

THE ROLE AND MANAGEMENT OF TENSION IN PEDAGOGICAL APPROACHES TO PIANO TECHNIQUE

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ABSTRACT

Mastering the piano to play with freedom and without physical limitations has long been a topic of great interest and importance to pianists. This is borne out in the numerous pedagogical approaches to piano technique. Playing without tension is considered an important key to technical freedom among many of these approaches. However, conflicting advice on the role and management of tension abounds. The purpose of this study is to investigate the meaning and management of tension in current pedagogical approaches.

To do this, the language used to define and describe the positive and negative role of tension was collected from five pedagogues who have developed approaches that reflect current trends in piano technique: Barbara Lister-Sink; Dorothy Taubman; Thomas Mark; Fred Karpoff; and Alan Fraser.

The data was then analyzed by examining both the meaning and management of tension in each approach. This study showed that the authors view tension very differently—either as an impediment to motion, and thus a quality that must be banished—or as an essential component of control and activity, and thus a quality that must be carefully harnessed and managed.

Three reasons for this confusion were identified: there is an inaccurate understanding of the anatomical and biomechanical principles of the role of tension in piano technique; the authors waver between using scientific, common, and invented terms to describe tension; and, there are challenges describing the fine degree of muscular control needed to play the piano freely. By recognizing where the problems in the varied meanings and management of tension exist, this study represents an important first step for the pedagogical community to bring more clarity to how we teach the role and management of tension in piano technique.

INTRODUCTION

Since the invention of the early pianoforte over three hundred years ago to the modern day piano, pedagogues and pianists have developed approaches aimed at mastering piano technique.

The literature on this subject is vast and varied: the finger action school of Muzio Clementi (1803), Carl Czerny (1844), and Charles Hanon (1873); the relaxation and arm weight school of Rudolph Breithaupt (1905) and Tobias Matthay (1903, 1932); the scientific-based investigation of Otto Ortmann (1925, 1929); the empirical approaches developed by Abby Whiteside (1929, 1955), Seymour Bernstein (1981, 1991), Seymour Fink (1992, 1994); and more recently, the numerous approaches designed to address playing-related injuries from pedagogues such as Dorothy Taubman (Taubman, Golandsky, Schnitzer, Urvater, Bloomfield, & Yaguspsky, 2001), and Barbara Lister-Sink (1996, 2008).

Pedagogues have pursued piano technique from different perspectives over the piano's lifetime. Since the beginning of the twentieth century, many piano approaches are based on the conviction that technical mastery provides the key to injury-free technique, physical and musical freedom—and for many, the guiding principle is that this is achieved by avoiding excessive muscular tension.

Detrimental Tension

Throughout much of the literature on piano technique, tension figures as a major culprit in limiting agility and causing injury. Louis Adam (1758-1848), a pioneer of the Paris Conservatoire tradition, wrote early method books for piano that served as one of the first pedagogical resources of this venerable institution (Parakalis, 2001). In a letter advising young piano forte players, (1829), Adam wrote about the constrictions that come from tension: "...for all muscular tension blocks freedom of movement and makes it impossible for the hands to extend and contract the fingers properly, which one needs to be able to do at all times" (as cited by Rosenblum, 1998, p. 195).

Almost two hundred years later, Thomas Mark, author of *What Every Pianist Needs to Know About Their Body* (2003), an approach designed to teach musicians how to move in accordance with an accurate understanding of the anatomical design of the body, conveys the same prevailing view held by many pedagogues and pianists in the following statement: "Piano playing that is accomplished by high-quality movement, in which each part contributes its proper share with no tension, will be free, expressive, and secure" (p. 5).

This sentiment is also summed up in the title of Barbara Lister-Sink's popular approach to injury-free technique, *Freeing the Caged Bird* (1996, 2008), a metaphor for the freedom that comes from releasing the physical and mental entrapment of tension. The belief that tension is a major contributing factor to playing-related injuries and technical limitations even inspired one of Britain's leading piano pedagogues, Carola Grindea (1914-2009), to found the *International Society for the Study of Tension in Performance* (<http://www.isstip.org/>). This society provides symposiums, clinics, and articles to raise awareness of how tension impacts physical problems in performance and seeks solutions to managing tension for a healthy and free technique.

Disaccording Voices

Not all pedagogues have embraced this notion that tension must be avoided. Fixation of joints with a degree of tension was an important aspect of Rudolph Breithaupt's approach to piano technique. Indeed, he believed that "a gifted individual will, of his own accord and unconsciously, exert a certain muscular tension as required by the part or situation" (Breithaupt, p.99, 1909). Seymour Bernstein (1981), popular pedagogue, writer, and clinician criticizes the idea that pianists must eschew all tension from their playing. He states that it is important to recognize the different attributes of tension by categorizing all tension as either: 'organized tension', 'controlled tension', 'muscular tension', and 'emotional tension'. Similarly, Alan Fraser, author of *The Craft of Piano Playing* (2003, 2006), and *Honing the Pianistic Self-Image* (2010) contests the negative view of tension: "We must do away with this fear that tension will interfere with, or limit motion. Without tension there is no life at all" (Fraser, 2003, p. 38). These views differ dramatically from the more prevalent belief that tension is a major impediment to achieving technical freedom. Clearly, these conflicting views represent a significant source of confusion for pianists and pedagogues learning how best to approach the physical aspect of piano technique.

Relaxing As an Antidote to Tension

When pedagogues do agree that harmful tension must be avoided, they often advise relaxation as a remedy. Tobias Matthay, one of the most influential pedagogues of the early 20th century (Gerig, 2007), wrote extensively of the importance of 'relaxation'. He sums up his thoughts on relaxation in his landmark work, *The Act of Touch in All Its Diversity* (1903): "Really complete relaxation may possibly be physically unattainable, but the term thoroughly conveys what has *practically* to be striven for. For it is the completest possible *Relaxation* of all muscles that should be passive that forms the real 'secret' of all good tone-production (including Agility) at the Pianoforte" (p. 22). Matthay's belief that 'relaxation' was the key to the technical mastery required for good tone production shaped subsequent pedagogical approaches and is a concept that is firmly entrenched in much of the literature today (Gustafson, 2007). Indeed, of the many ways to avoid, reduce, or eliminate unhealthy tension, the ability to relax immediately after the finger makes contact with the key is presented as an important element of a healthy and skilled technique in modern day approaches (Lister-Sink, 1996, 2008; Riley, Coons, & Marcarian, 2005).

Despite his belief that the term 'relaxation' described an optimal muscular state, Matthay later regretted the use of this term as pianists had misunderstood this to mean throwing their arms on to the piano with absolutely no control (Bernstein, 1981). Other pedagogues such as Abby Whiteside, Arnold Schultz, and Seymour Fink have also shared concerns that the term 'relaxation' has led pianists to develop dangerous ideas of how to move to play the piano. Indeed, Dorothy Taubman (2001) has raised concerns that encouraging relaxation actually contributes to harmful tension. Alan Fraser (2010) suggests that pianists have become so accustomed to 'over-relaxation' that "we simply don't perceive its detrimental effect" (p. 232). He believes that encouraging relaxation can put the skeletal structure out of "alignment" and muscles cannot initiate movement efficiently. These opinions contrast starkly with the

view that relaxation is an important antidote to harmful tension and add to the confusion the pianist faces when considering how best to address harmful tension.

Science-Based Pedagogical Approaches

In an effort to legitimize and offer a more logical explanation of the mechanics of piano technique, some pedagogues have turned to science as a basis for their approaches. Taubman believed that it was a “lack of knowledge” that stymied piano virtuosity—not talent, and therefore it was essential “that we avail ourselves to scientific procedures” (Taubman, et al., 2001, chap 1). Lister-Sink defines her technique from a “neuromuscular and biomechanical viewpoint” (1996, 2008). Fred Karpoff has developed an award-winning approach to technique that comes from an understanding of “how to merge healthy biomechanics with dynamic music making” (2009, p. 6). Despite these claims of using science as a foundation for piano technique, underlying contradictions of the role and management of tension in piano technique continue to surface. For example, Taubman and Mark discourage situations causing opposing muscles to contract simultaneously around a joint. Yet, from a biomechanical standpoint, this is a necessity in any movement (Ackland, Elliott, & Bloomfield, 2009). Lister-Sink’s method also presents misleading information in suggesting that muscles only serve to fixate joints—not initiate movement (Fraser, 2010). Recently, scholars of both piano pedagogy (Wristen, 2000) and mechanical engineering (Vant, 2007) conducting research into the biomechanics of piano technique have also raised concerns that there is a widespread misunderstanding of muscle and joint function in the piano pedagogical literature. Even though pedagogues have embraced a more scientific perspective in analyzing and observing motions to play the piano, Wristen, piano pedagogue and researcher at the University of Nebraska-Lincoln states that “many of these pedagogues based their recommendations on an incomplete or even incorrect knowledge of anatomy and human motion” (p.55), ironically, creating situations that produce rather than prevent injury. In a study entitled *Driving point impedance measurements during piano playing*, Vant (2007) also points to the incongruity between the two fields of biomechanics and piano pedagogy: “Expertise and language in the two fields are considerably different and thus the two fields are divided by a great expanse...” (p. 34). Despite the stated inclusion of scientific principles in pedagogical approaches to piano technique, these are not always presented or articulated accurately, and the recurring confusion continues.

Research Problem

Although pedagogues today share the same goals of playing the piano freely, without physical limitation, and without injury—there is much conflicting advice with regards to muscular effort and joint function—particularly surrounding the concept of tension. Even when pedagogues claim to base their approaches on scientific principles, we are no closer to agreement on how tension figures in piano technique. With no consensus on the meaning, the role, and the ways of dealing with tension, there is little constructive debate and discussion, and the pedagogy of piano technique cannot advance. This is an acute problem. There is a need to better understand how contradictions and inconsistencies surrounding the meaning

and management of tension may contribute to the confusion in the pedagogy of piano technique. Therefore, this study poses the following questions:

1. What are the consistencies and inconsistencies in the meaning and management of tension among pedagogical approaches?
2. Does the pedagogical definition of tension align with the scientific definitions?

In answering these questions, this study brings to light the issues of misunderstandings in language surrounding the confusion in piano technique. This is an important first step in bringing more clarity and consistency to how language is used to convey the concept of tension in piano technique. Ultimately, a more precise, consistent, and common manner of communicating tension will lead to a more productive discussion and debate of its role and management in piano playing.

METHODOLOGY

To answer the above questions, this study conducted a content analysis of the usage of ‘tension’ in current pedagogical approaches. The following five approaches were selected for this study due to their focus on the physical aspect of piano technique: 1. *The Taubman Technique*, [DVD] (Taubman et al., 2001)¹; 2. *Freeing the Caged Bird* with Barbara Lister-Sink [DVD] (Wingsound, 1996, 2008); 3. *What Every Pianist Needs to Know about the Body* [DVD and book] (Mark, 2003)²; 4. *3-D Piano with Fred Karpoff*, [DVD and workbook] (Karpoff, 2009); 5. *The Craft of Piano Playing* [DVD, book, and workbook] (Fraser, 2003) and *Honing the Pianist Self-Image* ([book] Fraser, 2010). Collecting the data entailed a detailed reading and viewing of the books and DVDs. Each time ‘tension’ appeared in the material, it was systematically recorded into tables designed to assemble a detailed examination of its use. The tables include the following categories: Context (to show how the term is employed: i.e. ‘tension’ used when describing curled fingers); Definition/Description (to show how the author defines/describes the term); Terms (to provide words associated with the term; i.e., ‘stiff’ and ‘fixed’ associated with tension); Role (to determine if the concept is presented by the authors as contributing positively or negatively to piano technique); Summary (to provide a synopsis of the use of the term). This data was then amalgamated into a second set of tables that summarized underlying causes, effects, and ways to address both the positive and negative roles of tension in piano performance.

There were two components to the data analysis: 1) consistency of pedagogical usage, and 2) scientific accuracy. First, the consistency of the pedagogical usage of the concepts was examined by tallying the frequency of references to the positive and negative roles. These numbers indicated whether the authors consistently or inconsistently associate the concept with a positive or negative role. The terms the authors use to refer to tension in both its

¹ Taubman’s assistant at the time of the production of the DVD, Edna Golandsky, demonstrates Taubman’s principles and reads from Taubman’s lecture notes throughout the DVD.

²Body Mapping evolved from William Conable’s discovery in the mid-1970s that music students who mapped accurate anatomical information of their bodies were able to adopt principles of the Alexander technique more quickly. Barbara Conable developed Body Mapping into a course that trains musicians to move more freely and expressively by learning an accurate internal representation of the structure, size, and function of the body’s anatomy.

negative and positive role were then organized into “scientific”, “common”, and, “invented” categories.³

These categories emerged during the data collection. At times, the authors explain and describe how tension relates to muscle, joint function and movement with scientific terms, thus the inclusion of ‘scientific terms’ in the data collection. At times, the authors use these terms in a colloquial sense with broad meaning, thus the inclusion of ‘common terms’ in the data collection.

Lastly, at times, the authors blended the scientific and common terms to come up with their own interpretation of the meaning of tension and relaxation, thus the inclusion of ‘invented terms’ in the data collection.

Allocating each of the terms to scientific, common, and invented categories provided an overview in how the authors used the concept. To complete the analysis of pedagogical usage, the summary tables were consulted to determine how each author addressed the positive and negative aspects of tension.

The second component of the data analysis examined the scientific accuracy of the pedagogical usage of tension. Biomechanical resources were consulted to determine a standard definition of tension.

The scientific definition provided a benchmark to compare the pedagogical usage of tension and allowed for the identification of specific areas of accuracies and inaccuracies in how tension is presented in the pedagogical approaches.

RESULTS

Tension figures as a central concept in each of the author’s approaches. Indeed, a cursory reading would perhaps not have revealed how prevalent tension appears in all of the approaches. From the systematic and numerous records taken for the initial data collection tables it was possible to produce a chart, (Table 1.1), showing tension as having only a negligible positive impact on piano technique (14/157) with much more attention to its negative aspects (143/157).

Table 1.1. Frequency of references to tension as playing either a positive or negative role

Author	Positive	Negative
Lister-Sink	2/22	20/22
Taubman	0/10	10/10
Mark	0/69	69/69
Karpoff	0/12	12/12
Fraser	12/44	32/44
Total references from all approaches	14/157	143/157

³ By "invented" we mean a term created or re-defined by an author for use within the context of a particular work. By “scientific”, we mean a term that is clearly defined, accepted and used with consistency in science and engineering. By “common” we mean a generally vague or ambiguous term that is used in casual conversations or in a situation where sufficient background does not exist to use the term precisely.

Positive Role of Tension

In its positive manifestation, two of the authors agree that tension provides necessary joint stability. The difference lies in how this tension is managed. The language the authors use to describe positive aspects of tension in Table 1.2 sheds some light on these differences. Lister-Sink's method revolves around developing kinesthetic awareness of 'minimal' muscular tension needed to stabilize joints at the instant the finger makes contact with the key and learning to relax and release all of this tension immediately after it has performed this necessary task. Although Fraser also draws attention to the importance of cultivating sensory awareness to muscular tension, he devotes more attention to its positive role in all aspects of piano playing. He argues that in addition to providing important stability to joints, tension also serves to control, to move, and to provide important finger activity. Rather than completely eliminate tension, Fraser's approach focuses on how to best harness the positive aspect of the opposing forces created by tension. Recognizing the negative associations with the term 'tension', Fraser proposes using the term 'muscle tonus' to describe tension's positive attributes, defining this as the "appropriate muscular effort needed to hold bones in place" (2010, p. 241).

Table 1.2. Scientific, common, invented terms to describe tension as playing a positive role

Author	Scientific terms	Common terms	Invented terms ⁴
Lister-Sink	Muscle contraction; Stabilize;	<i>Quantifiers:</i> Minimal; "Just the right amount of tension—no more, no less" (chap. 2). <i>Qualifier:</i> Stability	N/A
Taubman	N/A	N/A	N/A
Mark	N/A	N/A	N/A
Karpoff	N/A	N/A	N/A
Fraser	Co-contraction; Muscle tonus; Tensile strength;	<i>Quantifiers:</i> Appropriate; Necessary; Healthy; Reduced; Minimal: <i>Qualifiers:</i> Muscular effort; Natural muscle tonus Stability	Internal tension; Transformative tension;

The relationship between stability and muscular tension is less clear among the other authors. Taubman and her assistant Golandsky describe the joints as serving as "fulcrums", but Golandsky states that "to fixate or mold is wrong, however much the amount...even a little bit would be wrong" (Taubman, et al., 2001, chap. 5). Similarly, Mark discourages any degree of fixation. He believes that movement must be organized around a stable bony structure, stating that this is a "stability achieved without tension" (p. 112). Despite speaking of this necessary 'stability', Mark also suggests that using the term 'stable' can create an

⁴ These are a blending of personal, scientific, and common terms.

erroneous idea that movement must initiate around a fixed place and thus lead to dangerous tension. Karpoff is less categorical in dismissing muscular activity for stability and advises students to “respect the antagonistic relationship” (2009, Unit 1, chap. 17) to provide ‘important stability’. Once again, the pianist confronts conflicting advice. From explanations of joints acting as fulcrums, avoiding any type of fixation, to a vague degree of muscular activity providing necessary stability, the pedagogues present a muddled picture of how muscles and joints work to play the piano.

Negative Role of Tension

The terms all of the authors use to describe the negative role of tension underscore its detrimental role in hampering healthy and free movement. As shown in Table 1.3, terms such as ‘lock’ ‘clenching’ ‘cramped’ and ‘paralysis’ convey tension as resisting movement. In almost all cases, the authors attribute playing-related pain and injury to excessive tension. The amounts of tension that can bring about these negative consequences range from ‘any’ to ‘excessive’. Clearly, in the view of these pedagogues, tension figures as a major impediment to healthy and free technique. Given this view, the pedagogues, to varying degrees, focus attention on reducing unnecessary tension from piano playing.

Differing Ways of Reducing Tension

Instructions to ‘release’ tension are found in all of the approaches. Although united in the view that releasing harmful tension leads to more fluid and healthy piano playing, there is inconsistency when describing how to execute this release. Learning to release tension by consciously controlling the activation and complete release and relaxation of muscular contractions is at the core of Lister-Sink’s approach. She likens the neuromuscular system to a light switchboard—when signals to the brain turn off, muscles relax. It is this state the pianist must return to, immediately and constantly, after the muscles contract to stabilize joints when making contact with the key. Instructing students to “relax the entire arm muscles completely, a state of release to which the pianist must always return” (Lister-Sink, 1996, 2008, chap. 1), Lister-Sink conveys full relaxation and release as vital to avoiding a build-up of tension. Conversely, Golandsky states that we cannot command muscles to relax and activate and even suggests, paradoxically, that relaxation is another guise of tension: “if people are very relaxed, they have a tremendous amount of tension” (2001, chap 10). She believes tension can only release by cultivating a quality of movement without undue tension. Mark takes this idea further by encouraging movement based on an accurate internal representation of the body’s anatomical design.

Broad instructions to ‘release tension’ accompany his descriptions of anatomy relevant to playing the piano. Although Fraser also draws attention to the important relationship of anatomy and movement, he advocates a completely different approach to addressing tension. Believing that a structurally secure hand and fingers will allow undue tension to release in the rest of the body, Fraser promotes a hand structure that is organized around strong and pronounced three bony arches of the forefinger, thumb, and metacarpophalangeal (MCP)

joints. In contrast, the other authors advocate a very loose, quiet, and natural hand position to avoid tension.

In fact, Taubman believes the very hand position of a pronounced MCP joint that Fraser recommends as a remedy for tension is actually a cause of tension. To add to the confusion, Karpoff describes ‘relaxed motion’, and a ‘very relaxed hand’ as desirable—a stark contrast from Golandsky’s belief that relaxation is another form of tension and Fraser’s ‘activated’ hand and fingers.

Table 1.3. Scientific, common, invented terms to describe tension as playing a negative role

Author	Scientific terms	Common terms	Invented terms
Lister-Sink	Muscular contraction	<i>Quantifiers:</i> Chronic; Excess; Accumulative; Any; Unnecessary; <i>Qualifiers:</i> Resistance; Paralysis; Locks; Dangerous; Harmful;	Inner tension; Hidden tension;
Taubman	Static muscular activity	<i>Quantifiers:</i> Too much; Slightest; Tremendous; <i>Qualifiers:</i> Muscular effort; Clenching; Fixating; Tightening;	Dual muscular pull
Mark	Static muscular activity	<i>Quantifiers:</i> Excessive; Chronic; Continual; Constant; Repeated Small amount; Compensatory <i>Qualifiers:</i> Muscular effort; Short, narrow muscles; Underlying; Upward; Stiff; Strain; Gripping; Fixed; Holding; Squeezed Stabilize; Counteract;	Dual muscular pull
Karpoff	Muscular tension	<i>Quantifiers:</i> Accumulative; Extra; Excess; Reduce; <i>Qualifiers:</i> Cramped; Held; Lock; Unbalanced;	N/A
Fraser	Co-contraction Excessive muscle tonus	<i>Quantifiers:</i> Extra Excess; Negative; Unwanted Undesired; Undue; Useless Increased; Inappropriate; Overly; Any; Too much; Persistent; Superfluous; Counterproductive Compensatory; <i>Qualifiers:</i> Muscular effort; Effortful; Opposing forces; Constraint; Destabilize; Stabilize; Immobility; Blocking; Inhibit;	Internal Inner

We can see that the pedagogues view the role of tension differently, resulting in contradictory recommendations. Either seeking its total absence to facilitate ease and

freedom, or discerning just the right amount to stabilize joints and empower technique, these varied ways of dealing with tension can be traced to how the authors define tension. In Lister-Sink's case, when tension is defined as a necessary but temporary muscle contraction in providing stability in joints, the approach focuses on a minimal contraction that is then completely released. If tension is viewed as too much muscular effort that inhibits movement, the authors focus on a piano technique that ranges from reducing tension to completely eliminating tension. In contrast, Fraser's concession that there are two forms of tension—healthy and unhealthy—results in an approach that revolves around creating structural support in the hand and fingers with muscular tension. Fraser's attempt to differentiate between healthy and unhealthy tension by using either the terms 'muscle tone' or 'tension,' though perhaps important steps in providing more clarity in how tension figures in piano technique, is not consistently used within Fraser's own approach; nor is it a term that is used by the other authors. Nonetheless, Fraser's proposal to use different terms to refer to healthy and unhealthy tension recognizes that there is a problem in how the term 'tension' is used. Indeed, the differing interpretations found among the authors leads to conflicting advice in piano technique. To come to a clearer understanding of the meaning of tension, we now turn to the scientific definition and consider the accuracy of the pedagogical usage of this concept.

Analyzing Accuracy

In mechanics, the word *tension* refers to a *force* (a vector, that is, it has both magnitude and direction) that tends to pull on the object on which the force acts⁵ (Brickmann, Frobin, Leivseth, 2002). The application of a force to an object does not imply that the object will be in motion as other forces applied to the object may create a situation in which the net force applied to the object is zero.

When the object is a muscle several other basic principles of mechanics and biomechanics are also important. Skeletal muscles generally act to cause two bones to rotate relative to each other (a joint). Motion will only occur in a joint if the net effect of all of the muscles and any external forces applied to the bones is unbalanced. Muscle is connected to bone through tendons. Tendons (and muscles) in the body cannot support compression - only *tension*.⁶ As a direct result of this, almost all joints have more than one muscles acting across the joint - the contraction of one muscle will tend to cause the joint to rotate in one direction while contraction of the other muscle will tend to cause the joint to rotate in the opposite direction. In the situation where all of the forces tending to rotate the joint are appropriately balanced the joint will not move and neither muscle will change length. A muscle that is contracting but not changing length is said to undergo an *isometric* contraction. In the situation where all of the forces applied to a joint result in motion of the joint one (or more) muscles will lengthen and one (or more) muscles will shorten. An active muscle that is *shortening* is generating a force (*tension*) that acts in a direction that tends to increase the movement of the joint. The contraction in such a muscle is described as *concentric*. A muscle acting on the other side of the joint that is contracting will be generating a tensile force that

⁵ The opposite of tension is compression - a pushing force.

⁶ Obeying the often stated axiom in introductory mechanics: "You can't push on a rope."

tends to reduce the movement of the joint. The contraction in such a muscle is described as *eccentric*.⁷ (See Vant, 2007).

The force applied to (or by) a muscle is not solely dependent on whether or not the muscle is being contracted. A muscle that is not contracting can still be under tension; for example, when external forces arising from other muscles or outside of the body act to lengthen the muscle, the *passive* material properties of the muscle result in the muscle stretching and, as a result, in a spring-like force that resists the applied tension.

There is only one length, the so-called, *rest length*, of the muscle where, without a contraction, it generates no force. As a result, in almost all positions, every muscle in a limb is generating some *passive tension* as a result of being stretched but not as a result of it contracting (See McMahon, 1984).

A muscle contraction (the active generation of force) may be voluntary or involuntary. A voluntary contraction is one that results from intent - a decision to move. An involuntary contraction of a skeletal muscle, is generally the result of a reflex. Whether a contraction is voluntary or involuntary does not change the biomechanics of the muscular contraction. In both cases, the contractile elements within the muscle work to create tension in the muscle. Tension arising from the contraction of a muscle is often described as being *active* (as opposed to passive).

The use of the term tension is properly limited to describing the force generated by the muscle and not the cause of any contraction that might be involved or the resulting motion of the muscle or any joints across which it may act.

In the act of playing the piano muscles in the arm will be generating both active and passive tension. At any particular time, muscles in the arm and hand will be contracting concentrically and others contracting eccentrically; postural muscles, for example, in the back and shoulders may be contracting but not changing length - isometric contraction⁸; most will be contracting voluntarily but involuntary activity will be contributing to the development of *tension* in the muscles. The level of voluntary contraction in a muscles will be the result of many factors (including sensory and emotional factors) and as a result may be more or less than is required, from a mechanical point of view, to achieve the task of performing a piano work.

Four points from the scientific use of *tension* provide a framework to examine and analyze the accuracy of the pedagogical usage of tension: (1) all muscular contractions—concentric, eccentric, and isometric—produce *tension*, (2) the degree of *tension* varies according to the amount and duration, (3) a degree of *tension* is always present, albeit a very small amount and (4) *tension* describes the force generated by a muscle and does not describe a joint.

The following examines how the pedagogical usage of tension aligns with these scientific points.

⁷ Note that in addition to isometric, concentric and eccentric, muscles are often described as having an *isotonic* contraction. The word isotonic describes a situation in which the tension generated by the muscle is constant. The adjectives isometric, concentric and eccentric are mutually exclusive but unrelated to whether or not a contraction is isotonic.

⁸ In some situations, it may be the case that, in holding a chord, a muscle maintains a contraction without changing length (an isometric contraction) but it is important to realize that just because the finger tips are not being moved does not mean that the muscles associated with the movement of the finger tips are not changing length. It is a simple task to hold down a piano key and move all of the joints in the arm.

1. All Muscular Contractions—Concentric, Eccentric and Isometric—Produce Tension

All of the pedagogues agree that muscular contractions produce tension, however, with the exception of Fraser, they exclusively associate tension with an isometric contraction that serves to maintain a stationary position and impede the motion of a joint. Thus, the majority of terms referring to tension found in the pedagogical approaches do not consider tension's role in producing and controlling movement. Terms such as fixate, tighten, hold, lock, and stiffen, repeatedly emphasize a static quality of tension. Fraser stands out as the only author who allows that tension is present in all types of muscular contractions. He argues that the supportive function that comes from the simultaneous contraction of muscles can free movement, describing tension as “two opposing muscle groups working purposefully one against the other, to achieve musical ends” (2010, p. 38). To avoid confusion for his readers, and knowing that tension is viewed so negatively, Fraser proposes reserving the word ‘tension’ to describe a contraction that serves to inhibit movement, and ‘muscle tonus’ for necessary muscular activity. Although it is true that tension can resist movement, the language found in the pedagogical approaches narrows the description of tension to a product of isometric contraction and fails to acknowledge its role in producing and controlling movement from concentric and eccentric muscle contraction.

2. The Degree of Tension Varies According to the Amount and Duration of Muscular Contraction

There is a tendency among the pedagogues to present extremes of either too much or a total absence of tension with little possibility of a changing amount and duration of tension to accommodate changing situations. The pedagogues share the common concern that poor movement patterns and poor skeletal alignment will lead to an increase of magnitude and duration of tension. Extra effort is required to move; therefore, tension accumulates and is generally regarded as too much. According to Mark, tension decreases when using just the right amount of muscular effort to execute the task at hand. In this manner, there is an acknowledgement that tension increases and decreases with effort. However, there are challenges in articulating an optimal degree of *tension* that will provide stability but not impede movement. In Lister-Sink's words: “It is a question of finding just the right amount of tension—no more, no less” (1996, 2008, chap. 2). Karpoff's instruction to ‘respect the antagonistic relationship’ implies that there is a fine but vague muscular activity the pianist should strive for. Yet, when Golandsky states “the slightest tension will limit motion” (2001, chap. 5), the pianist is left with the impression that all tension must be eliminated.

3. Tension Is Always Present in Healthy Muscles, Albeit a Very Small Amount

The language found in the pedagogical approaches vacillates between acknowledgements that tension is always present or absent. Fraser states: “Without tension, there is no life” (2003, p. 38), pointing to the fact there is always a degree of muscular activity that gives the

skeletal structure support. Even though his overarching approach is that of finding an optimal balance of tension, some of his advice implies that any degree of tension is detrimental. In describing the transmission of arm weight, Fraser warns, “If any tension remains in the elbows, it will interfere with the free transmission of energy from your arm to the key” (2010, p. 207). As shown in the analysis of consistency, instructions and comments from the other pedagogues are also often directed towards playing with a total absence of tension. While qualifying tension with terms such as minimal and excessive suggest the constant presence of *tension*, the pedagogues’ directions to release ‘all’ tension mislead and misinform. In conveying *tension* as something that can be totally eliminated, the pedagogical use of tension does not align with the scientific fact that a degree of *tension*, albeit at times very small, is always present in healthy muscles.

4. Tension Describes the Force Generated by a Muscle and Does Not Describe a Joint

Much confusion arises from the use of the word tension to describe what is happening at a joint. When a single muscle is contracting it will generate *tension* that will tend to cause (or resist) the rotation of one or more joints.

If a second contracting muscle also generates *tension* that acts to prevent this motion (Taubman’s “dual-muscular pull” or, from a biomechanical point of view, “co-contraction”), the joint may remain stationary. Pedagogues often describe this situation as a joint under tension, but this only serves to confuse the meaning of the word. Clear use scientific terminology, would use the term “stiffness” (or its opposite “relaxation”) to describe joints which are subject to multiple opposing muscular forces. The role that co-contraction and joint stiffness plays in piano playing is complicated but it is clear that in many situations undue amounts of co-contraction are not beneficial.

This analysis of accuracy shows that although there are steps to move towards a more scientific use of tension, there are still inaccuracies in the pedagogical usage. The pedagogues predominantly use tension in the context of isometric contractions that most often results in unwanted and harmful resistance to movement. Some of the authors suggest that no tension is needed at all to stabilize joints, leading to a use of terms that qualify tension as an all or nothing state.

Even Fraser, who shines a light on the positive effects that come from muscular tension, and advocates for an approach to playing that uses tension ‘intelligently’, also recommends relegating the term to its negative manifestations of inhibiting motion. Although this effort to distinguish between the positive and negative consequences of tension is an admirable attempt at bringing more clarity to this issue, Fraser does not consistently use ‘tension’ to refer to solely its negative attributes within his own work.

This highlights the confusion in narrowing the definition of tension to only impeding movement. A more accurate description of tension would consider its role in producing and controlling movement and encompass a variety of physical movements needed to play the piano results with differing degrees of *tension*. Instead, the pianist is left with the overriding impression that tension serves only to impede movement at joints and is a quality that must be banished, not managed.

CONCLUSION

The extensive collection of data on the language used to describe the role and management of tension from the selected authors revealed significant problems with inconsistency and inaccuracy. An analysis of the language found various reasons for these problems: there is an incomplete or inconsistent understanding and explanation of anatomical and biomechanical principles; the authors freely interchange “scientific”, “common”, and “invented” terminology; and the authors struggle to articulate the opposing dualities of stability and flexibility that comes from managing tension. Note that the terms “stability” and “flexibility” also exhibit problems similar to those identified in this paper for “tension”.

The language presents a confusing and inaccurate picture of the role of tension in joint and muscle function. As shown, much of the confusion surrounds how tension figures in joint stability. When viewed as necessary to providing stability, the management of tension ranges from its complete elimination to finding the correct amount. When viewed as unnecessary to providing stability, the pedagogues focus on playing without any degree of tension. The belief that tension does not provide stability or that stable joints do not play a role in movement clearly contradicts biomechanical principles. It is possible that this emphasis on banishing tension from piano playing comes from concerns that most pianists move with too much tension (or perhaps more accurately joint stiffness) that impedes free movement. In addition, there is some confusion in the subjective and objective nature of tension. Lister-Sink makes the point that even though a minimal amount of tension is needed, it will not be felt thus. Rather than giving directives that reflect the true mechanics of tension in movement, advice reflects the common belief that all tension is unnecessary and the subjective idea of “harmful” tension.

This tendency to address tension with such broad strokes is illustrated in the use of colloquial and invented terms. Nonetheless, as shown, there are times when an attempt is made to explain tension in scientific terms. Frequently switching between the terms, the concepts take on different meanings depending on how they are being used. For example, as a common term, tension can mean a chronic state of tight muscles that inhibits movement (“stiffness”) and becomes a primary cause of playing-related-injury; as an invented term, it can mean something that must be ‘emptied’; and lastly, as a scientific term, tension may refer to a muscle contraction that is a necessity in all intentional movement. This extraordinary array of scientific, common, and invented use of the word tension underscores the complexity of describing the mechanics and the perception of physical movement. However, it is this wide range of terminology that often contributes to ambiguous, vague, conflicting and confusing advice.

In part, the reasons for this inaccurate and inconsistent representation of tension come from the difficulty in describing “just the right amount of tension”, and “just the right amount of relaxation”, to provide “just the right amount of joint stability”. Neither too tense, nor too relaxed, it is this state of stability and flexibility that often proves difficult to explain. Lacking a terminology that adequately conveys these contrasting qualities, the language tends to focus on the desirable qualities of a relaxed muscle, flexible joints, and the absence of tension, but often overlooks the necessary qualities of stiffness and stability associated with tension. Of note, Fraser has begun to flesh out this discussion of the complex and subtle degrees of relaxation and tension with his in-depth descriptions of muscular and joint function. The next

step will be to engage the pedagogical community at large in an exploration of a language that accurately describes the dual opposing effects that come from the delicate balance of tension and relaxation. An open and frank dialogue about the challenges of describing this state will, first, acknowledge the true nature of tension; and secondly, address the issue of the management of tension, rather than focusing on its complete elimination. Exploring a vocabulary that communicates this balance will bring both more consistency and accuracy in the understanding and management of tension.

As this research evolves, there will be pedagogical implications. Pedagogy books may adopt anatomical terms and use more discretion in the use of terms such as tension and relaxation. Exploring terms that describe the appropriate balance of tension and relaxation and of movement at the joints will lead to a more informed and open discussion of piano technique. The language used by pedagogues to discuss the mechanics of technique amongst themselves will not necessarily be the same language used to communicate concepts to young students; but it is important that language aimed at a younger audience is rooted in accuracy with a common understanding of its meaning. This scope of this study was limited to pedagogical material directed at more advanced pianists. Although this allowed for a more intense investigation, research into similar issues surrounding the use of language in novice pedagogical material would be a valuable contribution. Although this study focused on the concept of tension, other core concepts such as arm weight, hand shape, joint stiffness and finger shape also surfaced as areas of contradictory advice within the pedagogical literature. These concepts may be the subject of further investigation in forthcoming papers.

This study has identified inconsistencies and inaccuracies in the language used to describe piano technique and sheds light on some of the issues contributing to these problems. To address these problems and issues, changes are needed. If piano technique is promoted as being based on anatomical and biomechanical principles, then the pedagogical community has an obligation to ensure that the language they use accurately reflects this. This will require a solid understanding of anatomy, joint function and muscle function along with a commitment to ensure that the language is consistent and accurate. This will require an effort to use language that clearly differentiates between the subjective experience and the reality, between metaphor and science, and this will require an open discussion of the challenges pedagogues face when describing the often opposing concepts that are the nature of piano technique. These represent some first steps in addressing the issues of how language is used. Ultimately, it is not just a matter of employing accurate language, but of developing a better understanding of the relationship of anatomy and mechanics of movement to piano playing. These are complex issues that require a consistent and accurate language. Moving towards a language that is clearly understood will facilitate advances in understanding the mechanics of technique. Piano technique need no longer remain a mystery, but a skill that can be explained logically and clearly to all students.

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