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Ululations and Gurgles of the Invisible

A dissertation submitted in partial satisfaction of the
requirements for the degree
Doctor of Philosophy

in

Music

by

Elisabet Curbelo Gonzalez

Committee in charge:

Roger Reynolds, Chair
Tom Erbe
Susan Narucki
Yolande Snaith
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2018

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The dissertation of Elisabet Curbelo Gonzalez is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California San Diego

2018

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LIST OF SUPPLEMENTAL FILES

Videos for Ululations and Gurgles of the Invisible designed by John Burnett and Maya VanderSchuit:

Gurgles1.mov

Gurgles2.mov

Gurgles3.mov

Gurgles4.mov

TheRing.mov

Audio Files for Gurgles recorded and processed by Elisabet Curbelo:

Drops.wav

Water.wav

Bubbles.wav

Bvoice.wav

Video of the premiere of Ululations and Gurgles of the Invisible:

Ululations.mov

Video of ASL for Betrothal interpreted by Angelo C. I. Ricasata:

Pianist1.mp4

Pianist2.mp4

Soprano1.mp4

Soprano2.mp4

Soprano3.mp4

Soprano4.mp4

Video of the premiere of L'anello by Steven Schick and Renga Ensemble:

Lanello.mov

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The Supplemental Files ”Videos for Ululations and Gurgles of the Invisible” contain material created in collaboration with John Burnett and Maya VanderSchuit. Also the Supplemental Files ”Video of ASL for Betrothal” contain the Americam Sign Language interpretation of Federico García Lorca’s poem ”Bethrotal” by Angelo C. I. Ricasata.

Finally I would like to thank my family for their unconditional love and support from the distance and my friends for their patience, help and support during this six years I have stayed in San Diego.

VITA

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ABSTRACT OF THE DISSERTATION

Ululations and Gurgles of the Invisible

by

Elisabet Curbelo Gonzalez

Doctor of Philosophy in Music

University of California San Diego, 2018

Roger Reynolds, Chair

Ululations and Gurgles of the Invisible is an interdisciplinary piece where visual and auditory experience is connected not only by their content but also through the use of different types of wearable sensors.

It is an hour-long piece divided in the four parts presented below. It is based on the poems *El niño mudo* (The Silent Boy) and *Desposorio* (Betrothal) by Federico García Lorca. The poems not only help to build the narrative of the piece, it is also performed using American and Spanish Sign Language.

1. The Silent Boy, for percussion, ASL and lights.
2. Gurgles, for 5 dancers wearing sensors, ASL, LSE, video and lights.

3. Betrothal, for soprano, piano and ASL.

4. The ring, for soprano, piano, percussion, dancers wearing sensors, ASL, video and lights.

The gestural control of sound has existed since the use of the first music instruments. All music instruments need the gesture of the performer to sound. These gestures consist of a performer in contact with physical materials that produce sound. Nevertheless, in group performances, the conductor's collection of gestures don't enter contact with physical materials but control the sound others produce, free-space gestures.

My research interest is focused on free-space gestures as it can encompass disciplines as dance and sign language and make them exist as musical expressions. In this piece the dancers are also music performers.

Introduction

Ululations and Gurgles of the Invisible is an interdisciplinary piece where visual and auditory experiences are connected not only by their content but also through the use of wearable controllers containing different types of sensors.

The gestural control of sound has existed since the use of the first music instruments. All music instruments need the gesture of the performer in order to sound. These gestures consist of a performer in contact with physical materials that produce sound. Nevertheless, in-group performances, the conductor's collection of gestures don't enter into contact with physical materials but control the sound others produce: free-space gestures.

My research interest is focused on free-space gestures as they can encompass disciplines such as dance and sign language, and make them exist as musical expressions. In this piece the dancers are also music performers and the music performers use sign language to convey a message while performing their instrument or singing. In addition, the singer is not the only performer whose role is to carry the text as usually happens in vocal music. Instead, the pianist, soprano, percussionist and one of the dancers all perform the text using sign language.

Below is a list of roles and what they perform:

The Silent Boy	Percussion and American Sign Language
The Guiding Voice	Dance, American and Spanish Sign Language
The Luminous Voice	Dance and Lights
The High Voice	Dance and Electronics
The Middle Voice	Dance and Electronics
The Low voice	Dance and Electronics
The Shadow	Piano and American Sign Language
The Queen of the Crickets	Voice and American Sign Language

Figure 0.1: Performers' Roles.

The title of the piece was conceived in Spanish as *Albórbolas y Gorgoteos del Trasmundo*. It is based on the poems *El niño mudo* ("The Silent Boy") and *Desposorio* ("Betrothal") by Federico García Lorca (1898-1936). The poems helped to build the narrative of the piece and they are also performed using American and Spanish Sign Language. It is an hour-long piece divided in the four parts presented below.

1. The Silent Boy, for percussion, ASL and lights.
2. Gurgles, for 5 dancers wearing sensors, ASL, LSE, video and lights.
3. Betrothal, for soprano, piano and ASL.
4. The ring, for soprano, piano, percussion, dancers wearing sensors, ASL, video and lights.

The first two pieces use the poem "The Silent Boy" while the last two pieces are based on the poem "Betrothal". These two poems are part of *Canciones de Trasmundo* (Songs of the Secret World) written in 1927 by Federico García Lorca.

The first time I read "The Silent Boy" was when I was a child. I then forgot about it until encountering it again when analyzing *Ancient Voices of Children* by George Crumb. In 2017, while conceiving my dissertation piece, I started looking for a short poem by a Spanish author to be performed using sign language in an imaginary underwater world. The first poem that caught my eyes on that search was "The Silent Boy"; it was definitely the poem I was looking for.

While analyzing the poem, I composed the piece *L'anello* for large ensemble and conductor/percussionist which was commissioned by Steven Schick for the Renga Ensemble and premiered on April 25th 2018 in San Diego. The piece (see Appendix C) is based on the ring that appears in the poem "The Silent Boy".

Later I composed "Gorgoteo" (Gurgles) for five dancers with wearable controllers, electronics, lights, piano, video and sign language (ASL and LSE). This piece was premiered on June 15th 2018 in the IDEAS Performance Series in San Diego (see Appendix B). The data from the wearable sensors was translated into parameters that process and trigger electronic sounds and lighting in different ways throughout the piece. In addition, a new biosensor developed with a grant from a Chancellor's Interdisciplinary Fellowship controlled the form of the piece, triggering its four sections by means of detecting the exertion level of one of the dancers. The piece is based on the poem "The Silent Boy" that was performed using American and Spanish Sign Language on video and also live by one of the dancers.

After some time working on the first poem and having decided the structure of my dissertation piece - four sections based on two different poems that were related by their main elements - I started searching for a second poem. I went through the full work of Federico García Lorca looking for a short poem containing the largest number of key words. The key words I searched for were: silence, ring, droplet, cricket and water. The only poem I found that matched the most of these characteristics was "Betrothal", which is also part of the same cycle. In addition, the theme of the poem immediately appealed to me, as I was going through a divorce and my initial plan of setting this poem for a soprano and piano piece now completely made sense. I saw myself represented in the role of the soprano.

The Silent Boy

The little boy was looking for his voice.
(The king of the crickets had it.)
In a drop of water
the little boy was looking for his voice.

I do not want it to speak with;
I will make a ring of it
so that he may wear my silence
on his little finger.

In a drop of water
the little boy was looking for his voice.

(The captive voice, far away,
put on a crickets clothes.)

El Niño Mudo

El niño busca su voz.
(La tena el rey de los grillos.)
En una gota de agua
buscaba su voz el niño.

No la quiero para hablar;
me haé con ella un anillo
que llevará mi silencio
en su dedo pequeñito.

En una gota de agua
buscaba su voz el niño.

(La voz cautiva, a lo lejos,
se ponía un traje de grillo.

Bethrotal

Throw that ring
into the water.
(The shadow places its fingers
on my back.)

Throw that ring. I am
more than a hundred years old. Silence!

Don't ask me anything!

Throw that ring
into the water.

Desposorio

Tirad ese anillo
al agua.
(La sombra apoya sus dedos
sobre mi espalda.)

Tirad ese anillo. Tengo
ms de cien años. Silencio!

No preguntadme nada!

Tirad ese anillo
al agua.

When analyzing the first poem, I classified its words by their function and semantic significance. In "The Silent Boy", those words, by order of appearance, are: voice, cricket, droplet/drop of water, ring and silence.

Three of these words also appear as key words on the second poem: ring, water, silence.

The identification of these words and the research done to understand the meaning they had for Federico García Lorca helped me create a complementary narrative. This new storyline

connects the two poems under my personal take on the topics presented by Lorca. In other words, I utilize the issues of the *trasmundo* (secret world) that Lorca codifies in these poems to create a companion narrative of *my* secret world.

In this companion narrative I include the role of Queen of the Crickets; elements such as bubbles, gurgles, ululations and the use sign language as a way of successfully communicating in an underwater environment to convey a message that only a few can understand.

One of the issues of Lorca's secret world that appears in both poems as Quance reveals, "a dissenting stance with respect to heterosexuality and the traditional aims of marriage and children". [Qua10] She affirms this motivates poems which have to do with an unborn child or a wedding that will never take place." We could see the silent boy as that unborn child or because Andalusians call everybody a boy, Lorca might refer to his adult self as a boy. As Binding states, "The Voiceless Child, constitutes a presentation of Lorca's homosexual position." [Bin09]

I believe both positions are right as Lorca refers to the boy in both the third person and later in first person. In my opinion, *El niño mudo* is Lorca's unborn child as well as Lorca himself, but in a state where he cannot express his reality. In fact he was executed by fascist forces at the beginning of the Spanish Civil War because of his political ideas and homosexuality.[GA13]

I see the element of water in both poems as a way to silence ones voice. Underwater we cannot speak nor exist. Living oppressed is like trying to live underwater.

The King of Crickets has the role of the oppressor to me. He took the voice from the boy. Lorca grew up in Fuente Vaqueros, a rural area of Andalucía, in the South of Spain.[Mau] We can perceive this in the occurrence of elements of nature in his poems or a number of his works set in rural Spain. In the countryside, at night when there is supposed to be silence as everybody is sleeping the only sound we hear persisting is the sound of the cricket. When everybody is silenced, the oppressor takes the stand and imposes values.

In the second stanza Lorca doesn't want the voice to speak with, he wants to make a ring of it. To some people, a ring is more valuable; it is a jewel that represents a position in society, a

union or a perpetuation of a name. I translate this stanza as his intention to place his voice in an object that is valuable for society and remains existent for a long time.

We can all be victims of oppression. At the same time, we have the capacity to become the oppressor without even realizing it. At the end of the poem ”the captive voice, far away, put on a cricket’s clothes. To me ”far away” represents the unconscious, while putting on the cricket’s clothes is taking the role of the oppressor.

I decided not to include the role of the King of the Crickets in *Ululation and Gurgles of the Invisible* as it represents to me the male oppressor. Instead I created a new role of Queen of the Crickets who is a victim of the King’s oppression but an oppressor at the same time as she is a queen. The bubbles, gurgles and ululations are the result of trying to speak inside a drop of water or underwater. However, I present the use of sign language as a solution to communicate underwater and only be understood by the few who know the secret.

In the second poem ”Betrothal”, by reiterating three times ”throw that ring into the water,” Lorca expresses a clear rejection to heterosexual marriage, which at that time was the only marital option in Spain. According to Martínez Nadal [Mar74], in the first and fifth poems of *Canciones de trasmundo*, the ancestors of the poet hope, he will perpetuate his name, but the poet refuses to do it [Mar74].

The ring is ”more than a hundred years old” in representing the tradition of heterosexual marriage. Again in this poem the water is used to silence a message, here to silence the ring and what it represents.

> ’el símbolo del anillo. / no lo quiero’ [The symbol of the ring. / I do not want it]. In ’Desposorio’ [Betrothal], a mysterious shade (sombra), whose presence might already indicate a suppressed self standing behind him, or who may possibly be death personified, urges the poet to throw the wedding ring into the water, as if to abjure romance [Qua10].

In my companion narrative, the Queen of the Crickets is getting married to the abusive King of Crickets but her shadow is helping her to make the decision of rejecting the traditions and throwing the engagement ring into the water as it contains the oppressed voice of her unborn child.

Chapter 1

The Silent Boy

In this section the silent boy is looking for his voice

1.1 Instructions for The Silent Boy

Hang from the ceiling of the stage five pieces of bubble wrap with slightly different sizes and textures. Colors can be soft pink and clear.



Figure 1.1: Performers with Bubble Wrap.

Each piece of bubble wrap will be illuminated using lighting patterns that can be triggered from the control table on stage following the score and the speed of the performer. The purpose is to have the lights strobe following the rhythmic patterns in the music score. Those patterns follow the letters V (from voice), C (from cricket), D (from droplet), R (from ring) and S (silence) in Morse Code.

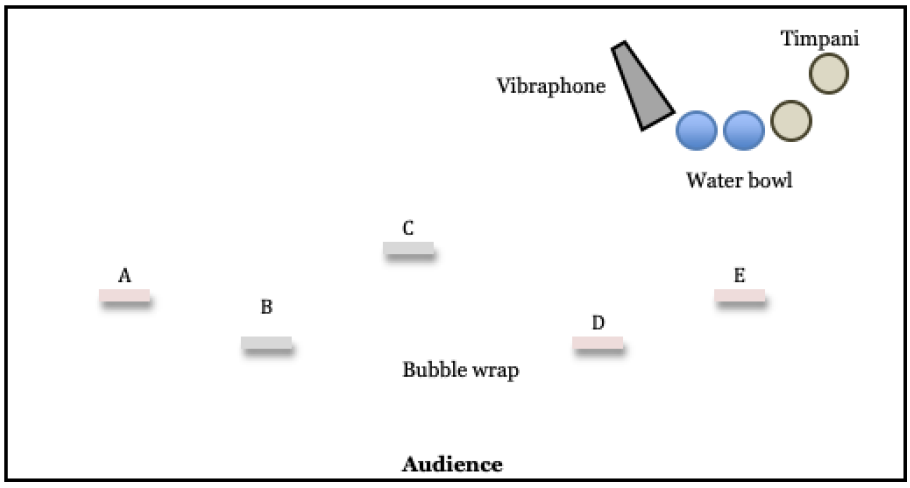


Figure 1.2: The Silent Boy Stage Setting.

1.2 Instrumentation

- Two water bowls with a different tone of blue light under each of them, glass stones and small percussion instruments inside them. Choose 10 different timbres including small instruments and sounds made with the sides of the water bowls. Five of the sounds should be of short duration and five, long duration sounds.
- Two timpani.
- Vibraphone played with hands and a bow.

1.3 Other Instructions

A concert version of the introduction of ”The Silent Boy” can be done with the percussionist doing the light rhythmic patterns with a hand light and bubble wrap on a small table or music stand.

The rhythmic patterns on this piece are based on the words voice, cricket, droplet,ring and silence in Morse Code.

American Sign Language should be performed at all times facing the audience.

The Silent Boy

For Percussion, Lights and American Sign Language

Elisabet Curbelo (2018)




Lento
42
w/ bow
Vib.
medium motor
SILENCE
43
♩=160
Bowls
VOICE
48
Bowls
RING
52
Bowls
CRICKET
59
Bowls
DROPLET
66
drop stone
Bowls
move stone
SILENCE
73
Vib.
"V"
Bowls
"O"
Timp.
"I"
76
Vib.
"E"
bubble wrap
Bowls
3
"C"
78
Vib.
"G" bubble wrap
Bowls
"R"
"N"
Timp.
"I"


82
Bowls
Timp.
"C"
"I"
"R"
85
Vib.
Bowls
Timp.
"C"
bubble wrap
"K"
"T"
"E"
89
Vib.
Bowls
Timp.
"D"
"R"
"O"
92
Vib.
Bowls
Timp.
"L"
"P"
"E"
bubble wrap
"T"
96
Vib.
Bowls
Timp.
"I"
"S"
"L"
"E"
100
Vib.
Bowls
Timp.
"C"
bubble wrap
"N"
"E"


103
Vib.
Bowls
Timp.
"O"
"V"
"I"
"C"
107
"I"
"E"
SILENCE
"G"
SILENCE
"R"
"N"
112
"R"
"C"
"I"
115
"K"
"T"
SILENCE
"C"
"E"
"D"


120
Vib.
Bowls
Timp.
"O"
"P"
"L"
"R"
124
"E"
"S"
"I"
"L"
"T"
SILENCE
129
"E"
"E" SILENCE
"N"
"C"
133
SILENCE
140
walk offstage
Body
SILENCE

Chapter 2

Gurgles

The voices dance underwater

2.1 Structure

The structure of the piece is listed below. The following figure is of use for the projection designer, choreographer and computer musician to be on the same page. This is a bilingual piece where the sign language on the videos of each section is both in Spanish and English.

Section	Video	Audio	Video ASL	Text for Sign Language
1	Water drops	Drops (water drops)	AngeloEnglish1	In a drop of water the little boy was looking for his voice.
			AngeloSpanish1	En una gota de agua buscaba su voz el niño.
2	Water	Water (water splashing)	AngeloEnglish2	(The king of the crickets had it.)
			AngeloSpanish2	(La tenía el rey de los grillos.)
3	Bubbles	Bubbles (water boiling)	AngeloEnglish3	I do not want it to speak with; I will make a ring of it so that he may wear my silence on his little finger.
			AngeloSpanish3	No la quiero para hablar; me haré con ella un anillo que llevará mi silencio en su dedo pequeñito.
4	Wet skin	Bvoice (choir of gurgles) * The pianist walks on stage and plays	AngeloEnglish4	(The captive voice, far away, put on a cricket's clothes.)
			AngeloSpanish4	(La voz cautiva, a lo lejos, se ponía un traje de grillo.)

Figure 2.1: Structure for Gurgles.

2.2 Instructions for the Choreographer

The duration of the piece is approximately 20 minutes. The five dancers have the role of voices dancing under water. They are the voices of the silent boy.

- The Guiding Voice, dancer and sign language performer
- The Luminous Voice, dancer with light controller
- The High Voice, dancer controlling audio samples in the high register.

- The Middle Voice, dancer controlling audio samples in the middle register.
- The Low Voice, dancer controlling audio samples in the low register.

The sensors used to modify sound and light by The Luminous Voice, High Voice, Middle Voice and Low Voice are accelerometer and gyroscope. The accelerometer measures acceleration (rate of change of velocity) and the gyroscope measures orientation. This data modifies lights the same way throughout the piece but modifies sound samples in different ways for each section.

Light controller: the orientation of the dancer wearing this controller turns on and off the four different LED lights placed on the floor of the stage. Acceleration modifies the brightness of these lights.

Sound controllers: Orientation spatializes the sound through the different speakers in all sections.

Section 1: acceleration triggers short audio samples of droplets. If there is no movement or the movement is slow, the samples wont be triggered.

Sections 2 and 3: acceleration modifies the volume of a long audio sample of water splashing (section 2) and water boiling (section 3). If there is no movement, there is no sound.

Section 4: acceleration modifies the volume of a long sample of gurgles. In this section there is always sound but the volume is low when there is no movement.

In the first two sections, it is important to present each sound individually and then in groups as each dancer controls a different pitch register. Economy of movement is recommended since it has to be clear to the audience that the movement of the dancers is generating electronic sound. In addition the audience may associate the register of the sound with a dancer. This association is clearly perceived when the role of the dancer matches their personality, movements and appearance.

In sections 1 and 2 The Guiding Voice appears only on the video. It is not until the beginning of section 3 that The Guiding Voice comes on stage to perform a solo of dance and Sign Language following the text of section 3 (see figure 2.1). The dancers wearing the sound

controllers should not move so the solo of the guiding voice is in silence.

In section 4 it is essential to generate more movement with the purpose of creating a choir of gurgles. Each dancer is controlling a different pitch so that when they sound together they make chords.

A dance score has to be made to share with the projection designer, computer musician and pianist. In this score there has to be a cue to transition from section 1 to section 2 synchronized with sound and video. The cue to start the video of section 3 and stop sound is when The Guiding Voice comes on stage. The cue to turn on sound for section 3 is when the high, middle and low voice start moving again. A cue has to be created for the video, audio and pianist to transition from section 3 to section 4. The cue for the dancers to come off stage leaving only The Luminous Voice on stage with the pianist, is the piano playing the ”Theme of the Shadow”. The cue for The Luminous Voice to leave stage is the ”Queen of the Crickets March”.

2.3 Instructions for the Computer Musician

The Pure Data patch is divided in four sections (see figure 2.2). Turn on and off each section accordingly by following the dance score the choreographer provides. Cross fade the samples to transition between sections. During the solo of The Guiding Voice at the beginning of section 3 it is advised to lower the volume of the sound and then fade it in again when the group of high, middle and low voices move again. The pianist walks on stage and plays together with the electronics during section 4. At the end of this section fade out the volume of the group of high, middle and low voices as they walk off stage. The luminous voice and piano remain on stage for the end of this piece.

The PD patch used for this piece was developed through a collaboration between the composer and Elliot Patros in 2018. Patros developed an object for this piece called Panner 2D which is an amplitude panner used for maintaining steady amplitude during spatialization.



Figure 2.2: The Main Pure Data Patch.

2.4 Instructions for the Video

Maya VanderSchuit and John Burnett created the videos for Gurgles in collaboration me. I filmed Angelo C.I. Ricasata signing the poem ”The Silent Boy” in English and Spanish. Then trimmed the videos and classified them as they appear in figure 2.1

VanderSchuit processed the sign language videos and added the video content of water drops, water, bubbles and wet skin. With this video content, John Burnett designed video loops of 15 minutes per section of the piece mixing the sign language videos with the water drops, water, bubbles and wet skin videos.

Create a playlist with the videos ”Gurgles1”, ”Gurgles2”, ”Gurgles3” and ”Gurgles4” to transition through the videos during the performance of ”Gurgles” following the score that the choreographer provides and the structure of the piece. The visual material for each section is organized in relation to the sound material and the poem.

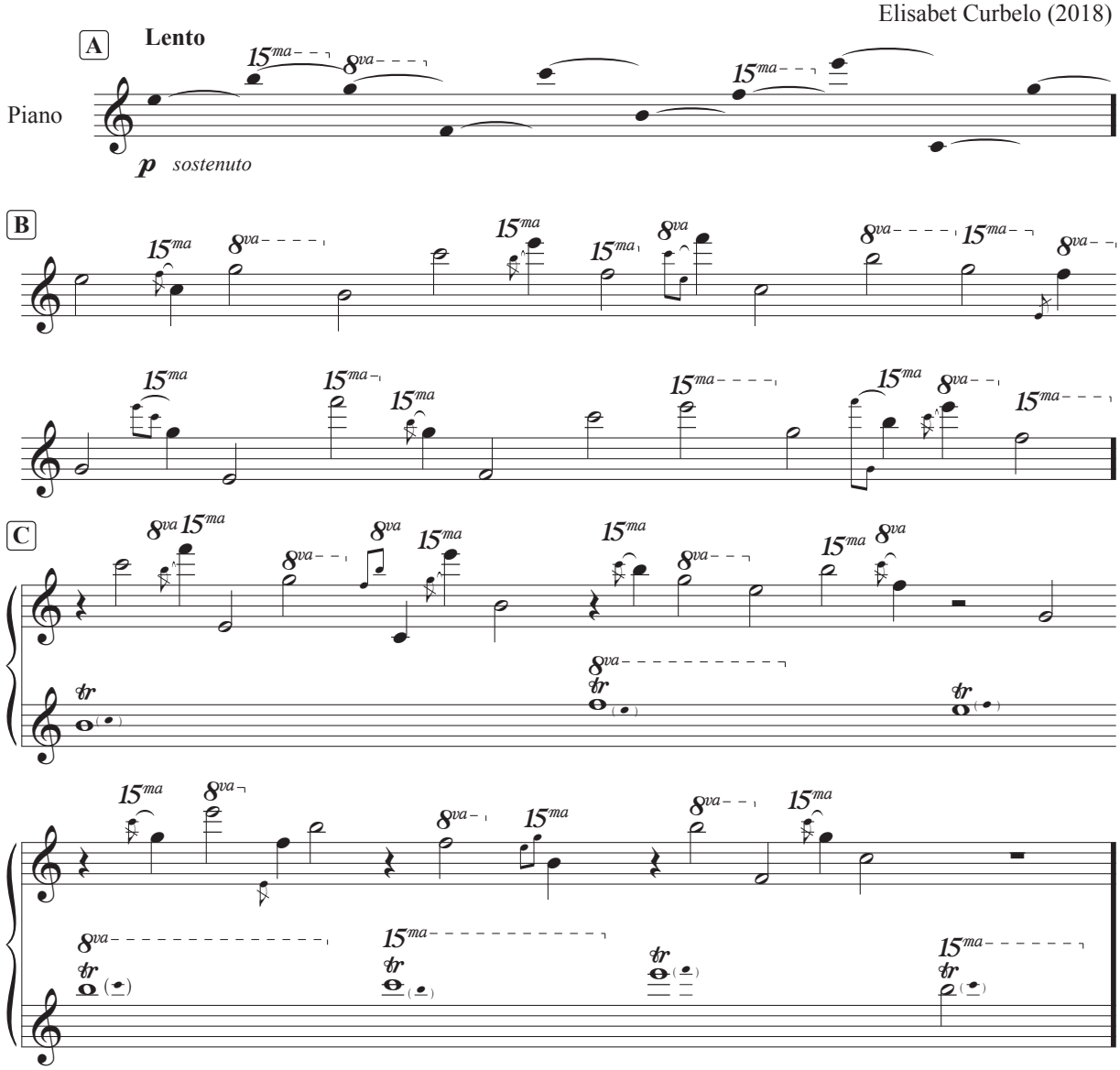
Other videos can be designed using the structure that appears in figure 2.1

Gurgles

for Five Dancers, Sign Language, Electronics, Lights, Video and Piano

Before pianist walks on stage five dancers dance to the following electronic sounds (aprox. 8'):
1.Water drops
2.Water splashing
3.Water boiling
4.Choir of gurgles ----------> **Pianist walks on stage and plays**

Elisabet Curbelo (2018)




D
15ma
8va
mp
E
F
mf
tr

The Shadow's Theme



Transition

The soprano walks on stage and the dancer walks off stage

The Queen of the Crickets March



Chapter 3

Betrothal

The Queen of the Crickets is getting married and her wedding ring contains the voice of The Silent Boy. The Queen and her Shadow try to help the silent boy to find his voice. She demands that he throw the ring into the water.

3.1 Instructions for the American Sign Language

In ”Betrothal” the poem *Desposorio* by Federico García Lorca is performed using American Sign Language by both the pianist and soprano as it is indicated in the score. The notation used for ASL in the score is an interpretation of the poem realized by Angelo C. I. Ricasata and notated by the composer using rhythmic notation.

The figure below presents the poem indicating who performs the different parts of it and the corresponding video for its study (see List of Supplemental Files).

Spanish	English	Performer	Video
Tirad ese anillo al agua.	Throw that ring into the water.	Soprano	Soprano1
(La sombra apoya sus dedos sobre mi espalda.)	(The shadow places its fingers on my back.)	Pianist	Pianist1
Tirad ese anillo.	Throw that ring.	Soprano	Soprano2
Tengo más de cien años.	I am more than a hundred years old.	Pianist	Pianist2
¡Silencio!	Silence!	Soprano	Soprano3
¡No preguntadme nada!	Don´t ask me anything!	Soprano	Soprano4
Tirad ese anillo al agua.	Throw that ring into the water	Soprano	Soprano1

Figure 3.1: Performers and Corresponding Video.

3.2 Instructions for the Vocal Techniques

3.2.1 Tongue tremolo

The tongue tremolo is executed by quickly repeating light flicks with the tip of the tongue at the alveolar ridge while pronouncing a vowel. As we see in figure 3.2, the tongue is positioned as if we were to pronounce the lateral approximant consonant [l] as in loop. The [l] is repeated at

an approximate speed of eight flicks per second. This can be practiced pronouncing any vowel. The quality of the sound changes depending of which vowel we use.

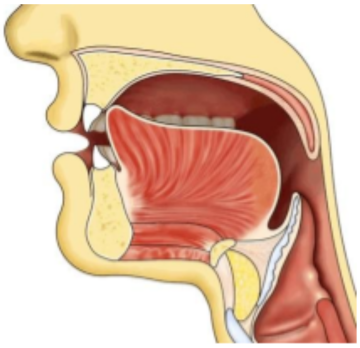


Figure 3.2: Position of the Tongue to Produce the Tongue Tremolo.

3.2.2 Glottal Tremolo

The glottal tremolo is produced in a lower area of the phonation apparatus. As we can see in figure 3.3, the tongue stays in a position of phonetic rest while a glottal stop is produced. A glottal stop occurs when the vocal folds are drawn firmly together and no air passes through them. This resembles a gentle cough. The glottal stop is a type of consonant sound represented in the International Phonetic Alphabet as [ʔ]. This is the sound produced in uh-oh or Hawai'i. The tahrir is produced making a glottal stop and right after letting the air pass producing a [h] with a vowel of choice. This is similar to the sound we emit when we laugh.

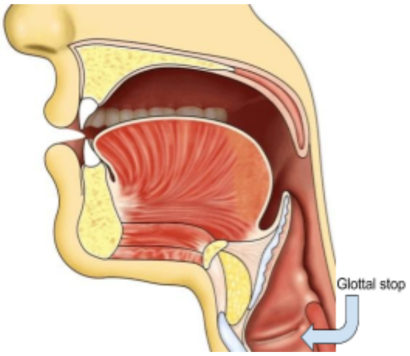


Figure 3.3: Position of the Tongue to Produce the Glottal Tremolo.

The glottis is the space between the vocal folds which are located in the larynx. The fact that when performing the glottal tremolo a soft [h] is produced after the glottal stop, creates a wider glottis movement than only producing a vowel.

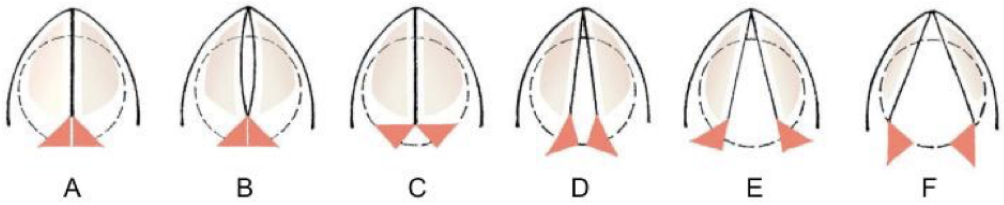


Figure 3.4: Diagram of Schematized Images of the Glottis.

In 3.4, the two orange triangles are the arytenoid cartilages, which govern the vocal folds. The edges of the vocal folds are represented by the vertical lines in the middle.

In image A, glottal stop, we can see how the vocal folds are closed, firmly blocking the airflow from the lungs. By forcing the air strong enough, it can get through the closed vocal folds making them vibrate producing a creaky voice (image B). In normal voicing, as we can see in image C, the arytenoids do not press the vocal folds together. Therefore air can pass through them without extra pressure, making them vibrate. If the vocal folds are pulled apart, a high rate of airflow is necessary to make them vibrate producing a breathy voice (see figure 3.4). Pulling the vocal folds further apart inhibits their vibration, the result of image E is a voiceless sound. Finally, in image F we can see the vocal folds are so far from each other that they cannot get close enough to even voice the next sound. This is aspiration.

The pattern presented in images C-A-E-C sound emission, glottal stop, air emission and sound emission is the repeated movement the vocal folds produce when executing the glottal tremolo.

3.2.3 Vibrato

The Italian word vibrato is used to describe pitch and intensity fluctuation that occurs during a sustained tone. The definition of Seashore and his associates [Sea36] of a good vibrato for bel canto technique is: ”a pulsation of pitch usually accompanied with synchronous pulsations of loudness and timbre, of such extent and rate as to give pleasing flexibility, tenderness and richness to the tone.” In a well regulated vibrato, the pitch variant is seldom as large as a semitone; its undulation pattern averages about a third of a whole tone. 6.5 undulations per second seem to represent the normal vibrato in singing [Mil99].

Research points out that vibrato is produced by a physiologic intermittent supply of energy originated in the brain stem and transmitted to the cricothyroid muscles through the superior laryngeal nerve. This produces an oscillation of cricothyroid muscles which varies the stiffness of the vocal folds causing a slight variation of pitch. This means vibrato is natural and everyone has it. ”The singer has no conscious control over the vibrato rate, but can control a wide range of the vibrato frequency extent” [Shi85].

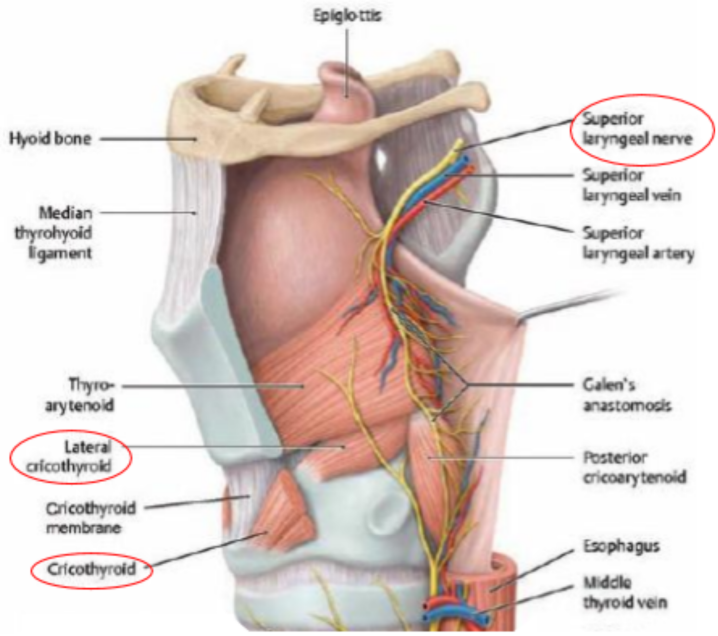
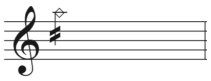


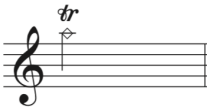
Figure 3.5: Laryngeal anatomy (From THIEME Atlas of Anatomy, Neck and Internal Organs, Thieme 2006. Illustration by Markus Voll.)

Nevertheless it is possible to induce vibrato through conscious physical motion such as to have an external force applied to the abdominal wall, tongue movement and jaw shaking. Furthermore it is possible to remove the vibrato by the use of muscular tension, this produces the straight-tone.

NOTATION



Tongue tremolo (LLLL)



Tongue trill (LRLR or RRRR)



Glottal tremolo



Glottal grace note



Wide vibrato



Non vibrato and wide vibrato



Mouth closed

Betrothal

for Soprano, Piano and American Sign Language

Elisabet Curbelo (2018)




C
Pno.
marcato
mf
S
ASL S
Water
Water(space)
ring
Throw
Pno.
on the strings
mp
Ped.
D
S
ASL S
ring
expectations
burden
throw
ASL P
Shadow
behind
place
fingers on her back


S
ASL S
ASL P
Pno.
Pno.
S
ASL S
Pno.
tr
f
ring
expectations list burden throw
many years
long time/
continue
me
ring
E
mp
cresc. pesante
mf
8va
15ma
f
ff
Silence!
silence! silence! silence!


F
S
Pno.
mp
mf
8va
Ped.
G
ASL S
barrage of questions
expectations
enough! I am done
marcato


S
Pno.
S
Pno.
S
mp
ASL S
water
water(place)
ring
throw
Pno.
mp


H
S
59
Pno.
I
Ped.


J
S
ASL S
Pno.
water
Ped.
water(place)
ring
throw
p

Chapter 4

The Ring

The ring is shining with all the voices it has inside.

4.1 Stage Setup

At the end of ”Betrothal” the soprano takes the music stand and changes positions from the side of the piano to the position of the circle indicated in the figure below. The action of the soprano lifting the music stand is the cue for all the performers to come on stage taking their respective positions. These positions are to be kept until the last part of the piece. The Guiding Voice and The Luminous Voice remain inside the circle at all time only getting out of it at the last part of the piece which is indicated in the score as Material 5.

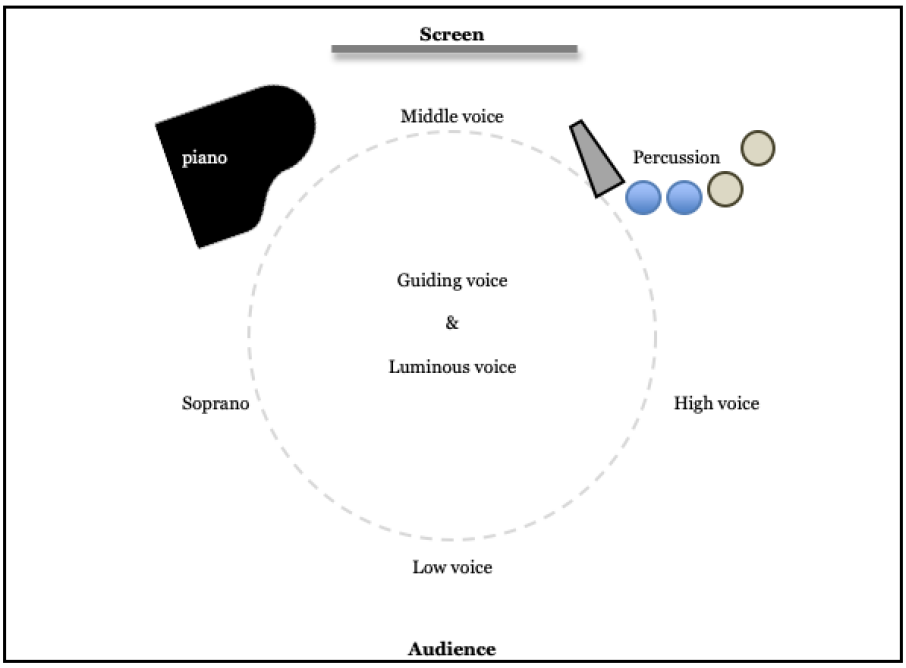


Figure 4.1: Stage Setup for ”The Ring”.

To perform the last part of the piece move slowly from your original position to the position on the line indicated in the figure below. Move while performing Material 5.

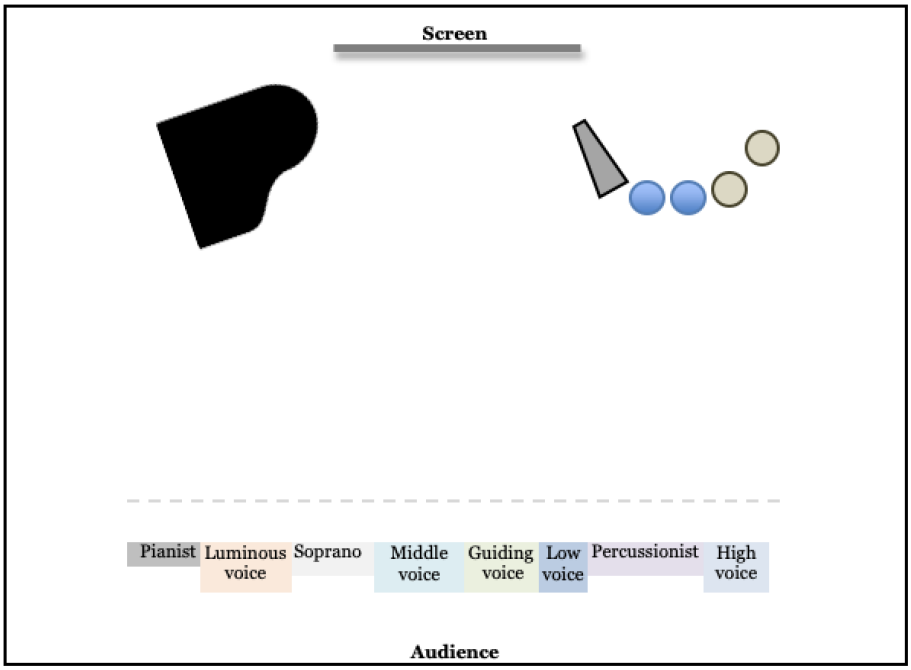


Figure 4.2: End of Piece Stage Setup.

4.2 Instructions for the Video

Project the video loop ”TheRing” (see List of Supplemental Files). Press play when the soprano lifts the music stand and press stop when the lights black out at the end of the piece.

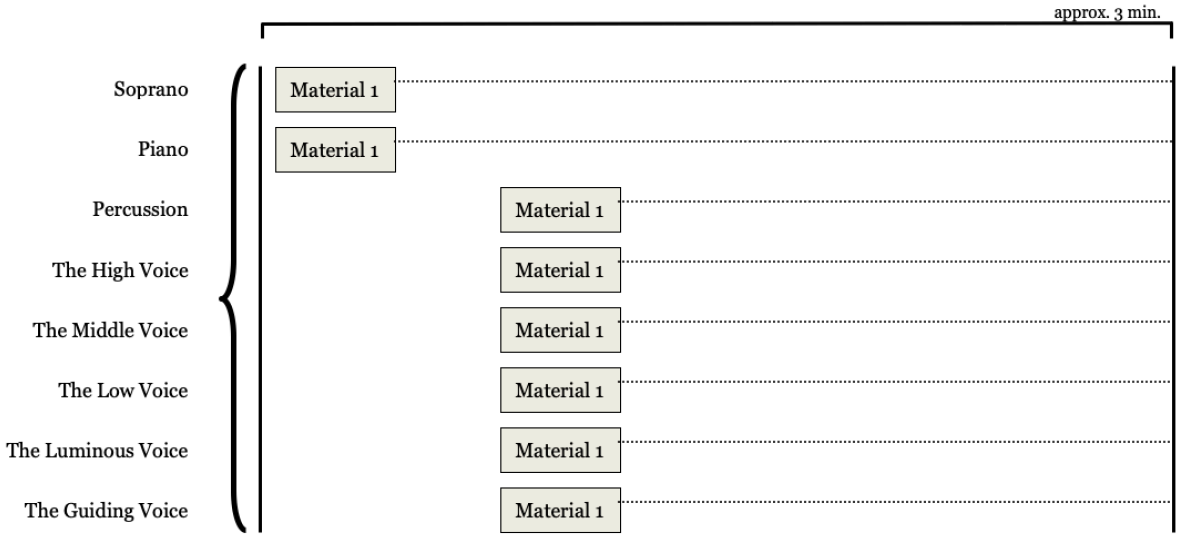
4.3 Instructions for the Computer Musician

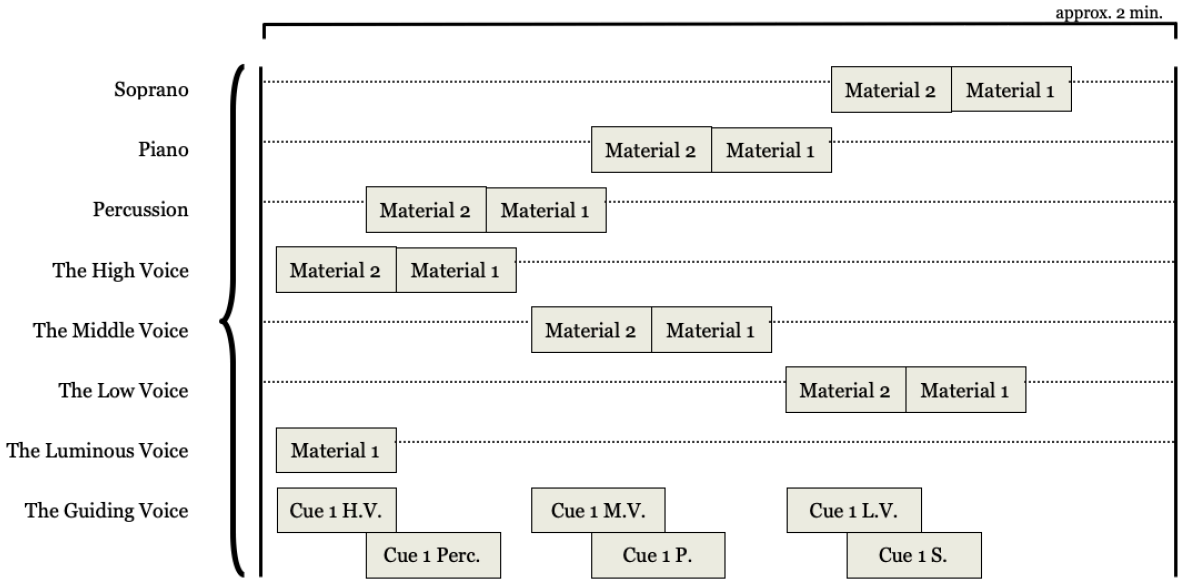
Turn on in the PD patch the light controller for The Luminous Voice, the drop samples only for The Middle Voice, the water samples only for The High Voice and the bubbles samples only for The Low Voice. This is the only part of the piece where the High, Middle and Low Voices each control a different sample while dancing together. Follow the cue of the video and lights at the end of the piece to fade out sound and turn off the LED lights.

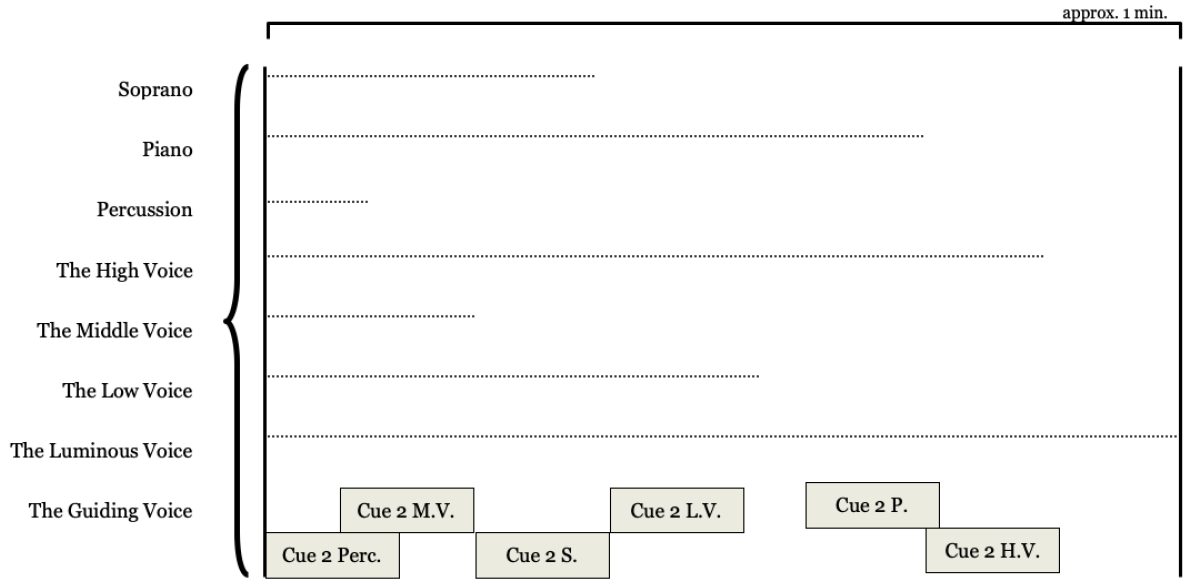
The Ring

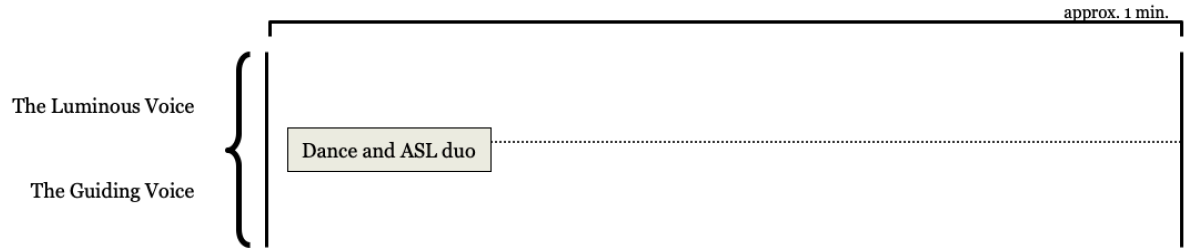
for Soprano, Piano, Percussion, Five Dancers, Electronics, Lights, Video and American Sign Language

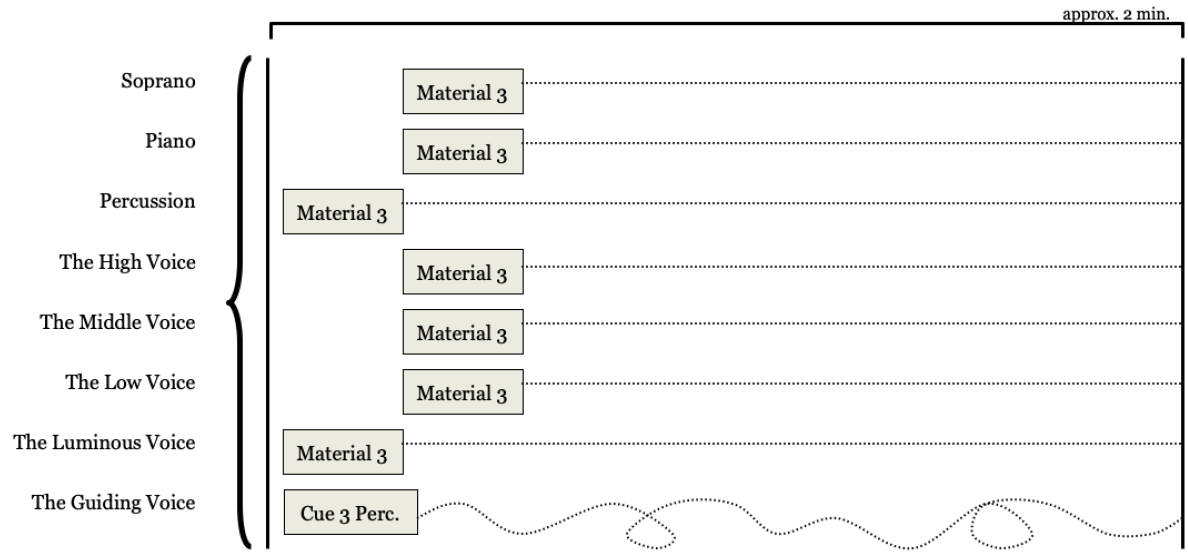
Elisabet Curbelo (2018)

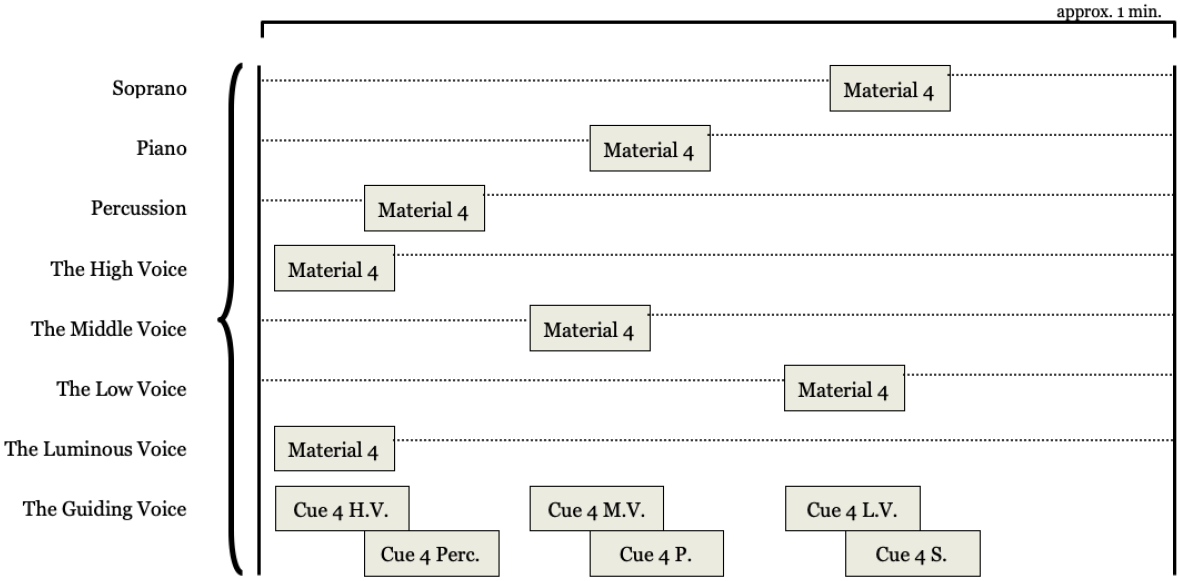


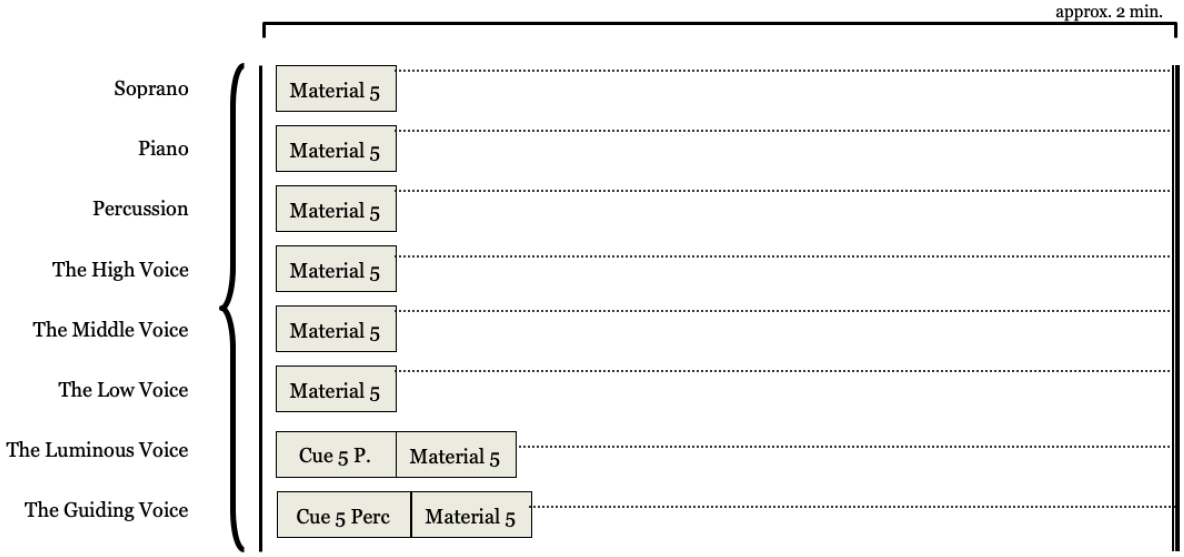



approx. 1 min.
Soprano
Piano
Percussion
The High Voice
The Middle Voice
The Low Voice
The Luminous Voice
The Guiding Voice
Cue 2 M.V.
Cue 2 L.V.
Cue 2 P.
Cue 2 Perc.
Cue 2 S.
Cue 2 H.V.


approx. 1 min.
The Luminous Voice
The Guiding Voice
Dance and ASL duo


approx. 2 min.
Soprano
Piano
Percussion
The High Voice
The Middle Voice
The Low Voice
The Luminous Voice
The Guiding Voice
Material 3
Material 3
Material 3
Material 3
Material 3
Material 3
Material 3
Cue 3 Perc.

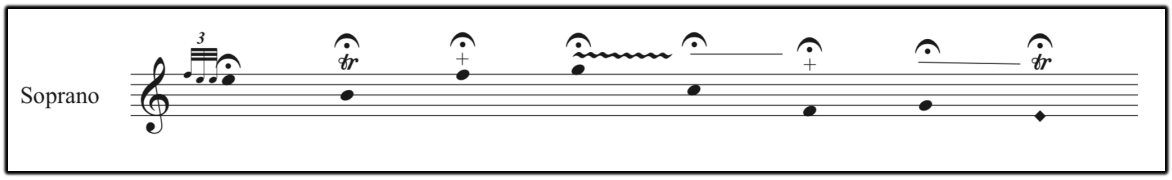

approx. 1 min.
Soprano
Material 4
Piano
Material 4
Percussion
Material 4
The High Voice
Material 4
The Middle Voice
Material 4
The Low Voice
Material 4
The Luminous Voice
Material 4
The Guiding Voice
Cue 4 H.V.
Cue 4 Perc.
Cue 4 M.V.
Cue 4 P.
Cue 4 L.V.
Cue 4 S.


approx. 2 min.
Soprano
Material 5
Piano
Material 5
Percussion
Material 5
The High Voice
Material 5
The Middle Voice
Material 5
The Low Voice
Material 5
The Luminous Voice
Cue 5 P.
Material 5
The Guiding Voice
Cue 5 Perc
Material 5

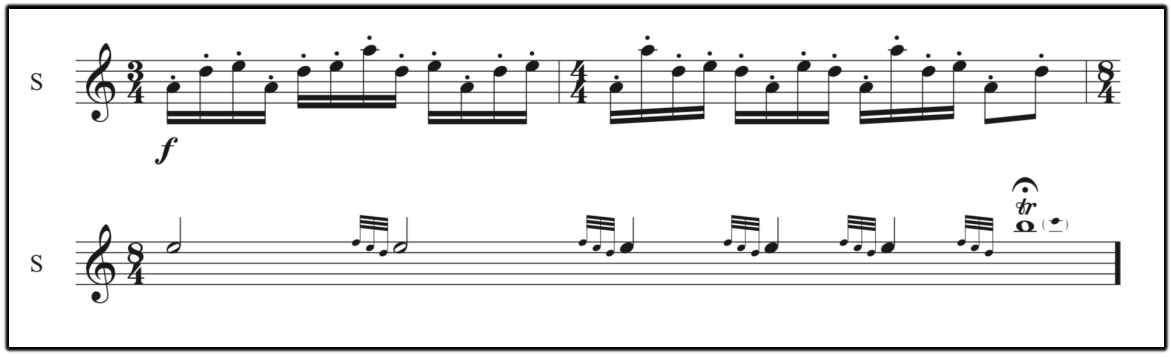
The Ring

Soprano Part

Material 1: Choose from the pitches below, singing them in the desired order repeating them until the next cue. Slow tempo. Dynamics may fluctuate from *pp* to *mp*.

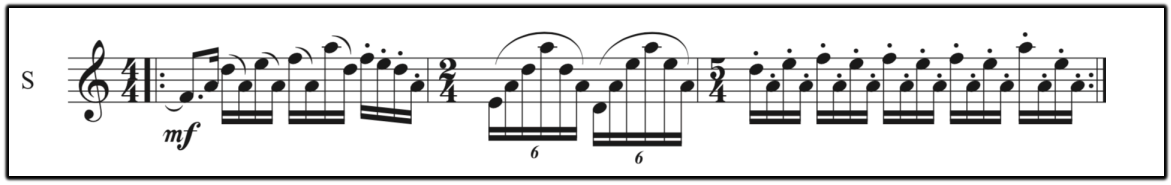


Material 2: Sing once when The Guiding Voice touches you (Cue 1 S.). After singing Material 2, keep singing material 1 until Cue 2.

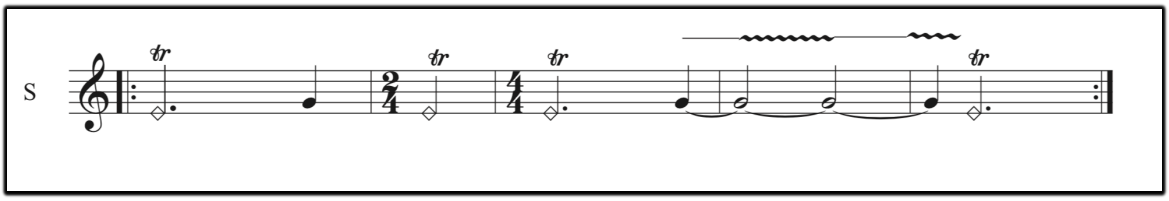


Silence: When The Guiding Voice cues you with the word “silence” in ASL (Cue 2 S), stop singing.

Material 3: Sing after The Guiding Voice cues the percussionist with the sign “voice” (Cue 3 Perc.). Sing only when The Guiding voice passes by your side and stop playing immediately when The Guiding Voice moves to a different side of the circle (see figure 4.1).



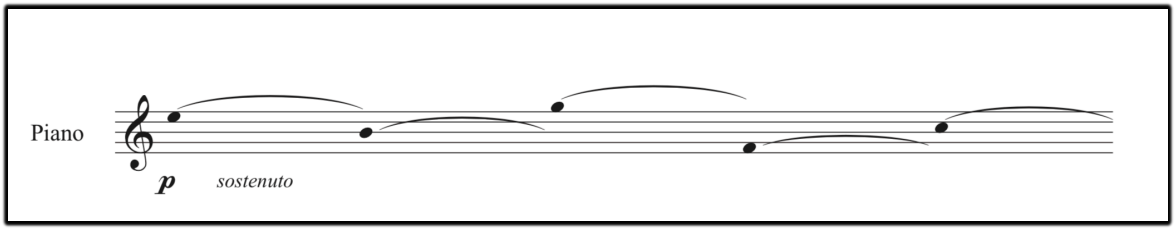
Material 4 & 5: Sing in a dynamic range of *mf-ff* when The Guiding Voice cues you with the sign “voice continue” (Cue 4 S.). When The Luminous Voice cues the piano and The Guiding voice cues the percussion, follow the performers to the front of the stage and remain singing in a dynamic range of *p-pp*. Fade out with the other of the performers and lights.



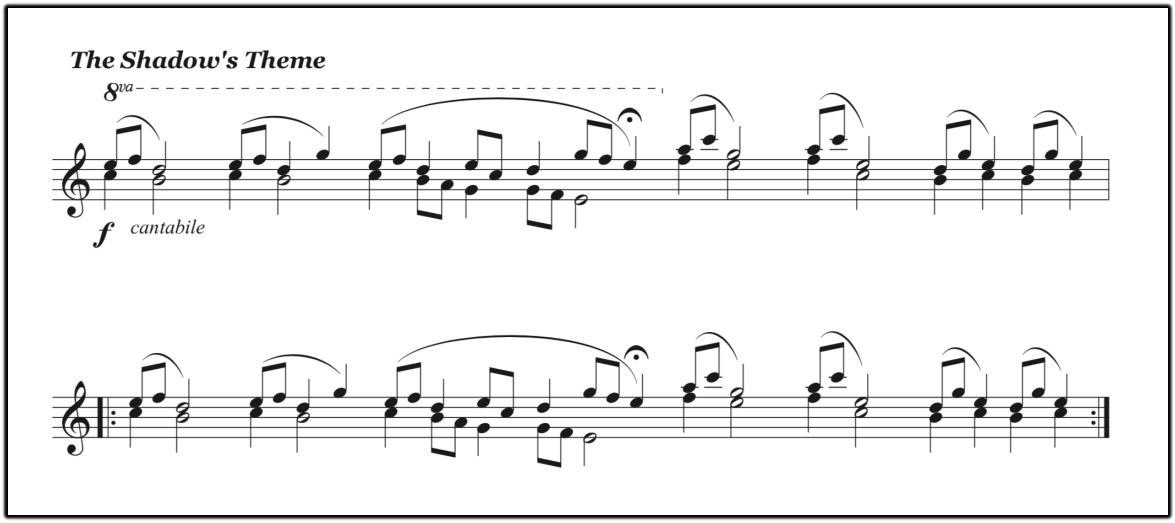
The Ring

Piano Part

Material 1: Choose from the pitches below playing only in the middle and high register of the piano until next cue. Slow tempo. Use the pedal continuously. Dynamics may fluctuate from *pp* to *mp*.

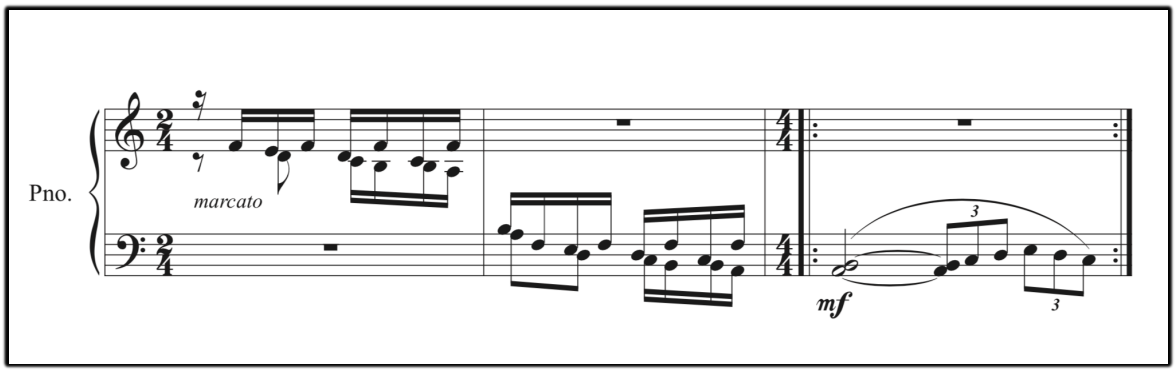


Material 2: Play once when the guiding voice touches you or the piano (Cue 1 P.). After playing Material 2, keep playing Material 1 until Cue 2.

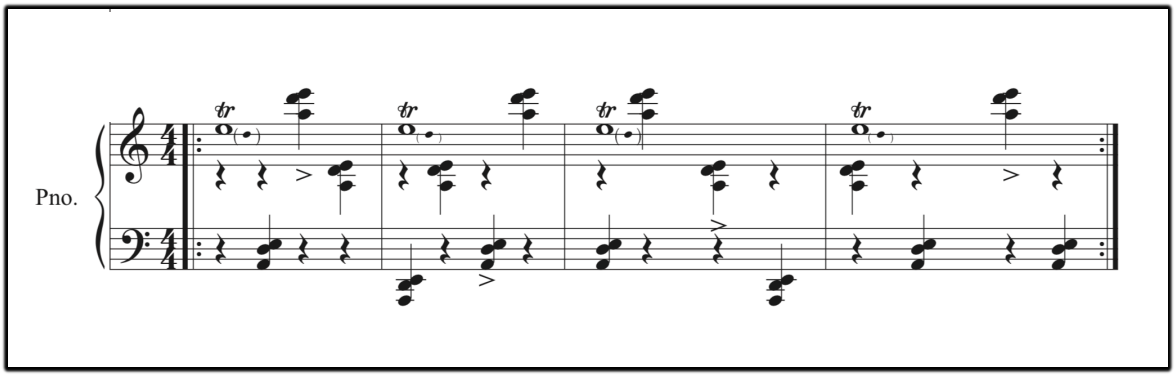


Silence: When The Guiding Voice cues you with the word “silence” in ASL (Cue 2 P), stop playing.

Material 3: Play after The Guiding Voice cues the percussionist with the sign "voice" (Cue 3 Perc.). Play only when The Guiding voice passes by the piano side and stop playing immediately when The Guiding Voice moves to a different side of the circle (see figure 4.1).



Material 4: Play in a dynamic range of *mf-ff* when The Guiding Voice cues you with the sign "voice continue" (Cue 4 P.)

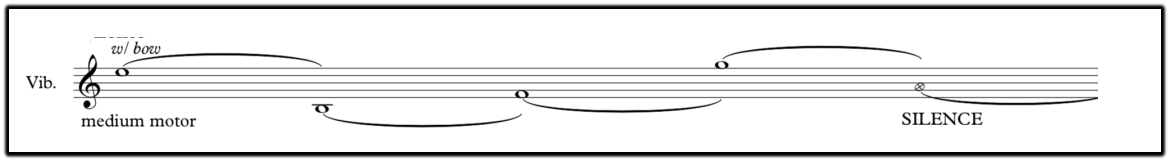


Material 5: When The Luminous Voice cues you by taking you away from the piano (Cue 5 P.). Repeat the word "voice" using ASL. Slowly put your hand down for the fade out of sound and lights at the end.

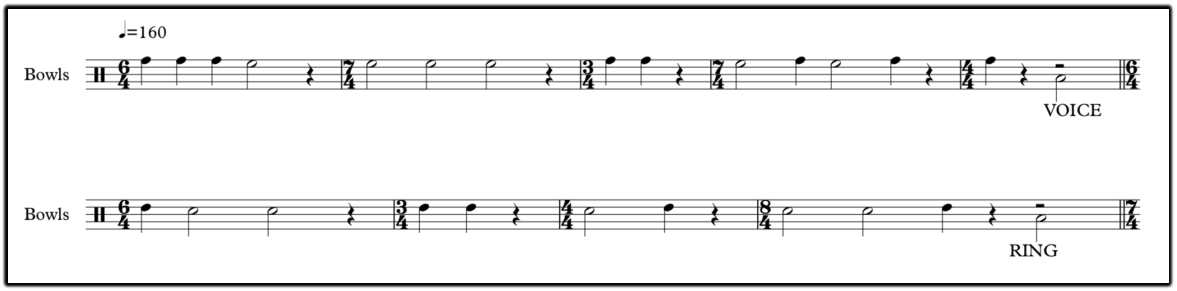
The Ring

Percussion Part

Material 1: Choose from the pitches below until next cue. Slow tempo. Dynamics may fluctuate from *pp* to *mp*.



Material 2: Play once when the guiding voice touches you or the percussion instruments (Cue 1 Perc.). After playing Material 2, keep playing Material 1 until Cue 2.



Silence: When The Guiding Voice cues you with the word “silence” in ASL (Cue 2 Perc.), stop playing.

Material 3 & 4: Play after The Guiding Voice cues you with the sign “voice” (Cue 3 Perc.). Play only when The Guiding voice passes by the percussion side and stop playing immediately when The Guiding Voice moves to a different side of the circle (see figure 4.1).

When The Guiding Voice cues you with the sign “voice continue” (Cue 4 Perc.) Play in a dynamic range of *mf-ff* .



Material 5: When The Guiding Voice cues you by taking you out of the percussion set (Cue 5 Perc.). Repeat the word “silence” using ASL. Slowly put your hands down for the fade out of sound and lights at the end.

The Ring

Luminous and Guiding Voice Part

Material 1: Slow movements close to the floor inside the circle (see figure 4.1). Both the Luminous and Guiding Voice move always inside the circle. Only in Material 5 and Cue 5 move outside the circle (see figure 4.2).

Cue 1: The G.V. touches each performer or their instruments to cue them to play a solo. Cue them as indicated in the full score.

Cue 2: The G.V. cues each performer with the word "silence" in ASL as indicated in the full score. The performers stop playing and moving.

Dance and ASL duo: When all performers are quiet The Lu.V. and The G.V. dance a duo. The G.V. signs parts of the poem *Desposorio*:

- Throw that ring into the water!
- Silence!
- Don't ask me anything!
- Throw that ring!

Material 3 and Cue 3: The G.V. cues the percussionist with the sign "voice" and moves quickly to different parts of the circle in different directions. When The G.V. passes by the side of the performers they move, sing or play then stop performing immediately when The G.V. moves to a different side. The Lu.V. can interact with The G.V. visually while staying close to the floor.

Material 4 and Cue 4: The G.V. cues each performer with the sign "voice continue". This is the most energetic part of the piece. Both The Lu.V. and G.V. move using wide-ranging movements inside the circle.

Cue 5: The Lu.V. cues the pianist (Cue 5 P.) and The G.V. cues the percussionist (Cue 5 Perc.) by guiding them to the line as indicated in the stage set up instructions.

Material 5: When in the line, The Lu.V. performs in loops a set of 2 movements while The G.V. repeats in ASL: "Throw that ring into the water". Slow the movements down at the end.

The Ring

High Voice Part

Material 1: Slow movements that don't produce electronic sound alternated with sparse short and quick movements that produce an electronic sound of water splashing of short duration.

Material 2: When The Guiding Voice touches you (Cue 1 H.V.) dance for a maximum of 30 seconds using the same material of your solo in "Gurgles". After finishing your solo, return to performing Material 1.

Silence: When The Guiding Voice cues you with the word "silence" in ASL (Cue 2 H.V), stop moving.

Material 3: After The Guiding Voice cues the percussionist with the sign "voice" (Cue 3 Perc.), move only when The Guiding voice passes by your side and stop moving immediately when The Guiding Voice moves to a different side of the circle.

Material 4: When The Guiding Voice cues you with the sign "voice continue" (Cue 4 H.V.), do a set of 4 wide-ranging movements in loops at a fast speed.

Material 5: When The Luminous Voice cues the pianist (Cue 5 P.) and The Guiding Voice cues the percussionist (Cue 5 Perc.), continue doing the same 4 movements of Material 4 but smaller and slower each time. Move from your original location in the circle to your position in the line indicated in the stage set up instructions.

The Ring

Middle Voice Part

Material 1: Slow movements that don't produce electronic sound alternated with sparse short and quick movements that produce an electronic sound of water drops of short duration.

Material 2: When The Guiding Voice touches you (Cue 1 M.V.) dance for a maximum of 30 seconds using the same material of your solo in "Gurgles". After finishing your solo, return to performing Material 1.

Silence: When The Guiding Voice cues you with the word "silence" in ASL (Cue 2 M.V), stop moving.

Material 3: After The Guiding Voice cues the percussionist with the sign "voice" (Cue 3 Perc.), move only when The Guiding voice passes by your side and stop moving immediately when The Guiding Voice moves to a different side of the circle.

Material 4: When The Guiding Voice cues you with the sign "voice continue" (Cue 4 M.V.), do a set of 5 wide-ranging movements in loops at a fast speed.

Material 5: When The Luminous Voice cues the pianist (Cue 5 P.) and The Guiding Voice cues the percussionist (Cue 5 Perc.), continue doing the same 5 movements of Material 4 but smaller and slower each time. Move from your original location in the circle to your position in the line indicated in the stage set up instructions.

The Ring

Low Voice Part

Material 1: Slow movements that don't produce electronic sound alternated with sparse short and quick movements that produce an electronic sound of water boiling of short duration.

Material 2: When The Guiding Voice touches you (Cue 1 L.V.) dance for a maximum of 30 seconds using the same material of your solo in "Gurgles". After finishing your solo, return to performing Material 1.

Silence: When The Guiding Voice cues you with the word "silence" in ASL (Cue 2 L.V), stop moving.

Material 3: After The Guiding Voice cues the percussionist with the sign "voice" (Cue 3 Perc.), move only when The Guiding voice passes by your side and stop moving immediately when The Guiding Voice moves to a different side of the circle.

Material 4: When The Guiding Voice cues you with the sign "voice continue" (Cue 4 L.V.), do a set of 3 wide-ranging movements in loops at a fast speed.

Material 5: When The Luminous Voice cues the pianist (Cue 5 P.) and The Guiding Voice cues the percussionist (Cue 5 Perc.), continue doing the same 3 movements of Material 4 but smaller and slower each time. Move from your original location in the circle to your position in the line indicated in the stage set up instructions.

Conclusion

Following the premiere of *Ululations and Gurgles of the Invisible*, there are particular factors that require consideration for future performances of this piece or for the future creation of other interdisciplinary performances.

Even when the performers are brilliant and extremely professional, an adequate amount of rehearsals in the performance space is essential for a successful realization of the piece. When working with lighting design, video projection, stage set up, sound technology and multiple performers from different disciplines, it is necessary to provide adequate time for technical set up and to rehearse all aspects of the performance. A minimum of two run-throughs of the piece is necessary before the performance. This is especially important when elements are integrated and depend on each other to be triggered or performed, and when everybody needs to know the piece in detail in order to participate fully in the performance. In an interdisciplinary piece without breaks but rather continuous transitions, where all participants are located next to the stage, it is essential to provide rehearsal time with all parties involved.

In addition, a good environment needs to be generated for all performers so they feel welcomed and have time to familiarize themselves with the particular space. This is especially important for dancers. When working with performers from different disciplines, it is necessary to know what are the conditions that performers need in order to give their best and try to fulfill their roles. This will definitely avoid confrontations that can be harmful to the performance.

Before the dissertation presentation, there was an initial performance of an extended

version of ”Gorgoteo” (”Gurgles”, the second section of the dissertation piece) at the Calit2 Theater through the IDEAS Performance series, in June 2018, and subsequently a performance of the full dissertation piece *Ululations and Gurgles of the Invisible* at the Conrad Prebys Music Center Experimental Theater in November 2018. After these two performances in which I worked with different production teams, I came to the conclusion that a minimum of five consecutive days of rehearsals in the performance space, with staff available, is extremely important.

To compensate for the lack of rehearsal time, all performers were sitting next to the stage, witnessing all sections of the rehearsal even when they weren't performing. This enabled them to establish a better connection between the section when they were performing and the other sections when they were not. In the end, this benefited the overall performance significantly.

While running sound for the dance rehearsals of the second section, ”Gurgles”, I realized some important aspects to consider for future research. The realization of the complete dissertation wouldn't have been possible without collaborating with the same group of dancers and choreographer on two different occasions. The amount of time I spent with the five dancers, which enabled me to witness the creative process of choreographing and rehearsing, was crucial.

Dancers are used to working within certain environments and the choreographer organizes the rehearsals in a specific way. They need to be aware of the space in relation to their bodies, get used to the other dancers, their movements and their personal understanding of the piece. In addition, they need a wooden, clean floor. For this they need to practice in a dance studio and they need to spend time warming up, discussing ideas, and improvising together.

In preparation for the first performance of ”Gorgoteo/Gurgles”, the rehearsals took place at a dance studio for almost a month. I provided the audio files for the piece (see ”List of Additional Files”) but they didn't have the wearable controllers during those rehearsals. Dance studios do not have the built-in audio technology necessary for the dancers to familiarize themselves, from the first rehearsals, with the wearable controllers that elicit sounds.

The moment we started rehearsing with the wearable controllers at the performance space,

we realized how important it is for the dancers to spend more time with them, as their interaction with the devices completely altered the work they had done at the dance studio. The use of wearable controllers for guiding light and sound during performance take the dancers out of their comfort zones. They are used to reacting to sound that is played by some other agency, not by their own movements; in ”Gorgoteo/Gurgles” they are the sound producers.

My goal for future research is to collaborate in the creation of wearable controllers that are user-friendly. This would allow dancers to practice with them in their dance studio from the time of their first rehearsal. Those wearable controllers should connect wirelessly to speakers and enable the dancers to press buttons in order to navigate through the different samples already programmed and stored on a memory card.

Finally, I need to point out the importance of working on this piece with a Deaf dancer. Angelo C. I. Ricasata not only performed but also interpreted the two Lorca poems in American and Spanish Sign Language. I recorded videos of him (see ”List of Additional Files”) that I used to compose the different sections and also sent them to the musicians so that they could learn the signs they were going to perform. Ricasata also oversaw all the performers, often correcting their interpretations of the signs. In addition, he answered all my questions about understanding the poems from the signing point of view. Based on this understanding, I decided to write in the music score of ”Betrothal” (see chapter 3) the identity of each sign in a rhythmic notation, instead of only the verse it corresponded to, without any reference other than the video provided. This helped performers who are not familiar with sign language to understand the meaning of the different signs and accompany them with facial expressions that were rhythmically aligned.

The purpose of using sign language by hearing people should never be to appropriate a language and culture for its beauty, or to simply justify a narrative. It is very important to proceed with respect and interest in learning, to ask as many questions as possible, and to collaborate with a Deaf expert. In my dissertation piece I had the privilege to collaborate with the Deaf performer Angelo C. I. Ricasata. My purpose was to include individuals with different backgrounds, to

exchange knowledge and create a performance where all members of the audience, deaf or hearing, feel included in all sections of the piece. For that reason the piece cannot be performed without a minimum of one Deaf performer. In addition, it is essential that the performers who are new to ASL receive tutoring from an interpreter to acquire the correct realization of each of the signs. Watching the videos I provided was not enough as it is a complex language.

Ululations and Gurgles of the Invisible is a piece about the oppression Federico García Lorca suffered. Identified as a woman I felt these things, and interpreted Lorca's poems by adding my personal take. The use of sign language has the purpose of including the Deaf community in a musical experience in a concert hall, as I believe in the social responsibility of inclusion of underrepresented communities. At the same time the signing gestures allowed me to incorporate gestures into my work that had, as the Morse Code, or the selected words from Lorca's writing, or the themes of water and circularity, an underlying meaning that helped to support my artistic vision.

During my time at UCSD I have been part of numerous collaborative projects as a composer and also as a performer. In the last year of my PhD studies I had the opportunity to lead projects in which I worked in collaboration with experts in different areas. I led a research group of graduate students including an electrical engineer, a materials engineer, a dancer, a computer musician and myself as a composer. Our project was to create "a performance controller for dancer based on electrochemical and biological feedback" (see appendix D). While it was an enriching experience, the challenges of this collaboration were multiple. One of the challenges was to motivate a dialogue across different disciplines. Communication is of the utmost import. Sometimes, we are so immersed in our own disciplines that we forget others do not share the same knowledge; important aspects are not communicated because they are so basic to our own discipline that we assume others know about it as well.

One example of this was when Jayoung, the materials engineer, took us on a tour of her laboratory. This is when we learned that the sensors she was making are disposable. This

information was extremely important because this meant that the sensors had an expiration date of a week and they could be used only once. This information came up when we asked questions during the lab tour, while in our previous meetings in a conference room it was never brought up because she assumed we already knew this. Another example is when the rehearsals with the dancers started and we were using other sensors in addition to the new biosensor created for the project. Only when they attended the rehearsals and actually the dancers began to perform did they fully understand the concept of the piece, how sounds were created and modified and how dancers were to work. The engineers were not aware of the amount of preparation and rehearsal necessary for music technology and dance until this point. After these multiple challenges, I saw how important it is to invite opportunities for dialogue through experiences outside the conference room. Attending a music or dance performance and going on a lab tour helped us establish this dialogue.

As covered in the previous paragraph, communication is very important to create a good collaborative environment. In the previous paragraph I talk about a lack of communication and the solution I found for it. While working as the artistic director of my dissertation piece I encountered a different challenge - an excess of participation from the choreographer. I was constantly receiving feedback and new ideas for the piece that were distracting and far away from the clear concept I had created ”for the dancers to be musicians”. This created tensions and frustration as the choreographer did not feel fulfilled because she was not the central part in the artistic direction. To address this challenge, I firmly stuck to my vision, as it was based on my years of research. On the other hand, when there were conflicting ideas presented by one of the collaborators, I had to act with extreme patience and, sometimes, to sacrifice some of my views as an artistic director in order to have the performance take place. For example the colors and costumes of the dancers - I had imagined they would be light blue, white and metallic colors, but that did not happen.

Finally the multiple challenges I faced to create and have performed an interdisciplinary

piece with multiple collaborators didn't discouraged me to continue pursuing this path in my career. I am highly motivated to continue research into how to incorporate new wearable technologies to control electronics by the movement of the performers. I learned how important it is to have firm ideas based on knowledge, but at the same time be open to the enhancement of those ideas through the expertise of my collaborators. I also learned how important it is to work with collaborators whose line of work is parallel to mine, or collaborators who easily adapt to any line of work. Furthermore, in a social dimension, I realized how important it is to develop a non-confrontational personality in which patience, kindness, confidence and authority are important values.

Appendix A

Concert Program of Ululations and Gurgles of the Invisible

Ululations and Gurgles of the Invisible

an interdisciplinary piece composed by Elisabet Curbelo

Based on poems by Federico García Lorca

Silent Boy, CHRISTOPHER CLARINO, percussion and American Sign Language

Guiding voice, ANGELO C. I. RICASATA, dance, American and Spanish Sign Language

Luminous voice, VERONICA SANTIAGO MONIELLO, dance and choreography

High voice, EMILY AUST, dance

Middle voice, ANNE GEHMAN, dance

Low voice, MANUEL GONZÁLEZ ESQUIVEL, dance

Shadow, KYLE ADAM BLAIR, piano and American Sign Language

Queen of the crickets, KIRSTEN ASHLEY WIEST, soprano and American Sign Language

***

Justin Beets, lighting designer

Colin Zyskowski, sound and software assistant

John Burnett and Maya VanderSchuit, video

Jacob Halpern Weitzman, stage manager

***

The Silent Boy

The little boy was looking for his voice.
(The king of the crickets had it.)
In a drop of water
the little boy was looking for his voice.

I do not want it to speak with;
I will make a ring of it
so that he may wear my silence
on his little finger

In a drop of water
the little boy was looking for his voice.

(The captive voice, far away,
put on a cricket's clothes.)

Betrothal

Throw that ring
into the water.
(The shadow places its fingers
on my back.)

Throw that ring. I am
more than a hundred years old. Silence!

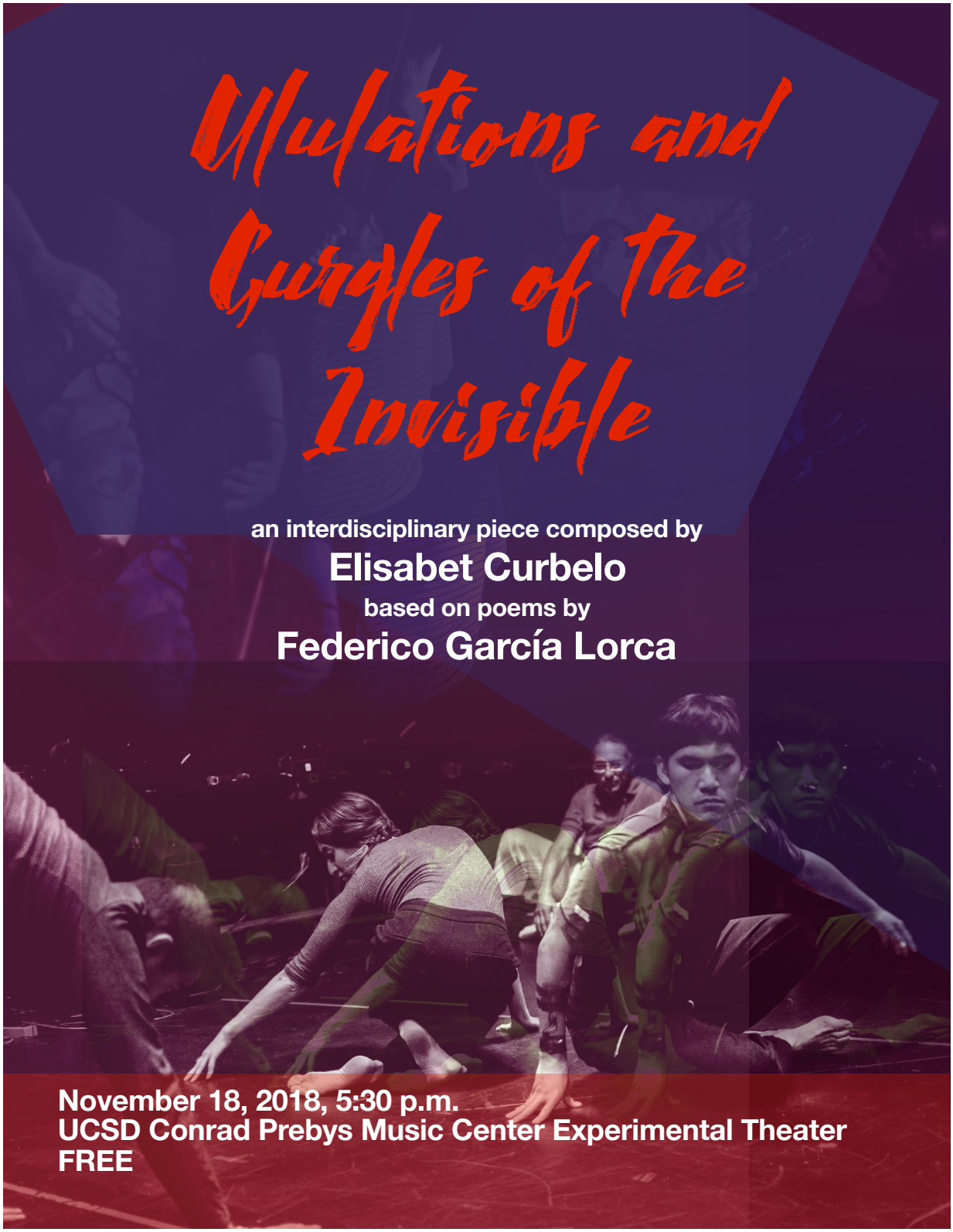
Don't ask me anything!

Throw that ring
into the water.

For program notes go to http://www.elisabetcurbelo.com/elisabetcurbelo/Ululations.html

Appendix B

Concert Flyer of Ululations and Gurgles of the Invisible


Ululations and Gurgles of the Invisible
an interdisciplinary piece composed by
Elisabet Curbelo
based on poems by
Federico García Lorca
November 18, 2018, 5:30 p.m.
UCSD Conrad Prebys Music Center Experimental Theater
FREE

Appendix C

Score of L'anello

Notation

Wind

 Air without pitch.

 Slap tongue.

 Flutter tongue.

 Glissando from E to the highest pitch possible in your instrument.

 Whole notes with fermata and breath mark. If circular breathing is possible it is preferable. If not, move in and out of the breathing rest pianissimo. Cuts shouldn't be noticeable.

Strings



White noise. Play softly muting the strings.

 Grotesque vibrato. Wide vibrato with undulating pitch.

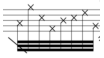
 Over pressure and mute strings

 Glissando from highest to lowest pitch on the string I.

 Move the bow quickly in circular motion while muting strings.

 Move the bow quickly from behind the bridge to *sul tasto*.

 Highest pitch possible in your instrument including harmonics.

 Over pressure on random strings using the indicated rhythm.

 Slap on the fingerboard.

 Harmonics glissando.

Description of the piece

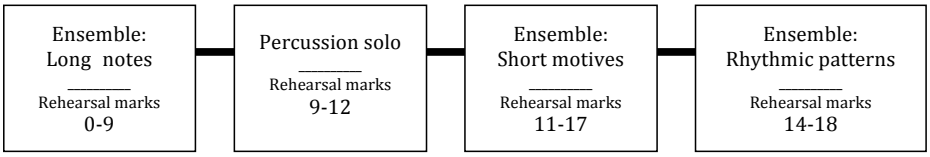
L'anello (the ring) is a piece about sound, space and the choreographic gestures of the conductor who is also a soloist. The piece was inspired by the multifaceted work of Steven Schick. Here the gestures of the conductor mix traditional conducting movements with different gestures and movements created to indicate changes in volume, articulation and the spatialization of sounds in certain parts of the piece.

The name of the piece not only suggests the positions of the instruments and the conductor on the stage but also the form, timbre, texture and pitch content of the piece. The soloist is located in the middle of the ensemble arrangement as a diamond in a solitaire ring. The sound at the beginning emerges from silence and, at the end, it disappears as the shank of the ring disappears behind the finger as we view it. The soloist, using only high, non-pitched percussion instruments, suggests the multiple facets of a diamond.

In addition, when the soloist moves, playing at different sides of his station and the sound of the ensemble is spatialized, it suggests the way a diamond shines when the ring moves. The entire piece was composed thinking of shapes and their movements. The textures where constructed through the creation of a matrix which distributes pitch, articulation, accentuation, the placement and duration of the rests in particular ways. The composition process started with the soloist's materials without clear pitch structure and moved out into the instrumental groups at his side, where the harmonic content is greater than at the beginning or end of the piece. There, all instruments play the same note: B at the beginning and E at the end.

Form of the piece

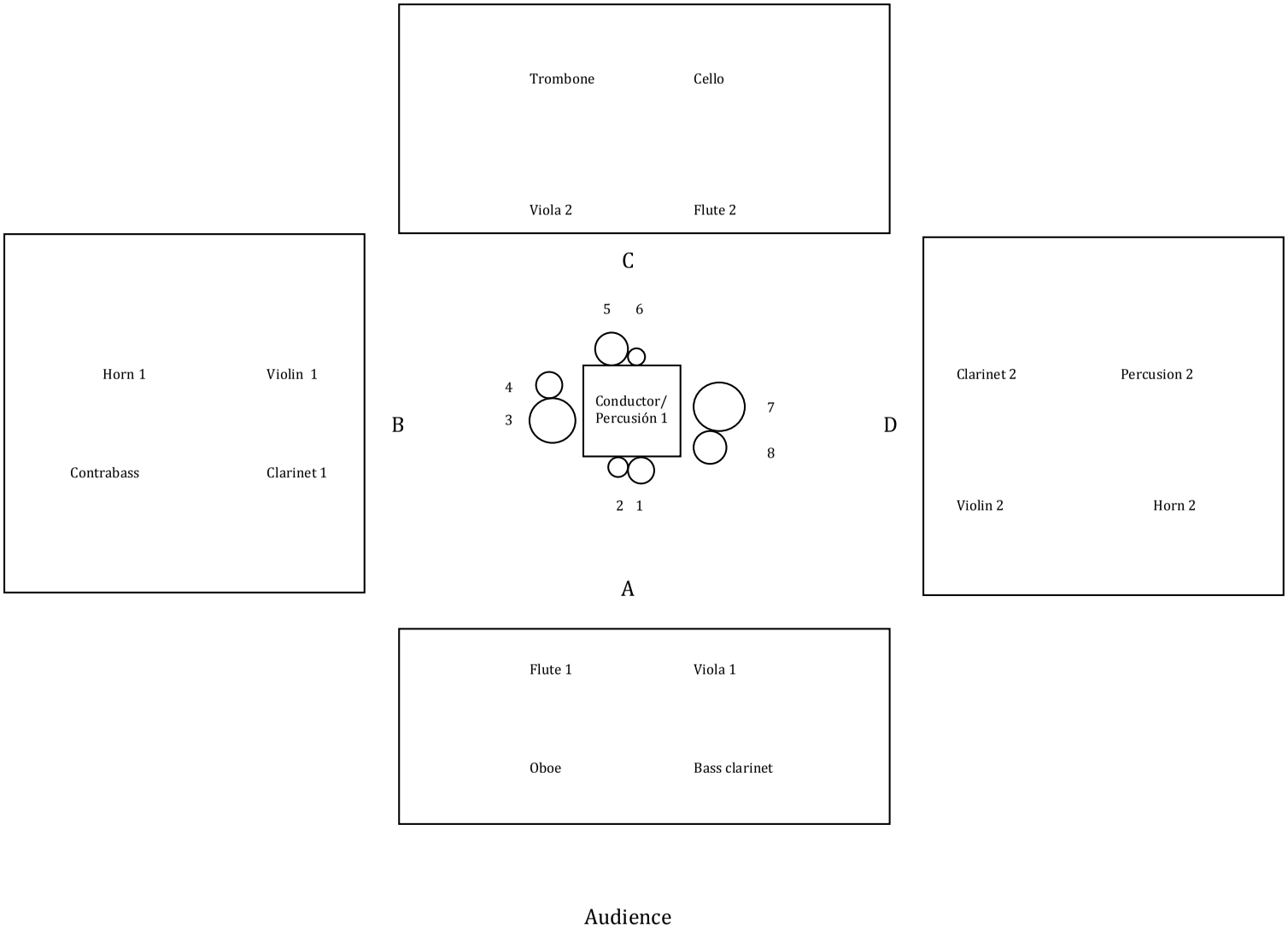
Approx. 12 min.



Pitch content:

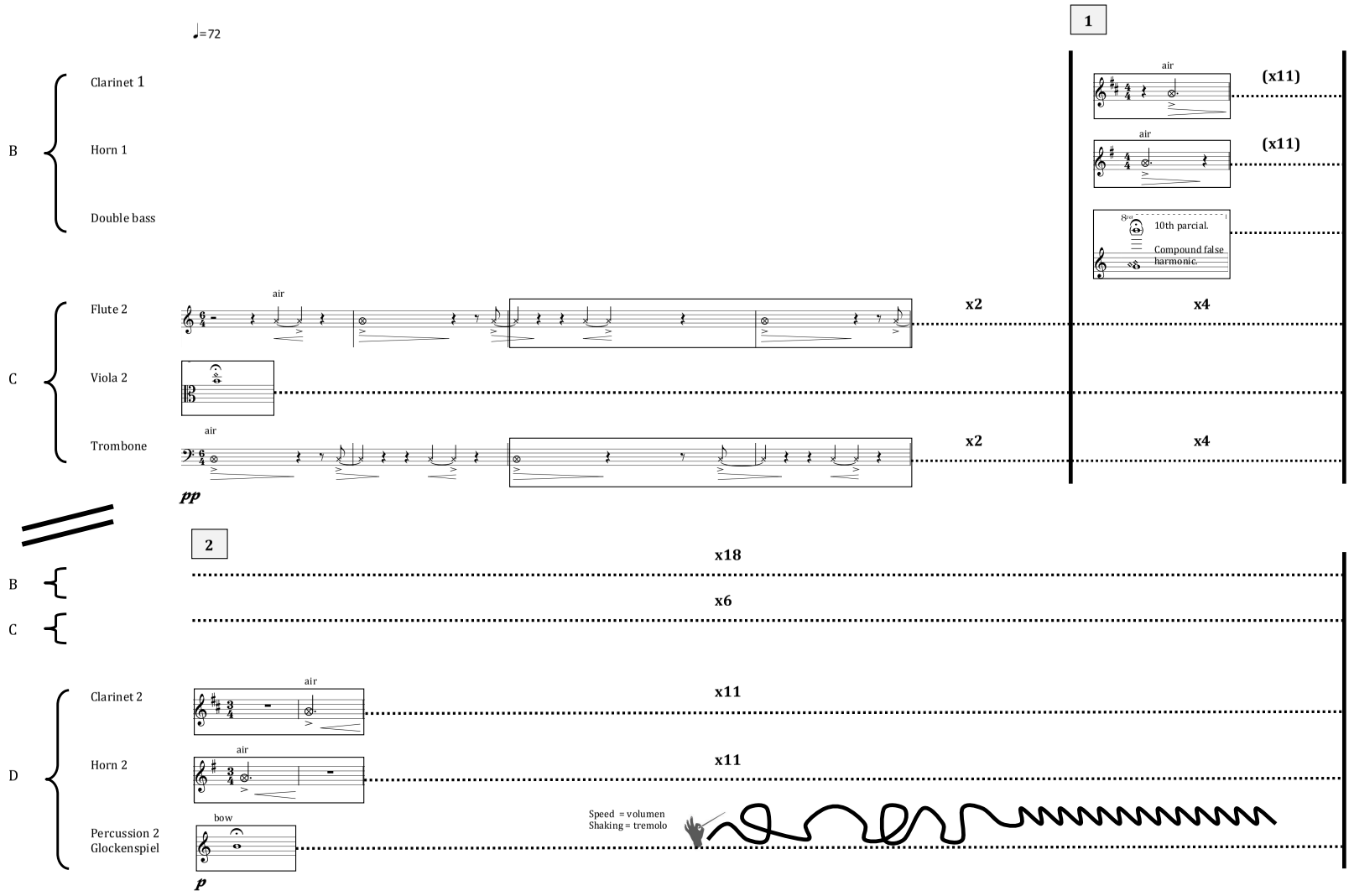
B Bb-C D,D#, F, F# E

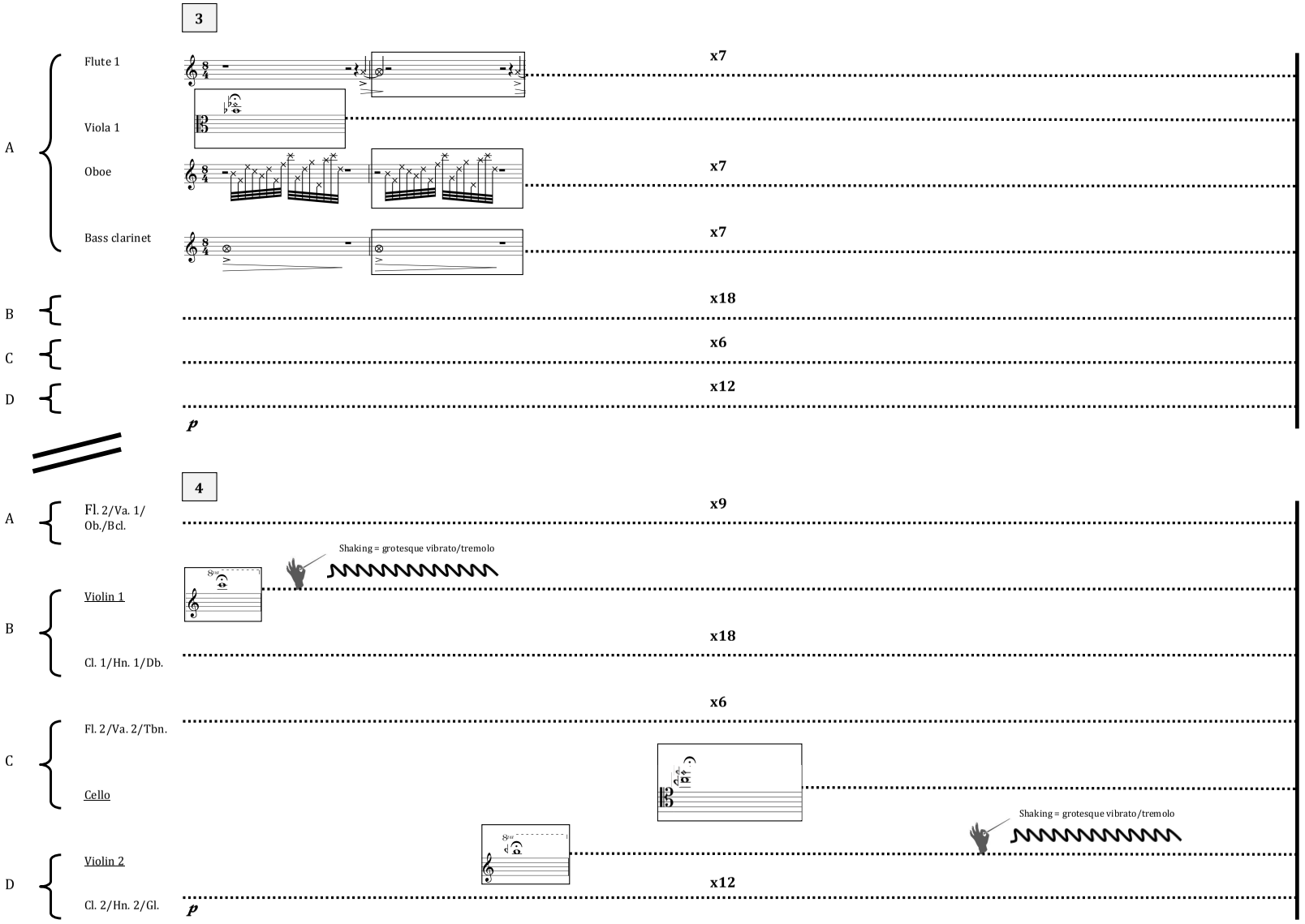
¼ tone cluster


Trombone
Cello
Viola 2
Flute 2
C
Horn 1
Violin 1
Contrabass
Clarinet 1
B
5
6
4
3
Conductor/
Percusión 1
7
8
2
1
D
Clarinet 2
Percusion 2
Violin 2
Horn 2
A
Flute 1
Viola 1
Oboe
Bass clarinet
Audience

L' anello

Elisabet Curbelo
San Diego, March 2018




3
A
Flute 1
Viola 1
Oboe
Bass clarinet
x7
x7
x7
B
x18
C
x6
D
x12
p
4
A
Fl. 2/Va. 1/
Ob./Bcl.
x9
Shaking = grotesque vibrato/tremolo
B
Violin 1
x18
Cl. 1/Hn. 1/Db.
x6
C
Fl. 2/Va. 2/Tbn.
Cello
Shaking = grotesque vibrato/tremolo
D
Violin 2
x12
Cl. 2/Hn. 2/Gl.
p

5

A

Fl. 2/Va. 1/
Ob./Bcl.

x9

x18

B

Vn. 1/Hn. 1

Clarinet 1

x17

Speed = volumen
Shaking = tremolo/grotesque vib.

Double bass

C

Flute 2

x5

Cello

jeté
bh. b.

pizz.

Tbn./Va. 2

x6

x12

D

Vn. 2/Hn. 2

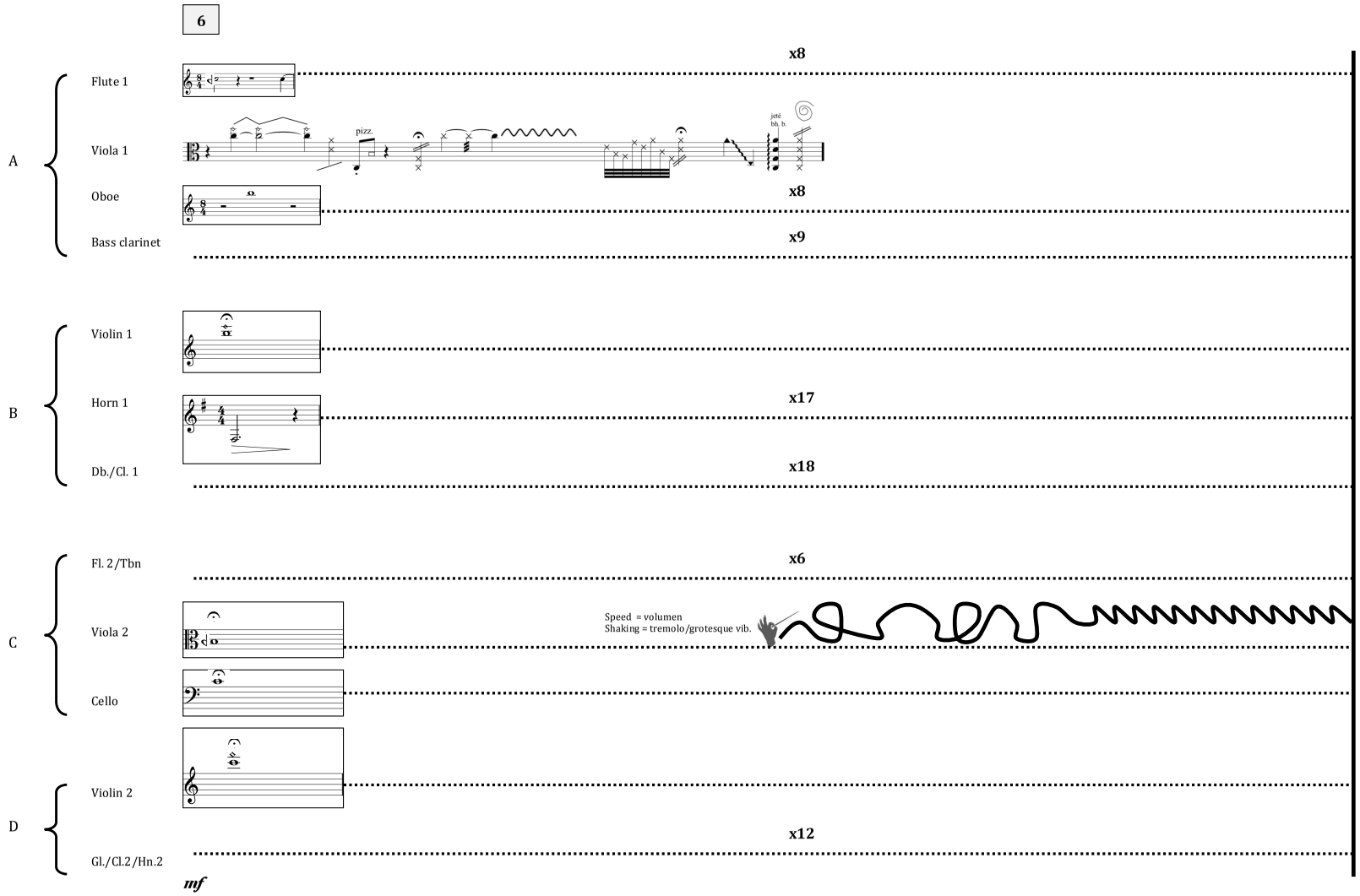
Clarinet 2

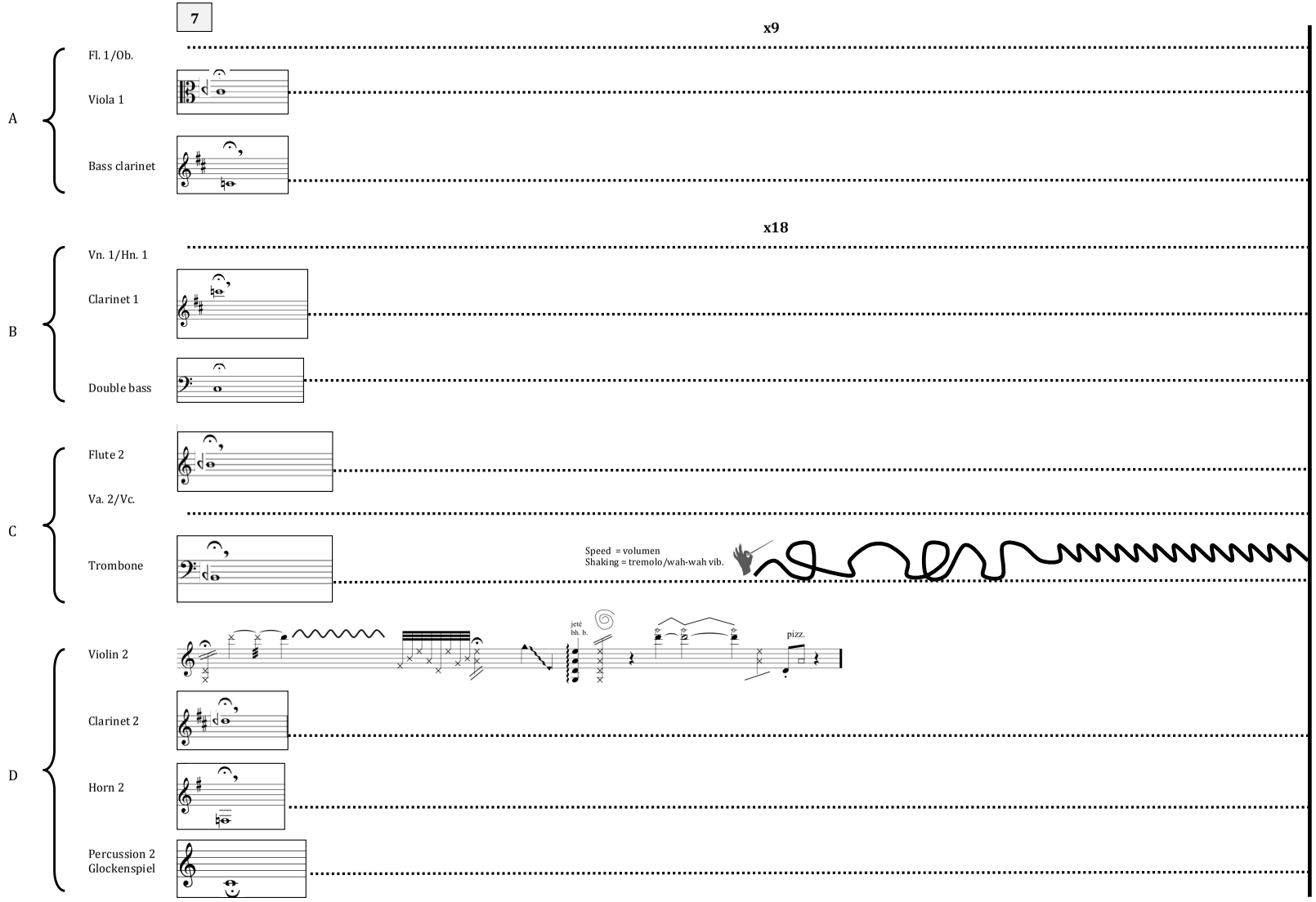
x11

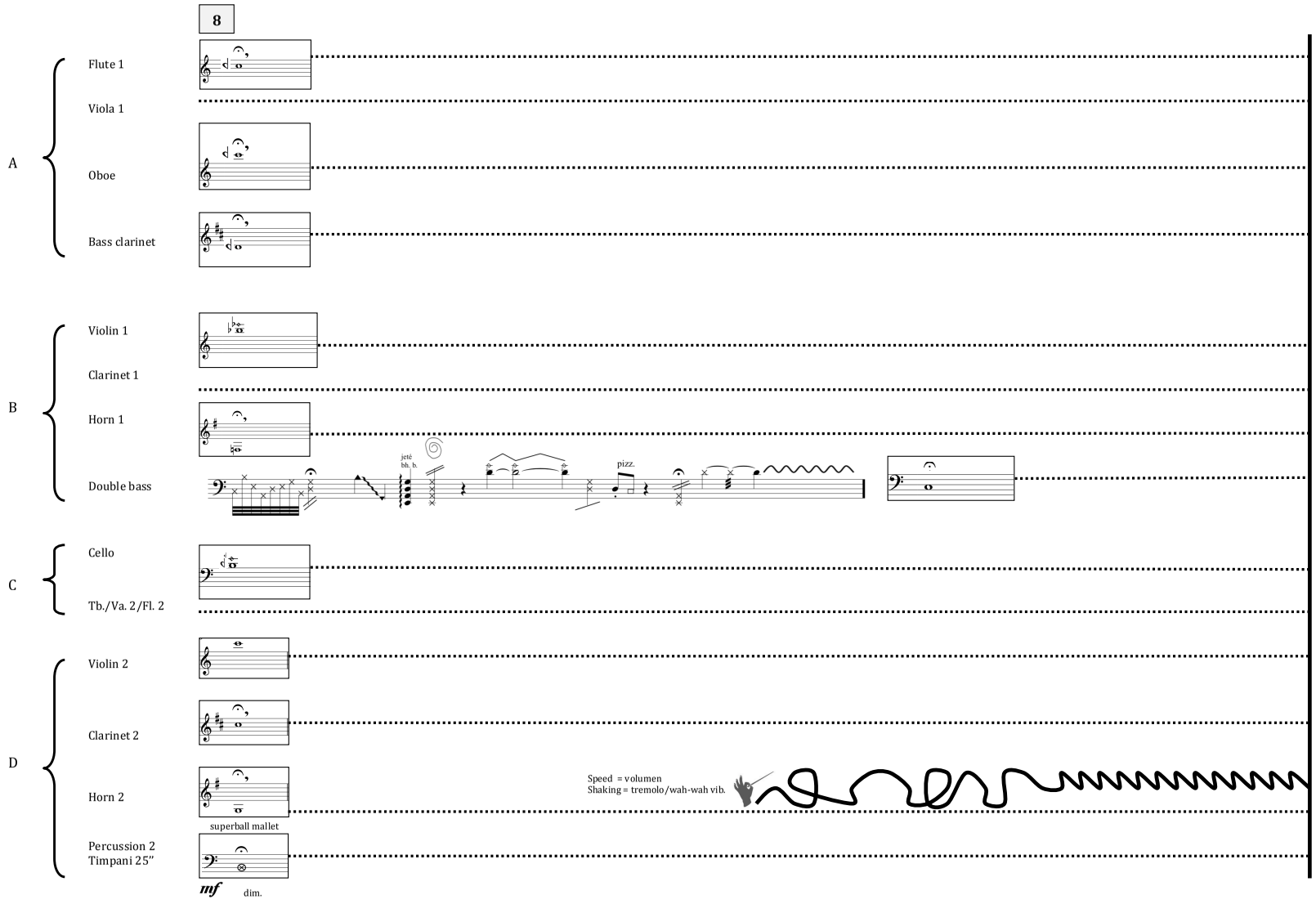
bow

Percussion 2
Glockenspiel

mp


6
A
Flute 1
Viola 1
Oboe
Bass clarinet
B
Violin 1
Horn 1
Db./Cl. 1
C
Fl. 2/Tbn
Viola 2
Cello
D
Violin 2
Gl./Cl.2/Hn.2
pizz.
jeté
bh. b.
x8
x8
x9
x17
x18
x6
x12
Speed = volumen
Shaking = tremolo/grotesque vib.
mf


7
x9
A
Fl. 1/Ob.
Viola 1
Bass clarinet
x18
B
Vn. 1/Hn. 1
Clarinet 1
Double bass
C
Flute 2
Va. 2/Vc.
Trombone
Speed = volumen
Shaking = tremolo/wah-wah vib.
D
Violin 2
jeté
bh. b.
pizz.
Clarinet 2
Horn 2
Percussion 2
Glockenspiel
mf


8
A
Flute 1
Viola 1
Oboe
Bass clarinet
B
Violin 1
Clarinet 1
Horn 1
Double bass
jeté
bh. b.
pizz.
C
Cello
Tb./Va. 2/Fl. 2
D
Violin 2
Clarinet 2
Horn 2
superball mallet
Percussion 2
Timpani 25"
mf
dim.
Speed = volumen
Shaking = tremolo/wah-wah vib.

Conductor/Percussion 1 solo

9

The cues to individual instruments indicate they have to stop playing.



10

Solo percussion





Cue the ensemble to play only when soloist is playing on their side

11

Cue the ensemble to play only when soloist is playing on their side

30"



Play the sextuplets approximately following the pattern above. Play most of the notes in the odd instrument using the even instrument only for the accentuated notes. Transition to a different side of instruments only after playing the even instrument. Move to the different sides in different directions and in the wished order. It is possible to stay longer playing in one side than what is shown in the example.

12



Playing in the air while looking at the group of instrumen on that side. This cue indicates the group continues playi after the conductor moves to a different side.

10"





15"





10"





11 Play only when the conductor plays percussion on your side.

12 Play continuously after the conductor plays in the air facing your side. Repeat until new cue.

(approx. 1 min.)

A
- Flute 1
- Viola 1
- Oboe
- Bass clarinet

B
- Violin 1
- Clarinet 1
- Horn 1
- Double bass

C
- Flute 2
- Viola 2
- Cello
- Trombone

D
- Violin 2
- Clarinet 2
- Horn 2
- Perc. 2:
  Glockenspiel
  Timpani 25''
  Hi-hat cymbals



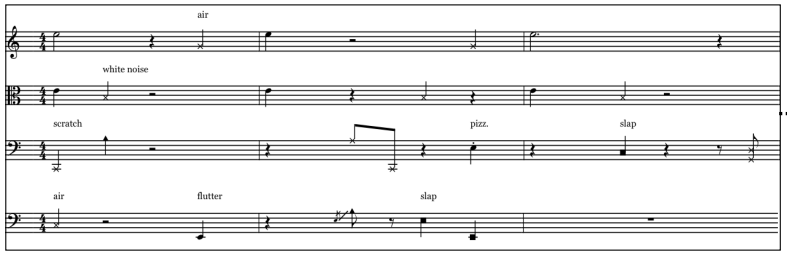

13
Repeat in order until new cue (approx. 1 min.)
A
B
C
D
Flute 1
Viola 1
Oboe
Bass clarinet
Violin 1
Clarinet 1
Horn 1
Double bass
Flute 2
Viola 2
Cello
Trombone
Violin 2
Clarinet 2
Horn 2
Perc. 2:
Glockenspiel
Timpani 25''
Hi-hat cymbals
mf
bow

14

A — Fl. 1/Va. 1/Ob./B.cl.

B — Vn. 1/Cl. 1/Hn. 1/Db.

C — Flute 2 / Viola 2 / Cello / Trombone



D — Vn. 2/Cl. 2/Hn. 2/Prc. 2

f

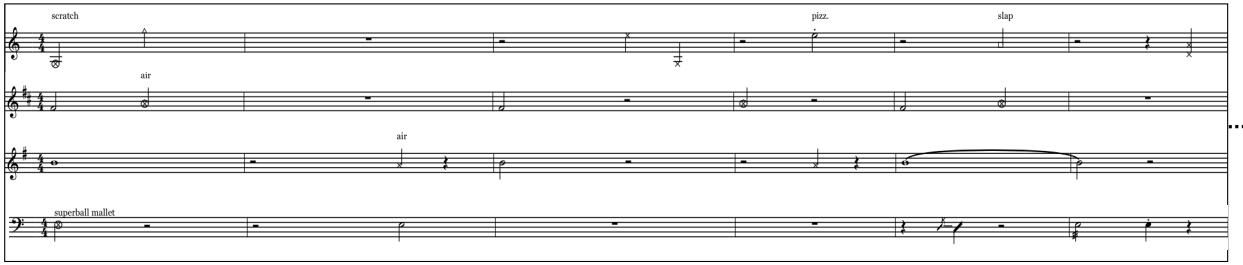
15

A — Fl. 1/Va. 1/Ob./B.cl.

B — Vn. 1/Cl. 1/Hn. 1/Db.

C — Fl. 2/Va. 2/Vc. 2/Tb. 2

D — Violin 2 / Clarinet 2 / Horn 2 / Perc. 2: Timpani 25'' Hi-hat cymbals



f dim.

16

A

Flute 1 — air — flutter — slap

Viola 1 — scratch — pizz. — slap

Oboe — air

Bass clarinet — air

B

Vn. 1/Cl. 1/Hn. 1/Db.

C

Fl. 2/Va. 2/Vc. 2/Tb. 2

D

Vn. 2/Cl. 2/Hn. 2/Prc. 2

mf dim.

17

A

Fl. 1/Va. 1/Ob./B.cl.

B

Violin 1 — white noise

Clarinet 1

Horn 1 — air — flutter — slap — sucked pitch

Double bass — scratch — pizz. — slap

C

Fl. 2/Va. 2/Vc. 2/Tb. 2

D

Vn. 2/Cl. 2/Hn. 2/Prc. 2

mp dim.


18
A
Flute 1
Viola 1
Oboe
Bass clarinet
B
Violin 1
Clarinet 1
Horn 1
Double bass
C
Flute 2
Viola 2
Cello
Trombone
D
Violin 2
Clarinet 2
Horn 2
Percussion 2
Glockenspiel
p
dim.
ppp

Appendix D

Concert Program of Gorgoteo


a multi sensorial piece composed by
Elisabet Curbelo
and choreographed by
Veronica Santiago Moniello
based on a poem by
Federico García Lorca
gorgoteo
June.14, 2018, 5:30 p.m.
UCSD Calit2 Theater, Atkinson Hall

Composer and Artistic Director
Elisabet Curbelo

Choreographer
Verónica Santiago Moniello

Dancers
Emily Aust
Marcos Duran
Manuel González Esquivel
Angelo C. I. Ricasata
Verónica Santiago Moniello

Sign Language
Angelo C. I. Ricasata

Piano
Elisabet Curbelo

Software Engineer
Elliot Patros

Modified WII Remote Wearable Controllers
Yen-Chun Yang

Lactate Sensor and Controller Development
Jayoung Kim
Somayeh Imani

Video Creator
Maya VanderSchuit

Video Design
John Burnett

Lighting Designers
Sam Bedford
Valerie Lam
Eunice Kim

Graphic Design
Javier Fresneda

Photographer
Amy Strauwald

El Niño Mudo (The little mute boy)
By Federico García Lorca

El niño busca su voz.
(La tenía el rey de los grillos.)
En una gota de agua
buscaba su voz el niño.

No la quiero para hablar;
me haré con ella un anillo
que llevará mi silencio
en su dedo pequeñito.

En una gota de agua
buscaba su voz el niño.

(La voz cautiva, a lo lejos,
se ponía un traje de grillo.

**

The little boy was looking for his voice.
(The king of the crickets had it.)
In a drop of water
the little boy was looking for his voice.

I do not want it for speaking with;
I will make a ring of it
so that he may wear my silence
on his little finger

In a drop of water
the little boy was looking for his voice.

(The captive voice, far away,
put on a cricket's clothes.)

Note from the composer
Gorgoteo (the Spanish word for "gurgle") is a multisensory piece where visual and auditory experience are connected not only by their content but also through the use of different types of wearable sensors. The data from those sensors is translated into parameters that process and trigger electronic sounds and and also lighting in different ways throughout the piece. In addition, a new biosensor developed with a grant from a Chancellor's Interdisciplinary Fellowship controls the form of the piece, triggering its four sections by means of detecting the exertion level of one of the dancers. The piece is based on the poem El niño mudo ("the little mute boy") by Federico García Lorca. The poem not only helps to build the narrative of the piece, it is also performed using American and Spanish Sign Language.

The gestural control of sound has existed since the use of the first music instruments. All music instruments need the gesture of the performer to sound. These gestures consist of a performer in contact with physical materials that produce sound. Nevertheless, in group performances, the conductor's collection of gestures don't enter contact with physical materials but control the sound others produce, free-space gestures.

My research interest is focused on free-space gestures as it can encompass disciplines as dance and sign language and make them exist as musical expressions. In this piece the dancers are also music performers.

As a composer specialized in the composition of electronic music, with a background in piano and voice performance, I approach my compositions through my personal experiences as a performer. I was never satisfied with the limited mobility at the performance space and adapting my performance to the speed and volume of the fixed electronics. Thus, I decided to utilize motion controllers so the performer could trigger and process electronic sounds with movement.

The theatrical aspect of a music performance has always been very important to me. It is also obvious when a performer is in a state of musical trance, performing with extreme passion and engagement, what is called in flamenco music "duende".
My goal is to create an interdisciplinary performance of electronic music capable of transmitting even as subtle a factor as the "duende", because all aspects of the performance are connected to and controlled by the movements of the performer. This does not, however, mean that the performance is automatic. The issue is influence, not total control which is still in the composer's hands.

From the perspective of sonification, sensors of this piece can be classified in two ways. They either have a fast or a slow rate of change. For example, gyroscopes, which measure orientation, have a fast rate of change. On the other hand, a lactate sensor which measures sweat level has a slow rate of change. Both types of sensors are useful for controlling music, and in fact they work well together when used to control small and large time scale parameters respectively. The lactate sensor in this piece controls the form of the piece while the accelerometers trigger the samples, change their volume and gyroscopes spatialize the sound.

Note from the choreographer
Throughout this work I have been able to experience the contradictory relationship that I perceive between the body and technology and to answer question from the perspective created by bodies through dance. Questions such as: what does the body want to say? Especially, if we know that there is a possibility of contributing to a memory that is stored outside of the body. Is the protection of these data an inclusive, common, collective process? Or is this a private space in which our voices and experiences are accumulated in such a way that new schemes and formats of coexistence can be created without acknowledging the cost of our labor? And if so, what are these new spaces? From what part of our bodies come from?
What is the rhythm that molds them? Will there be room for being autonomous, visceral, subjective?

Personally, I find fascinating to realize that technology still cannot get anywhere without the human body. Working with sensors has made me navigate the need and the ability of our bodies to be connected in a deeper way beyond the use of devices. Everything that generates human contact exceed any software, yet for me, the paradox lies in-between the intention of an experiment and the existence of its facilitator which operates and generates it.

The comprehension of one body and another that inhabit the same space (or even that are synchronized beyond proximity) surpasses the empathy of what we assume as human and artificial. All that the body cannot yet say and cannot create is more a social convention or a pattern for establishing limits and generating structures of control than an impossibility.

I am very curious about how emotions and our daily practices (those that expose us as sentient beings) are represented in numerical figures or numbers. In Gorgoteo, the fluids and the sweat can express everything that safeguards the body and its rituals while bringing us back the voices and the poetry of characters like Lorca.
I am looking for a parallelism between what we can discover by using technology and how we can return to the magical; re-imagining and understanding that everything we have done and created so far comes from the earth; the place in which we simultaneously inhabit the world of dreams and the dead. Everything that is reflected as matter before us is a hybrid, and is part of a polarity in which we can name the chaos of the unknown and integrate the inorganic as a call of a nature that is mutating. It is a powerful potency to stay in the exploration of everything we want to imagine as nature, assuming and remembering that we are her. Within our elastic capacity to exchange, deliver, move, say, resist and absorb reality, shifting in many directions, experiencing constant change.

About the Lactate sensor
Wearable epidermal biosensor system has been utilized for real-time monitoring of lactate in sweat during the performance. The non-invasive sensor has been fabricated on flexible plastic substrate as a patch type that conforms to the wearer's skin. Monitoring, and data transmission of the sensor is performed by using a wireless instrumentation electronics circuit. The output data is detectable by any Bluetooth Low Energy (BLE) enabled devices. The new skin-worn enzymatic biosensor system, which is embedded in a wristband form factor, exhibits selectivity toward lactate and demonstrates resiliency against continuous mechanical

deformation expected from epidermal wear. The device previously was successfully tested by human subjects for real-time continuous monitoring of sweat lactate dynamics during prolonged body movement. As such skin-worn metabolite biosensor systems can lead to useful insights into physical performance and overall physiological status, here, we are exploiting this device to collect some information regarding the activity, and fatigueness level of the performer, and using this data to define the pace of the music. In this performance, the resulting temporal lactate profiles reflect changes in the production of sweat lactate upon varying the exercise intensity.

Biographies

Federico García Lorca (1898-1936) is a well recognized Spanish poet and dramatist. He was born in 1898, in Fuente Vaqueros in the South of Spain. Lorca moved to Madrid in 1919 where he entered the Residencia de Estudiantes (Residence of scholars) a meeting place open to creativity, intellectual and interdisciplinary dialogue. While at the residence, he met and collaborated with artists such as Luis Buñuel, Manuel de Falla and Salvador Dalí. One of his collaborations with Manuel de Falla was fundamental to avoid the decadence of flamenco in Spain, the creation of Cante Jondo Competition. Lorca's two most successful poetry collections were Canciones (Songs) and Romancero Gitano (The Gypsy Ballads). He was executed by fascist forces at the beginning of the Spanish Civil War.

Elisabet Curbelo is a Spanish composer and performer born in Gran Canaria. She studied piano pedagogy, voice and composition in her hometown, Madrid and Istanbul. Today she pursues a PhD in Composition at UC San Diego under the advisory of Roger Reynolds.
Elisabet's work and dedication has been valued throughout her career by diverse institutions, as she has been awarded numerous grants, prizes, and commissions. Her pieces have been performed in Spain, Turkey, USA, Germany, Switzerland and Holland. Her research focuses on the use of sensors to control electronics with movement and the use of extended vocal techniques based on her research of Middle Eastern music and culture. For more information visit www.elisabetcurbelo.com

Verónica Santiago Moniello is a Venezuelan-Italian choreographer and dancer currently based in the south of California and Mexico. She holds an M.F.A. Master of Fine Arts in the Theatre & Dance Program at UCSD, the University of California San Diego (U.S.) and a B.A. in Dance Making by the Folkwang Universität der Künste, Essen (Germany), where she was part of Pina Bausch's "Le Sacre Du Printemps" repertoire.
Her projects have been presented in Mexico, Venezuela, Belize, Germany, Czech Republic, Lithuania, Spain and the U.S.
https://vimeo.com/veronicasantiagomoniello www.habitualhabitual.com

Manuel González Esquivel dances almost every day, shows up for as many dance performances as he can and enthusiastically embraces all practices designed to enhance somatic awareness. Currently, researches best practice applications of Liz Lerman's Critical Process to the dramaturg in dance creation. Believes in the power that our emerging artists have to "dis-identify" us from mass hypnosis by weaving technology, art, and "flash mobs". Manuel has decided to stay young for as long as he can.

Angelo Ricasata is a San Diegan native, a first-generational Filipino-American, and a Deaf/Hard of Hearing individual, with a Bachelor of Architecture Degree from Cal Poly Pomona. Although he has minimal experience of professional dancing, he has an innate ability as a dancer, quickly adapting to the various styles of dance. Among his favorite styles are Latin ballroom and social dancing, urban/hip-hop, and several cultural dances. This project is the first time he is invited to take on an interpretive dance approach, though he had experimented with modern and contemporary dances in his own time. Aside from dancing, he has played the violin for 15+ years, coming from a family with a strong musical background. He also likes to experiment a concept of combining ASL and Dance, as they both stress the notion of expression of the body.

Emily Aust holds an MFA in Dance Theatre from the University of California San Diego. Her primary dance and performance studies include: Contemporary Dance techniques; Improvisation ensemble collaboration, Contact Improvisation, writing and Classical and Contemporary Theatre performance techniques. Her current research is linked through embodiment practices and community interaction. She seeks engagement in dance making that serves to cultivate an embodied relationship between place, people and their environment in order to effect change in the ways we know the world. I am continuously humbled and amazed by the generosity and talent of artists and collaborators that come together again and again to create together. Thank you

Marcos Duran is pursuing an MFA in Dance Making and Performance at UC San Diego. Focusing on the movement of the craniosacral system, he is drawn to stories that lie within the human skeleton. From 2012 - 2017 he directed and performed in the Brooklyn based Marcos Duran Performance Group, and was invited to share work throughout New York City at venues such as Movement Research at The Judson Church, La MaMa Experimental Theater, Dixon Place, and Center for Performance Research. Marcos has been supported by a 2013 - 2017 Andrew W. Mellon Foundation Artist Residency at Center for Performance Research in Brooklyn. He holds a BFA in Dance from UC Santa Barbara, Pilates certifications, and studies CranioSacral Therapy through the Upledger Institute.

Somayeh Imani received the B.S. degrees (Hons.) in both electrical engineering and biomedical engineering from Amirkabir University of Technology (Tehran Polytechnic) in Tehran, Iran, and the M.S. degree in electrical engineering from the University of New Mexico, Albuquerque, NM, USA, in 2013. She is currently pursuing the Ph.D. degree in electrical and computer engineering at the University of California San Diego, La Jolla, CA, USA. She is working under the supervision of Prof. Patrick Mercier in Energy-Efficient Microsystem lab, and her current research interests include low-power circuit design for wearable applications, sensor interfaces, energy-efficient analog and mixed-signal circuit design.

Jayoung Kim is a PhD candidate in the Material Science and Engineering Program at University of California San Diego (UCSD), currently studying in Dr. Joseph Wang's

group. Her research interests lie in the development of wearable electrochemical devices for healthcare applications. She received her B.S. and M.S. in chemistry from Yonsei University, Korea with a focus on developing nanomaterial-based composite film for electrochemical biosensors.

Elliot Patros holds a BFA in new music composition from the University of Wisconsin Milwaukee. There he wrote multichannel electroacoustic pieces, and improvised with diy software/hardware setups. Now Elliot is a PhD candidate in computer music at the University of California San Diego. His current research focuses on acoustic beamforming for transaural audio production, and on the interpolation of head-related transfer functions for binaural synthesis. In spare moments, he develops software for batch editing audio files, and has also written a number of plugins for popular real time audio softwares. Elliot enjoys collaborative projects with composers and artists, and thinks MATLAB is a DAW.

John Burnett (b. 1993) is a multimedia artist based in San Diego, California. Drawing from a background in music composition, sound design, and technology, they create technologically-augmented, reactive installation and concert works that derive their materials from the present environment or synthesize new virtual/hybrid spaces. John is also a member of the Sonic Arts research team, based in the Qualcomm Institute at UC San Diego, where they research audio-spatialization and audio-visual technology. John is a graduate of Oberlin Conservatory and is currently attending UC San Diego in pursuit of a PhD in music.

Maya VanderSchuit is an MFA Visual Arts candidate at UC San Diego in the Visual Arts department. She received her B.A. from the University of San Diego (USD) with a double major in Visual Arts and Art History. VanderSchuit has exhibited her work at San Diego Art Institute, UCSD's Visual Arts Gallery, Birch Aquarium, IKO Studios in Los Angeles, USD's Visual Arts Gallery. Her work has been awarded the SURE Grant and AS Grant. VanderSchuit's recent work uses the surfaces of digital video projections and iridescent materials to explore the body's ontological relationship to real and virtual spaces. The time-based installations juxtapose the real and the virtual by extending screen space into actual space.

Valerie Hao Lam (Light Designer) is a third-year undergraduate Theatre major from Los Angeles. This is her first year at UCSD after transferring from Pierce Community College. UCSD credits: 53% Of (ALD),
The Skriker (ALD), VCN 2018 Daydreamers (LD). PCC credits: Tartuffe (LB op), Harum-Scarum Dance Concert (LB op), Tales, Myths, & Fables Dance Concert (Projection and Follow Spot op), Hairspray! The Musical (Property Master).

Sam Bedford is an undergraduate theatre major at UC San Diego focusing on stage management. After transferring from Palomar Community College with an A.A. in technical theatre, Sam came to UCSD to continue studying and refining his stage management, play writing and design skills. Recent productions include Into the Woods (Patio Playhouse Community Theatre), Women in Black (California State University San Marcos), Clybourne Park (Palomar College), The Green Cockatoo (UCSD Department of Theatre and Dance), Othello (UCSD Department of Theatre and Dance) and Wolfiilieder (UCSD Music and Visual Arts Department).

Eunice Kim (Associate Lighting Designer) is a fourth year undergraduate. Threatre major and Film production minor. UC San Diego Credits: Mothers(WNPF 2018, ALD), MFA One Acts (WNPF 2018, ALD), Peer Gynt (ALD), Revolt. She said. Revolt Again (Light Board Op.), Green Cockatoo (Sound Board Op.)

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Appendix E

Chancellors Interdisciplinary Collaboratories Grant Proposal and Progress Report

Title

A performance controller for dancer based on electrochemical and biological feedbacks

Abstract

Modern works in sonification attempt to convert data from sensors into musical parameter streams. In a collaboration between UCSD scientists and artists, we propose to adopt a novel wearable health and fitness sensor into a new work for music and dance. The sensor, which marks a significant contribution toward overcoming the trade off between nonrestrictive form factor and the ability to measure hybrid data sets, will be used to monitor dancers' fatigue. This data will control musical parameters in real time, creating an artistically interesting feedback loop, and providing a mature test platform for the sensor.

Description

The use of performer's body movements to control electronic music is not a new concept; it has existed since the past century. Artists interested in this concept have taken advantage of the creation of new sensors, their development and commercialization to pursue the creation of motion controlled electronic music. In the early eighties the pioneer Michel Waisvisz, together with engineers a STEIM (Studio for Electro-Instrumental Music) in Amsterdam created *The Hands*, an instrument made with pressure sensors, ultrasonic sensors, dials and switches on the hands. *The Hands* was an instrument very sensitive to gestures that permitted to control the electronic sounds in an intuitive way. The first time Michel performed with *The Hands* was in 1984 at the Concertgebouw in Amsterdam, over the years the numerous pieces he composed for *The Hands* changed radically.

In 1982 Thomas G. Zimmerman while at MIT filed a patent (US Patent 4542291) on an optical flex sensor mounted in a glove to measure finger bending. He continued developing this technology to create the *Data Glove* that in 1989 was released by Nintendo as the *Power Glove*, where the player moved a glove controller around to control games. Many sound artists modified the *Power Glove* to create their own instrument such as the *SonoGlove*, *Chromasone* and *The Lady's Glove*. These instruments were used in performances and developed to satisfy the creative necessities of their creators. They are some of the first wearable motion-based music controllers, however over the years so many other sensors have been created as well as sound artists have been using them, their possibilities in music performances are becoming limitless.

Each artist has his or her own personal ideas as of how to use the body movement to control electronic music. As a composer specialized in the composition of electronic music, with a background in piano and voice performance, I feel the necessity of using the motion of the performer to shape real time electronic music performance. The theatrical aspect of a music performance has always been very important to me. In opera the movement of the singers helps to convey the story. Even in an instrumental performance the audience can see how the movement of the performer influences and is influenced by the sounds we hear. Our empathic investment is shaped by the performer's body. It is even possible to gauge the technical demands of the piece through gesture. It is also obvious when a performer is in a state of musical trance, performing with extreme passion and engagement, what is called in flamenco music "duende".

In many electronic music performances, we see the performer static in front of a computer pressing a few keys while the music we hear is very intense music. The movement of the performer is not visually related to the music. The goal of this project is to create an interdisciplinary performance of electronic music capable of transmitting even as subtle a factor as the "duende", because all aspects of the performance are connected to and controlled by the movements of the performer. This does not, however, mean that the performance is automatic. The issue is influence, not total control which is still in the composer's hands.

Recently, UCSD's Department of Electrical and Computer Engineering together with the Department of nanoengineering have developed a wearable chemical-electrophysiological hybrid bio-sensing system. This system offers simultaneous real-time monitoring of a biochemical (lactate) and electrophysiological signal (electrocardiogram) for more comprehensive fitness monitoring that from physical or electrophysiological sensors alone. The researchers in Nano and ECE departments have also earlier introduced other wearable

applications, particularly real-time health, fitness and alcohol levels monitoring. In collaboration with ECE and Nanoengineering, the UCSD Music and Theatre & Dance Departments intend to expand on the field of arts performance and music composition using bio-feedback.

The five members of our research group present a balanced combination of skills to secure the success of this project. Elisabet Curbelo Gonzalez is the composer of the music and the responsible for the gestation of the idea. Elliot Patros, computer musician, is responsible for mapping data from the sensors to be useful in music software. Somayeh Imani, an electrical engineer co-author of the paper on the wearable chemical–electrophysiological hybrid biosensing system is responsible for developing electronic circuits to collect information from the body. Jayoung kim is a PhD candidate in Material Science and Engineering Program who will work on designing electrochemical sensors. Veronica Santiago Moniello is a dancer choreographer. Her role in this project is going to be either as a dancer and choreographer of a group of dancers.

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Progress report

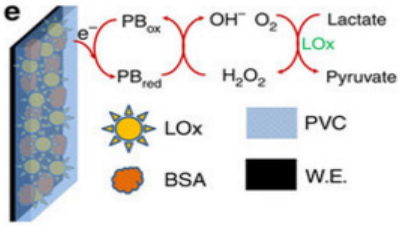
A performance controller for dancer based on electrochemical and biological feedback

1. Objective : Develop a wearable biosensor for lactate monitoring of sweat for a dancer to wear during performance.

2. Significance : Lactate is a physical stress marker, it can be used to track an individual's performance and exertion level, and is also an important biomarker for tissue oxygenation and pressure ischaemia.

3. Electrochemical lactate sensor

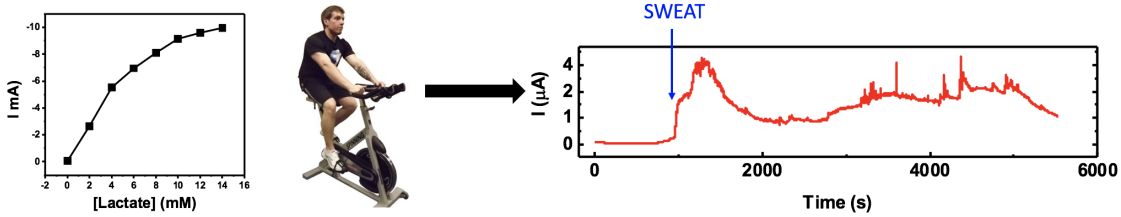
a) Electrodes are fabricated on Flexible plastic (PET) substrate using screen printing technique





b) Printed electrodes are modified with lactate oxidase enzyme that reacts with lactate selectively. A lactate signal was recorded by reading current level by applying -0.2V to the sensor to read the electrochemical response.

c) On-body Evaluation during Exercise (indoor cycling)



➔ The prototype sensor was applied to subject while riding an indoor cycling bike. The sensor started to show response (increasing current level) when the subject had enough amount of sweat on his skin, and the lactate level changed with the strength of exertion.

We tested the sensor on a dancer and we saw a similar trend during the dancer's performance showing different levels of lactate production. The differences we observed between indoor cycling bike and indoor dance performance correlated with the amount of movement in the area where the sensor was placed. While a subject when cycling barely moves the chest area, the whole body of a dancer is in constant movement. For this reason it was necessary to do multiple tests with a dancer in order to place the sensor and the circuit board in a position where the amount of noise is minimal.



Due to the interdisciplinary nature of the project, certain group activities had to be organized to introduce the group members to the working process and results that have been obtained in previous projects of the students or in the field of research interest.

In this picture Jayoung introduces her work and previous research on sensors to the members of the group.

University Professor Roger Reynolds facilitated a meeting of our group with R. Benjamin Knapp, Director of the Institute for Creativity, Arts, and Technology (ICAT) and Professor of Computer Science at Virginia Tech. In this meeting Professor Knapp presented his research and performances done on human-computer interaction. He has focused on the development and design of user-interfaces and software that allow both composers and performers to augment the physical control of a musical instrument with direct sensory interaction. In addition our group gave a presentation on our research to Professor Knapp who then gave us valuable advice on how to continue development of the Project.

Our goal for the next year is to add a heart rate sensor to the controller, combine it with other sensors already on the market, such as accelerometers and gyroscope sensors, and to create more of the new controllers to use in a performance with more than one dancer. The sensors and controllers will inform a procedural electroacoustic musical score in real time. The performance of the piece composed as a result of this research has been selected to be premiered at the performance series IDEAS at UC San Diego's Qualcomm Institute. In this performance one or more dancers will control sound, video projections and lights with their movement and exertion level.

The faculty group Jointly affirms that the supported students are making progress toward their degree programs.

Faculty signatures

Prof. Joseph Wang | Prof. Yolande Snaith | Prof. Patrick Mercier | Roger Reynolds, University Professor

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