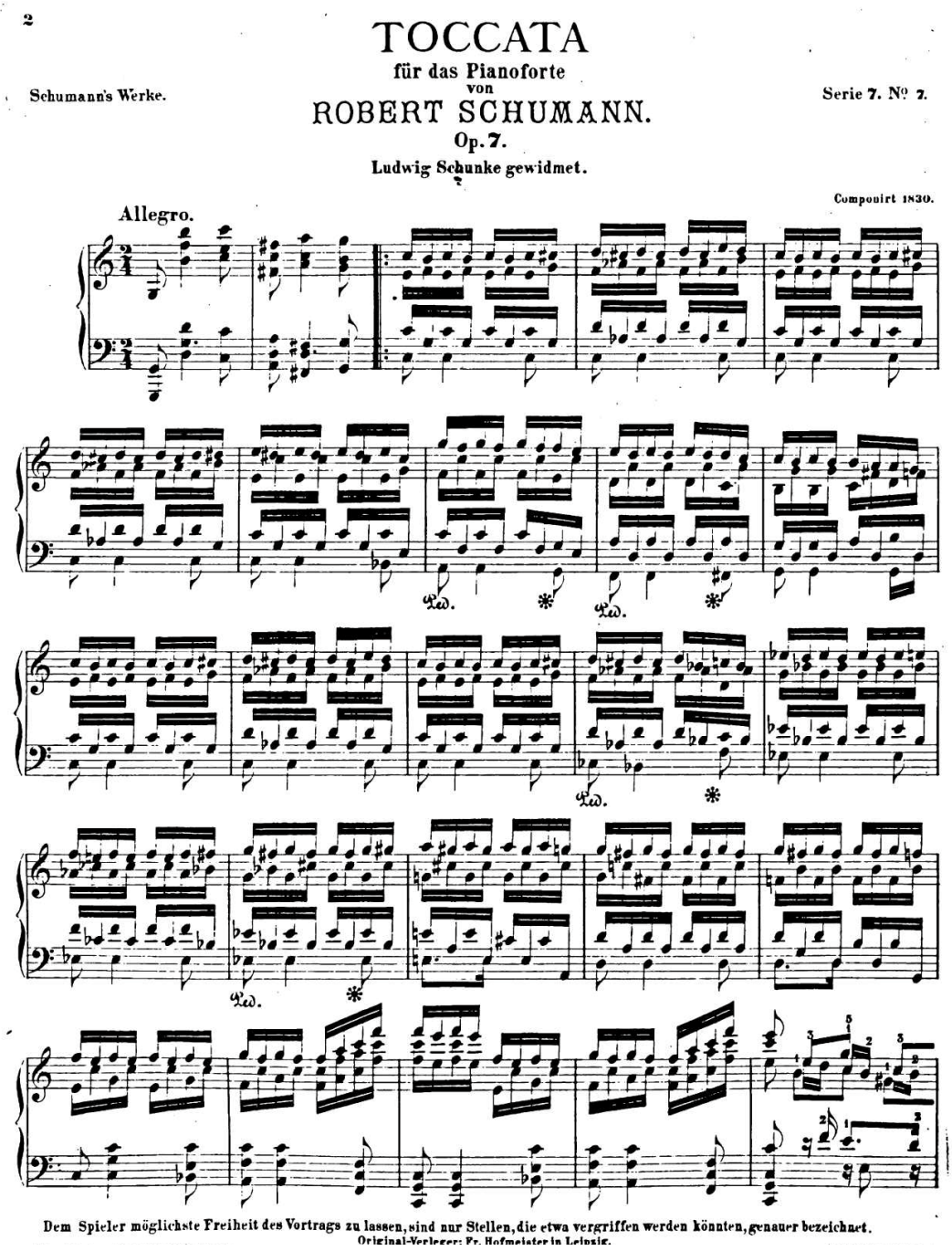
Rae de Lisle's Pedagogical Retraining Program: Brahms Exercises, WoO 6.



*) Repetitions (𝄆 𝄇) are to be played in different octaves (one and two higher or lower) than written.

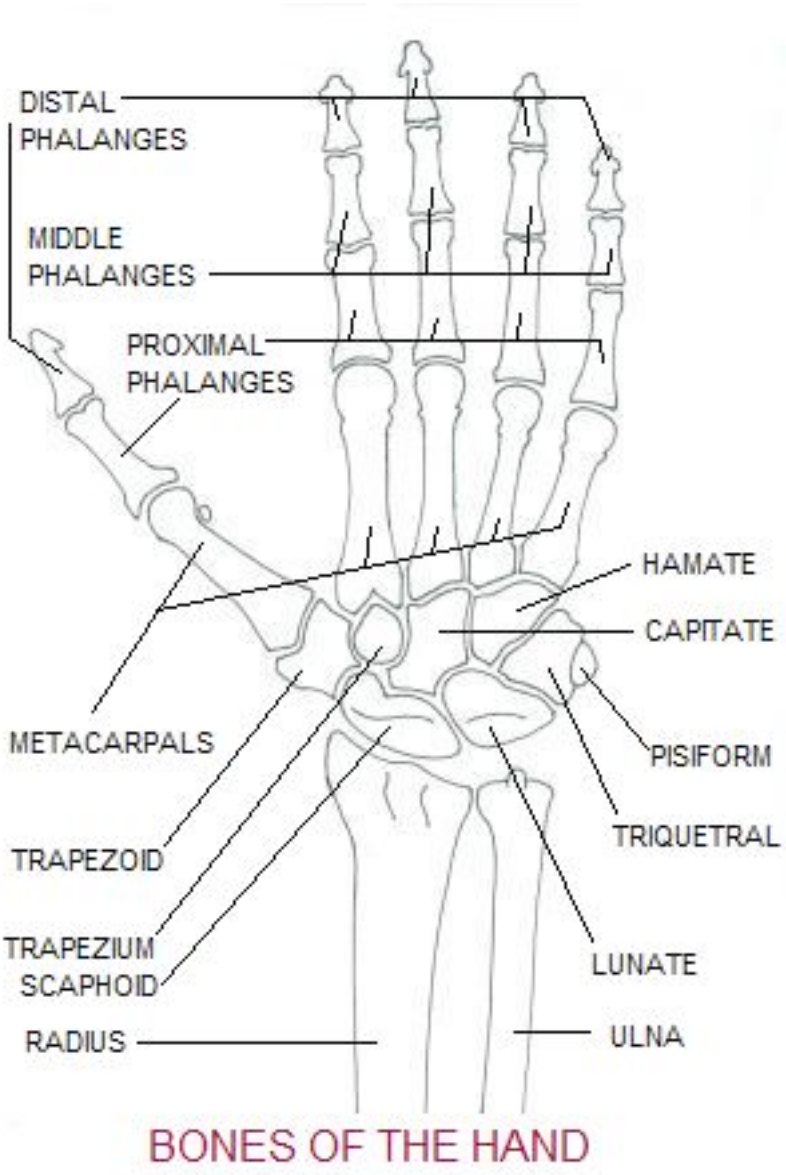


Robert Schumann's Toccata Op. 7 (first page), which leaves out his dystonic third finger in the right hand:



APPENDIX VI:

Bones of the Hand Diagram[108]



[108] Image taken from *joint-pain-expert.net* found at www.joint-pain-expert.net/hand-anatomy.html [accessed July 14, 2010]

APPENDIX VII:

Glossary of Medical Terms

Blephorospasm – a form of focal dystonia, is a neurological movement disorder involving involuntary and sustained contractions of the muscles around the eyes.

Botulinum toxin (Botox) - a drug made from a toxin produced by the bacterium Clostridium botulinum, the same toxin that causes a life-threatening type of food poisoning called botulism. Botox injections work by weakening or paralyzing certain muscles or by blocking certain nerves, the effects last about three to four months.

Carpal tunnel syndrome – a painful disorder caused by compression of a nerve in the carpal tunnel; characterized by discomfort and weakness in the hands and fingers and by sensations of tingling, burning or numbness.

Cupping - an ancient Chinese practice in which a cup is applied to the skin and the pressure in the cup is reduced (by using change in heat or by suctioning out air), so that the skin and superficial muscle layer is drawn into and held in the cup.

Cetyl myristoleate - an all-natural medium chain fatty acid found in only a small number of very select species of animals which never get arthritis. Clinical experience suggests this acid promotes the growth of cartilage cells, acts as an anti-inflammatory, as well as a surfactant and lubricant for damaged joints. It has been used in connection with Osteoarthritis and Rheumatoid arthritis, gout, ankylosing spondylitis, Reiter's syndrome, Sjogren's syndrome, psoriasis, and various types of back pain.

Distal muscles - the muscles furthest from the body, such as the fingers.

Dorsal interrossei muscles - the muscles that occupy the space between the metacarpals.

Dystonia - a movement disorder that causes the muscles to contract and spasm involuntarily. The neurological mechanism that makes muscles relax when they are not in use does not function properly; opposing muscles often contract simultaneously as if they are "competing" for control of a body part. The involuntary muscle contractions force the body into repetitive and often twisting movements as well as awkward, irregular postures. Focal dystonia is a type of dystonia that affects only a specific body part.

Electromyography (EMG) - a technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, recruitment order or to analyze the biomechanics of human or animal movement.

Exteroceptive - pertaining to stimuli that originate from outside the body or to the sensory receptors that they activate.

Fasciculations - muscle twitches which are visible under the skin arising from the spontaneous discharge of a bundle of skeletal muscle fibers

Ganglion Cysts - swelling that often appear on or around joints and tendons in the hand or foot. The size of the cyst can vary over time. It is most frequently located around the dorsum of wrist and on the fingers.

Hyperkinesia – a state of overactive restlessness.

Interosseuous muscles – muscles pertaining to the area between the bones.

Interphalangeal joints - any of the joints between the fingers.

Ischial tuberosities - rounded protuberances of the lower part of the ischium. They form the bony area on which the human body rests when in sitting position.

Metacarpals - the "knuckles" of the hand. The base lies proximal and the head lies distal.

Metacarpophalangeal joint - formed by the reception of the metacarpal head in the shallow cavity of the first phalange.

Muscle Spasm or Cramp - an involuntary contraction of a muscle. Muscle spasms occur suddenly, usually resolve quickly, and are often painful.

Nerve compression - harmful pressure on a nerve (especially in nerves that pass over rigid prominences); causes nerve damage and muscle weakness.

Nerve entrapment - repeated and long-term nerve compression (usually in nerves near joints that are subject to inflammation or swelling).

Overuse Syndrome - also called cumulative trauma disorder (CTD) or repetitive strain injury (RSI), is a general term for conditions characterized by chronic irritation to a body part.

Paralysis - the complete loss of muscle function in one or more muscles

Paresthesias: abnormal sensations in the skin, such as numbness, tingling, pricking, burning, or creeping on the skin that has no objective cause.

Proprioception - one's own sense of the relative positioning of the neighboring parts of the body**.**

Scapulothoracic girdle - the shoulder girdle.

Sensory Motor Integration - the process by which the sensory and motor systems communicate and coordinate with each other. It involves stimulus reception and transmission to the central nervous system (CNS) where the stimulus is interpreted. The CNS then determines which response to make and transmits its instructions as nerve impulses along a motor neurone to the appropriate effector (e.g. a group of muscle fibres), which carries out the response.

Somatosensory - pertaining to sensations received in the skin and deep tissues.

Splinting – used to support or immobilize a part of the body to prevent further injury; in focal dystonia, this is done by wrapping medical tape around the dystonic finger to keep it from curling under.

Stereognosis - the ability to perceive the form of an object by using the sense of touch.

Tendonitis – an inflammation or irritation of a tendon, a thick cord that attaches bone to muscle. It is most often caused by repetitive, minor impact on the affected area, or from a sudden more serious injury.

Tenosynovitis – an inflammation of the lining of the sheath that surrounds a tendon (the cord that joins muscle to bone). The wrists, hands, and feet are commonly affected. However, the condition may occur with any tendon sheath.

Torticollis - one of a broader category of dystonic disorders that exhibit flexion, extension, or twisting of muscles of the neck beyond their normal position. In torticollis your neck tends to twist to one side. The condition can either develop slowly if you have a family history of the disorder, acutely from trauma, or as an adverse reaction to medications.

Trapezius - a large superficial muscle that extends longitudinally from the occipital bone to the lower thoracic vertebrae and laterally to the spine of the scapula (shoulder blade). Its functions are to move the scapulae and support the arm.

Trigger Finger - a condition in which one of your fingers or your thumb catches in a bent position. The finger or thumb may straighten with a snap — like a trigger being pulled and released. If trigger finger is severe, your finger may become locked in a bent position. Often painful, trigger finger is caused by a narrowing of the sheath that surrounds the tendon in the affected finger. People whose work or hobbies require repetitive gripping actions are more susceptible.

Tremor – an involuntary, somewhat rhythmic, muscle contraction and relaxation involving to-and-fro movements (oscillations or twitching) of one or more body parts.

Trihexyphenidyl – medication used to treat the symptoms of Parkinson's disease and tremors caused by other medical problems or drugs, including focal dystonia.

Writer's cramp - a form of task-specific focal dystonia; it affects an individual by inhibiting their ability to write.

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