THE DOUBLE BASS:

A TECHNICAL STUDY OF TIMBRE

by

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A TECHNICAL STUDY OF TIMBRE

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ABSTRACT

Timbre is the distinguishing aural quality of a sound, regardless of pitch or volume. Repertoire composed for the double bass since the 1960s exhibits a high frequency of extended techniques, used as a variant of timbre. This project serves to analyze these extended technical elements by examining their aural qualities, performance practices, and the context in which the composers of the late twentieth century have used them in their works.

The project analyzes specific works from the period that incorporate extended bowing, pizzicato, harmonic, and percussive elements and consults manuals on extended and standard technique for string instruments and recordings of the repertoire. The techniques were then practiced on a double bass. It is the goal of the project to offer informed opinions on the optimal contexts in which these techniques may be used by the performer or composer.

INTRODUCTION

Double bass performance lends itself well to "extended" techniques, which the modern repertoire has enjoyed an increased frequency of since the 1960s. The surge of compositions featuring non-traditional performance elements in the 1960s and 70s stemmed most directly from Bertram Turetzky's (b. 1933) open request for composers to write new music for the double bass in 1959.[1] The results of Turetzky's working relationship with composers gave a monumental boost to the depth and popularity of solo works for double bass. In 1974, Turetzky further inspired composers by publishing the first edition of *The Contemporary Contrabass*, an account of the different techniques the composers incorporated into their pieces. However, Turetzky's explanations of the techniques lack aural analyses and details of performance practice. Regardless, the compositions from this period, the first wave directly commissioned by Turetzky and the second wave inspired by him after 1974, draw upon a wide pallet of unprecedented timbres.

This study catalogues the less traditional timbres available from the double bass and analyzes them with regards to the technical application and reception of the

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[1] Bertram Turetzky, *The Contemporary Contrabass* (Berkeley: University of California Press, 1989), x.

performance practices required to produce them. The aural qualities of extended techniques are dependent upon the methods by which the bassist performs them. The success of extended techniques in the musical context of a composition is dependent upon a composer's insight towards performance requirements and the desired overall aural effect. While existing guides on extended string instrument techniques offer some performance practice suggestions, this study intends to be comprehensive in its conclusions for benefit in particular to composers as well as performers. In addition to technical explanations related to production, contextual examples are given of many techniques employed successfully in musical compositions for the purpose of referencing not only how these new timbres have been used, but more importantly what potential still remains for their use in the future.

Techniques have been arranged into four major categories: bowing, pizzicato, harmonics, and percussion. While many variants of traditional arco and pizzicato techniques exist and have been experimented with throughout the twentieth century and beyond, many of these techniques have already become familiar to many players and composers. Articulation complexities dealing with bow stroke and finger dexterity of pizzicato are not afforded a great deal of discussion in this study because, while still interesting and important considerations for performers and composers, these techniques do not expand the trimbral palette of the double bass.

The weight of discussion here is directed towards techniques that produce differing timbres than *normale*; *normale* being defined here as "traditional" arco and pizzicato sound. In this respect, the chapters that focus on techniques that deviate from *normale* timbres most dramatically require more intense investigation and may result in more radical conclusions regarding their applications.

Finally, many of these techniques are not specific to the double bass but are universal to bowed string instruments. Advantages to performing certain techniques on the double bass over other instruments are noted if present, but few techniques exist which are disadvantageous on the bass compared to the violin for example. For this reason, a great deal of double bass repertoire is consulted to examine the use of non-standard techniques, but repertoire and research for other string instruments applies to the bass as well; in some cases (such as subharmonics) notated examples of these techniques do not occur in the double bass repertoire and, while possible and effective on the bass, other repertoire must supplement contextual examples. Some conclusions, especially those dealing with notation, possess a great deal of universality and are intended to apply to the broader scope of string instrument technique in general.

Chapter I

BOWING TECHNIQUES

The bow has traditionally served as a primary activator of sound in double bass performance. When employed *normale*, many are familiar with the resultant timbre. Similar to the violin, viola, and cello, the arco sound gives the string instrument family its characteristic tone, warm and full of expression. Many variants of the arco technique exist, and have been used extensively throughout the history of double bass music. A great deal of these variants however, derives from differences in articulation rather than timbre. Whether an arco technique calls for a short or long stroke, prolonged contact with the string or bouncing off the string, or irregular up or down strokes, the timbre produced essentially remains static; simply the presentation changes. These variants of *normale* acro techniques will therefore not be discussed here, but instead focus will be given to techniques that function not merely as performance methods but also produce a new timbre by using the bow.[2]

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[2] For a detailed discussion of the more traditional, mono-timbral techniques, see: Kent Kennan, *The Technique of Orchestration* (Englewood Cliffs: Prentice-Hall, 1970), 54-64, or Charles Gigante's *Manual of Orchestral Bowing* (Bloomington: Frangipani Press, 1986).

Indeed many of the *normale* arco techniques, such as *spicatto* or ricochet, may be applied as attack variations to other timbres as well.

Typically the bow may activate one string or two adjacent strings together played *normale*. Double stops on the double bass are subject to clarity issues, especially in the lower register and with close intervals where they can become muddy.[3] It is worth noting then that clear nonadjacent double stops performed on the G and E strings together are possible by positioning the bow underneath of the strings with the hair facing up. These double stops are identical in timbre to traditional adjacent double stops, but the wide intervals produced are somewhat unusual. Effective use of nonadjacent double stops can be observed in *Mr. T His Fancy* by Barney Childs.

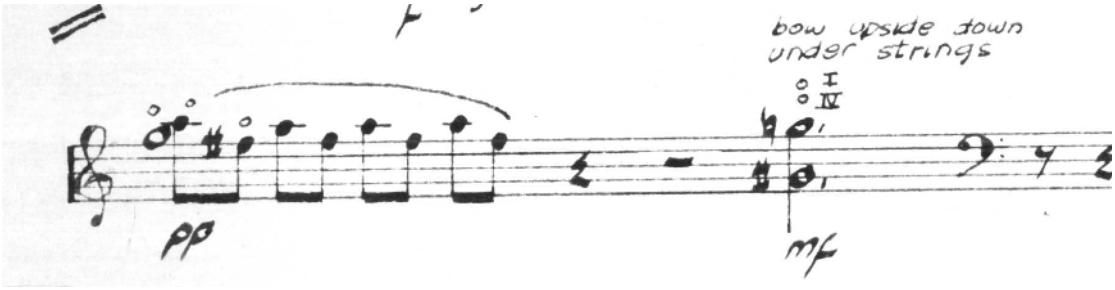

Figure I.1: *Mr. T His Fancy* (1967) by Barney Childs, page 3, system 3

[3] Walter Piston, *Orchestration* (New York: W.W. Norton, 1955), 104.

To directly vary timbre by use of the bow then, there are three major categories of techniques that can be performed on the double bass: on the string with the hair, on the string with the wood, and off the string. It cannot be recommended to use the wood of the bow on parts of the bass other than the strings.

Registration

The bow may be placed in any gradation of three general areas: *tasto*, *normale*, and *ponticello*. *Normale*, roughly in between the edge of the fingerboard, produces the traditional bowed timbre many are familiar with. As the bow registration moves closer to and over the fingerboard it becomes more *tasto*, and as it moves closer to the bridge it becomes more *ponticello*.[4]

The *tasto* timbre is light and airy. Attacks are subtler, and the more *tasto* the bow moves the less easily pitches will speak. The farther up the fingerboard the bow is placed, the more the accuracy of right hand angle must increase due to the plane where the strings lie becoming shallower away from the bridge. This opens

[4] The term "registration" will henceforth refer to the placement of the bow in any point in the afore-mentioned gradation. Bow register, rather than affecting pitch along a scale of frequency, affects timbre along an analogous scale of *ponticello* to *tasto*. The limits of the scale of bow registration are, however, clearly defined as directly on the bridge and as far over the fingerboard as the curvature of the strings will allow the desired number of stops to sound.

possibilities of true triple stops and even quadruple stops in situations of extreme *tasto*, however, dynamic range with this extreme bow placement is limited to softer colors. Also, "bow noise" becomes more prevalent over the fingerboard; the actual friction of hair on string is heard more clearly as a soft scratching. It may also present itself inconvenient to deposit rosin on the fingering positions of the string. When bowed *tasto* with light right hand pressure and quick bow speed, the timbre produced is similar to a flute and is called *flautando*.[5]

Ponticello timbre by contrast sounds much harsher. As the bow moves closer to the bridge, upper partials are brought out very clearly and under some conditions the fundamental may not even sound at all. The actual pitched output of *ponticello* bowing can vary greatly depending on the instrument or the bow speed and pressure used. In most cases specific pitches or prevailing overtones are unpredictable, and indeterminacy of pitch will increase as distance from the bridge decreases.[6]

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[5] It is important to note that the indications *sul tasto* and *flautando* are not interchangeable. *Tasto* refers only to bow registration and *flautando* represents a specific timbre and style to be played in the *tasto* registration. Samuel Adler incorrectly assigns a specific and separate registration value to *flautando* that differs from *tasto* (simply near the fingerboard rather than over it) but thereafter trivializes any such distinction anyway in *The Study of Orchestration* (New York: W.W. Norton, 1989), 35. Alban Berg makes this important distinction of bowing styles in his *Lyric Suite* (1926).

[6] Certain harmonic partials will only speak with proper bow registration, usually in the *ponitcello* range. Using *ponticello* bowing to facilitate the production of specified natural and artificial harmonics primarily enhances the harmonic timbre by isolating one (or a determined greater amount of) partial(s) and is not representative of true

Therefore the *ponticello* timbre is complex and similar to multiphonics on some woodwind instruments and is also capable of wildly loud dynamic levels (as well as extremely subtle and soft levels).[7]

Performance of *tasto*, *normale*, and *ponticello* timbres may be used either to color notes in individual situations or as gradations in a single spectrum of bow registration. John Cage specifies bow registration of every bowed note in *26'1.1499" for a String Player* (1960) by using symbols B, BN, NB, N, NF, FN, F as a scale from *ponticello* to *tasto*. These examples illustrate rapid and gradual registration changes.

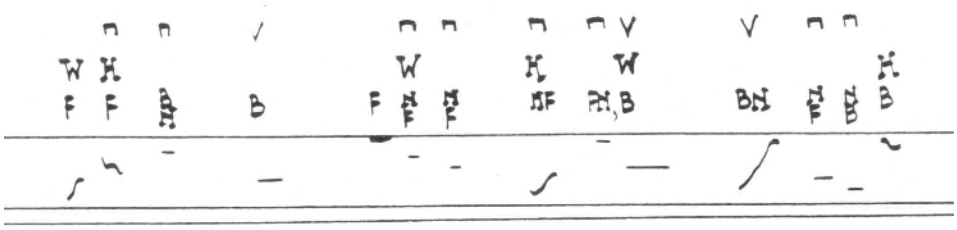

Figure I.2: *26'1.1499" for a String Player* (1960) by John Cage, page 7

ponticello timbre, which creates a complex output of many partials simultaneously. Bow registration to assist in the production of harmonics will be discussed in Part III.

[7] True multiphonics on string instruments (those which can be requested in specificity by composers as determinate musical occurrences) have a similar timbre to traditional harmonics and are not capable of high dynamic levels. String multiphonics will be discussed in Part III.

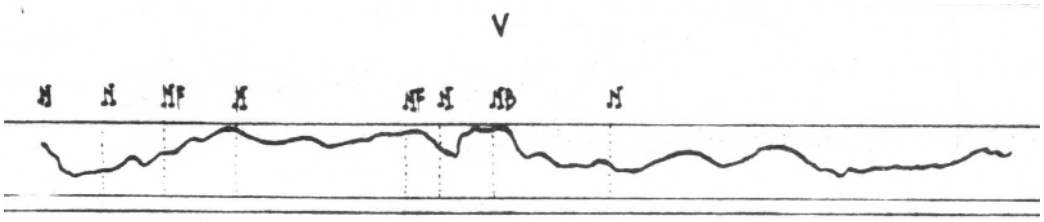

Figure I.3: *26'1.1499" for a String Player*, page 40

Bowing the string between the bridge and the tailpiece where the string is taut can produce a grating tone similar to the glassy edge of *ponticello*, but with a quicker bow speed produces a variation of *normale* timbre, similar to high register playing or harmonics. The pitch is not easily altered on a single string however, and may differ from instrument to instrument so as to prevent composers for asking for specific pitches in this area. The tone however is clear and ringing and readily available as a fixed timbral element that requires only the bow as activator. Whereas the pitch and tone in this area on the G and D strings may in some cases be easily replicated with high left hand positions and the bow placed *normale*, this tone is fairly unique to the lower two strings. The tautness of the A and E strings may be taken particular advantage of in rolled multiple stops. Penderecki was the first to

invent notation for playing below the bridge, either on a single string or with a rapid arpeggio, and used them extensively in his compositions.[8]

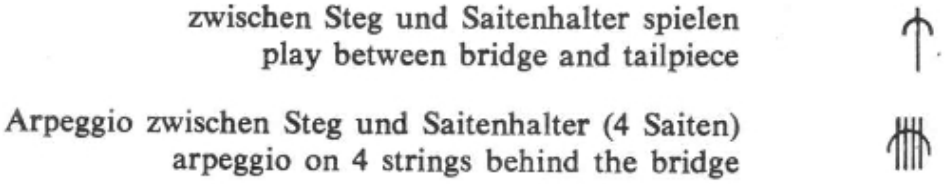

Figure I.4: *Threnody* (1960) by Krzysztof Penderecki, notation guide

Above Left Hand

When the bow is placed so extremely *tasto* that it draws above the left hand, it is quite difficult to activate only one string at a time. Intonation also becomes more of an issue, as the fingerboard is essentially turned into a mirror image, thus normal left hand positions no longer correspond to standard equal-tempered pitches. The timbre afforded by bowing in this area however is quite useful, and possesses an eerie or muted quality. It is not possible to produce a high dynamic level because the large hollow resonating chamber that is the body of the instrument is no longer utilized to amplify sound and add resonance. While the extreme *tasto* registration produces a thin and airy tone as expected, the pitched output of the

[8] Gardner Read, *Contemporary Instrumental Techniques* (New York: Schirmer Books, 1976), 215.

strings becomes darker and mellower than usual. This technique has been used by George Crumb on the smaller instruments of the string family to imitate the sound of a viol in *Black Angels* (1970).[9] On the bass, Jon Deak notates the fingered pitch and sounding pitch in *Color Studies* (1969).

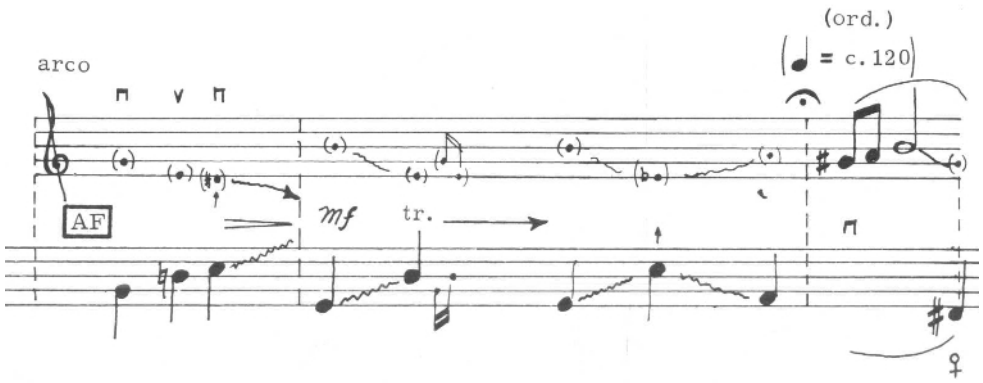

Figure I.5: *Color Studies* (1969) by Jon Deak, mvt. 3 "Thick Purple," system 3

Angular Directions

Drawing the bow across the strings in non-perpendicular angles to the strings will produce tones of less clarity than normal. The more acute the angle, the more scratchy noise will infiltrate the pitch. Bowing with a perpendicular bow in a vertical direction will also produce the same effect; the bow hair grinds into the string rather

[9] Adler 54.

than across it. A combination and gradation of bowed angles with and against the string can be used as a circular bowing technique. Jon Deak asks for this mixed timbre in *Color Studies* and Paul Chihara provides a diagram for the technique's execution in *Logs* (1969).

INTRODUCTION AND CODA

("Circular Bowing")

Begin down-bow at the normal distance from the bridge, and gradually slide over the finger board as the stroke approaches the tip. Then return quickly and lightly *sul tasto* up-bow to the bridge. No attempt need be made to make this stroke perfectly circular: rather, a sighing sound, as continuous and even as possible.

Figure I.6: *Logs* (1969) by Paul Chihara, notation guide

Overpressure

An extreme application of right hand pressure interrupts the normal stick-slip motion of the bow over the strings. Especially if a good deal of rosin is used, increased friction causes the pitch to become less apparent. If used as a purely timbral gesture, the left hand need not actually stop specific pitches; it should be sufficient to simply mute the strings and stop them from vibrating unnecessarily by placing the left hand lightly over the strings. With quick bow speed, overpressure will

produce an unpitched scratching sound. With slower bow speed, a low groaning is elicited and pitched content of the stopped string may be audible which Alfred Blatter refers to as a scratch tone[10]. Both effects are only possible with at least a *forte* dynamic due the great amount of pressure required. John Corigliano capitalizes on the aggressive quality of quick, overpressured bow strokes in the *Scherzo* movement of his *Symphony No. 2*.

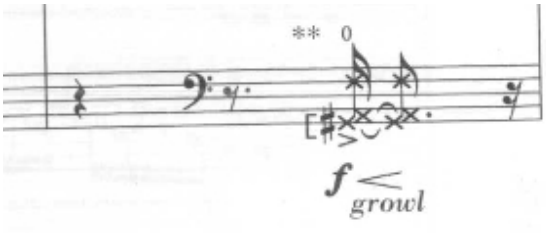

Figure I.7: *Symphony No. 2* (2001) by John Corigliano, II. Scherzo, m. 75

Col Legno Battuto

Perhaps the most common of the bowing techniques utilizing the wood of the bow rather than the hair, *col legno battuto* involves striking the strings in a bouncing motion with the stick. There are two components to the resulting sound of this technique: the pitched output, which cannot reach a very high dynamic level, and the

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[10] Alfred Blatter, *Instrumentation and Orchestration* (New York: Schirmer Books, 1997), 42.

percussive click of contact sound.[11] The woody tone of striking the strings with the bow stick is slightly mellower than thicker sticks or non-wood objects that can be used for percussive purposes. This timbre blends well with that of percussion instruments like the marimba or xylophone.

Battuto between the bridge and tailpiece gives more sustain than *normale* and produces a dull bell-like tone. This timbre is used effectively with percussion instruments in George Crumb's *Songs, Drones, and Refrains of Death* (1968).

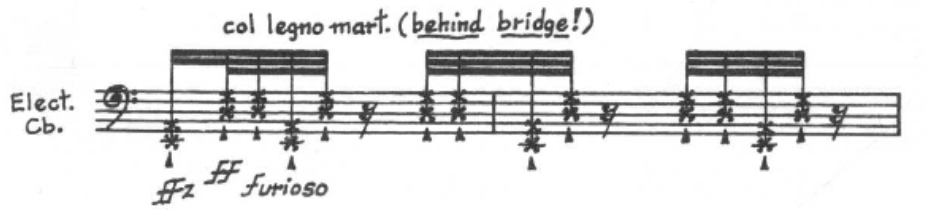

Figure I.8: *Songs, Drones, and Refrains of Death* (1968) by George Crumb, page 16

[11] Strike tones, the contact sound of any hard implement on the strings of the bass will be discussed as a percussive timbre in detail in Part IV. As an unavoidable side effect of *col legno battuto*, strike tones are rarely mentioned as a controllable element of the bowing technique, but in cases where registration of *col legno battuto* passages is specified, an implement other than the bow may often be substituted, thus creating an element of percussive technique (which will be discussed in Part IV). In short, if the string is struck closer to the bridge the pitch of the strike tone will be higher than if it is struck over the fingerboard, regardless of stopped length of the string.

Col Legno Tratto

Less common than *battuto* (and less desirable for many string players with the livelihood of their bows in mind), *tratto* involves dragging the wood of the bow across the strings in the same manner usually used with the hair. The tone is somewhat scratchy and woody, and available dynamic inflection is subtle, but the sustain afforded by the technique makes for a very useful timbre, especially in contrast and conjunction with *col legno battuto*.

Players may not be as nimble with the bow when it is turned upside down in the right hand, but fairly complex passagework may still be used with this technique. Usual arco articulations may also be applied, however soft sustains and tremolos have pervaded the repertoire as the most common applications for *col legno tratto*.

Half *Legno*

A variation of *tratto*, half *legno* requires the bow to be tilted on such an angle that the wood and hair are drawn across the string simultaneously. This is simply a mix of the *tratto* and *normale* timbres, but can be used to give volume or more pitch concentration to passages marked *tratto*.

On Top of the Bridge

The most extreme *ponticello* variation is to literally bow on top of the bridge. Many different screeching, complex tones are available if bowed with great pressure. High groaning sounds are called for by bowing in this manner in many scores of Penderecki. Bowing with less pressure elicits a softer, sighing tone. Jon Deak calls for the bow to move slowly on top of and the back off of the bridge in *Color Studies*, creating a switch from *ponticello* screeching to completely non-pitched groaning.

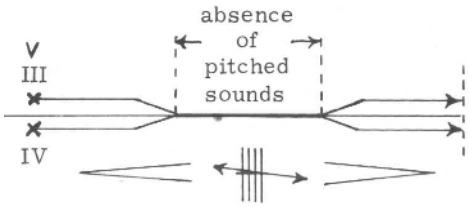

Figure I.9: *Color Studies*, mvt. 1 "Fogwhite," system 2

On Fixed Objects

Bowing on either the edge of the bridge or body will produce a soft "whooshing" sound. This technique provides only a subtle inflection, and is similar to

rubbing the body of the instrument is a cloth, which may be preferable to depositing rosin on other parts of the bass.[12]

On the Tailpiece

On the bass and sometimes on the cello it is possible (with enough rosin) to produce a low groaning or rattling sound by bowing on the tailpiece. Most famously this effect is called for in Penderecki's *Threnody*, but many other composers have similarly used it in compositions since then.

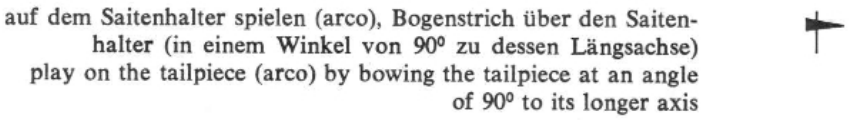

Figure I.10: *Threnody*, notation guide

Bow Substitutes

Often string players hesitate to use their expensive bows for *legno* techniques and will use a second bow in these situations, especially with *tratto*. The quality of the bow does not affect timbre, so it is not necessary to possibly endanger the bow by scratching if the music allows ample time to switch for *legno* techniques.

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[12] Soft rubs will be discussed as a percussive technique in Part IV.

Sometimes players will simply use a wooden dowel to perform these techniques, and some composers state outright to use dowels in their scores. For all intents and purposes the *legno* timbres are identical for whichever implement is used, and specification is not usually necessary from composers but remains a performance decision.

Other objects may be drawn across the strings to activate them as well. A comb will create a loud, abrasive timbre as its plastic teeth pluck a string in quick succession.

Chapter II

PIZZICATO TECHNIQUES

Plucking the strings with the fingers has long been a quick and easy switch to create an entirely new timbre on string instruments. Contrasted so much so with *arco* technique and timbre, pizzicato string instruments have even been classified as a separate orchestral family from arco strings by Nicolay Rimsky-Korsakov in his famous text on orchestration.[13] In this manner, many common practice composers have used pizzicato specifically for its unique timbre in comparison to bowed strings, a well-known example being the second movement of Tchaikovsky's Fourth Symphony, titled Pizzicato *Ostinato*.

In the twentieth century, especially with the advent of jazz, double bassists have refined the technique and increased the potential of pizzicato playing, employing as many as all five fingers of the right hand to independently activate the strings. Complex passages of rapid pizzicato notes are frequently performed in this manner in all genres of music. Franz Simandl's prescribed technique of using the single index finger in softer passages and coupling that with the middle finger for

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[13] Nikolay Rimsky-Korsakov, *Principles of Orchestration* (New York: Dover, 1964) 26.

reinforcement in louder passages[14] still remains relevant for a warm and full tone, but players today are capable of much more in terms of dexterity, especially with the use of the thumb in guitar-like strumming, or even with pizzicato in the left hand (either in alternation with or in addition to right hand technique, plucked *or* bowed).

Due the size of the double bass and length of its strings, we find a considerable advantage over the smaller string instruments in variety of articulation and expression of pizzicato attacks. Much more sustain is afforded for pizzicato on the double bass than certainly the violin, thus many of the same left hand techniques used for arco playing are equally effective with pizzicato. Multiple stops, vibrato, and glissandi for example all can enhance and enliven pizzicato on the double bass. In addition, groupings of notes slurred together may be articulated with a single attack, shaping phrases and making true *espressivo* performance possible.

As a timbre then, traditional pizzicato on the double bass is applicable to many different performance situations, and has been employed so for quite some time now. More recent advancements in pizzicato technique however have introduced a new set of colors, those which can be used for more than simply offsetting the traditional arco sound of the string section. Firstly, composers now specify registration from *ponticello* to *tasto* for pizzicato attacks as well. The gradation of pizzicato registration has the same effects as bow registration; Vincent

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[14] Franz Simandl, *New Method for the Double Bass*, ed. Lucas Drew (New York: Carl Fischer, 1984), 79.

Persichetti takes advantage of the rounder and duller tone of pizzicato *sul tasto* in the following example from *Parable XVII* (1975).[15]

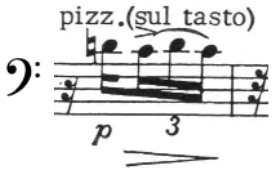


Figure II.1: *Parable XVII* (1975) by Vincent Persichetti, pg. 1

Snap Pizzicato

Often referred to as Bartók pizzicato, since popularized by the composer of the same name many are familiar with its harsh and biting attack. Snap pizzicato involves pulling the string up rather than across; its release will snap the string back into the fingerboard creating a loud pop. First used in the Scherzo of Mahler's Seventh Symphony, Gardner Read now proclaims the technique "too common to warrant individual citations."[16] Effective as an extremely accented pizzicato, this technique mixes well with traditional pizzicato passages to aggressively highlight certain pitches. In applications where pitch is less important, snap pizzicato may be

[15] In this piece Persichetti also applies expressive terminology characteristic of arco *normale* techniques to natural harmonics, providing opportunities for non-traditional techniques to be performed not as static effects but as dynamic elements of timbral vocabulary.

[16] Gardner Read, 221.

used as purely percussive attack blends well with other percussive techniques, as in Thomas Read's *Music for Solo Contrabass* (1975).

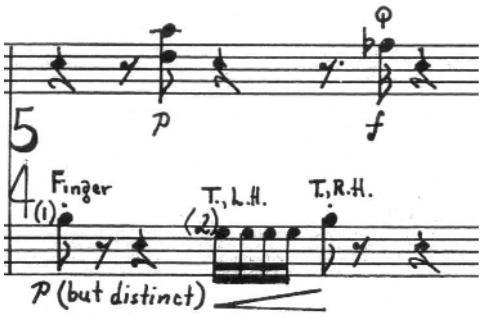
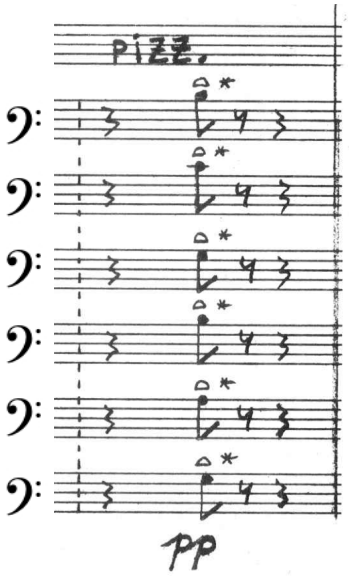


Figure II.2: *Music for Solo Contrabass* (1975) by Thomas Read, pg. 5

Pizzicato *Effleuré*

This technique is executed by the right hand in any normal variation, but the left hand does not completely depress a stopped pitch. This may be used to completely deaden the string, with the left hand finger lightly touching the string as if at a harmonic, or it may be used so that the left hand pressure is only slightly less than normal, producing a half-pitched pizzicato with very little sustain. This example for divided bass section is from György Ligeti's *Apparitions* (1958/59).



*pizz.; put the left-hand-finger gently on the prescribed place (wooden sound)

Figure II.3: *Apparitions* (1958/59) by György Ligeti, pg. 19

Below the Bridge, Behind the Nut

Both of these areas elicit similar timbres, but these areas of the strings offer only fixed pitches. Below the bridge the strings are higher pitched that most of the string length over the fingerboard, but behind the nut the pitches available reach higher still. The tautness of the strings in these positions will produce a clear, bell-like tone with short sustain. Plucking these areas instead of bowing them likens the resulting tone to that of the harp with a slightly more rounded attack.

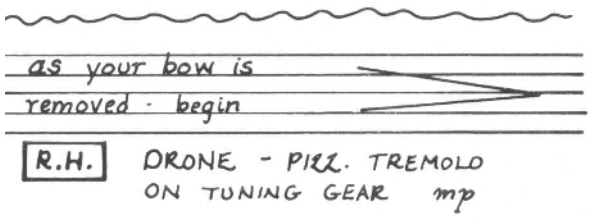


Figure II.4: *Six Haiku Settings* (1980) by Bertram Turetzky, mvt. 1

With Fingernail or Plectrum

Depending on the passage required to perform, it may be more dexterous to employ either the fingernail or a hard plectrum; both offer comparable timbres. There is more bite and definition to a "picked" pizzicato, and some of the warmth and roundness of traditional pizzicato is eliminated. A string set in motion with pizzicato may be "buzzed" by either a fingernail or plectrum by lightly pressing the implement into the vibrating string. This technique will slowly dampen the string while producing an audible buzz. Buzzed pizzicato usually appears in notation similar to crushes in percussion writing, with a "Z" through the note stem.[17]

Hammer On

Hammering on with either hand may activate a string without actually plucking it in the traditional manner. Pressing down a string with enough speed to

[17] Identical notation is used by Jacob Druckman in *Valentine* (1969) to indicate a crush against the string with a timpani mallet, see part IV.

make it sound will also elicit a percussive “tap” or a slightly dull, metallic contact sound. Even though a substantial amount of force is required to vibrate the string in this manner, available dynamic range remains limited to a low to medium level.

With left hand hammer ons, sometimes referred to as left hand alone, it is possible to mix this timbre with that of whatever technique the right hand is capable of performing alone, either plucked or bowed. When hammering on with the right hand as well, complex passagework becomes possible similar to “tapping” on a guitar.

Bi-tones

Sometimes audible as a byproduct of hammering on, bi-tones result from a stopped string simultaneously vibrating on either side of the finger stopping it. Often sounding quietly, the pitch behind the finger may be hard to tune as well, but in this manner (especially using both hands) it becomes possible to create chords of unusual intervals. Not vibrating over the F holes of the bass, the pitch behind the finger may seem dead or eerie, similar to the tone of pitches bowed above the left hand.

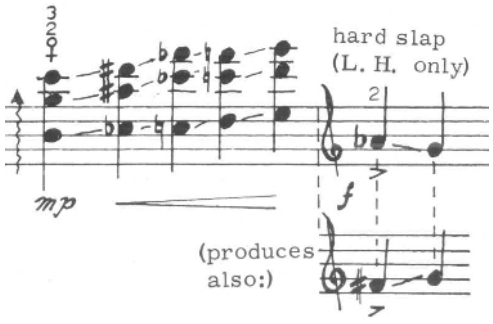


Figure II.5: *Color Studies*, mvt. 3 "Thick Purple," system 3

If bi-tones are intended as a result of hammering on, then the percussive snap of that technique will initiate the double pitch. Bi-tones may be attacked with a traditional pizzicato timbre however if the string is stopped with normal speed and then plucked on both sides, either with one hand alone or a combination of both hands. In either case, high dynamic levels generally do not exist with this technique. Kenneth Gaburo mixes this effect with glissandi in *Inside* (1976).

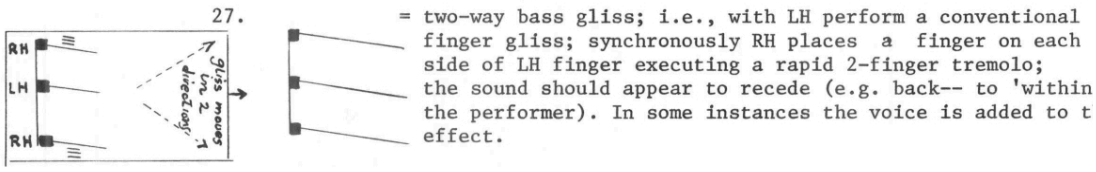


Figure II.6 *Inside: Quartet for One Double Bass Player* (1976) by Kenneth Gaburo, lexicon

Chapter III

HARMONIC TECHNIQUES

String harmonics have occupied an important place in orchestral, chamber, and solo repertoire for well over a century now. And since the early twentieth century composers as renowned as Schoenberg, Stravinsky, and Ravel have found increasingly complex and innovative applications of string harmonics. The double bass in particular has benefited from the increased experimentation and progressive use of harmonics present in contemporary works. The largest instrument of the violin family has one primary advantage over the smaller and higher string instruments: the lower range and greater length of the double bass' open strings allows more headroom to explore an extreme upper register. A greater number of partials are accessible on a double bass string before the length between nodes becomes miniscule and impossible to navigate. With the use of harmonics the range of the double bass can extend well into the upper register of the violin (and even down below the lower limit of the piano, with the application of subharmonics).

Many sources exist detailing the physical phenomenon of string harmonics, therefore it is not the aim of this paper to describe the application of harmonics on the double bass in terms of physical production, but rather as technical and aural

components of performance and composition.[18] A certain knowledge of the physical processes regarding string harmonics and the overtone series are assumed of the reader. The term partial will henceforth refer to each level of the overtone series, with the first partial as the fundamental. Nodes refer to the points on a string where waveforms begin and end and where by touching, all lower partials are eliminated. These points occur at all whole number divisions of the fundamental length.

The distances between nodes increases or decreases in direct proportion to the length of the string, so upper partials on a double bass string have more length to vibrate than those on a violin string. The average fundamental length of a violin string is about 13" and that of a bass string is about 41-42".[19] Therefore the eighth partial for example, is somewhat impractical on a violin as it leaves just over an inch and a half of the string to vibrate. On the double bass however, the eighth partial is still fairly accessible with over five inches of the string left to vibrate between nodes.

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[18] For a classic analysis of the physical acoustics of music, see Hermann von Helmholtz, *On the Sensations of Tone as a Physiological Basis for the Theory of Music*, translated by Alexander J. Ellis (Bristol: Thoemmes Press / Maruzen Co., LTD, 1998). Chapter 1 deals with the harmonic series on pp. 33-35.

[19] Norman Lamb and Susan Lamb Cook, *Guide to Teaching Strings* (New York: McGraw-Hill, 2002), 12, 15.

Examples of partials as high as the 21st are studied by modern players, and while challenging to perform, produce clear and definite audible effects.[20]

Natural and Artificial Harmonics

One of the most distinguishable characteristics of harmonics on the double bass is indeed the clarity of tone afforded by the technique. The tone of a traditionally stopped or open string is rather complex, as it possesses not only the fundamental pitch but also all overtones above the fundamental. As upper partials are isolated by interfering with the vibrations of the fundamental or lower partials, the harmonic tone becomes less complex and more pure in nature. The clear, glassy timbre of harmonics blends well with other sounds and instruments, as the distinct body of the tone associated with the timbre of the double bass becomes cut away and a simpler more generic tone remains.

In the very high partials the harmonic tone begins to thin out, which can possibly be undesirable. Available dynamic range also decreases as register of harmonics increases. Practical use of partials above the tenth or eleventh is generally

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[20] Dennis Lane Woodrich, "Multi-Nodal Performance Technique for Contrabass Harmonics," M.A. thesis, University of California, San Diego, 1980, appendix B.

limited to subtle or quiet passages due to these effects.[21] Also, as the harmonic tone becomes less defined in upper partials, bow noise becomes more apparent. This extraneous noise takes the form of a dull scratching sound as the bow moves across the string at a normal speed or pressure, but much less pitched output remains intact. When articulating with pizzicato, a percussive snap of the fingers on the string becomes more prominent over the harmonic tone with upper partials as well.

Harmonics can be produced with the bow or pizzicato, however articulating with the bow makes upper partials speak more easily. The left hand must lightly touch a node of the string, but not depress the string fully to the fingerboard so as to change the fundamental. When placed on a node, all upper partials still sound as they are in series with the selected partial; their waveforms fit inside the selected partial. Lower partials are eliminated in this manner because the node selected on the string rests at a point in the middle of larger waveforms, stopping their vibrations.

Bow registration is an important factor in producing harmonics. The placement of the bow may interfere with some partials if care is not taken to adjust registration for new harmonics in a passage.[22] Generally higher partials will speak

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[21] Bertram Turetzky, *The Contemporary Contrabass* (Berkeley: University of California Press), 124.
[22] Ibid., 124.

most easily when bow registration is closer to the bridge, but true sul ponticello bowing may produce unpredictable overtones. There is no single correct area of bow registration for each partial, as it may vary from instrument to instrument, and there may be several alternative positions available that work better for some performers than others. Bowing directly on one of the nodes of a desired partial however will interfere with the vibration of that harmonic. For this reason, higher partials with multiple nodes become more difficult to locate successful bow registrations.

As the number of nodes available increases with the higher partials, more options present themselves to left hand placement. Therefore the produced pitch does not relate to the position used to activate the harmonic. This discrepancy creates some confusion as to which node is optimal in generating a desired harmonic, especially with upper partials. The notation used to depict harmonics is often not as helpful as either composer or performer would prefer, but two general methods have been in practice since the early twentieth century. In either method, if the resulting pitch is given, it should be written an octave lower than sounding, consistent with normal double bass notation. Cecil Forsyth suggested otherwise in his text on orchestration,[23] but bassists now agree that the practice of notating harmonics *sons reale* is archaic and unnecessary.[24]

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[23] Cecil Forsyth, *Orchestration* (New York: Macmillan Company), 443.

[24] Barry Green, *Advanced Techniques of Double Bass Playing* (Cincinnati: Piper Company, 1976), 160.

The first method employs a symbol “o” above a pitch to indicate it is to be produced as a harmonic, but which node is to be used is left unspecified and remains the responsibility of the performer to determine which positioning is best. In passages where the use of harmonics is sparing and the partials are low, this system works well, as any “guesswork” is usually logically revealed to the performer in the context of the music. This system is also common when the harmonic node that is to be played is located at the same position of the stopped note of that pitch. At the upper end of the fingerboard many pitches are available as both harmonic and stopped tones, and this notational system was commonly used in solo repertoire by composers such as Bottesini who made extensive use of this tessitura.

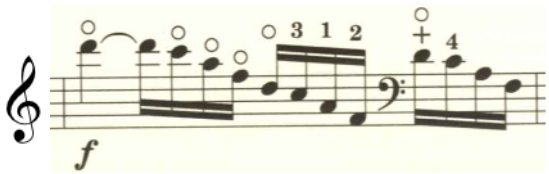

Figure III. 1: *Gran Duo Concertante* by Giovanni Bottesini (version for Clarinet, String Bass, and Piano) - m. 25

The second method indicates the positioning of the harmonic with a diamond-shaped notehead in tablature style. Tablature style notation does not concern itself with the designation of the sounding pitch. Composers such as Stravinsky and Ravel used this system when extended passagework of harmonics

were used, especially in conjunction with higher partials. In some cases this notational system seems to be an outgrowth of artificial harmonic notation (to be discussed later). While tablature style may seem at first to aid the individual performer, in orchestral pieces confusion almost always arises within a section of double basses or from the conductor as to what the desired pitch should actually be.

Figure III.2: *Ma Mere l'Oye* by Marice Ravel - I. Pavane de la Belle au bois dormant, mm. 7-8

Various styles of notation have been employed combining the two methods, but rarely with a great deal of success. Ravel actually changed his preferred method of notating harmonics throughout his compositional career, creating a great deal of discrepancies from piece to piece. Lucas Drew has managed to assemble a guide to interpreting Ravel's notation, which demands a careful read before performing works by the composer.[25] The performance of harmonics requires a large amount of information, which the performer must usually become reacquainted with for each

[25] Lucas Drew, *The Notation of Harmonics for Double Bass: A Guide to the Orchestral Works of Maurice Ravel* (New York: University of Miami Music Publications, 1972).

piece that is encountered. Unfortunately, standard notation usually becomes too cluttered to adequately display what is necessary**.** Schoenberg often notated harmonics rather redundantly.[26] In this example for violin and cello, he uses the "o" symbol, diamond shaped noteheads, writes an abbreviation for flageolet tone (harmonic), and gives the sounding pitch as well.

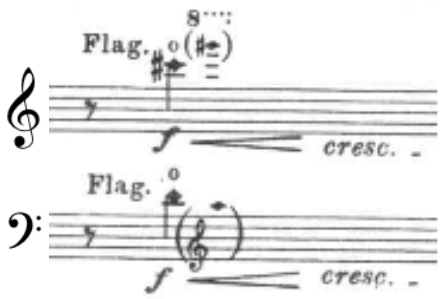

Figure III.3: *Pierrot Lunaire* by Arnold Schoenberg - 10. Raub m. 16

Another method of notating extended passages of harmonics, especially those utilizing more difficult upper partials, uses two separate staves. A primary staff should indicate positioning in tablature style, and a smaller *ossia* staff should indicate resulting pitches.[27]

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[26] Norman Del Mar, *Anatomy of the Orchestra* (Berkeley: University of California Press, 1981), 119.

[27] This notation is used by the author in the cello part of *Sand Walk* (2009), a setting of text by Aja Beech for baritone and cello.

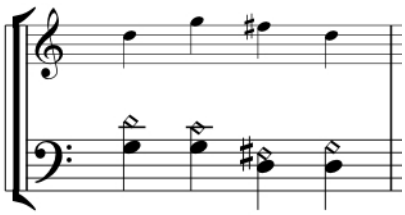

Figure III.4: Double staff notation of harmonics

Harmonics sounded on any of the open strings are referred to as natural or open harmonics. While a great variety of pitches are available in harmonics from the overtone series of just four (or five, depending on the instrument) fundamentals, the chromatic spectrum may be filled in completely with the use of artificial or stopped harmonics.

Artificial harmonics are identical in timbre and tone quality to natural harmonics, but are produced by stopping an open string and then touching a new node that is created by the shortened fundamental. If the left hand is used both to stop the string and touch a node, artificial harmonics are limited to the reach of the performer, typically within the middle to high register of a string where the distance between fundamental and partials is smaller. Higher partials that lie closer to the fundamental are also easier to reach. The right hand may also be used to touch a node and attack the string as pizzicato simultaneously. This technique makes reaching lower partials with fundamentals in all registers more practical.

While it may be safely assumed that some notes marked as a harmonic that are not located within the natural harmonic series of any open string must be played as an artificial harmonic, common practice dictates that they are always notated in tablature form. The stopped note is notated normally, and the position of the harmonic is notated above with a diamond notehead.[28] As this method is the only accepted notational system for the use of artificial harmonics, it is curious to observe so much confusion over the notation of natural harmonics. If two staves are used as the system of harmonic notation however, artificial harmonics fit in seamlessly with natural harmonics, and the ease of reading artificial harmonic positioning is combined with simple representation of sounding pitch.

The timbre and practical application of natural and artificial harmonics is familiar to most composers and performers, as the use of such techniques has been honed over the better part of the twentieth century. More recent developments in the performance of harmonics have found their way into modern repertoire, many of which require closer examination.

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[28] Kurt Stone, *Music Notation in the Twentieth Century: A Practical Guidebook* (New York: W. W. Norton & Company, 1980), 312. See also David Cope, *New Music Notation* (Dubuque: Kendall/Hunt Publishing Company, 1976), 99.

Pulled Harmonics

The sounding pitch of any harmonic may be raised slightly by touching the node on the side of the string and then pulling the string sideways towards the edge of the fingerboard. This technique will increase the tension of the string and can be used to raise the pitch of the harmonic more than a semitone in some applications.[29] Nodes located closer to the middle of the string are more useful when pulling, as their pitches can be raised higher and with greater ease than those of nodes closer to the nut or bridge. Aside from intentional bending of harmonic pitches, harmonics, which normally are of fixed intonation, may be adjusted in this manner to tune to other instruments in an ensemble,[30] or to compensate for upper partials in the harmonic series being flatter than equal temperament intonation.

The timbre of the harmonic generally remains the same, but if pulled to an extreme the tone begins to dampen. If the string is pulled taut enough, the left hand finger acts as a suspended bridge and a stopped pitch about a semitone higher than its placement over the fingerboard is heard. With proper control, rapid alternation between the pulled harmonic and "stopped" tone can be achieved.

In the extreme upper register off of the end of the fingerboard, pulling a harmonic to the side becomes the alternative to stopping a pitch on the fingerboard.

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[29] Gardner Read, *Contemporary Instrumental Techniques* (New York: Schirmer Books, 1976), 58.
[30] Green, 160.

This tone is not actually a harmonic, but has been classified as so in the old Italian school because the string is not stopped against the fingerboard, just as normal harmonics are produced.[31]

Harmonic Glissandi

Two categories of harmonic glissandi are used in contemporary literature. The more common category involves techniques that glissando over a harmonic series, so that the resulting pitch sequence breaks cleanly and pitches do not slide smoothly into the next. The most simple example of this technique calls for the left hand to lightly touch any node on an open string and then glissando upwards or downwards, still maintaining a light touch so as only to isolate partials and not stop the string. When the finger passes over a node, that partial is excited and will remain sounding until the finger passes through the node to another.

This technique is most useful with the bow, drawing a continuous sound. Pizzicato attacks will die out too quickly as the left hand finger passes through a node, thereby muting the string, and when the left hand finger finds a new node, the string will have stopped vibrating. Pizzicato tremolo will achieve a rearticulation once a new node is found, but dead space will still exist in between nodes. The continuous excitement of a string when attacked with the bow can sustain a

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[31] Knut Guettler, *A Guide to Advanced Modern Double Bass Technique* (London: Yorke Edition, 1992), 112.

harmonic even after the left hand finger has left the node, but if the glissando is too slow, dead space will occur in between nodes. With careful registration of the bow, it is possible to make very high partials speak better so that dead space between more familiar nodes is lessened. In any case, all pitches present as a result of any partial will sound cleanly and definitely, intonation remaining fixed as a component of the harmonic series.

Natural harmonic glissandi using open strings have been used routinely throughout the twentieth century for effect. One of the first notated examples occurs in the viola and cello parts near the beginning of the fourth movement of Ravels's *Rapsodie Espagnole* (1908). The instructions read "Slide the finger lightly over the string near the bridge."[32]

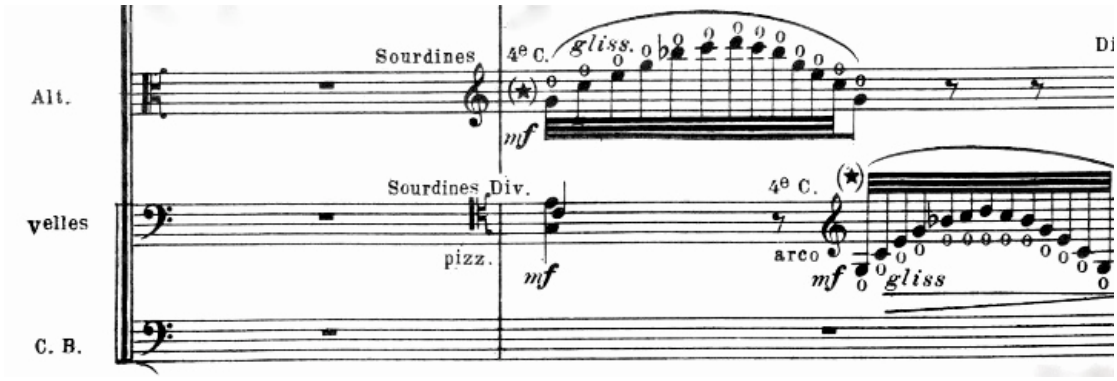

Figure III.5: *Rapsodie Espagnol* by Maurice Ravel - IV. Feria, mm. 5-6

[32] Maurice Ravel, *Four Orchestral Works in Full Score* (New York: Dover Publications, Inc., 1989) .

The same type of glissando may be used in conjunction with artificial harmonics, albeit with limited physical range. An artificial harmonic stopped anywhere on the string can be used to initiate a glissando by either of two methods. The first entails keeping the fundamental fixed (usually stopped by the left thumb) and sliding the finger touching the node either towards or away from the stopped note. The second, which is more difficult to maintain an even glissando with, requires the finger touching the node to remain fixed as the thumb stopping the fundamental slides towards or away from the node. Both methods result in similar effects as a natural harmonic glissando, but using artificial harmonics makes available a wider range of chromaticism in regards to the pitched output of the glissandi.

The second category of harmonic glissandi involves the even sliding of a pitch, much like traditional stopped glissando, but applied to the timbre of a harmonic. This sound can be achieved only with the use of artificial harmonics. To evenly slide an artificial harmonic up or down the fingerboard, the distance between fingers touching the string must change according to the distance between the fundamental and desired node. As the glissando moves up the distance between the stopped note and harmonic decreases, and as the glissando moves down the distance increases. This technique requires a great deal of precision from the performer in order to

control the rate of change in distance between points as well as an even glissando simultaneously.

Perhaps the most popular technique of harmonic glissandi is a combination of both main categories. The "seagull" glissando involves an evenly slid pitch that then breaks and resets to slide again, all stemming from a continuous motion of the left hand sliding down the fingerboard. This effect is achieved by fixing the distance between points of contact in an artificial harmonic, and initiating an even downwards glissando. As the even downwards slide of a pitch becomes unfocused due to the placement of the left hand finger no longer lying on a node, a higher partial of a lower fundamental will "catch" the slide, and the glissando will restart. The technique takes its name from the call of seagulls, which is quite accurately imitated in certain contexts.

Multi-nodal harmonics

Theoretically, any two or more nodes on a string may be isolated simultaneously, and the multiple of their partials will sound. For instance, if the nodes corresponding to the third and fourth partials are activated together, the pitch of the twelfth partial will be heard.[33] This technique is particularly useful to reach upper partials in positions on the fingerboard that do not approach the extremes

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[33] Dennis Lane Woodrich, *Multi-Nodal Performance Technique for Contrabass Harmonics*, M.A. thesis, University of California, San Diego, 1980, 16.

near the bridge or nut. And while the tone of sounding harmonic is identical to one produced normally, the left hand may be able to locate positioning quickly so that that higher partials speak more clearly with this technique.

Multi-nodal harmonics extend the upper range of the bass more consistently than any other performance technique. Previously only theoretical partials such as the twenty-first, nearly impossible to locate with the left hand, become within reach and more exact for the hand to pinpoint. While the left hand benefits greatly from the use of multi-nodal harmonics, the right hand must still take care in proper bow placement when attempting to articulate the extreme upper partials. Consistent with the traditional tendencies of harmonics, dynamic expression decreases greatly with the extreme upper partials, and these harmonics are still only useful in more subtle and soft contexts.

Multi-nodal techniques are most useful and practical around the upper limit that most composers adhere to in compositions utilizing harmonics (up to about the twelfth partial). Partials above this general area will still take a considerable amount of practice to produce consistently but are admittedly more certain in their execution than single node natural harmonics.

Harmonic Flautando

Traditional flautando bowing calls for the bow to be placed sul tasto and drawn lightly, imitating the timbre of a flute. Harmonic flautando operates with the same principles, but activates a partial above the fundamental, enhancing the flutelike qualities of the technique to a much more accurate imitation of an actual flute.

The left hand does not affect the production of harmonic flautando. Instead, partials are activated by the bow when placed on a node. Using a quick and light bowstroke appropriate for traditional flautando, a pitch an octave lower than that of the selected partial will sound. For example, to sound a harmonic flautando pitch an octave above the fundamental, the bow should be placed on a node of the fourth partial, normally two octaves above the fundamental. To sound a pitch an octave and a fifth above the fundamental, the bow should be placed on a node of the sixth partial, normally two octaves and a fifth above the fundamental, etc.

The technique presents its most useful opportunities at the two intervals described, but higher partials can also be produced with increased bow control. Harmonic flautando enables a performer to “pop” harmonics out of a texture without altering the left hand. Bassist Mark Dresser has used the technique to

achieve a drastically gentle quality in performance, and recommends the use of vibrato to further proliferate the pure flutelike expressiveness.[34]

While harmonic flautando has not been used prominently in current repertoire, it may be used as a substitute for passages marked with traditional flautando. One must simply use left hand positioning an octave lower than written and bow at the fourth partial to produce the correct pitch.

Subharmonics

The use of subharmonics enables the performer to play notes that are actually lower in pitch than the fundamental. The curious physical phenomenon of subharmonics has commanded the attention of several acoustical studies over recent years, with sometimes mystifying results.[35] Subharmonics exist as part of the undertone series, which is the logical inverse of the overtone series, and are produced by locating the normal harmonic nodes of the string with the bow and

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[34] Mark Dresser, "Discover, Develop, Integrate: Techniques Unveiled" (presentation at the 2009 International Society of Bassists Convention, State College, Pennsylvania, June 8-13, 2009).

[35] See R. J. Hanson, Andrew Scheider, and Frederick Halgedahl, "Anomalous Low-pitched Tones from a Bowed Violin String," *Catgut Acoustical Society Journal* 2, no. 6 (1994): 1, and Knut Guettler, "Wave Analysis of a String Bowed to Anomalous Low Frequencies," *Catgut Acoustical Society Journal* 2, no. 6 (1994): 4.

applying overpressure.[36] The scratching and groaning normally associated with an overpressured bow stroke can be controlled and will "catch" a lower pitch depending on the amount of pressure used and the exact location of the bow.

To present a considerable amount of confusion over the acoustical production of the technique, what limited use of subharmonics that has found its way into string repertoire does not actually correctly utilize the undertone series. The tones commonly referred to as subharmonics in the context of most musical applications are pitched between the fundamental and its lower octave. Since the second partial of the undertone series is the lower octave, these pitches are not located on true partials of the fundamental, and occur as part of the undertone series for a modified fundamental. As of a June 2009 feature on subharmonics in *Strings* magazine, the exact reasoning why these pitches occur is still unknown.[37] These pitches that are produced without satisfying physical explanation are referred to by Allen Strange and Patricia Strange as "Anomalous Low Frequencies" or ALFs.[38]

Regardless of their confusing acoustical origins, ALFs have been used with success in contemporary compositions, and modern performers are refining a highly

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[36] Carleen M. Hutchins, Alvin S. Hopping, and Frederick A. Saunders, "Subharmonics and Plate Tap Tones in Violin Acoustics," *The Journal of the Acoustical Society of America* 32 (Nov. 1960): 1444. See also Read, 59.

[37] James Reel, "Mari Kimura on Subharmonics," *Strings* 170 (June 2009): http://www.stringsmagazine.com/article/default.aspx?articleid=24421

[38] Allen Strange and Patricia Strange, *The Contemporary Violin: Extended Performance Technique* (Berkeley: University of California Press, 2001), 25.

specialized technique to produce them consistently. Most examples in printed music occur for violins, an instrument with considerably greater room to explore downwards in range. The first notated instance of subharmonics or ALFs appeared in *Black Angels* by George Crumb, and were referred to as "pedal tones."[39]

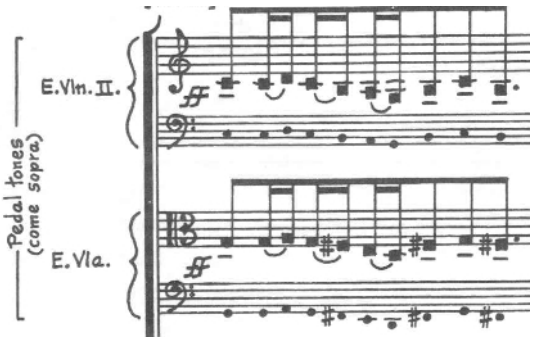

Figure III.6: *Black Angels* (1971) by George Crumb, 4. Devil-music, pg. 3

Since 1994 Japanese violinist Mari Kimura has been at the forefront of performing ALFs, and has demonstrated virtuosic control of the technique in compositions written for and by her. She has written articles on subharmonics and developed a system to control ALF pitches, in which she demonstrates in chart form

[39] The notational system of indicating finger positioning with block noteheads remains in practice today by the few composers incorporating subharmonics in string repertoire. Composers also still couple this notational designation with an additional staff to indicate sounding pitch. See James Reel, "Mari Kimura on Subharmonics."

where to place the bow in relation to the fundamental and how much pressure to apply in order to produce the desired interval below the fundamental.[40] However, many of her own compositions and those written for her do not include information as specific as required bow pressure and placement, and leaves it up to the violinist to figure out how to produce the notated pitch. This omission is partly due to inconsistencies from player to player but more importantly from instrument to instrument that unfortunately present the impossibility of a truly standardized technique in ALF production. Variables of string composition and twisting also produce issues with consistency.[41] Given the lack of flexibility in altering or manipulating double bass strings most performers are faced with in comparison to the violin, the application of subharmonics or ALFs in double bass performance therefore is decidedly more limited.

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[40] For chart demonstration, see Mari Kimura, "How to Produce Subharmonics on the Violin," *Journal of New Music Research* 28 (June 1999): 180-182. Kimura consistently (and erroneously) refers to any pitch below the fundamental as a subharmonic. She upholds this designation by reasoning that "Anomalous Low Frequency" is not a musical term and will not persist as vocabulary in describing the technique, even though her chart clearly indicates she does not use the traditional undertone series to produce the given intervals below the fundamental. She has made these assertions in "How to Produce Subharmonics on the Violin," 183, and in Mari Kimura, "The World Below G," *Strings* 16 (Aug. 2001): 29.

[41] Kimura, "How to Produce Subharmonics on the Violin," 181-182. Kimura has concluded that older strings produce more consistent results than new strings, and also that twisting a string counterclockwise from the tailpiece end replicates the properties of an older string on a new one. Twisting a string is impractical however on a double bass.

It can be recommended at this time that only the subharmonic octave be applied in musical contexts for the double bass.[42] While other intervals are certainly possible, the technique of performing them remains relatively unexplored, and performers seeking to use varied ALF intervals below the fundamental must currently specialize their own personal method of bow placement, pressure, and speed. The subharmonic or ALF octave however can be and is produced reliably and regularly, enough so that Mark Dresser has prescribed a standardized technique since 1988.[43]

To produce a pitch an octave lower than the note that is stopped, the bow should be placed on the node of the sixth partial (two octaves and a fifth above the fundamental) and a great deal pressure should be applied as the bow is drawn. The scratching and groaning sound of overpressure can be controlled with a very even bow stroke to "catch" the lower octave. Due to the increased girth of double bass strings, contrary to the violin it is desirable to stop the string with a left hand pressure that is less than normal. For this reason, producing ALFs on the bass is most difficult (but still possible) on open strings.

The tone of subharmonic octaves is much more gritty and nasal than a normally drawn bowed note. While first attempts to produce ALFs may still contain a

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[42] The octave lower than the fundamental is the only true subharmonic that can be used practically on the double bass. This interval may also fall under the umbrella term of ALF; the use of either term when describing this interval is current.

[43] Mark Dresser, "A Personal Pedagogy," in *Arcana: Musicians on Music,* ed. by John Zorn, 250-261 (New York: Granary Books, Inc., 2000) 256.

good deal of overpressure “noise,” it is possible to completely eliminate the extraneous scratching sounds and draw a consistent and even tone. The dynamic range is difficult to control, mostly resulting in at least forte because of the extreme amount of bow pressure required. It is possible however, with a great deal of control to produce a useful piano dynamic, especially with fundamentals in the lower part of the double bass’ range.

Using subharmonic octaves, it is theoretically possible to extend the range of the bass below the lower limit of the piano, and as far down as almost to the lower limit of human hearing. The lower the fundamental used, the harder it is to hear the complete pitch. The lowest pitches available begin to sound similar to an analog synthesizer producing square waveforms in the extreme low register. The clicking or beating that is observed in very low synthesized sounds is somewhat reproduced as the overpressured bow vibrates the string so slowly that individual catching and slipping of bow hairs is heard.

While subharmonic octaves from fundamentals on the low E string do have audible effects, they would be heard more easily and fully in a musical context that utilizes these ultra-low pitches as the foundation for other pitches, even if just a doubled octave at the normal fundamental. As with any tone, the presence of natural overtones will strengthen and give character to the fundamental. Therefore if the subharmonic pitch is treated as a fundamental and other pitches above it within

its own harmonic series are provided in addition, the subharmonic will appear louder. These ultra-low pitches are best utilized in musical contexts that require a deep foundation upon which to build other musical events.

This particular tessitura (E0 to B1, below the normal C extension range) is not practical at all for passagework. Using subharmonics as a substitute for a C extension below the normal E string generally will not produce smooth results, as even in contexts without active passagework, the timbre of a subharmonic C1 is not identical to the rich and deep tone of an open C extenstion on another bass, and within a double bass section or mixed ensemble the subharmonic pitch may not blend properly.

Multiphonics

As with other extended applications of string harmonics, multiphonics have long been deemed too imprecise and unpredictable to develop a standardized performance technique or to be demanded in any sort of fixed (non-aleatoric or -improvisational) musical context. Indeed, the production of multiphonics on the double bass is decidedly more delicate than the blaring and abrasive qualities normally associated with multiphonics on woodwind instruments like the clarinet

and saxophones.[44] The general physical properties occur similarly: the vibrating column of air in a woodwind instrument and the vibrating string of a double bass is split between two or more pitches. Just as variables such as fingering and embouchure affect the production of certain multiphonic chords and clusters, left hand positioning, bow location, speed, and pressure will affect those on double bass.

Multiphonics occur on a string by producing any combination of partials in the harmonic series and/or the fundamental simultaneously. A finger position must be located that will activate two or more partials together, usually at some point between closely positioned nodes.[45] When multiple partials sound together, the string vibrates in such a manner that the "dead" spot associated with a single node is no longer present. This property affects the sensation under the left hand that will thus be of the entire string still vibrating; there is no defined point on the string where waveforms begin and end that the finger rests. These points in between partials may be discovered by gently sliding the left hand back and forth between adjacent nodes with a light bow stroke until both partials are heard at once. This process may be used to find and sound multiple partials together, but the more partials that are used simultaneously, the less chordal qualities the multiphonic will

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[44] Phillip Rehfeldt, *New Directions for Clarinet* (Berkeley: University of California Press, 1994), 41.

[45] Håkon Thelin, "A New World of Sounds: Recent Advancements in Contemporary Double Bass Techniques: Harmonics and Multiphonics," (presentation at the 2009 International Society of Bassists Convention, State College, Pennsylvania, June 8-13, 2009).

contain. Higher partials that are closer together in pitch also lie closer together on the string, therefore when maximizing the amount of partials sounding simultaneously using nodes that are near to each other, dense upper partial content is sure to be present.

To sound a harmonic partial at the same time as the fundamental, the left hand must simply apply a lighter than usual pressure at the desired node. Using either method, possibilities of diads, triads, multi-voice chords, and clusters exist with mixes of different partials and/or the fundamental. While many of the available multiphonics are unpredictable, there are some chords and combinations that are more dependable than others, and which possess opportunities for definite musical events.[46] Generally, multiphonics using combinations that utilize lower partials produce more consistent chords, and also more tonally recognizable chords. The third, fourth, and fifth, partials in particular result in strong components to build multiphonics off of using surrounding nodes, and many multiphonics containing these partials offer potential for inclusion by composers as fixed musical elements.

To produce a major chord with the pitch of the fundamental as the root, some practicing and familiarity with an individual instrument will yield consistent results for the performer. To produce a G major chord on the G string, the left hand

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[46] Strange, 134. Allen Strange and Patricia Strange quote Tracy Silverman romanticizing the unpredictability of violin harmonics, but admit there are more certain applications available on the cello and double bass.

finger should be placed approximately at the D#3; the precise placement may vary by as much as a quartertone in either direction depending on the instrument or player. This location is close to the third, fifth, and eighth partials, which can all sound simultaneously.[47]

When exploring a specific multiphonic for the first time, it is best to start by isolating the lowest partial involved alone, and then slowly oscillate between that partial and the others, with a light bow stroke. Soon, the point in the oscillation at which all partials still sound can be identified and secured. If the open string fundamental is desired in the chord, the left hand must slightly lessen its pressure on the string. These techniques can be applied to finding multiphonics at any point on the bass string, as long as the performer is certain of the desired partials to be involved in the multiphonic.

Multiphonics should be notated with an additional staff to indicate sounding pitches. It may also be helpful to indicate in a musical context which partials are desired in addition to their sounding pitches. In order to avoid confusion and create a fixed musical purpose with an element that has long been as non-specific as multiphonics, composers must include more detail than is normally afforded for the notation of harmonics.

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[47] Dresser, "A Personal Pedagogy," 258.

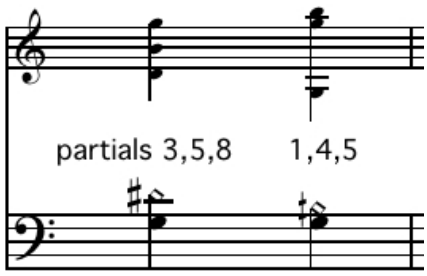

Figure III.7: Notation of multiphonics

Dynamics of multiphonics can be controlled with bow speed. As dynamic intensity rises however, it does become more difficult to sustain a controlled multiphonic. Most triadic multiphonics respond best at softer dynamic levels, but complex cluster multiphonics may achieve a very high volume. Drawing the bow diagonally may also aid in projection.[48] The tone of multiphonics falls in between that of a normally stopped note and a traditional harmonic. The pure and glassy harmonic tone is somewhat muddied by the string's indecision of pitch, which gives the tone a mildly grating or gritty quality. This characteristic split-tone has contributed to the perception of multiphonics as wild and uncontrollable, and has similar properties to multiphonics on wind instruments. Indeed, multiphonics may be employed in raucous contexts without definable pitch content, to extent of noticing beating from the conflict of very close partials. More importantly though,

[48] Dresser, "Discover, Develop, Integrate: Techniques Unveiled."

multiphonics are now capable of being tamed to a serene and more delicate role in double bass music.

Double Stops

Some problems arise when performing harmonic techniques on two strings simultaneously. As many of these techniques depend on a great deal of finesse and control with the bow hand, the elements of bow placement, speed, or pressure used to initiate an event on one string may not correlate to a different event on a neighboring string. For this reason, some combinations of harmonic techniques are more difficult than others, and some are impossible. The one timbre that may be combined successfully with any previously described harmonic technique remains a traditionally stopped or open string. A normally bowed note can sound under a high variance of conditions that may be required for another technique.

When using double stops of natural harmonics, most combinations are available without problems. As the specificity required of the bow hand increases with higher partials, pairings of natural harmonics that utilize extreme partials on both strings become more difficult to attain, and in some cases impossible. In general, combinations of partials above the eighth are not recommended.[49] For the same reason, even rapid alternation of single harmonics on different strings in

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[49] Lawrence E. Czoka and Dennis L. Woodrich, *Foundation Studies in Natural Harmonics for the Contrabassist* (San Diego: Christopher Publications, 1978), 32-38.

passagework may not speak due to bowing issues, even though the left hand positioning is perfectly logical.

Double stops involving subharmonic octaves and traditionally bowed notes or open strings work particularly well, especially with open strings at unison with or stopped fifths above the fundamental. Other intervals are possible but may sound muddy depending on the register. Double subharmonics are only possible in fourths so that the required bow placement for each string remains the same, and even so, eliciting a clear tone from double subharmonics invites a challenge. A better alternative would be to use a normally bowed note a fifth below the fundamental of the lower stop.

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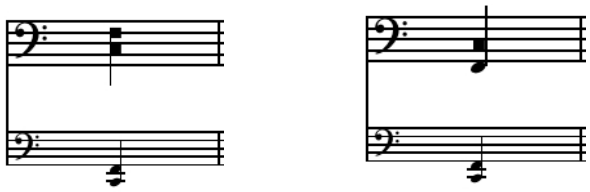

Figure III.8: Subharmonic double stops

Multiphonics can be combined with many other techniques, but as the density of bowing requirements increases, the predictability of multiphonic

specificity decreases. If pitched content of a multiphonic is not a defined concern, such as with indeterminate clusters, multiphonic double stops can be useful in musical contexts. Combinations of multiphonics with other techniques or double multiphonics can create some of the most complex timbres available from the double bass. A wide range is available from ethereal and clear chords and clusters to wild and grating indeterminate beating

Chapter 4

PERCUSSIVE TECHNIQUES

The qualities of percussive timbres depend on a number of factors including the method used in striking the bass, what the bass is struck with, and where the bass is struck. Application of these techniques draws a similarity between the double bass and a drum, but this comparison generally does not hold much longevity. The first problem with the analogy is the willingness of the performer to execute these techniques. Percussionists will more readily assault their instruments with various implements in an active pursuit of discovering new colors. String players on the other hand are not so keen to strike their comparatively less durable instruments. Even the idea of using the bow *col legno* is uncomfortable to many, for fear of damage to the bow or instrument. Although the bass is not as durable as an actual drum, it does have an advantage over the smaller string instruments in this area. The bass is considerably less susceptible to harm than the cello and certainly the violin or viola. Also owing to its large size, a bassist must have a very physical relationship with his instrument, and most performers will have a good idea of where the level of force applied approaches excess when striking the bass with their hands or another implement. It is therefore recommended that the performer take special care when

playing percussively on the bass, but it still represents a profitable opportunity to multiply the instrument's sonic possibilities uncountable times.

The process of eliciting these extra percussive colors from the bass is also quite different than from a drum. While hitting the double bass with the hands and playing a conga drum may look similar, the process in which sound is produced is not. The primary distinction between bass and drum is the surface that is being attacked. Drums are membranophones, they have a pliable membrane that is struck and vibrates freely. [50] This makes variation in color easy to produce, based on factors such as tension, point of contact, and dampening.[51] The double bass is of course made of wood, and as a "membrane" upon which to strike, it is fairly fixed. Thus, variations in percussive color are subtler and take a particular amount of nuance to create.

Two components of an aural quality are relevant in describing a percussive sound on the bass: attack and resonance. If the wood of the bass that is struck is very hard, most conventional attacks will therefore sound hard and well defined. The attack also sounds quickly, resulting from the instant of direct contact between hand and wood. Percussionists also refer to this sound as the contact sound.[52] The

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[50] Reginald Smith Brindle, *Contemporary Percussion*, (London: Oxford University Press): 1991, 4.
[51] Ibid., 23.
[52] Ibid., 24.

resonance gives each percussive sound its body. Once the attack sounds, it resonates within the large chamber of the bass and emits through the F-holes. In order to resonate properly, the bass must be held slightly away from the body. If the performer desires an effect of greatly reduced resonance and a raw attack sound, then the bass can be held tightly, and even clutched between the knees. If the natural resonance of the instrument is desired though, then it is recommended to support the instrument normally, with the left hand on the neck and fingerboard, which are solid and do not effect resonance (it will usually be desirable to hold the bass here by necessity of muting the strings alone; they will be set in motion by any percussive strike in any location).

From a notational perspective, it is easy to observe that the modern repertoire is rife with the use of percussive elements. Since the 1960s, the amount of new rhythmic and timbral possibilities that bassists have seen appear on manuscript has been explosive. The examples are great and varied, and owing to the prolific base upon which to draw them, notational practices are far from standardized. The method in which a composer chooses to notate percussive effects is dependent on the role of those effects within the overall piece. If percussion is used as a central element of the composition, then there must be a pervasive, unhindered approach that clearly indicates how the percussive techniques are integrated into the rest of the material. An established system is to add a percussion

staff below the bass staff.[53] Each line or space on the percussion staff indicates a different striking point on the instrument, similar to multi-percussion music where each line or space on the staff indicates a different percussion instrument, drum, cymbal, etc.[54] Jacob Druckman (1928 – 1926) uses this model successfully in *Valentine* (1969):

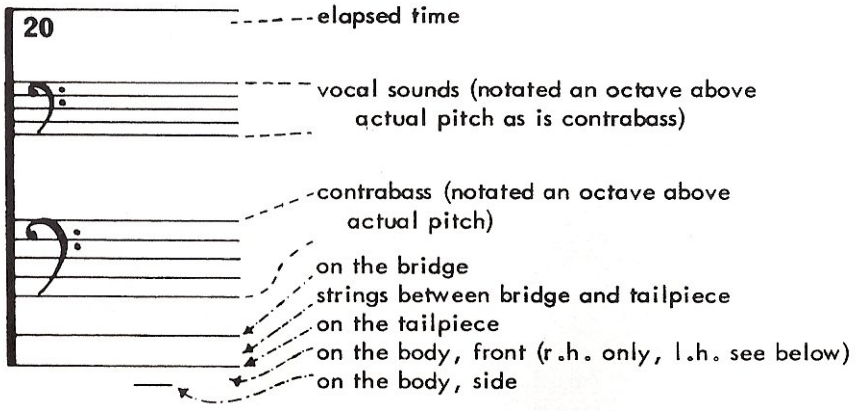

Figure IV.1: *Valentine* by Jacob Druckman, lexicon

Thomas Read (b. 1938) further clarifies the model by including an illustration that maps out the striking points in *Music For Solo Contrabass* (1975):

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[53] Kurt Stone, *Music Notation in the Twentieth Century: A Practical Guidebook* (New York: W.W. Norton & Company, Inc, 1980), 307-308.
[54] Stone, 216.

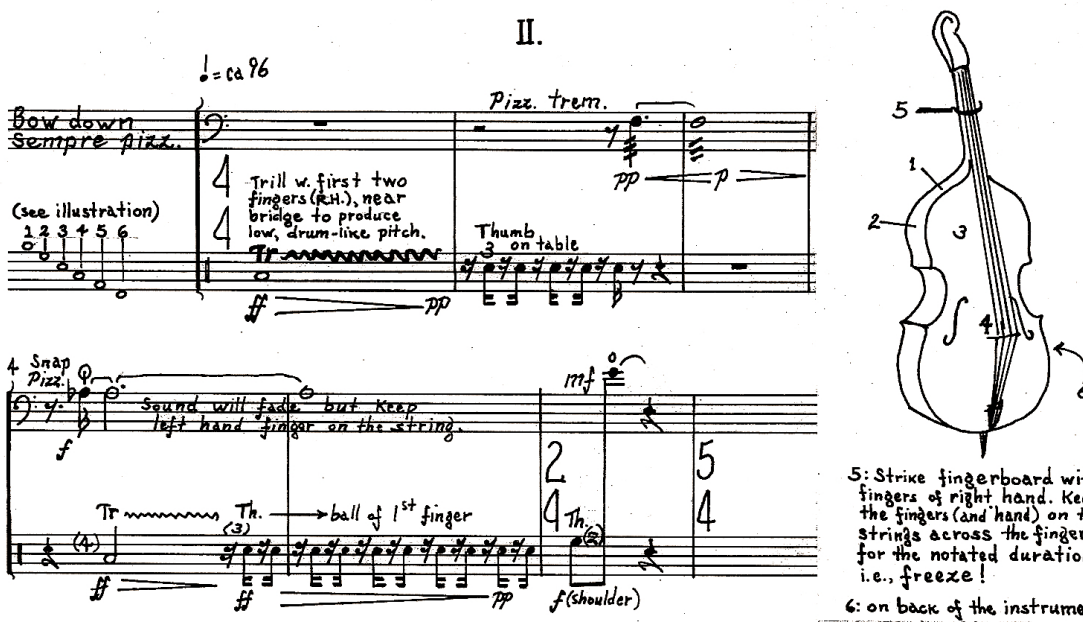

Figure IV.2: *Music for Solo Contrabass*, mvt. II, systems 1-2

The primary difference in the application of these two examples is the manner in which the composer conveys the methods used to strike the bass. Druckman favors differentiating the noteheads to indicate the attack, and even applies specific noteheads to traditional pizzicato and *arco* techniques:

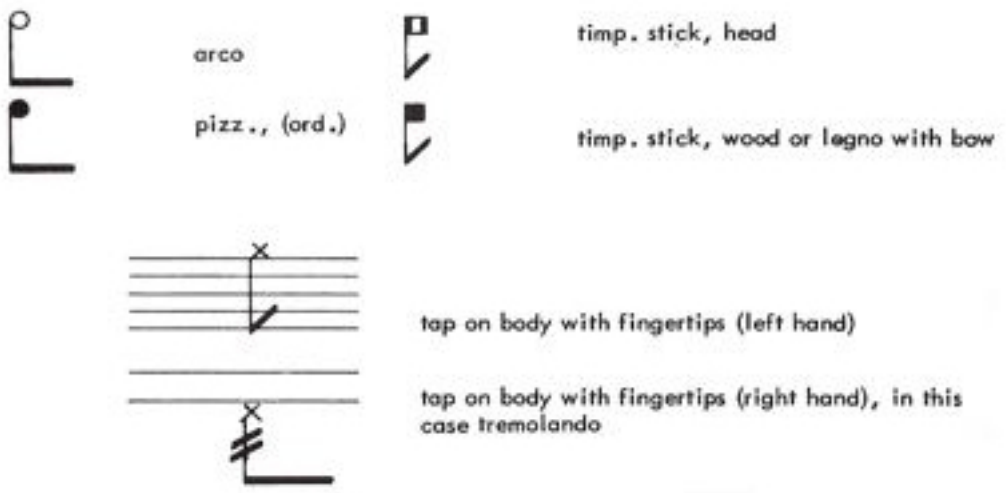

Figure IV.3: *Valentine*, lexicon

Read, as previously shown, simply indicates with text which parts of the hand to use.

In *Mr. T. His Fancy* (1967) Barney Childs (1926 – 2000) uses similar instructions to Read's piece:

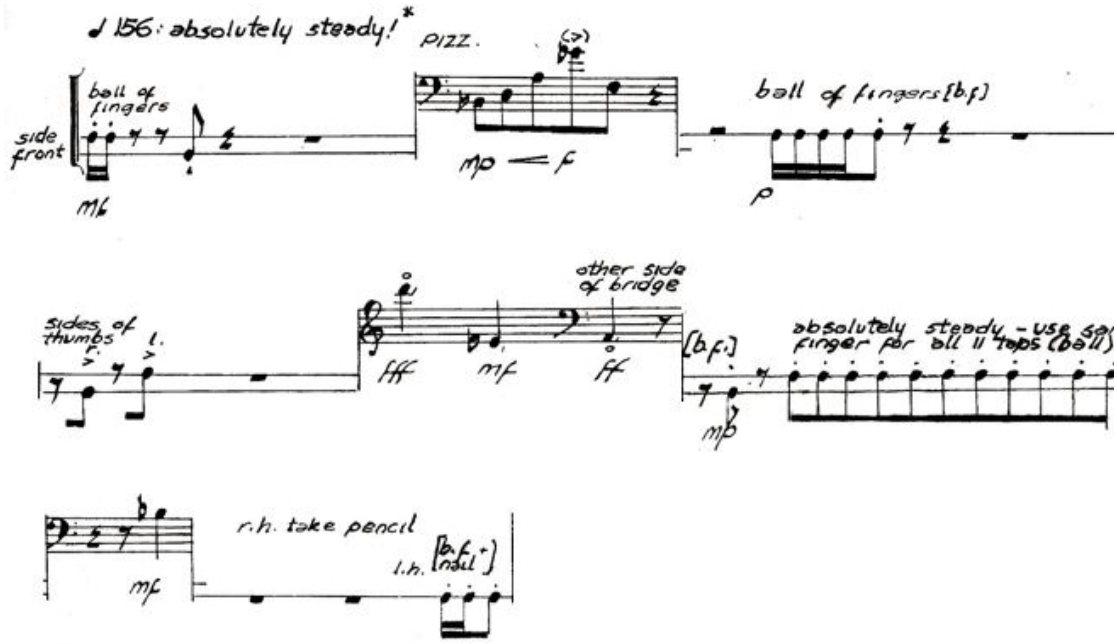

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Figure IV.4: *Mr. T. His Fancy*, mvt. 2 systems 1-2

The advantage to using texted instructions is considerable in regards to the clarity of communication between composer and performer, but it can be disadvantageous if the page becomes too cluttered with text, impairing the visual clarity of the score.[55] The determining factor in the matter is, once again, the context of the percussive elements in the entire piece. If the percussive sections alternate cleanly with sections of more traditional *arco* and pizzicato technique like the second movement of *Mr. T. His Fancy*, then texted instructions are favorable. In

[55] David Cope, *New Music Notation*, (Dubuque: Kendall/Hunt Publishing Company, 1976) 5.

B.B. Wolf (1982) by Jon Deak (b. 1943), percussive elements are used as accents or to cap off phrases. At times in the piece, Deak chose to present the bass part on a grand staff due to the large range required.[56] When percussive elements are used after phrases of primarily pitched material, he keeps both staves on the page even in the absence of the upper tessitura, so there is ample room to use the same kind of texted notation:

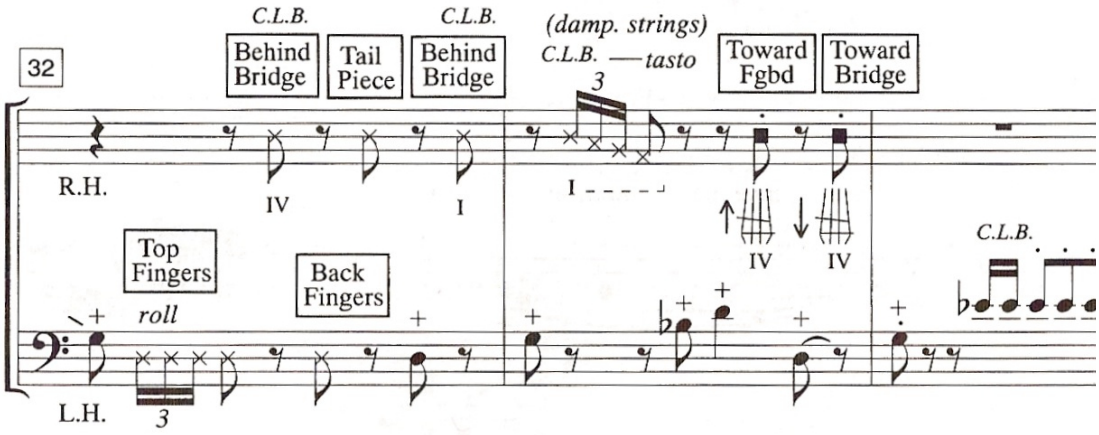

Figure IV.5: *B.B. Wolf* by Jon Deak, mm. 32-34

However, when percussive parts are heavily integrated into the piece, to the point where they simultaneously exist with other techniques, a less verbose method

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[56] For an example of simultaneous low and extreme high registers across more than one staff, see mm. 62-67 of *B.B. Wolf.* The overall range of the piece extends from EE to g" (sounding). Deak also frequently includes a third staff above the grand staff in order to accommodate vocal narration.

of notation is called for. Druckman's use of predetermined noteheads clearly expresses the multitude of simultaneous techniques required of the extraordinarily dense texture of *Valentine:*

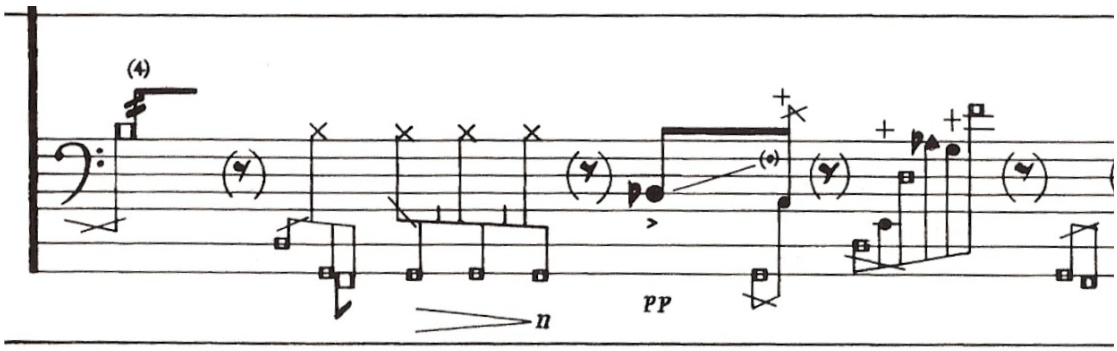

Figure IV.6: *Valentine,* pg. 1, system 2

Some adventurous composers place less importance on any sort of traditional notation in contemporary music. Kenneth Gaburo (1926 – 1993) eliminates the role of the traditional staff in *Inside: Quartet for One Double Bass Player* (1969), by placing symbols in a pitchal field. His choice of predetermined symbols rest in relation to each other and the overall range of the instrument. The symbols chosen for percussive effects are clear abbreviations:

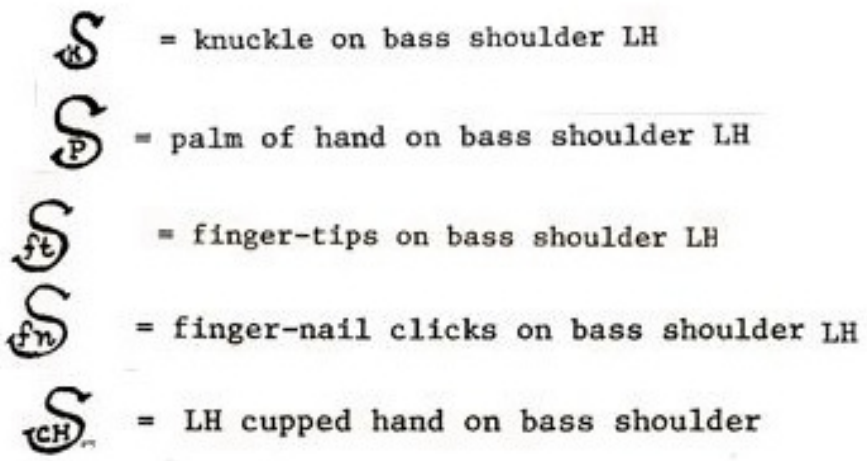

Figure IV.7: *Inside: Quartet for One Double Bass Player*, lexicon

Gaburo also uses a large “B” for belly, “BR” for bridge, and “TP” for tailpiece. Conversely, Bertram Turetzky uses *only* texted instructions in *Six Timbral Studies* (1974). The performers are expected to follow the directions in order to elicit specific colors from the instrument. The nature of the movements tend to be aleatoric, because focus is placed solely on executing a technique in the prescribed manner:

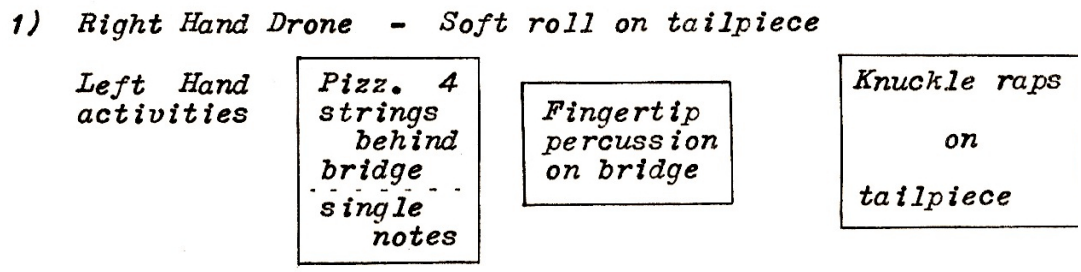

Figure IV.8: *Six Timbral Studies* by Bertram Turetzky, mvt. 1 "Nightmusic," player 1 instructions

Hand Initiated Techniques

Most of the examined musical excerpts focus on the hands as the generators for percussive techniques. Figures 1-9 from the previous section give an overview of how these techniques have been integrated into larger contexts.

These techniques can all be performed in two variations: rebounded and muffled.[57] When rebounded, the performer should bounce the hand off of the bass as soon as it makes contact on the attack. When muffled, the performer should leave the hand on the bass after the point of contact. Generally, a rebounded technique has a slightly more resonant sound than a muffled version of the same technique. Also, the attack of a muffled technique is less crisp. Composers rarely

[57] A muffled attack can also be referred to as muted; the terminology varies in traditional hand drumming practices.

specify the difference between rebounded and muffled attacks, as the pace and context of the individual piece will usually dictate the proper method to be used. For the sake of clarity though, if a composer does intend for differentiation between the two methods, specification should be made in performance notes. Unless an exception is noted, the relative properties of rebounded and muffled attacks apply to all percussive techniques.

On the Front of the Bass[58]

Open Tone: The open tone is one of the few techniques that directly correlate to traditional hand drumming performance. Its execution begins by placing the hand on the edge of the upper bout. The heel of the hand rests slightly on the side of the bass, and the fingers and palm curve around to strike the front, where the front panel begins to bow. The resulting sound has the most character of any percussive technique. The attack is strong and bright, and the resonance is full and colorful. The open tone is similar to the technique of the same name used on a conga drum, of which it is idiomatic. The open tone is just that; a tone is heard that emanates from the whole bass. It is capable of loud dynamic levels and is the best representation of how powerful the double bass is as a large resonating chamber. When muffled, the

[58] For notational examples of most of these techniques, refer to figures II.2-II.9.

resonance is not dampened, but the wild attack is tamed to a duller but more focused shape.

If the palm is cupped slightly so that it will catch air, a distinct popping sound is made. It can be difficult to attain, but a "popped" open tone is the one sound that could easily be mistaken for an actual conga by the untrained ear. None of the compositions from the examined timeframe call specifically for an open tone.[59]

Palm Slap: This technique is similar to what is called a bass tone in hand drumming. It is produced by striking the bass with the flat palm of the hand, as the name suggests. A palm slap has a more severe attack than the open tone, but is also thinner. The frequency response consists of more upper harmonics than lower ones. The resonance is brighter, but there is less tone and ring, and thus less of a scope to the full character of the instrument. It is very effective however for a sudden accented slap.

The perceived pitch of this technique rises as the striking point approaches the edge of the bout. It becomes lower as the striking point moves toward the center, under the fingerboard. When used on the lower bout, below the F-hole, the attack is noticeably lower in pitch wherever the bass is struck. The resonance is greatly increased on the bottom of the bass, and elicits a full, "bassy," if somewhat

[59] An example in current repertoire can be found in *Rhythm Studies* (2008) by the author.

unfocused sound. Muffling the attack adds focus but cuts out the main body of resonance.

Cupped Palm: When a palm slap is performed with the palm cupped, the full surface area of the hand does not come in contact with the wood. Compared to the palm slap, the attack of a cupped palm is duller and rounder, but the resonance remains just as full. When using this variation muffled, it eliminates less resonance than a palm slap would, especially on the lower bout.

Fist: Pounding the wood with the bottom of a clenched fist is one of the more subtle techniques used. The attack is extremely muted and unresponsive, and cannot achieve a great deal of volume. The resulting sound is resonant and warm, but dull.

Knocking: Using the knuckles to knock on the bass elicits a sound similar to a door knock. The attack is a pointed and punchy rapping. When knocking on the bass though, there is resonance that does not normally accompany solid objects. On the upper bout, there is little body to the resonance; rather the attack is simply amplified. On the lower bout however, the resonance approaches a slight echo effect. This gives the knock a “wet” quality; the attack is well defined, but there is an unfocused aftereffect in its wake.

Finger Slap: Using the pad of the finger to strike the bass produces a similar effect to the palm slap. The attack is thinner and higher-pitched and there is slightly less resonance than a palm slap. The advantage to using the finger slap over other techniques is that creating a tremolo is easy, with multiple fingers of the same hand or both hands.

Finger Tips: A variation on the finger slap, using the tips of the fingers (but not quite at the fingernails) produces the roundest, most unobtrusive attack available from the hands. The resulting sound is warm and low pitched; a characteristic of the resonance's dominance over the attack. The deepness of this technique is clearly heard on the lower bout. By using the index finger and middle finger together for support, a comparable bass drum sound is produced by striking the lower bout below the F-hole.

Fingernail: Tapping on the bass with the fingernails produces a bright clicking sound with negligible resonance. The sound produced remains consistent throughout the instrument, but the perceived pitches of the attacks will sound lower on the lower bout. Tremolo is performed with ease.

Thumb Slap: This technique is performed by striking the bass with the outside of the knuckle on the thumb, similar to the method used of slapping on an electric bass guitar. The quality of this sound is similar to knocking in all ways except for a slightly duller attack. Thumb slaps are useful as accents in passages when quick finger tremolos are used with either the pads, tips, or nails. During a period of high activity it is easier to use the thumb independently than to halt the tremolo of other fingers in order to clench them into a fist and knock.[60]

On the Side of the Bass

All aforementioned techniques for use on the front of the bass are also available on the sides. All techniques go through the same alterations when performed on the sides: the attacks become punchier, brighter, and more pointed, but lose resonance. Relative to each other, the techniques retain their unique qualities. Most of these techniques can be performed on the side of the bass with the same amount of ease as exhibited on the front, with the exception of the open tone. It is possible to produce an open tone if one stands behind or in front of the bass, with the heel of the hand on the edge of the side and back (or front) panels.

[60] For a table representing the qualities of each technique, see the appendix.

On the Back of the Bass

All techniques also can apply to the back of the bass, but with varying success. Because there are no F-holes on the back of the bass, most percussive techniques can sound dead to the performer. The audience does not necessarily perceive the techniques in the same way. Each aforementioned technique retains its relative qualities on the back of the bass, but the attack is rounded out with less focus and then amplified. The resonance remains the same, but sounds diminished when compared to the more prominent attacks. This effect happens because any attack on the back of the bass must travel through its chamber and out of the F-holes before reaching the audience. Thus, the attack sound is actually a component of the resonance, and less of the warmth and body generally associated with this quality is heard. The initial hand-on-wood contact is never actually heard. It is an interesting effect, but it does not serve some of the more quiet techniques (like the fist) as well, since they depend on an already unfocused attack.

On Solid Wood

The solid areas of the bass, chiefly the scroll, neck, and fingerboard have little noticeable resonance when struck percussively. Therefore any technique used on these areas must have a clearly defined attack, usually indicative of a hard part of the

hand (either nail or knuckle). The three techniques that are used with the most success on the scroll, neck, and fingerboard are the knock, thumb slap, and fingernail. It is improbable to use any technique involving the palm because these parts of the bass are not flat. The rare exception is a palm slap on the back of the neck, which takes a considerable amount of force to produce a dull "thwack."

These techniques retain all the characteristics of their sound when played on the front of the bass, except resonance is generally not noticeable, and the attack will be of a softer dynamic. The most successfully employed color variation dealing with these areas is that as the edge of the fingerboard is struck, the perceived pitch becomes lower as the striking point moves farther down towards the bridge.

On Other Parts of the Bass

It is also possible to use the bridge of the bass as a striking point. Any performer must exercise strong caution when attempting this percussive effect though. If struck too forcefully, the bridge can be knocked out of position and collapse, which can further collapse the sound post of the bass. Due to its proximity to the sound post, the bridge is also useful as an amplification device. It amplifies any attack, without extra resonance. Because of this quality and its extreme delicacy, it is only practical to use light techniques involving the fingers. Subtle and gentle

finger tapping or clicking will not put the bridge in any danger, and the character of the attacks will be enhanced through the bridge's amplification.

Techniques used on the tailpiece of the bass are generally bland in character. Any technique can be used, but not with great force because of its close proximity to the bridge. Playing on the tailpiece gives the effect of an extreme dulling to the attack. In fact, most techniques sound very similar to each other here, even if they are vastly different in execution. There is negligible resonance to the tailpiece itself, but because it is suspended by the strings, the strings will often vibrate below the bridge. This produces an eerie high-pitched sympathetic vibration that is consistent to any technique used on the tailpiece.

Finally, the strings may be slapped percussively against the fingerboard. This technique is quite common in solo and orchestral repertoire and very distinct, as it is actually a product of metal hitting wood; the hand is not involved in the sound of the attack. It is used frequently as a muted accent while playing pizzicato, and may even be the unintended result of exuberant pizzicato performance. It is similar in sound to a Bartók or snap pizzicato, but there is no stopped pitch in the left hand, and instead of pulling the string away from the fingerboard and letting it snap back, the right (or left) palm slaps the strings directly into the fingerboard. The attack contains mainly high frequency response, and the relative pitch will rise as the slap is moved towards the end of the fingerboard. Joji Yuasa (b. 1929) calls for this distinction in pitch in

Triplicity for Contrabass (1970). The three bass parts are placed on staves marked with relative pitch: high, middle, or low:

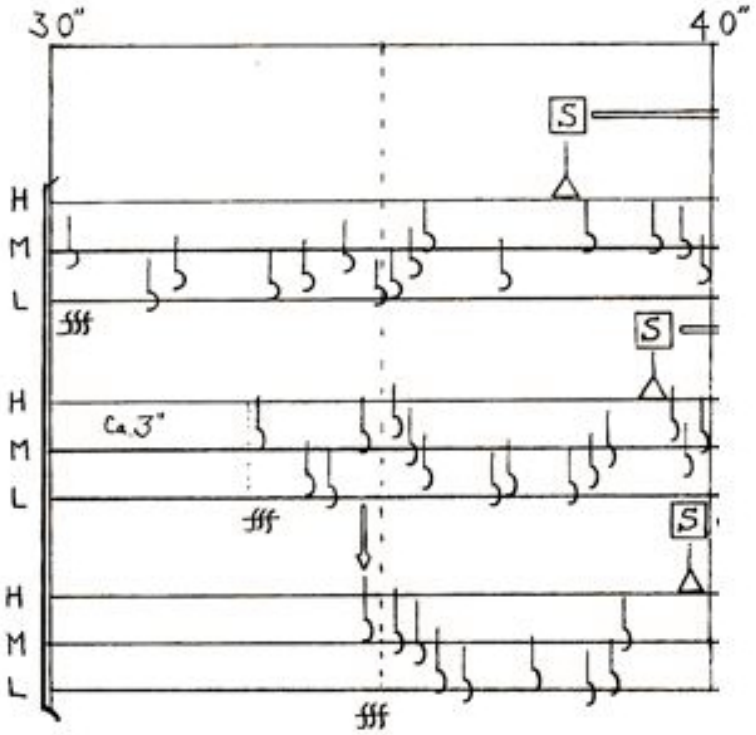

Figure IV.9: *Triplicity for Contrabass* (1970) by Joji Yuasa, 30" – 40"

Rubbing

One of the more subtle percussive techniques available is rubbing. A "soft rub" is produced by lightly moving the palm in circular or back and forth motions

anywhere on the body of the bass. The easiest area to perform this technique (and that which projects the most, because it produces an inherently quiet tone) is the front of the bass, on the upper bout underneath the fingerboard and above the bridge. The resultant sound can range from an uninterrupted "whooshing" of varying intensity depending on the speed, to short and soft punctuations like the sweeping of a broom. A soft rub can also be performed on the strings giving a very slight difference in timbre then rubbing on the wood, it appears thinner and more metallic.[61] This technique rarely appears in print. Here is an example used by Jon Deak in *Color Studies* (1969) that also has theatrical connotations:

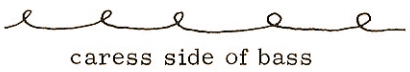

Figure IV.10: *Color Studies*, mvt. 3 "Thick Purple," system 2

The hard rub is one of the wildest sounds available from the bass. The technique has been inaccurately described as a "tambourine roll," which produces a

[61] The strings can be rubbed with the fingernails as well, but this technique is more similar to using coins and other hard materials than to using the palm. Additional applications of rubbing or scraping techniques using other materials will be discussed in Part III.

warm, sustained pitch from a tambourine or bass drum head.[62] The hard rub actually sounds more similar to the modern percussion technique of dragging a rubber ball across a timpani head, where friction from the rub causes a high-pitched screech or squeak. In order to obtain the necessary friction required to make the rub screech, slightly more pressure is needed than from a soft rub. It may also help if it is executed on an area of the bass that has collected rosin dust, or if the hand is slightly moist. A slight adhesive may even be applied to the hand to facilitate this. With practice, the performer who is well acquainted with his instrument should be able to obtain this color consistently. In the second movement of *Color Studies*, Deak instructs the performer to "rub back or rib, try to produce high squeak." [63]

Other Materials as Generators

Besides the hands, various other implements can be used to initiate percussive attacks on the bass. Sticks, mallets, and even pencils have all found places in the repertoire. A popularly performed example would be Druckman's use of a timpani stick in *Valentine*.[64] The work calls for the performer to strike the bass in a

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[62] Turetzky, 68.

[63] Jon Deak, *Color Studies*, (Chicago: Media Press Inc.): 1969, mvt. 2.

[64] Druckman refers to a "timpani stick" in the performance notes of *Valentine*. "Timpani mallet" is the term more widely accepted by concert percussionists. For the sake of consistency, the term "timpani stick" will be used in this article in reference to *Valentine*.

multitude of different ways, using both the soft, felt head and the wooden handle of the timpani stick. The opening statement of *Valentine* immediately exhibits a number of percussive permutations:[65]

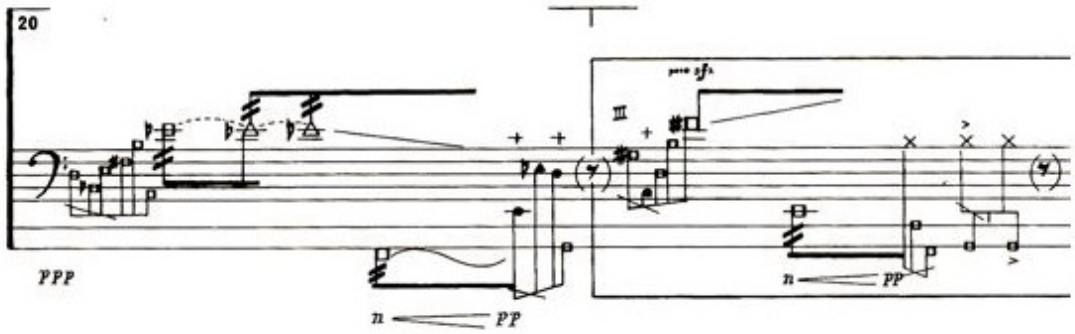

Figure IV.11: *Valentine*, pg. 1, system 1.

First, Druckman calls for the performer to play with the head of the timpani stick on the strings. The resulting timbre of this technique is similar to an unfocused, dull pizzicato. After a left hand alone tremolo, the performer must initiate a tremolo on the front of the bass with the timpani stick. The attack is similar to a dull knock, but there is much more resonance. The overall color is very sonorous, but somewhat distant, as if it were underwater. A wavy line indicates to change the position of the

[65] The timecode of the example in Figure 13 starts at twenty seconds. In live performances, the first twenty seconds are "ghosted" or mimed. It appears as if the performer is furiously executing a variety of percussion techniques but no contact is made with the double bass. Audible activity begins after twenty seconds. On recordings, the first twenty seconds is usually omitted.

striking point on the body of the bass in order to vary the timbre, which relates to the perceived pitch of the striking point (lower towards the center, higher towards the side, the same as with the hands). When striking the side of the bass, the same qualities persist, but the general pitch of the attack is higher.

Throughout the rest of the piece, the performer must use the head of the timpani stick to strike the front and side of the body, the stopped and open strings, the strings below the bridge, and the tailpiece. Both the strings below the bridge and the tailpiece have similar percussive colors as the body when using the head of the timpani stick. The taut strings below the bridge also produce a slight bell-like tone that is the fundamental pitch, but the ping of a strike tone normally associated with percussive effects on the metal strings is eliminated due to the softness of the felt head.[66] When striking the tailpiece, the timbre is similar to the wood, and there is a slight, drone created by the strings below the bridge. Druckman calls for all these techniques in very quick alternation with pizzicato and left hand taps.

Possible uses of the timpani stick increase once it is turned around and the wooden handle is used to initiate percussive attacks. Druckman never demands that the performer strike the body of the bass with the wooden handle (to the relief of many), but it is used on the strings and tailpiece:

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[66] Strike tones are the resultant sound from the direct contact of a hard implement on the strings. These effects are most commonly associated with the bowing technique *col legno battuto.* The use of strike tones as an isolated percussive technique is discussed after the presentation of more examples.

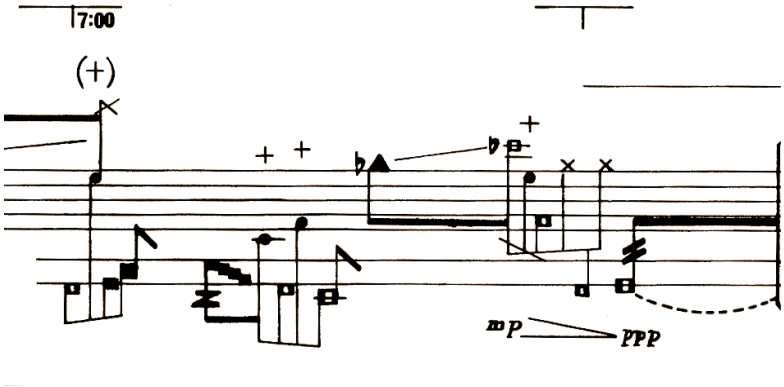
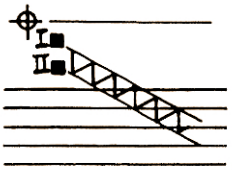


Figure IV.12: *Valentine*, pg. 7, system 4.

The aural effect is very similar to *col legno battuto*, albeit with more intensity. The shorter length of the stick makes control easier than when using a bow. The example in figure 14 calls for a "buzzed" descending arpeggio of the strings behind the bridge. This is achieved by applying pressure to the stick as it bounces off the strings. The resulting effect is that of a tremolo that increases in speed and decreases in dynamic level of the bell-like tones associated with the strings behind the bridge. All these techniques are possible using relatively traditional *col legno* bowing variations. Druckman does call for one technique that utilizes the small size and enhanced control unique to the timpani stick:



insert handle of timp stick between the indicated strings, beat rapidly from side to side while moving from pont. to tasto (in this case ⊕ indicates that strings are lightly choked; also appears without ⊕, indicating that pitch of open strings is added to the sound.

Figure IV.13: *Valentine*, lexicon.

As the stick moves from ponticello to tasto, the strike tones from the strings appear to glissando downwards, a color of the double bass that can be elicited in no other way. A similar technique is employed by Childs in *Mr. T. His Fancy*:

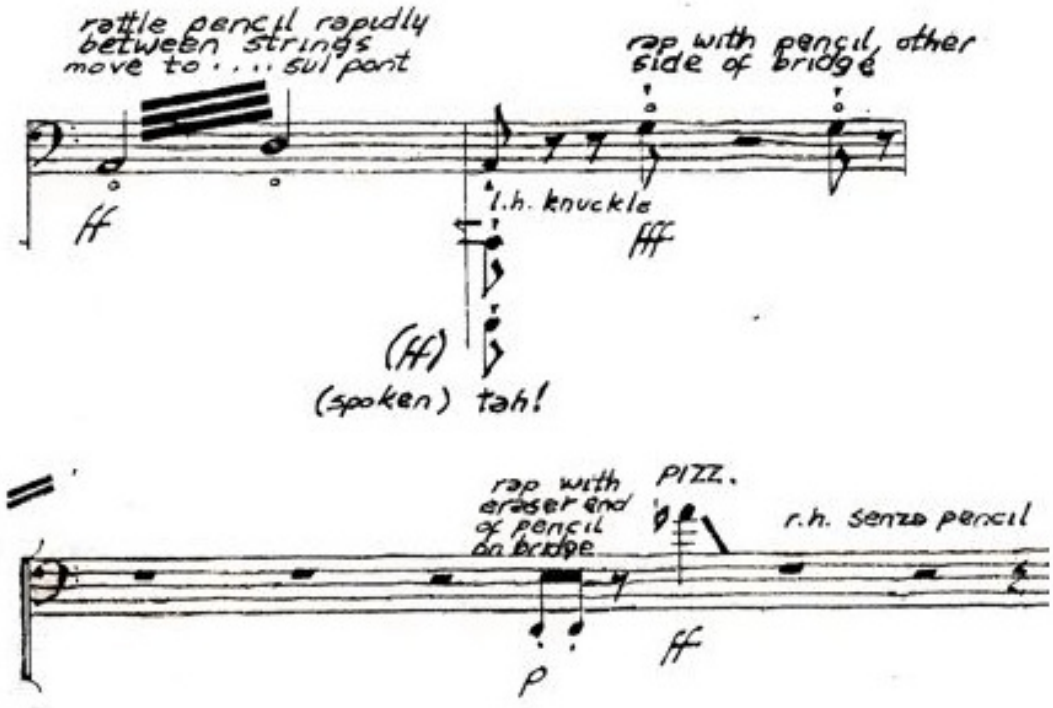


Figure IV.14: *Mr. T. His Fancy*, mvt. 2, systems 2-3.

The nature of strike tones is somewhat unorthodox. Strike tones will sound whenever a string is attacked with a hard implement, such as the bow; they are the sound produced by the direct contact of the attack and a common byproduct of *col legno battuto*. Strike tones do possess audible pitches, which are usually secondary to that of the actual string, unless it is the composer's intent to bring them to the forefront. The pitch of the strike tone is not dependent on the overall string length, i.e. where it is stopped. The pitch will rise as the striking point nears the bridge, and fall as the striking point approaches the fingerboard. Druckman calls for the above technique using the handle of the timpani stick both with and without choking the strings. When the strings are dampened, the only pitch heard is that of the strike tone, but when the strings are left open, both pitches sound simultaneously. The strike tone can also be singled out by dampening the string with the striker i.e. using a muffled attack.

The difference between Druckman's timpani stick handle and Childs' pencil is that the pencil is much thinner, so the *col legno battuto* tendencies sound comparatively weaker and the overall relative pitch is higher. When instructed to "rap with eraser end of pencil on bridge" the effect is similar to fingertips on the bridge. In the style of *col legno battuto*, nearly any implement can be used. It is common to substitute a wooden dowel for the bow in such cases, more from desire

not to damage an expensive bow then to achieve a different timbre, because it is very similar to a normal bow. In *Triplicity*, Yuasa calls for a maraca to be bounced off the strings in one of the more adventurous applications of this technique. He actually defines the technique as *col maraca batutto*.[67] True *col legno batutto* will not be discussed further, because it is more of an actual bowing technique than a percussive one.

George Crumb (b. 1929) also used the technique of attacking the strings with mallets, but not by the bassist. In *Madrigals, Book I* (1965), the vibraphonist must walk over to the bass and roll on the strings while the pitches are fingered by the bassist with the left hand:

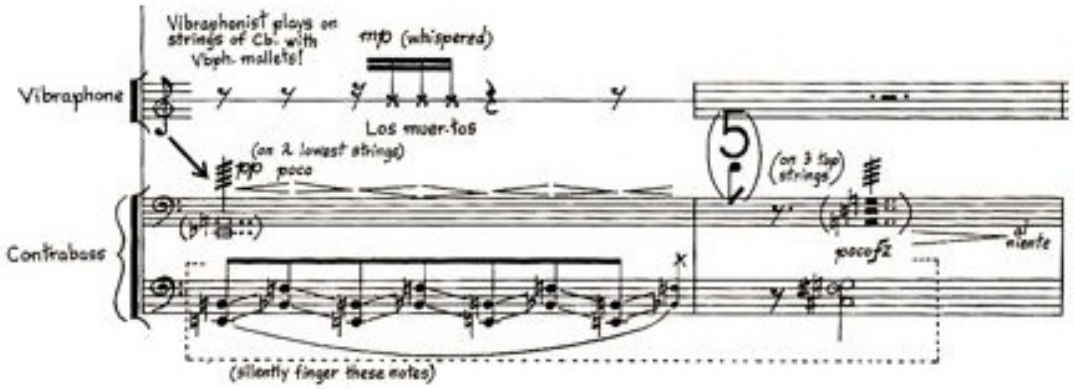


Figure IV.15: *Madrigals, Book I* (1965) by George Crumb, mvt 3 "Los Muertos Llevan Alas de Musgo [The Dead Wear Mossy Wings]," pg. 8, system 1.

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[67] Joji Yuasa, *Triplicity for Contrabass*, (Tokyo, Zen-On Music Company): 1970, Lexicon.

Crumb used this technique again in *Songs, Drones and Refrains of Death* (1971), but here the percussionist beats severely on open strings while the bassist performs additional percussive techniques:

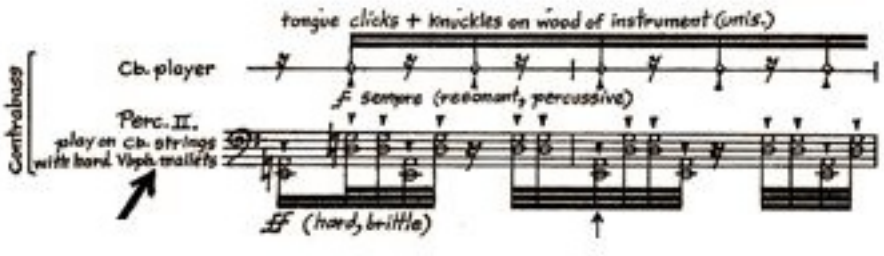

Figure IV.16: *Songs, Drones and Refrains of Death*, mvt. 3 "Cancion de Jingete, 1860 [Song of the Rider, 1860]," pg. 14, system 1.

The origin of a percussionist rolling on the strings of the bass has its roots in jazz music. In swing bands of the 1930s, it was popular for the bassist to play with a "slap" pizzicato that could clearly be heard above the whole band.[68] Of the same timbral qualities, the drum set player could leave the drum set and play with the drumsticks on the bassist's strings. Although pitches do not have great sustaining power, the technique produces a very loud and crisp attack that (on recordings) can give the aural illusion of virtuosic facility of extremely rapid slap pizzicato. At a live

[68] David Chevan, "The Double Bass as a Solo Instrument in Early Jazz," *The Black Perspective in Music,* Vol. 17, No. 1/2, (1989): 77

performance, it created quite a spectacle and was considered something of a novelty. Bob Haggart, bassist for Bob Crosby and his Bobcats, was the first to experiment with this technique with drummer Ray Bauduc.[69] It saw its recorded debut on "Big Noise from Winnetka" (1939).[70]

A technique that is not often used on the double bass, but championed on the smaller string instruments by George Crumb, is to strike the strings with thimbles affixed to the fingers. It is most distinctive as a tremolo; having a thimble affixed to each the index and middle finger and rapidly beating the string in alternation. While not the loudest technique available, a useful dynamic level can be reached on the bass when a considerable amount of force is used. Crumb's applications of the technique never occur at a dynamic level louder than *pianissimo* anyway (on amplified string instruments), and always depend on a great deal of nuance.

Finger tremolo with thimbles produces strike tones that are very prominent due to the hard metal of the thimbles. In *Black Angels* (1970) for electric string

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[69] Ibid., 82

[70] John F. Szwed and Morton Marks, "The Afro-American Transformation of European Set Dances and Dance Suites," *Dance Research Journal*, Vol. 20, No. 1 (Summer 1988): 32

quartet, Crumb takes advantage of this effect and manipulates both the pitch of the stopped string and the strike tone together.[71] His own instructions are very clear:

> Two distinct musical events will emerge: a faint echo of the Sarabanda and the high-pitched "insect-music" glissandos. Play on two strings (using open strings instead of 4th finger). The right hand (thimbles) must change strings exactly with the left hand. It is of utmost importance that the Sarabanda be clearly heard! Therefore, lift thimbles well off the strings in order not to choke the "fundamental" pitches. A very rapid tremolo with high finger action will produce the desired effect.[72]

[71] The best example of using thimbles from this period are from a piece that is not written for double bass, but the technique is directly applicable to the larger string instrument.

[72] Crumb, George. *Black Angels (Images 1)*, (New York: C. F. Peters Corporation, 1970, 1971) 9.

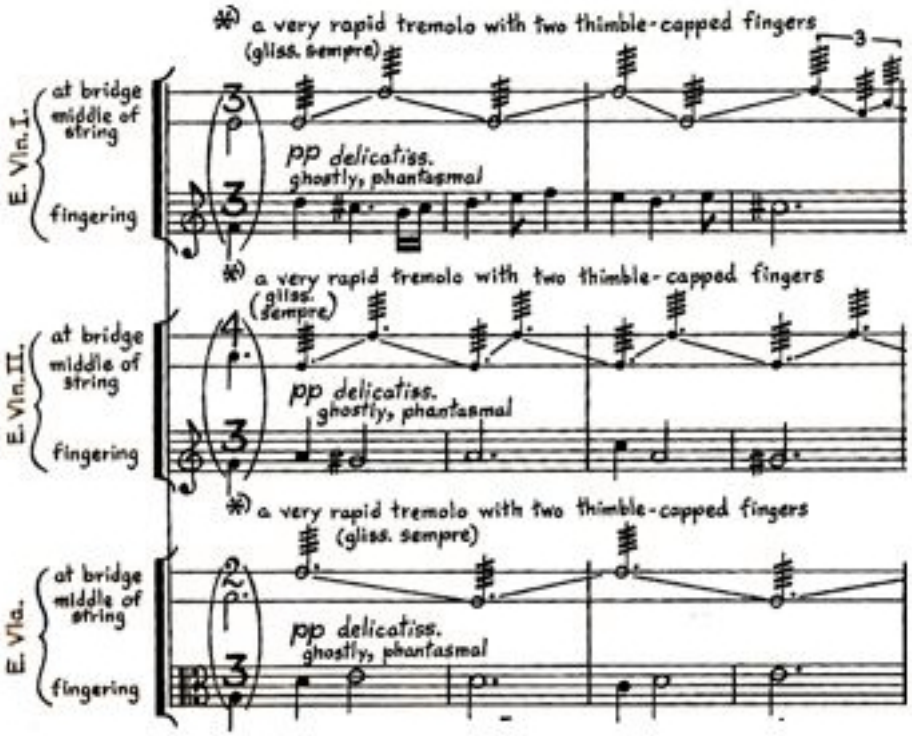

Figure IV.17: *Black Angels*, mvt. 13 "Threnody III: Night of the Electric Insects" pg. 9, system 1.

When applied to the double bass, the strike tone will sound louder than the pitch of the string. Plastic thimbles may also be used, and generally sound duller than metal ones, with less prominent strike tones.

Rubbing and Scraping

A cloth or rag can be used to facilitate rubbing sounds on the bass. On the body of the instrument, the sound is only slightly different from a soft rub using only the hands, but it is louder, which is an advantage to a generally quiet technique. It also provides a more uniform sound throughout the rub, because it is easier to control a cloth or rag on the wood; a hand can be subject to inconsistencies in friction and response. Using a cloth or rag on the strings sounds similar to using a cloth or rag elsewhere; the unique character of the strings becomes more muffled than when only using the hand. Specification of where to apply the cloth is still necessary though because enough of the metallic glissando qualities carry through the cloth to make a slight difference audible.

Using harder materials to initiate rubs should only be performed on the strings, so as not to scratch the instrument. Scraping a coin over the strings gives a quick metallic scratching sound, similar to a jacket being fastened with a zipper. This sound is also mixed with overtones of the string that is scraped. Using a coin, it is possible to scrape over two adjacent strings simultaneously nearer to the nut. Depending on the size of the coin, this effect becomes less useful nearer to the bridge where the distance between strings widens. Using a larger guitar plectrum in the same manner, a greater distance over the fingerboard can be covered using two strings, but the sound is thinner because plectrums are not as hard as coins. The

velocity of the scrape affects the pitch of the sound. A slow drag across the strings elicits a low, raspy sound. If scraped quickly enough, the sound of "scratching" on a record player can be emulated. These scraping techniques sound most colorful above the nut, in the pegbox, where the strings are taut. This area produces more clearly defined pitches that are higher than on the main part of the string, and is slightly louder as well. The same applies to rubbing the strings below the bridge, except most coins or plectrums are not large enough to activate two strings at once.

Although not previously discussed as a hand initiated technique, the fingernail can be used in the same manner and its comparison to a coin or plectrum is more relevant here. Generally, scraping the strings with the fingernails produces a much smoother sound than when using a coin or plectrum. There is not as much extraneous scratching noise than as with another implement, but overtones of the string are still clear. The fingernail loses its effect above the nut and below the bridge. The pitch and color normally associated with these areas are lessened considerably, and the resultant sound is airy and loose, more similar to a soft rub with the hand.

Body Percussion Sounds

The hands can also be used exclusively as percussive generators. Snapping or clapping is common throughout modern repertoire, including that for other

instruments. Whenever the hands are free from initiating an attack on the bass, they can be used alone in this way. In the same vein, foot stomps can be employed completely independently of whatever playing is going on involving the bass.

Vocal percussion is another useful technique that does not depend directly on the bass. Any sound that can be shaped using the performer's vocal chords or mouth is a quite successful method of providing accents or a separate percussion part altogether. "Unvoiced vocal effects" are usually considered an extended technique of vocal performance.[73] These techniques may be combined with any traditional voiced techniques or with any instrumental techniques on the double bass. Tongue clicks, lip smacks, glottal stops, etc. can all be used to this effect successfully. Deak ends *B.B. Wolf* with a comical combination of hand initiated and body percussion sounds, including a snap, stomp, and tongue click:[74]

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[73] Stone, 302.

[74] The example from *B.B. Wolf* demonstrates body percussion techniques in a linear fashion, i.e. no two elements occur at the same time. A more modern example of completely independent body percussion parts is heard in *Rhythm Studies* (2008) by the author where the performer must imitate a hi-hat with vocal percussion and keep time with foot stomps while simultaneously using hand-drumming techniques.

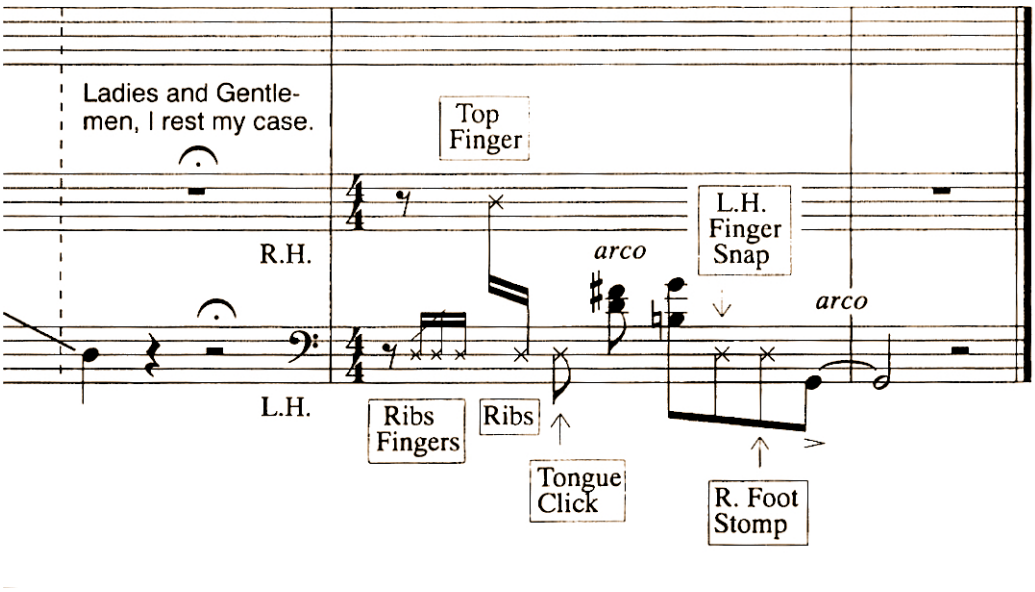

Figure IV.18: *B.B. Wolf*, mm. 137-139.

AFTERWORD

Many of the techniques catalogued in this study have already found staying power in today's repertoire for the double bass, and many, such as some of the arco and pizzicato techniques, have still commanded players to refine them to the point of expertise. Conversely, other techniques, especially many harmonic and percussive techniques remain in experimental stages and composers and performers have much work yet to do in order to bring these timbres to the mainstream. Harmonics on the double bass in particular have existed simultaneously as one of the most common, and also one of the most confusing techniques of the twentieth century.

The vast array of percussive sounds available to the double bassist remarkably only made their way into common practice by the mid-twentieth century, given a tradition of repertoire that spans several centuries. One would be hard-pressed to find examples of composers using these techniques before the 1960s, even though some of the hand-drumming methods in particular seem so logically idiomatic from today's perspective. The twenty-first century presents many more options and variations for use by the performer and composer, and hopefully, in

newly clear and concise contexts. Overall, there still remains a great deal of room for exploration and perfection of extended timbres on the double bass.

The descriptions and analyses of these techniques are the result of careful examination of the existing repertoire and my own experimentations. Some of the techniques are more common and useful than others, but each has served to extend the scope of the double bass' possibilities far beyond that of many other instruments. The double bass holds an immense amount of colors and blends on its pallet, and it is becoming increasingly evident that sounds other than *normale* acro and pizzicato occupy an important portion of the overall soundscape that can be painted.

I am very certain that composers and performers will continue to use and experiment with these techniques as pervasively as they have the past fifty years through the next fifty and beyond. It is my hope though that the performance techniques detailed in this article will not be approached as novelties or extended techniques; there is nothing "extended" about them. Whatever sound can be elicited from an instrument (without causing it harm) is a legitimate component of its aural output. Thus, it is not my intent to describe these techniques in order to inform others how to "throw it in" to their music as an afterthought or to shock audiences. Rather, I would prefer that composers continue to use these techniques to *make* their music. The most successful instances of non-traditional techniques in the repertoire are defined as so by the ability of composer and performer alike to dispel

their notions of defined and separate techniques and to embrace them all as equal components of the music

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Appendix A

HAND PERCUSSION TECHNIQUES TABLE

Technique	Attack	Resonance	Other Notes
Finger Nail	crisp, bright	negligible	tremolo performed with ease
Finger Tip	round, unpronounced	warm, low-pitched	compares to a bass drum on lower bout
Finger Slap	thin	bright	median of all percussive techniques
Palm Slap	severe, thin	bright, full	high overtones are prevalant
Cupped Palm	dull, round	bright, full	similar to palm slap with muted attack
Knock	crisp, punchy	little	attack becomes amplified in chamber
Thumb Slap	punchy	little	similar to knock with duller attack

Appendix B

ORIGINAL COMPOSITION:

RHYTHM STUDIES

Eric Daino

Rhythm Studies

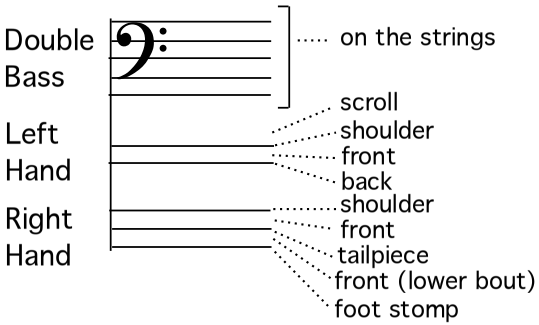
for Double Bass

Rhythm Studies is an in-depth look at rhythmic and percussive complexities from a perspective not often viewed by double bassists. Similar to playing Latin drum set, a high level of rhythmic independence is required. At times, traditional Afro-Cuban rhythms such as clave and cascara are called for in the hands, while keeping time with the feet and vocal percussion. These percussive techniques are all used to support a simultaneous melody line. A vast array of percussive timbres is also employed, which expands the double bass' sonic depth to that of a full percussion ensemble. Most importantly though, the only generators of sound are the performer and the bass. No other implement (including the bow) is called for, therefore nothing impedes the intensely personal and physical relationship the performer must have with the instrument. For performance, the bow should be left offstage, and the use of a stool is discouraged.

The systems are divided into 3 staves at most: double bass, left hand, and right hand. The staves for each hand indicate the striking point on the bass. For timbral vareity, striking points may be altered slightly according to texted instructions. "Under fingerboard" means to strike the front of the bass in the middle of the front panel, directly under the fingerboard. A migratory vocal percussion staff is also used at times. When percussive effects are employed in a linear fashion, cross-staff beaming is used to show phrasing. When percussive effects are used independently as in drum set performance, each staff has independent rhythms and rests to facilitate reading and accentuate their distinction. Dynamics apply to all staves unless otherwise indicated.

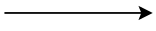
Lyrics are half-sung, with an easy flow, but with clearly defined pitches. All lyrics are in Spanish.

A box around a figure indicates a repeat. The number of repeats will be indicated in the box. The first section of the piece does not use meter. This section, from the beginning until the introduction of the first time signature, is to be played freely with visual duration symbols to be used as a guide. The approximate length of the unmetered section is 2:00. Total duration should last 8:30 - 9:00.



hold note for indicated duration, visual length is to be used as a guide

repeat figure in box indicated number of times



gradually change position of striking point as indicated

Percussive Attacks:


finger nail


finger tip


finger slap with pad

palm slap


knock with knuckle


cupped hand


pound with fist


soft rub


hard rub producing screech


non-bass produced sound, i.e. foot stomps or vocal percussion


open tone – with heel of hand on edge of shoulder, strike front of bass with finger pads to produce loud pop

Other Symbols:


mute or choke string so pitch does not sound

snap pizzicato


with thumb (see below)


touch harmonic node with thumb and left hand pizz.

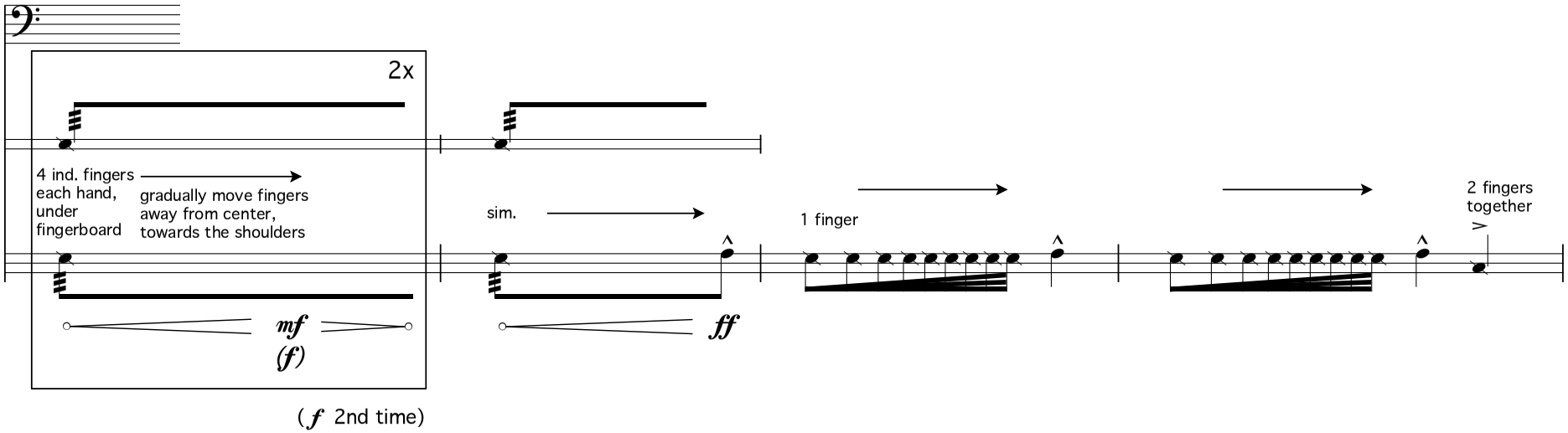

knock with knuckle of thumb

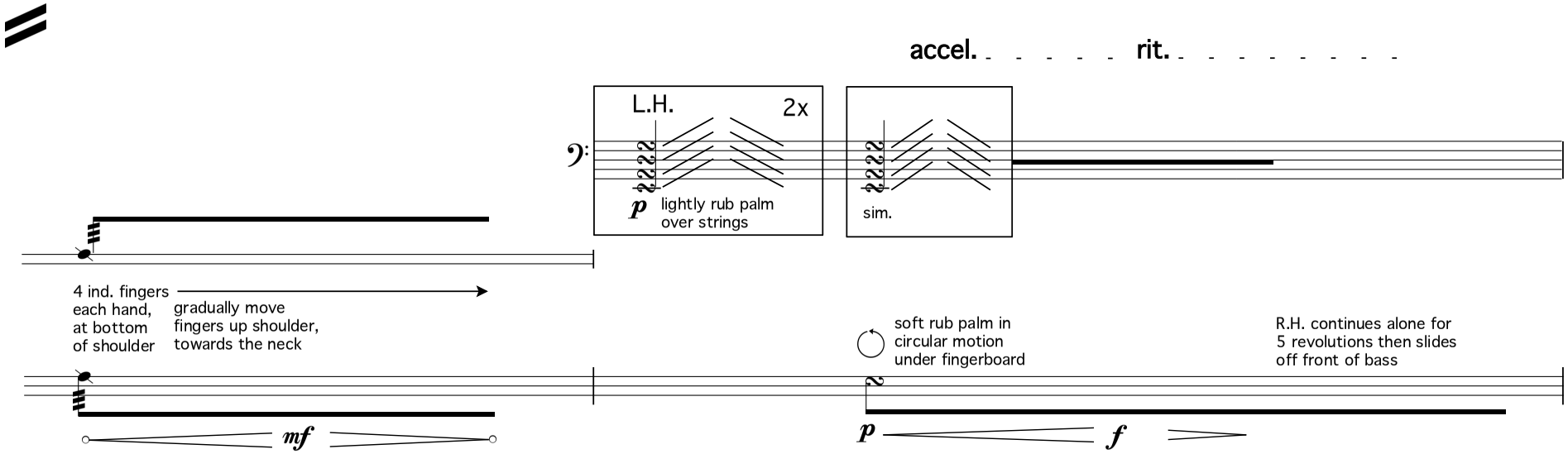

hold for indicated number of seconds

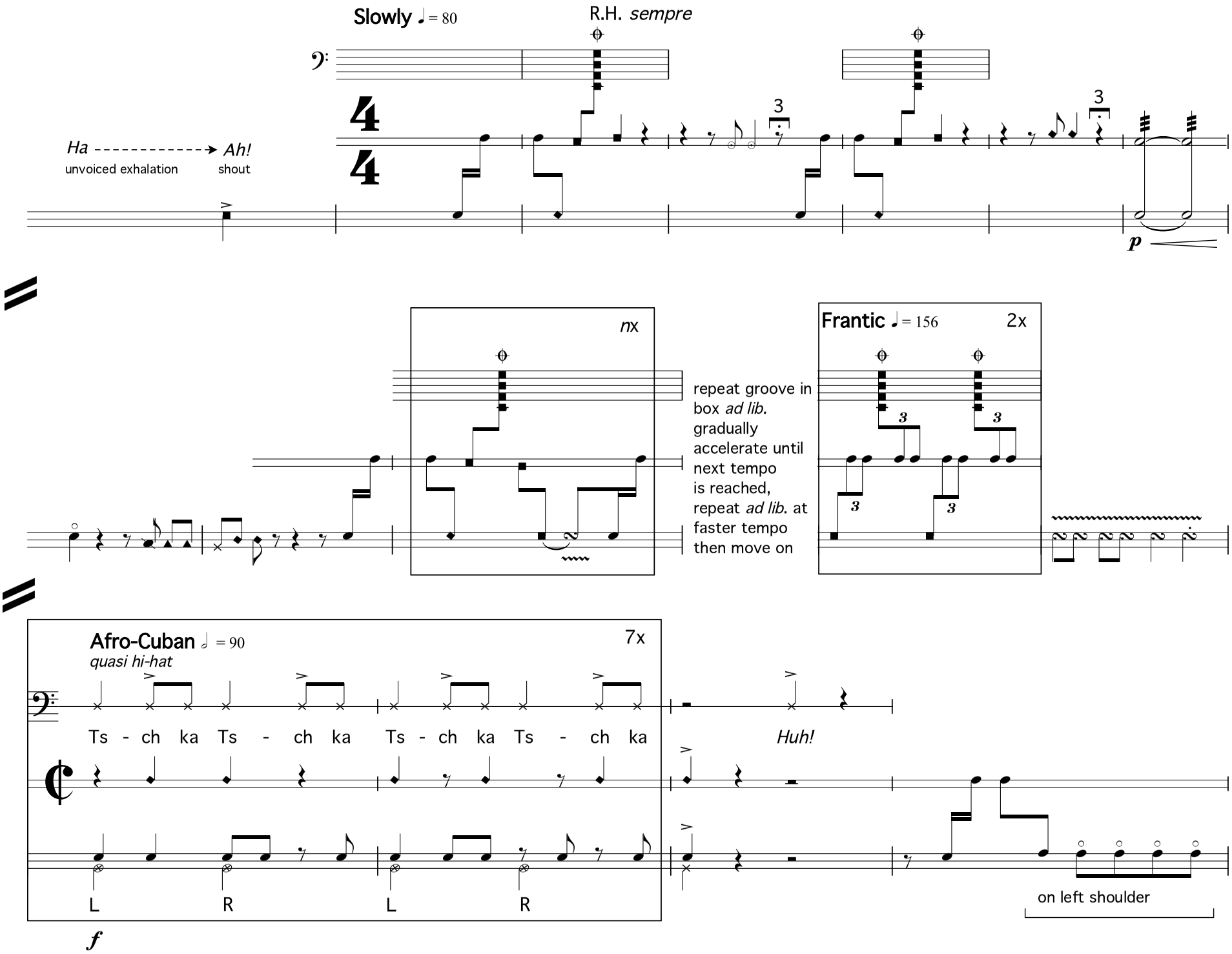

gradual change from metered repitition of a note to tremolo

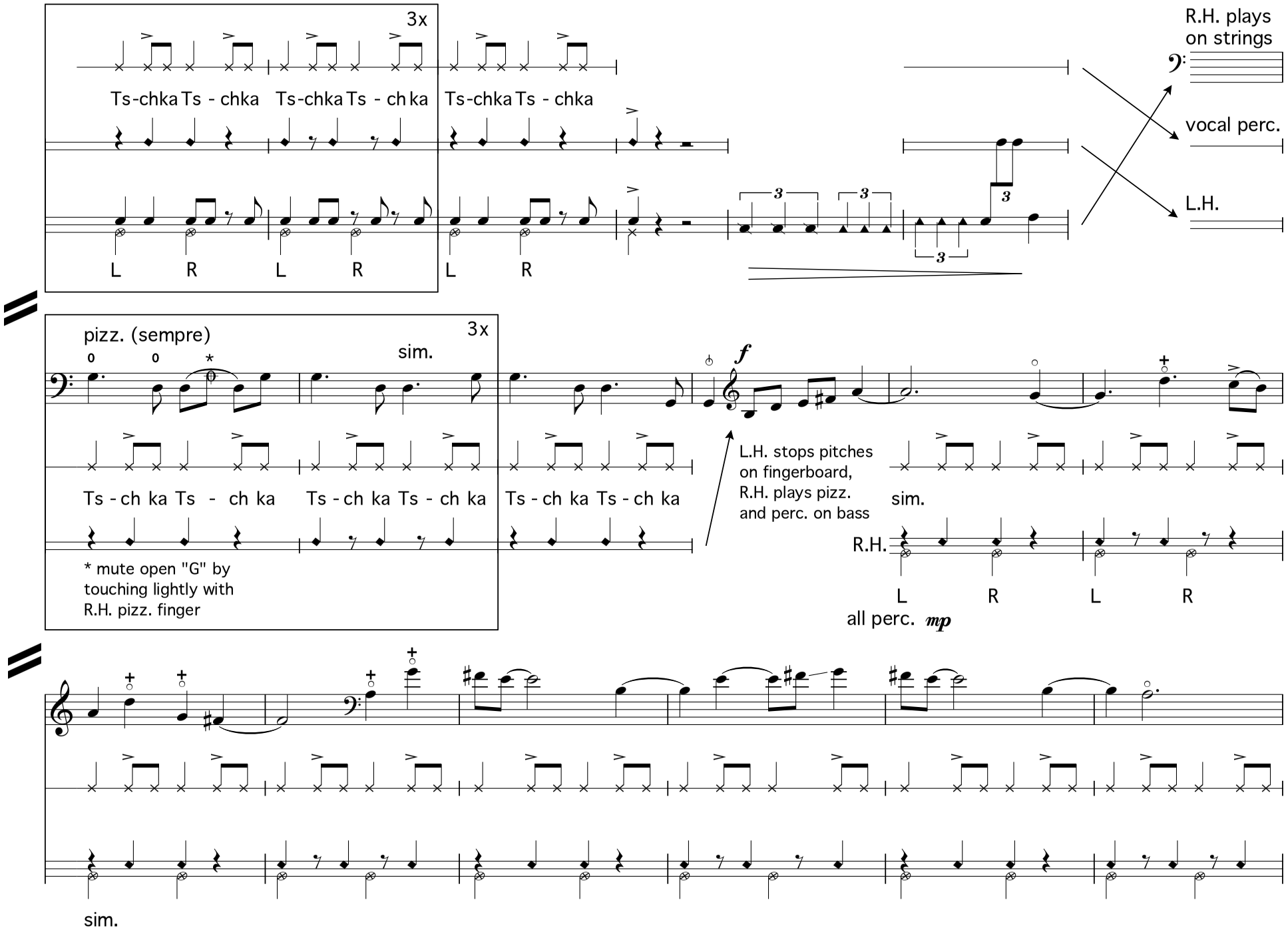
Rhythm Studies

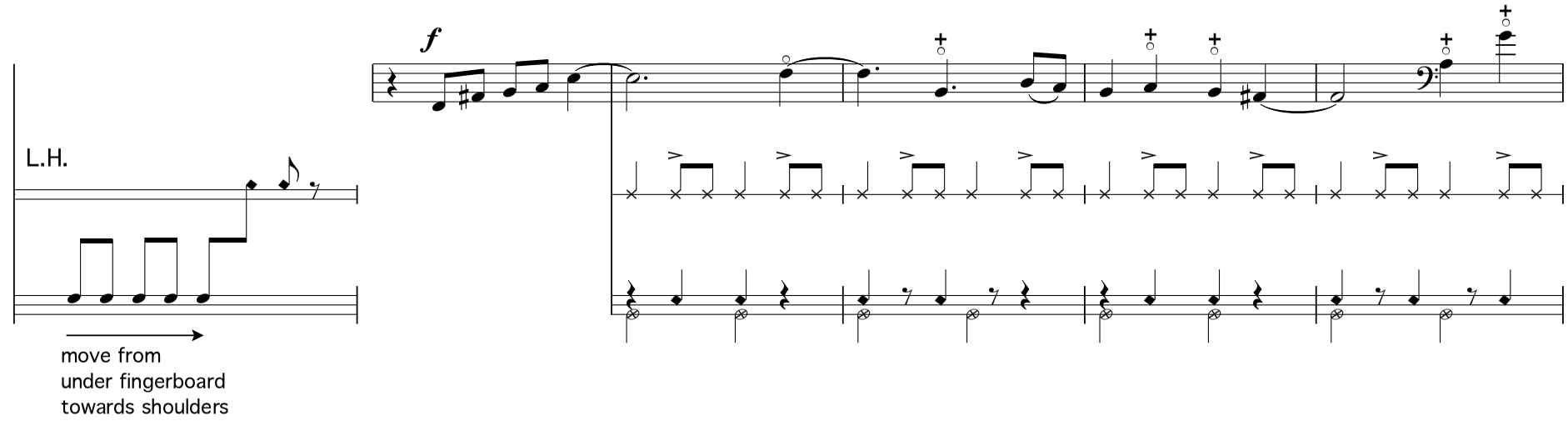
Eric Daino (b. 1988)
(Newark, DE – Jul. 2008)

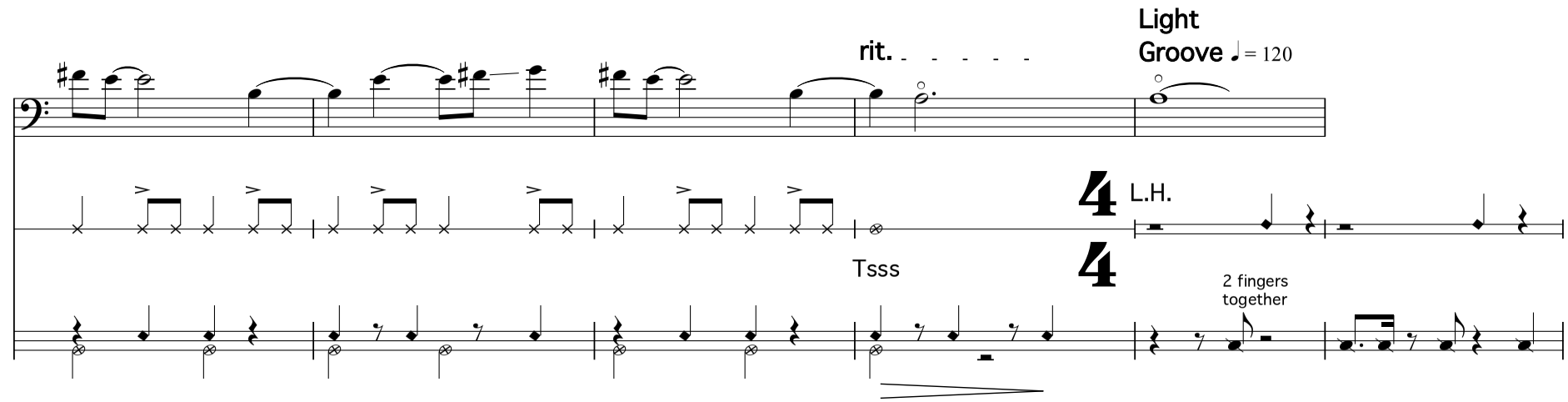


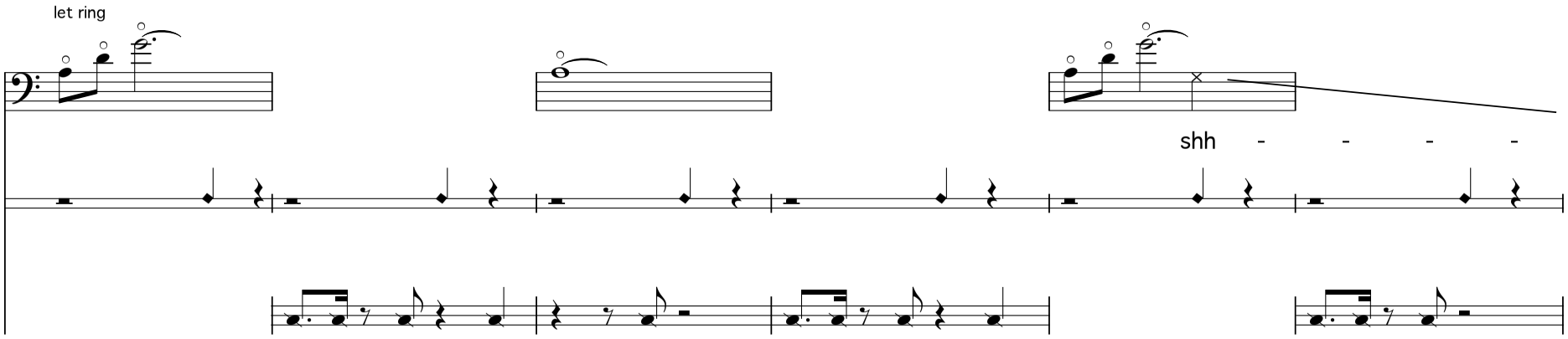


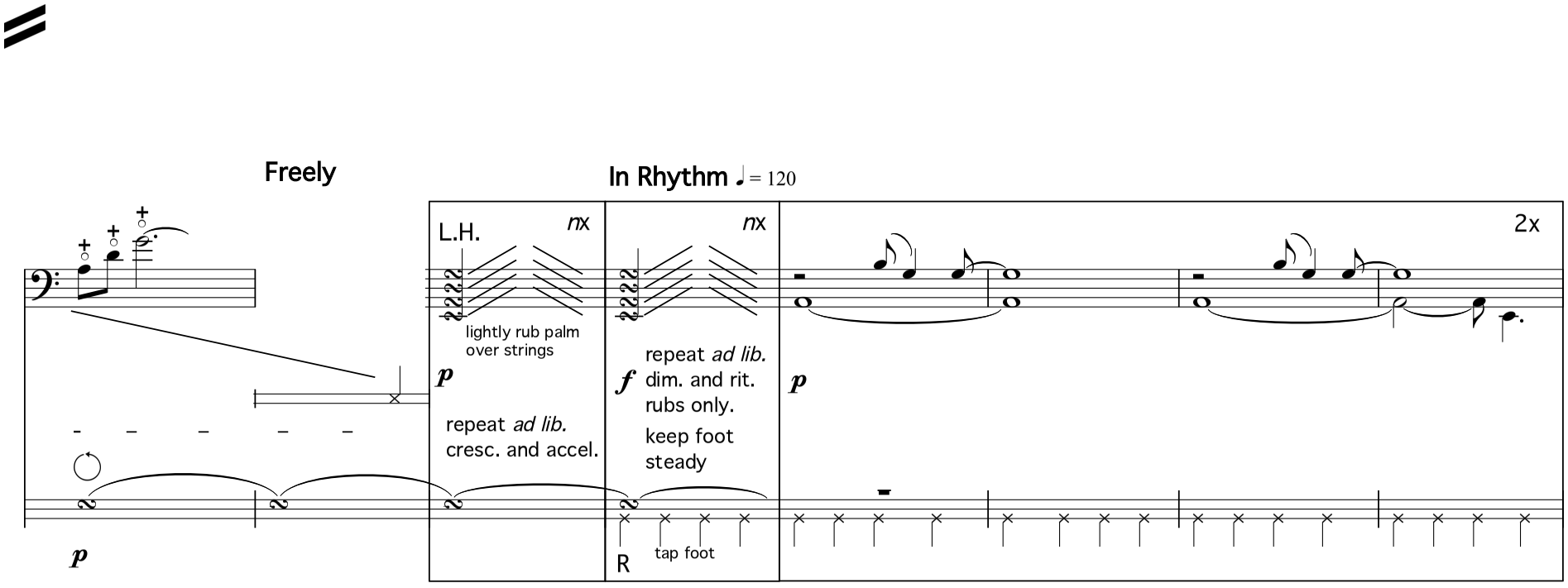

Slowly ♩= 80
R.H. sempre
Ha
unvoiced exhalation
Ah!
shout
3
3
p
nx
repeat groove in box ad lib. gradually accelerate until next tempo is reached, repeat ad lib. at faster tempo then move on
Frantic ♩= 156
2x
3
3
3
3
Afro-Cuban ♩ = 90
quasi hi-fat
7x
Ts - ch ka Ts - ch ka Ts - ch ka Ts - ch ka
Huh!
L R L R
on left shoulder
f

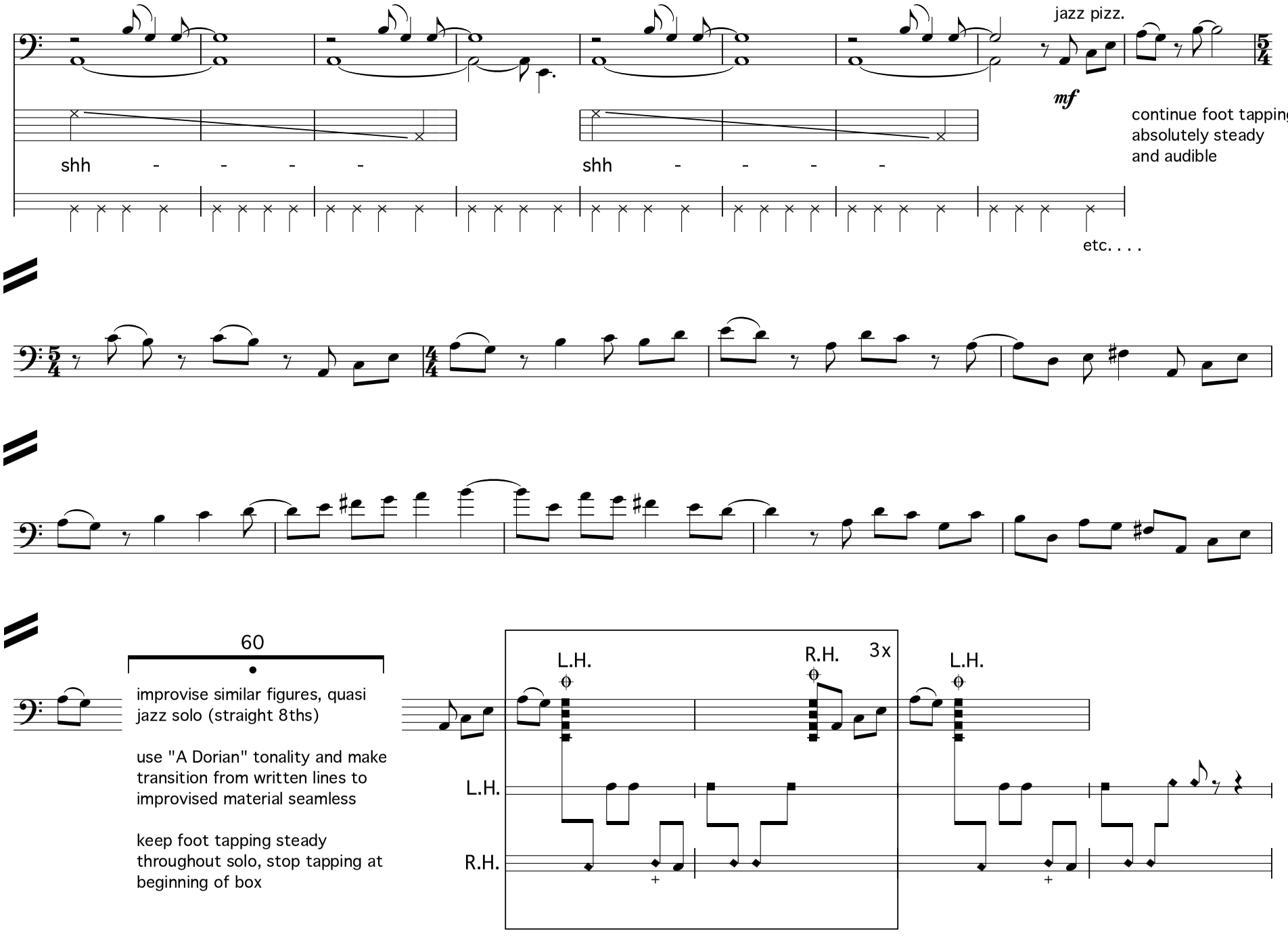

3x
Ts-chka Ts - chka Ts-chka Ts - ch ka Ts-chka Ts - chka
L R L R L R
R.H. plays on strings
vocal perc.
L.H.
pizz. (sempre)
3x
sim.
Ts - ch ka Ts - ch ka Ts - ch ka Ts - ch ka Ts - ch ka Ts - ch ka
* mute open "G" by touching lightly with R.H. pizz. finger
L.H. stops pitches on fingerboard, R.H. plays pizz. and perc. on bass
sim.
R.H.
L R L R
all perc. mp
sim.

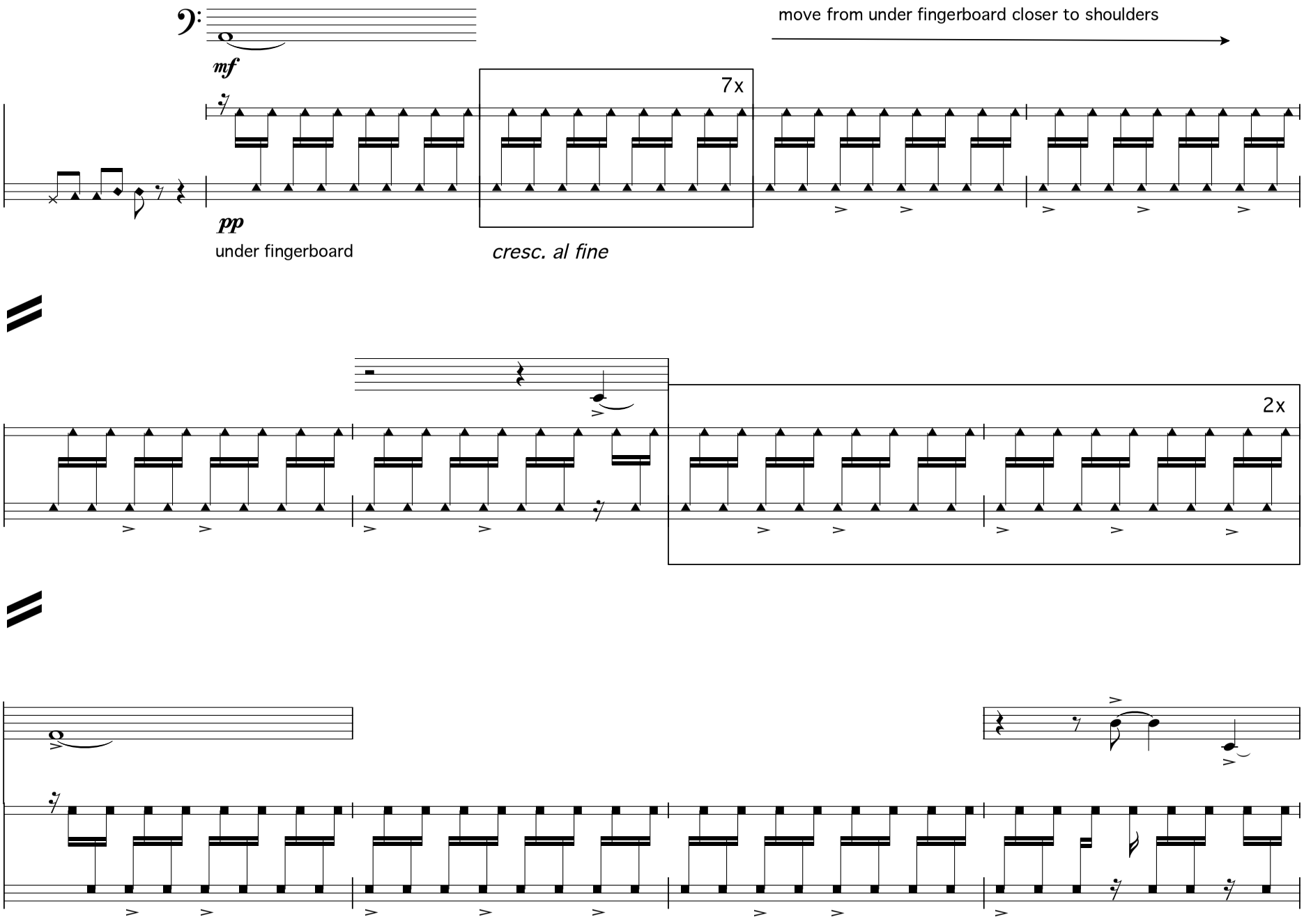

f
L.H.
move from
under fingerboard
towards shoulders

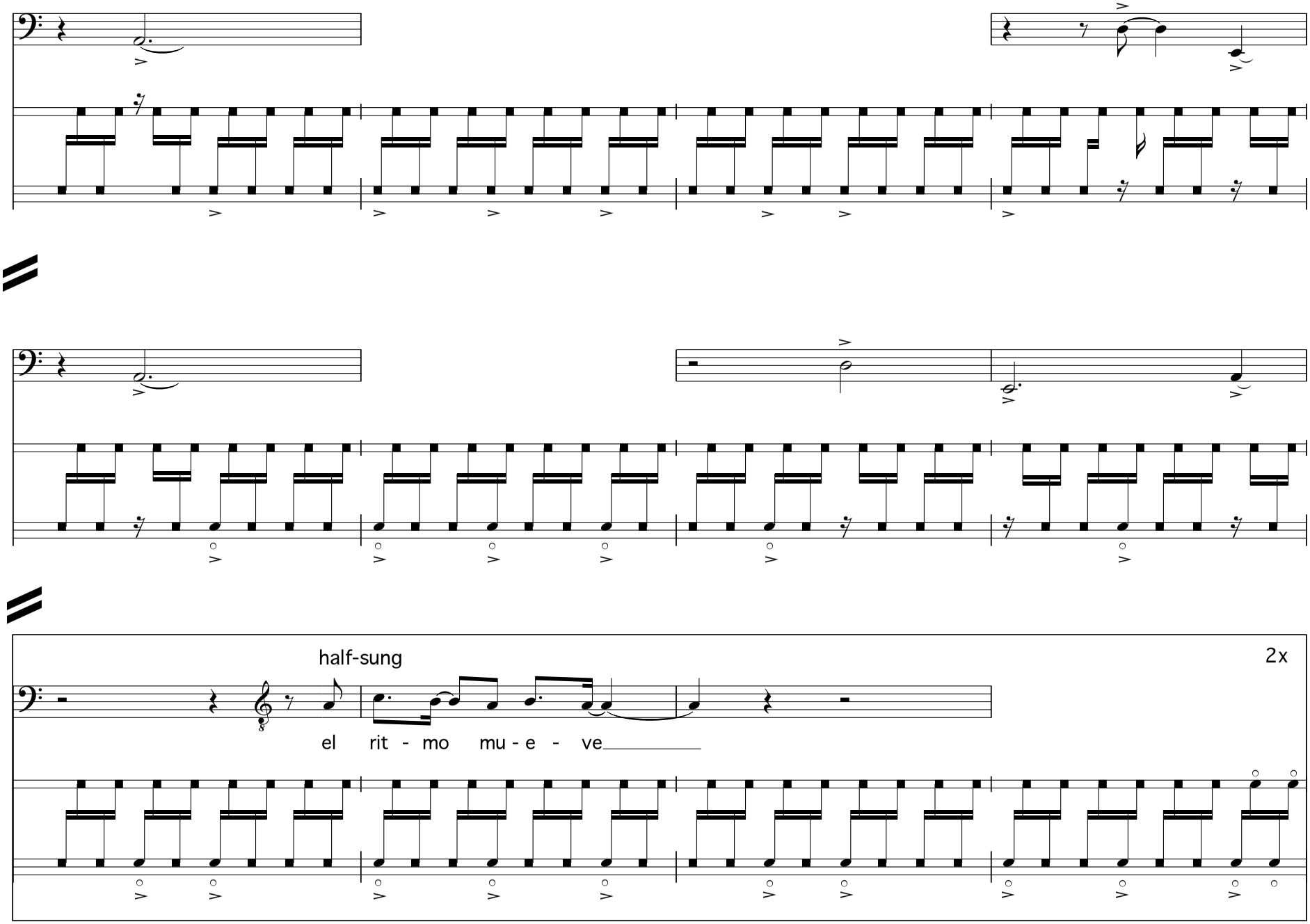

rit.
Light
Groove
= 120
L.H.
Tsss
2 fingers
together

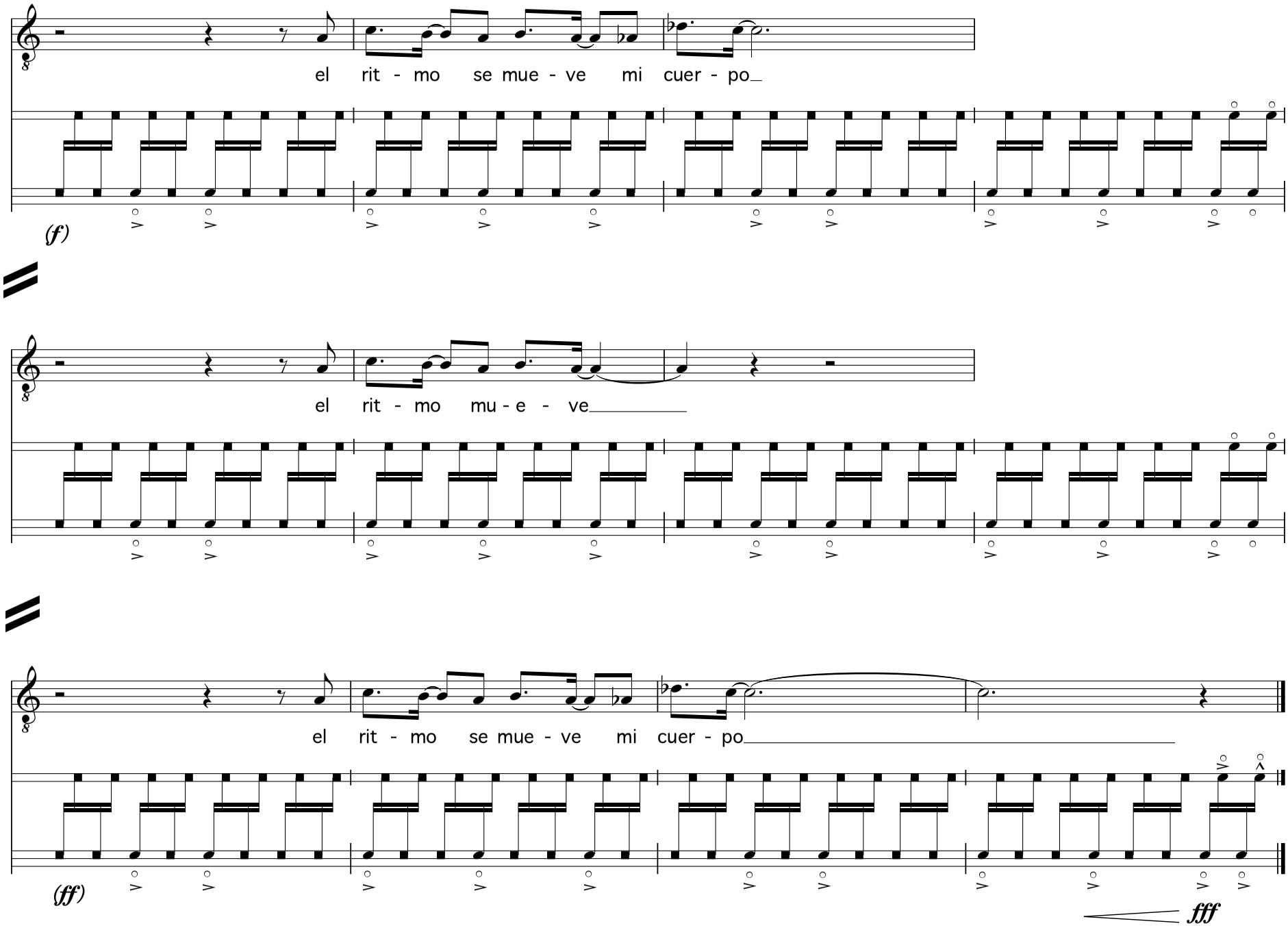

let ring
shh - - - -


Freely
In Rhythm ♩= 120
L.H.
nx
nx
2x
lightly rub palm
over strings
p
repeat ad lib.
cresc. and accel.
f
repeat ad lib.
dim. and rit.
rubs only.
keep foot
steady
p
p
R
tap foot


jazz pizz.
mf
continue foot tapping,
absolutely steady
and audible
shh - - - -
shh - - - -
etc. . . .
60
improvise similar figures, quasi
jazz solo (straight 8ths)
use "A Dorian" tonality and make
transition from written lines to
improvised material seamless
keep foot tapping steady
throughout solo, stop tapping at
beginning of box
L.H.
R.H.
3x
L.H.
L.H.
R.H.


mf
pp
under fingerboard
7x
cresc. al fine
move from under fingerboard closer to shoulders
2x


half-sung
2x
el rit - mo mu - e - ve


el rit - mo se mue - ve mi cuer - po
(f)
el rit - mo mu - e - ve
el rit - mo se mue - ve mi cuer - po
(ff)
fff

Appendix C

ORIGINAL COMPOSITION:

SAND WALK

Eric Daino

Sand Walk

for Baritone Voice
and Violoncello

The cellist must have a soft cloth or rag to rub on
the body of the cello.

A note on cello subharmonics: with proper technique, it is possible to produce "pedal tones," or pitches an octave below the fundamental stopped pitch. The key element in subharmonic production on string instruments is very specific bow control. Overpressure must be focused into a definite and audible pitch by maintaining a consistent pressure level throughout the draw of the bow, as well as maintaining proper bow registration. Usually, placing the bow on a node of the harmonic series will aid the production of subharmonics; the sixth partial works well. It may also be beneficial on the cello to use slightly less left hand pressure than usual to stop pitches. These are here notated with square noteheads. For more information on subharmonics, refer to the work of violinist Mari Kimura.

Time is generally free, use visual indications of duration to coordinate cues between both performers when no specific time scale is provided. When Baritone pitches are not notated with a bass clef staff, specific pitches are not important, rather pitches should be relative to a middle registration.

-Eric Daino
Newark, DE
10/17/2009

I'm walking on the sand
staring at
what surrounds
staring at me
sitting comfortably
floating stationary.

I walk
for ages
tensing up
developing a sharp
forward arch
in my shoulders

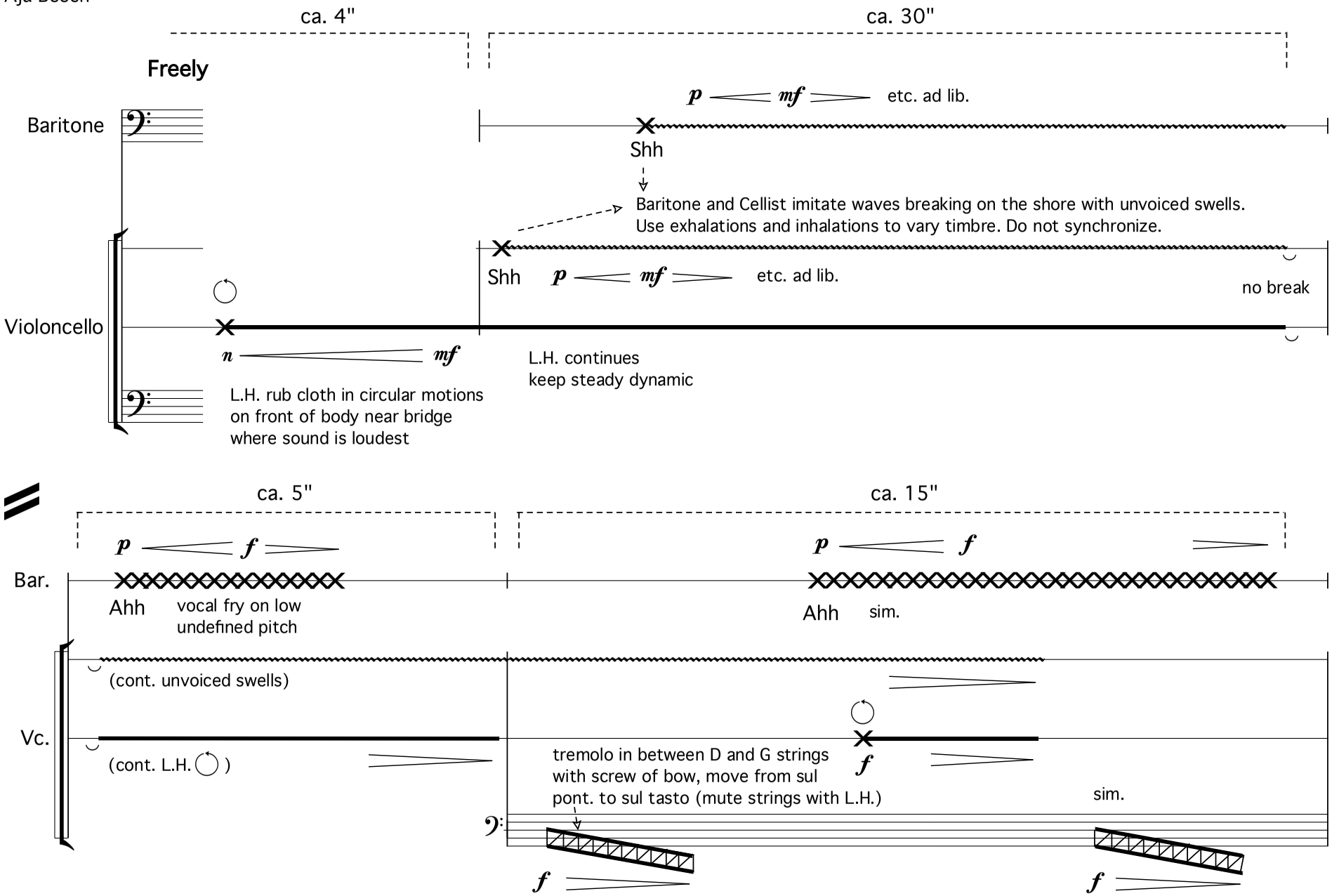
peering at each grain
of sand
wondering how
it supports itself enough
to hold me.

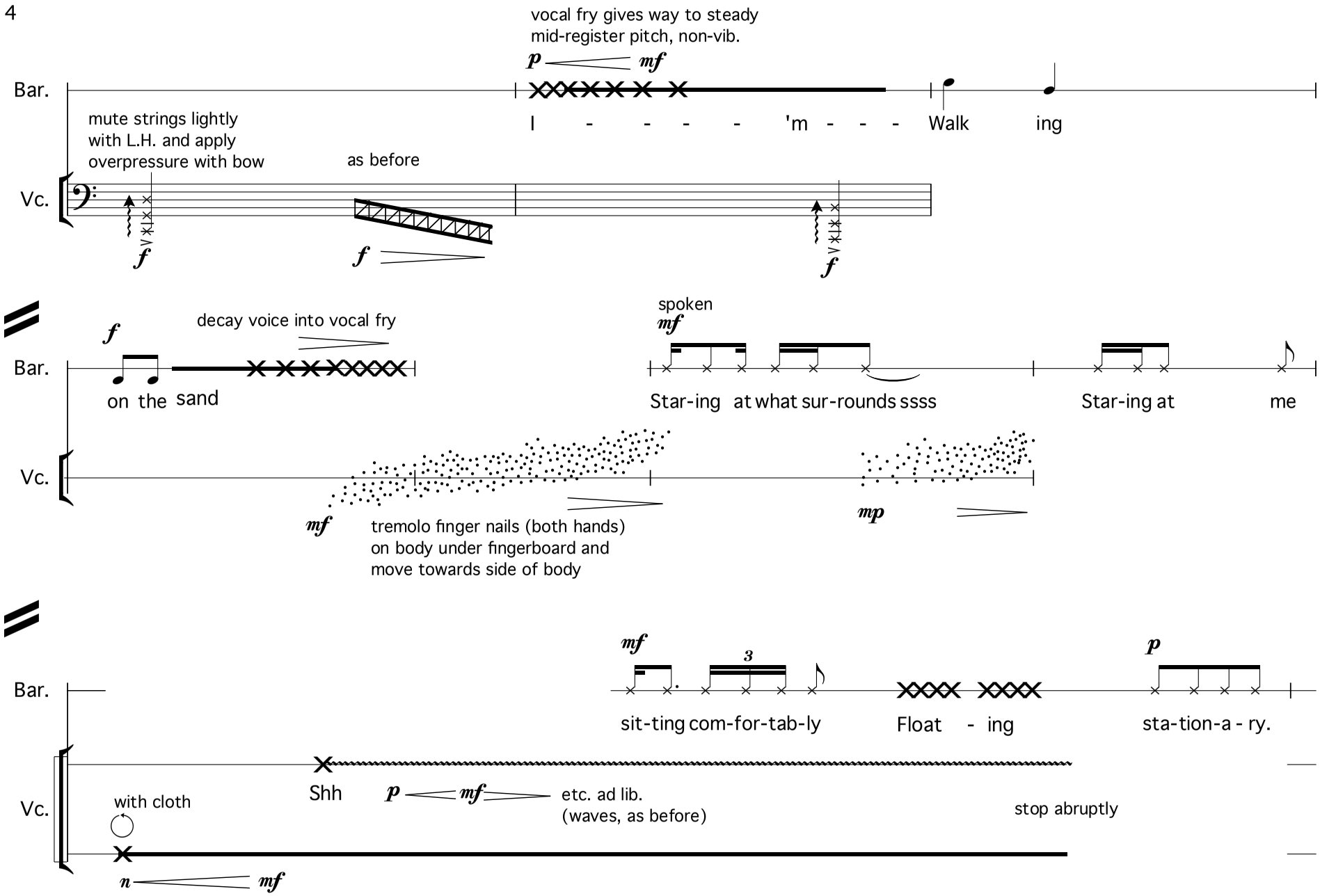
By Aja Beech

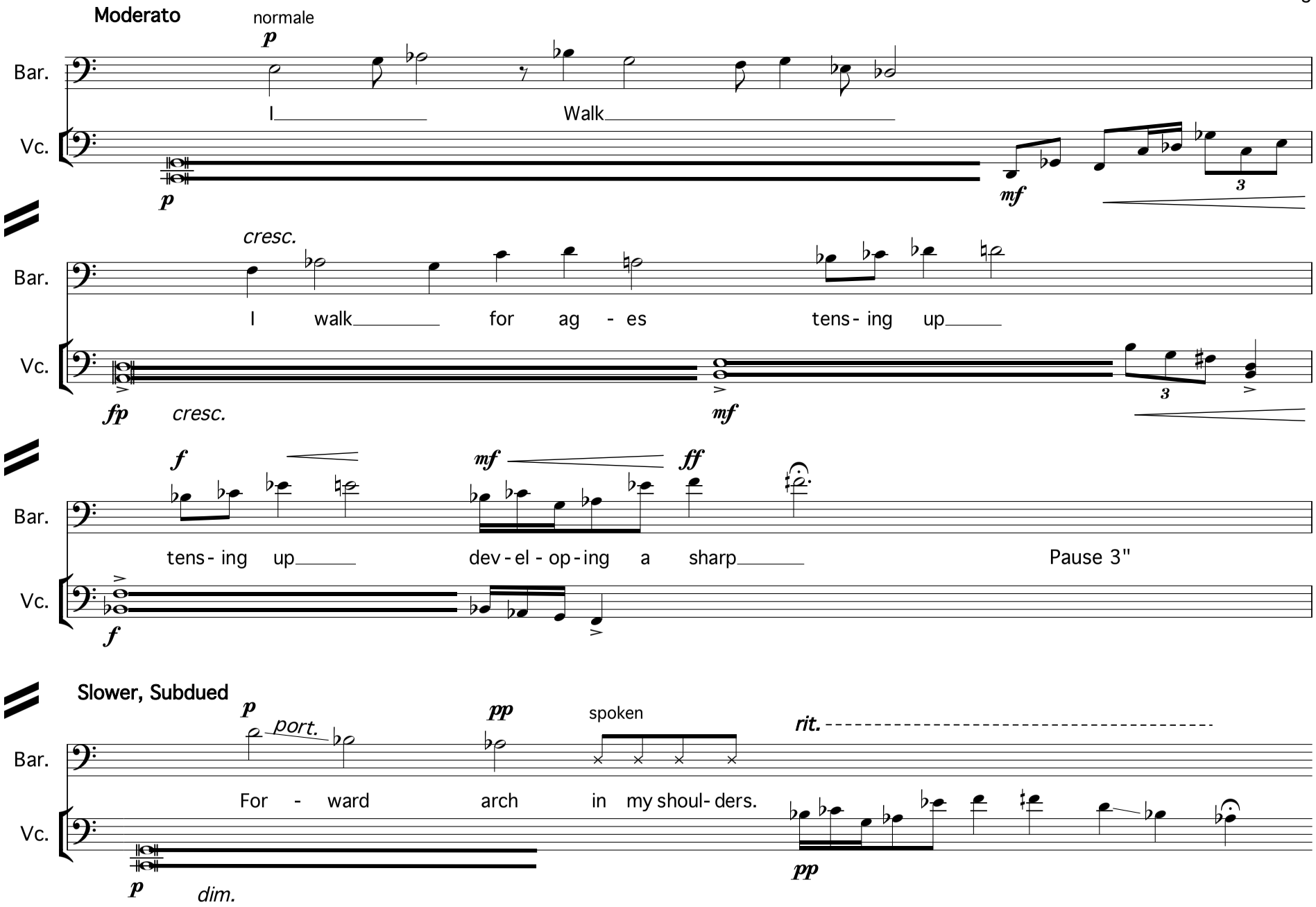
Sand Walk

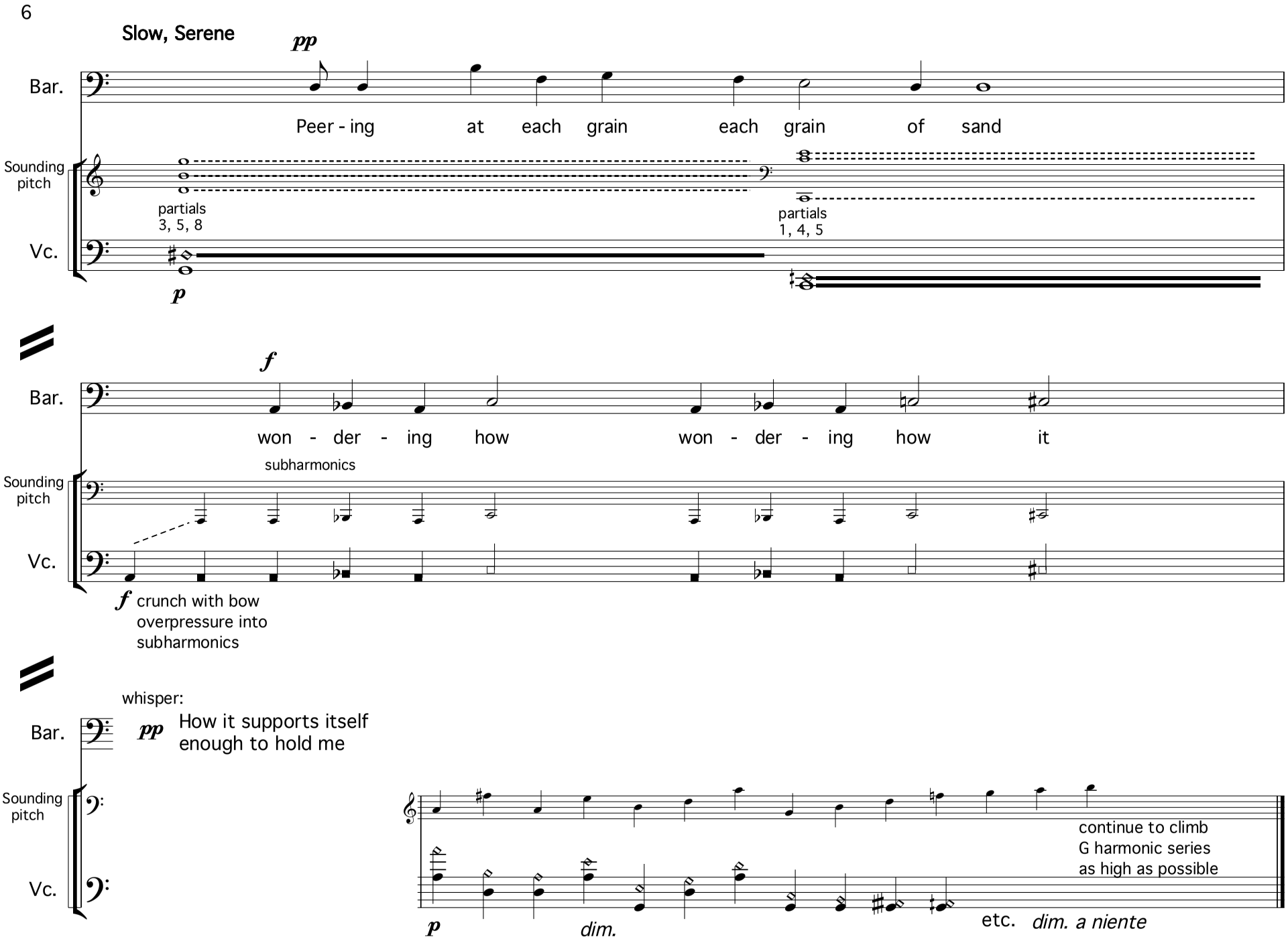
Eric Daino
(b. 1988)

Aja Beech




vocal fry gives way to steady
mid-register pitch, non-vib.
p
mf
Bar.
I - - - - 'm - - - Walk ing
mute strings lightly
with L.H. and apply
overpressure with bow
as before
Vc.
f
f
f
f
decay voice into vocal fry
spoken
mf
Bar.
on the sand
Star-ing at what sur-rounds ssss
Star-ing at me
Vc.
mf
tremolo finger nails (both hands)
on body under fingerboard and
move towards side of body
mp
mf
3
p
Bar.
sit-ting com-for-tab-ly
Float - ing
sta-tion-a - ry.
Shh
p
mf
etc. ad lib.
(waves, as before)
stop abruptly
Vc.
with cloth
n
mf


Moderato
normale
Bar.
Vc.
I Walk
cresc.
I walk for ag - es tens - ing up
tens - ing up dev - el - op - ing a sharp
Pause 3"
Slower, Subdued
port.
spoken
rit.
For - ward arch in my shoul - ders.
dim.


Slow, Serene
pp
Bar.
Peer - ing at each grain each grain of sand
Sounding pitch
partials 3, 5, 8
partials 1, 4, 5
Vc.
p
f
Bar.
won - der - ing how won - der - ing how it
subharmonics
Sounding pitch
Vc.
f crunch with bow overpressure into subharmonics
whisper:
Bar.
pp How it supports itself enough to hold me
Sounding pitch
Vc.
continue to climb G harmonic series as high as possible
p
dim.
etc. dim. a niente