UNIVERSITY OF CALIFORNIA,
IRVINE

Composing with Sound-Objects: A Methodology

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

In Integrated Composition, Improvisation, and Technology, ICIT

By

George Stockton Wheeler

Dissertation Committee:
Professor Christopher Dobrian, Chair
Associate Professor Amy Bauer
Professor James Steintrager
Professor Kojiro Umezaki

2019

DEDICATION

To the memory of my father who taught me confidence and perseverance, and to my son who continues to teach me balance.

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGMENTS

I would like to express my deepest appreciation to my mentor and committee chair, Professor Christopher Dobrian. Without his steady guidance, this dissertation would not have been possible. It was truly an honor to work with him these past five years. His depth of knowledge, dedication and compassion is an inspiration.

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To Dr. Alan Shockley, for his steadfast encouragement and mentoring before, during, and after this process. My recital was a success in large part to his overly generous contribution. It was an absolute pleasure working with him and his CSULB New Music Ensemble.

To all of my colleagues past and present: to the memory of Steve Moshier for jumpstarting my college career through his mentoring and the demonstration of his craft; to the memory of my dear friend and mentor Dr. Carolyn Bremer for training me as a teacher and composer; to Dr. Deb Mitchell for her counsel and encouragement; and to my Rio Hondo College family—especially my music department colleagues, Jannine Livingston, Frank Accardo, and Dr. Joanne Choe—for their support and consistent presence in our goal to move our Music and Music Technology departments forward together.

To my composer and musicology friends: Louie Molina, Justin Scheid, Ciera Ott, and Christine Mattera, for their selfless assistance by their feedback and support. I am so fortunate to have their friendship over the past many years. Thank you for always being there for me.

There are two people that I would like to acknowledge for their help during this long journey, my son, Diego, and my Mom. I would surely not have completed this very long journey without the unconditional love and support from them; this accomplishment is just as much theirs as mine. Diego was my partner-in-crime, he allowed me to spend valuable time away from him to complete this Ph.D. degree. We have been through many adventures together and will continue to forge our way through life. My Mom is an amazing person who understands what I'm trying to accomplish and always offers her unwavering support.

CURRICULUM VITAE

George S. Wheeler

EDUCATION

Ph.D., University of California, Irvine, 2019

ICIT Program (Integrated Composition, Improvisation, and Technology)
Dissertation: Composing with Sound-Objects: A Methodology
Dissertation Committee: (chair) Professor Christopher Dobrian, Associate Professor Amy Bauer, Professor James Steintrager, Professor Kojiro Umezaki.

Master of Music, California State University, Long Beach, Summa Cum Laude, 2006

Concentration: Music Composition
Thesis: Altar: Exploring the Duality of Día de los Muertos.
Thesis Committee: Dr. Carolyn Bremer, Dr. Martin Herman, Dr. Kristine Forney

Bachelor of Music, California State University, Long Beach, 2002

Concentrations: Music Composition and Saxophone
Senior Project: Sueños de los Razon: Multimedia with Visuals of Francisco Goya's Etchings.
Advisor: Dr. Martin Herman

TEACHING EXPERIENCE

Rio Hondo College

Tenure-Track Faculty – Music Department, 2016 - present
Classes Taught: Electronic Music, Theory I-IV and Musicianship I-IV, Electronic Music I-III, Recording Studio I-II, History of Electronic Music, Introduction to Music Technology, Diverse Instruments Ensemble, and Industrial Orchestra.

California Institute of the Arts (Cal Arts)

Faculty — Composer/Music Technology, Sharon Lund Disney Dance Department, 2013 - 2017
Classes Taught: Music for Dancers I: Electronic Music Editing, and II: 20th-Century Music Practices, Graduate Music Seminar I: Electronic Music Editing, and II: 20th-Century Music Practices.

Bob Cole Conservatory of Music at California State University, Long Beach

Lecturer – Music Composition and Theory, 2006 - 2016
Classes Taught: Basic Music Theory, Harmony I, Musicianship I, Harmony II, Musicianship II, Counterpoint, Advanced Musicianship, Form and Analysis, Materials of Modern Music, Basic Music Technology, Arranging, Composition Workshop I-II, and Applied Composition Studio Lessons.

Cypress College

Adjunct Faculty – Recording Arts and Electronic Music, History and Theory, 2005 – 2012
Classes Taught: Recording Studio I, Recording Studio II, Recording Studio Lab, Electronic Music I, Theatre Sound and Recording, History of Rock, American Popular Music, Theory and Musicianship II, and the Cypress Scratch Orchestra.

Rio Hondo College

Adjunct Faculty – Music Department, Spring 2011
Class: Music Appreciation.

Orange County High School of the Arts

Instructor – Music, 2004 – 2005
Classes Taught: A.P. Music Theory, Music Notation (Finale and Illustrator), Guitar Ensemble.

Bob Cole Conservatory of Music at California State University, Long Beach

Graduate Teaching Assistant – Music Theory, 2002 - 2005
Classes Taught: Basic Music Theory, Harmony I, Musicianship I, Advanced Musicianship

Rio Hondo College

Theatre Technician – Performing Arts Division (Music, Theatre, Dance), 1993 – 1999
Directly supervised and taught students Sound and Lighting Design.

Guest Lecturer, April 2009

"No Talent, No Problem! Samples, Loops, Vocoder, and Autotune", SAI event, CSULB

Guest Lecturer, Feb. 2007

"Avoiding Recital Woes", Composer's Guild, CSULB

Guest Lecturer, November 2006

"Altar: Performance Presentation", Composer's Guild, CSULB

Guest Lecturer, March 2006

"Microphone Technique from Rock to Classical" Transylvania University -Lexington, KY

PROFESSIONAL EXPERIENCE

Cypress College

Adjunct Faculty, 2005 – 2012
In addition to teaching classes, I helped coordinate the Electronic Music and Recording Arts program, wrote curriculum, served on Fine Arts Division Multimedia Committee, maintained the Recording Studio and the Electronic Music Lab, and ordered equipment.

Liquid Skin Ensemble

Technical Director and Sound Engineer, 1995 - 2010
performed at major venues including the Aratani/Japan America Theater, the Getty Museum in Los Angeles and the LG Arts Complex in Seoul, Korea.

Robin Cox Ensemble

Sound Engineer, various concerts in Los Angeles, Santa Barbara, and Kentucky.

Long Beach Municipal Band

Sound Engineer, Summer Concert Series, 2002-2005

Bob Cole Conservatory of Music at California State University, Long Beach

Student Employee, Daniel Recital Hall, 1999 – 2003
Provided live sound and recording services for concerts, recitals and special events.

Rio Hondo College

Theatre Technician – Performing Arts Division (Music, Theatre, Dance), 1993 – 1999
Managed the Wren Theatre, served on committees, ordered equipment, and trained student workers from the Music, Theatre, and Dance Departments.

Blue Indian Recordings

Studio and Live Sound Engineer, 1990 - 1994
House Sound at Icehouse in Fullerton, with groups: Sublime, Korn, Vandals, Aquabats, etc.
Second Stage sound at Blockbuster Pavilion in Devore, various studio recording projects.

COMPOSITIONS

Gucci Concrète (2019)

Duration: 6'
Acousmatic sound
Premiere April 27, 2019, Ph.D. Recital, Winnifred Smith Hall, UCI

Modular Voices (2019)

Duration: 10'
Voice and Make Noise Morphagene modular synthesizer
Premiere April 27, 2019, Ph.D. Recital, Winnifred Smith Hall, UCI

Interconnectedness (2019)

Duration: 8'
Tenor Saxophone, Saxophone Sound-objects and Live Electronics
Premiere April 27, 2019, Ph.D. Recital, Winnifred Smith Hall, UCI

Acoustic Memories (2019)

Duration: 10'
Acousmatic sound with chamber ensemble
Premiere April 27, 2019, Ph.D. Recital, Winnifred Smith Hall, UCI

Synthetic Objects (2019)

Duration: 15'
Soprano and Tenor Voice, Clarinet, Two Violins, Two Cellos, Two Pianos, and Contrabass
CSULB New Music Ensemble directed by Dr. Alan Shockley
Premiere April 27, 2019, Ph.D. Recital, Winnifred Smith Hall, UCI

Interfacing Samsara (2016)

Duration: 10'
Live Electronics with infrared controller and motion capture controller, Spatialization
Premiere January 29, 2016, OCMA (Orange County Museum of Art) Newport Beach.

Grounded/ In the Absence of Light (2015)
Duration: 8'
Choreographer: Joshua D. Romero
Collaboration premiered December 2015, New Slate concert, Claire Trevor Theatre, UCI

Hot Air (2015)
Duration: 6'
Live Computer Music (based on probabilities)
ICIT Computer Music Live Streaming Concert, UCI

Randori- ランドリ (2015)
Duration: 12'
Koto, Two Flutes, Tenor Saxophone, Harmonica, and Accordion
Premiered December 2015, MOCAP, UCI
Featuring Kozue Matsumoto on Koto

The Book of Five Rings (2014)
Duration: 17'
Native American Flute and Live Electronics
Premiered November 2015, by John Barcelona, Daniel Recital Hall, CSULB

Arise (2015)
Duration: 15'
Percussion Quartet
Premiered May 2015, The Next Dance Company, REDCAT
Commissioned by Sharon Disney Lund School of Dance.

Louder (2014)
Duration: 10'
Performed Live by Frère Concrète
Premiered November 17, 2014, The R.O.D. Concert Hall, Cal Arts

(R)evolve (2014)
Duration: 7'
Choreography: Leslie Scott
Collaboration premiered October 17, 2014, Sharon Disney Lund Theatre, Cal Arts.

***Cantus- pour quatre musiciens* (2014)**
Duration: 22'
Performed Live by Frère Concrète
Premiered February 11, 2014, The Wild Beast, Cal Arts

Unfolding (2013)
Duration: 10'
Live Electronic Music
Choreography: Damon Rago
collaboration performed for the Iridian Arts event "Hook-Ups and Speed Dating" May 19, 2013, Art Share LA.

…hear the sounds of sounds (2013)
Duration: 11'
Performed Live by Frère Concrète
Premiered May 3, 2013, Daniel Recital Hall, CSULB

El Sueños de la Razón **(2011)**
Duration: 8'
Violin, Violoncello, Bass Clarinet, Vibraphone, Marimba, Piano, and live surround DSP
Commissioned by Robin Cox Ensemble. Premiere Feb. 2011

Jasmin (2010)
Duration: 9'30"
Commissioned by and arranged for the CSULB Sax Ensemble
Performances include North American Saxophone Alliance Regional Conference, UNLV, 2011

Spirit Seekers (2010)
Electronic film score
Film Short, Sci-Fi / Comedy
IMDb credit

Sitting Quietly (2010)
Duration: 5'31"
Electronic, stereo playback
Performance

For Each Ecstatic Instant (2009)
Duration: 2'
Mezzo-Soprano and Piano
Text by Emily Dickinson

Adjusting the Direction of the Gradient Blend (2009)
Duration: 5'
Mixed chamber ensemble

Make Us Worthy (2009)
Duration: 3'
Choir and Piano, commissioned by Julie Ramsey and the Bay Shore Congregational Church Choir
Text by Mother Theresa

The Woman Clothed with the Sun (2008)
Duration: 8'
Soprano Saxophone, Electric Guitar, Vibraphone, Marimba, Piano, Electric Bass
Written for the Trench Ensemble

The End and the Beginning (2008)
Duration: 7'
Mezzo-Soprano, Violoncello, Vocoder, and Electronic Playback
Text by Wislawa Szymborska

Saved from Freezing (2007)
Duration: 6'30"
Electric Guitar and Piano
Commissioned by Frank Accardo

Los Angeles (2006)
Sound installation with Max/MSP/Jitter
manipulated Radiohead samples and aerial pictures of LA

Altar (2006)
Duration: 22'
SATB and large chamber group

Eight Zen Meditations (2005)
Duration: 11'
Soprano Saxophone, Vibraphone, and Piano

Everywhere I Look (2004) Video
Duration: 8'
Electronic and spoken word, collaboration with Lauren Winslow-Kearns
Part of the permanent collection at the Jerome Robbins Dance Division of the New York Public Library for the Performing Arts at Lincoln Center in New York City.

Jasmin (2004)
Duration: 9'30"
Tenor Sax, Bassoon, E. Guitar, E. Bass, Vibraphone, and Piano

Dream for Diego (2004)
Wind Symphony (2:30)

Cempoaxochitl (2003)
Duration: 5'
Viola and Electronics
First Place- Student Research Competition-Creative Arts and Design-CSULB, 2003

Puedo Escribir (2002)
Duration: 6'
Tenor, English Horn and Piano
Text by Pablo Neruda

Dance with Satie (2002)
Duration: 6'
Soprano Sax and Piano, collaboration with BodyTalk Dance Company
Los Angeles Times review

Allegro Feroce con Appassionato (2001)
Duration: 3'30"
String Quartet

Good To The Last Drop (2001)
Duration: 20'
Chamber Musical

PERFORMANCE GROUPS

ICIT Graduate Ensemble, UCI, 2016

Founding Member, Frère Concrète, 2012 - present

Performer, Long Beach Laptop Ensemble, CSULB, 2010 - 2011

Director, Cypress Scratch Ensemble, 2008 - 2009

Founding Member, Trench Ensemble, 2008 - 2010

Founding Member, Liquid Skin Ensemble, 1995 - 2010

Guest Performer, The Robin Cox Ensemble, 2010

Founding Member, Herman Greene Ensemble, 2000 - 2002

California State University, Long Beach Performance Ensembles 2000-2002

Wind Symphony - John Carnahan, conductor

New Music Ensemble - Dr. Justus Matthews and Dr. Martin Herman, directors

CSULB Rally Band – Greg Florez, conductor

HONORS AND AWARDS

Dean's Fellowship, Claire Trevor School of the Arts, UCI, 2015-2018

Graduate Opportunity Fellowship, UCI, 2015-2018

Competitive Edge research stipend, UCI, 2015

Cypress College, Nominated Orange County Teacher of the Year, 2011

CSULB College of the Arts, Distinguished Achievement Award in Creative Activity, 2006

Member- Pi Kappa Lambda-National Music Honor Society, 2004

First Place- Student Research Competition-Creative Arts and Design-CSULB, 2003

Donald Andrus Composition Scholarship, 2003-2004

CSULB Composers Guild President, 2003-2004

Music Department Academic Award in Composition, 2002-2003

CSULB Composers Guild President, 2001-2002

TEACHERS

Dr. Christopher Dobrian, Composition and Computer Music, UCI, 2015 — 2019

Lukas Ligeti, Composition, UCI 2016 — 2019

Kojiro Umezaki, Shakuhachi and Computer Music, UCI, 2015 — 2018

Nicole Mitchell, Improvisation, UCI, 2015

Dr. Carolyn Bremer, Composition, CSULB, 2001 - 2006

Dr. Martin Herman, Composition and Electronic Music, CSULB, 2000 – 2004

Dr. Bruce Miller, Composition, CSULB, 1999 – 2000

Leo Potts, Saxophone, CSULB, 1999 - 2001

Supplemental study: Dr Justus Matthews, Dr. Robin Cox, Steve Moshier, and Dr. Alan Shockley

ABSTRACT OF THE DISSERTATION

Composing with Sound-Objects: A Methodology

By

George Stockton Wheeler

Doctor of Music in Integrated Composition, Improvisation, and Technology

University of California, Irvine, 2019

Professor Christopher Dobrian, Chair

Technology presents us with the ability to record and manipulate the entire universe of sound in a musical composition. As a result, composers are faced with an overwhelming—often paralyzing—amount of available musical options. My methodology focuses on how a sound-object informs the organization, collection, manipulation, and culmination of a work of electronic music. I believe that breaking down the number of choices to manageable bite-sized portions helps minimize ambiguity, and imposing limits on musical parameters helps the composer focus on productive musical options. This is a methodology where the sound-object holds primacy over the work and serves as the motivic touchstone from which to make all compositional decisions.

Part one of the dissertation provides a definition of a sound-object and an historical overview. Part two is my methodology, which is divided into three working stages: *onset*, *continuant*, and *termination*. The onset stage discusses a compositional approach to organizing a piece of music based on the sound-object as motivic touchstone; it introduces

the organizational process according to functional considerations as well as conceptual approaches. The continuant stage is the composer's playground where sound is transformed. It includes the technical and practical approaches used to assess the many parameters of a sound-object, as well as how the object itself informs the transformations. Additionally, the continuant stage represents an approach to composition and improvisation—informed by the sound-object—that uses acoustic instruments. Finally, the termination stage brings all these elements together in order to finish the piece. This stage explores how the sound-object can inform the structure of the piece at the subsequent levels of event, phrase, section, and overall form. I will demonstrate this methodology by explaining how I composed five original pieces with sound-objects—*Acoustic Memories* (2019), *Modular Voices* (2019), *Interconnected* (2019), S*ynthetic Objects* (2019), and *Gucci Concrète* (2019). Through the framework presented in this methodology, composers of electronic music will better understand this flexible medium of composition, by moving beyond the traditional grid of discrete pitches and rhythms, in order to control the entire universe of sound for their palette of inspiration.

Introduction

A Need for Organization

> *The development of Western music in the twentieth century is dominated by an historical bifurcation in musical language: tonality with its metrically organized harmonic and melodic relationships has continued to be the vernacular language, absorbed unconsciously from birth, while the other fork, in its most recent guise, is represented by spectromorphology.*[1]

This observation, from Denis Smalley's 1986 article "Spectromorphology and Structuring Processes," brings attention to the disconnect between music based on a grid of pitches in time and a music that explores the continuum of all sounds in multiple time scales.[2] This dissertation focuses on the latter with regard to how music has been imagined and composed using the vocabulary of all sounds.

Musical composition and improvisation are traditionally based on a framework of notes that exist on a grid of pitch and time. The entirety of Western musical history up to the twentieth century has evolved on this musical grid system. During the musical experimentations of the past century, this system has evolved with an expansion which interjected the focus of texture and the note-to-noise continuum[3] onto the pitch grid. Throughout the twentieth century, this grid has proven insufficient for charting all of the

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[1] Denis Smalley, "Spectromorphology and Structuring Processes," in *The Language of Electroacoustic Music,* edited by Simon Emmerson (London: Macmillan, 1986), 61.

[2] Curtis Roads' *Microsound* explains the time scales of music as labels for the measurement of the time continuum that goes from a very large time scale of months, years, and centuries (Supra Time Scale) to the very small time scales of samples and individual waveform lengths (Subsample Time Scale).

[3] Smalley describes the note-to-noise continuum as the spectral content that ranges from sounds with harmonic pitches, to inharmonic pitches, to noise, which has no perceptible pitch information.

frequencies that exist along the note-to-noise continuum. It is also inadequate for charting, in a useful way, the multiple time scales within the events and phrases of sound-objects.[4]

Technology presents us with the ability to record the entire universe of sound, to use it and manipulate it in a musical composition. As a result, the amount of available musical options has become overwhelming, quite often paralyzing. Ambiguity must be minimized by breaking down the number of choices to manageable, bite-sized portions.

Informed by the Sound-Object

The methodology presented in this dissertation focuses on how a sound-object informs the organization, collection, manipulation, and culmination of a piece of music. It is a methodology where the sound-object holds primacy over the work; the motivic touchstone on the basis of which all compositional decisions are made. This also means that by organizing the work that is based on sound-objects, it also holds predominance over the traditional Western music grid. The focus is on the spectral qualities of sound and their fluid movements more than actual notes and fixed metric time.

This is in contrast to the most common way of organizing music, because most modern Digital Audio Workstations (DAWs) offer a curated music-making experience that allow the user to mix and match prefabricated sound loops and preset software instruments in order to create a near-professional-level piece. In order for all of the preset synthetic sounds and prefabricated loops to easily work together, they must all conform to a musical grid. This is how composing with sound-objects is unique—and in stark contrast to Western music making conventions.

[4] Curtis Roads, *Microsound* (Cambridge: MIT Press, 2004), 17.

Additionally, this methodology focuses on the composerly approach to sound-objects and therefore will not cover soundscapes. I feel that the target audience and venues for soundscapes are different and stray away from this methodology. I believe that the topic of soundscapes is worthy of its own focus, as part of a larger discussion, deserving its own dissertation.

An Analogy of Sculpting

When I think about composing with sound-objects, I tend to think about sculpting with wood, which is an art form that concentrates on a subtractive quality to create a shape. Wood is to sound as sculptor is to the composer. Sculpting focuses on a "found" piece of wood. In nature, the piece of wood is part of a tree, but when the sculptor chooses a particular piece of wood to work on, they remove it from its natural setting and that "frames" it as a piece of art; it is an objectified piece and the starting point of the work.

It is important for the artist to gain the pre-existing knowledge that guides personal aesthetic, which is informed by the study of different wood species. The artist must also have experience with varying degrees of wood hardness that will work for the piece, as well as a knowledge of their own skill level. It is important to analyze the form of the wood-object and allow the original structure to inform its shaping. Only through studying the natural features of the wood can the wood sculptor understand how to proceed.

The sculptor must assemble a well-rounded collection of tools and learn when to use the correct tool for the job. The tools must be constantly maintained; knives must be sharpened regularly, and the electric tools properly oiled. Cutting techniques must be practiced. It is important to learn how to identify the direction of the wood grain in order to minimize tearing, chipping, and other unsightly visual artifacts.

Before cutting, it helps to plan out the design by lightly tracing on the wood. This will help keep the sculptor oriented as the piece begins to evolve. The first stage of the work begins with a very basic shape, while the next stages will continue to become increasingly refined until the final shape emerges.

Sculpting with wood is comparable to composing with sound-objects. For sounds that are recorded from the real world, I often find it useful to also think in terms of a subtractive process. It is important to listen to the sound and hear what it tells you. When creating something that requires a form or shape, the medium of wood is very malleable and the same is true with sound-objects.

Particle board is a type of pressed wood that is composed of wood chips and sawdust, which has lost its connection to the tree. Every sheet of particle board—in spite of an interesting textural design—looks similar, and they are measured and cut in order to conform to a predetermined size and shape. Like particle board, there are audio tools—which have their merits—that have the capability of completely destroying the sound, and then gluing it back together in a predetermined shape and size. But, in order for a listener to follow the variations of the original sound-object, it is important to create constellations that combine a variety of manipulations. This allows the listener to trace its trajectory back to, or reference, the original sound.

Just like a piece of wood, sound also exists in a three-dimensional space; on an X—Y—Z-axis. The X-axis refers to either time (visualizing sound) or the stereo field (listening to sound), the Y-axis refers to frequencies, and the Z-axis refers to the depth of the environment. This paper will focus mainly on the X—Y-axes. Frequencies in time are the basic descriptors of any sound. These two basic parameters of sound visually represent how the sonic spectrum is evolving over time.

The approach of a wood sculptor is an excellent analogy to that of a composer working with sound-objects. This methodology with guide you through the process of sculpting sound.

For Whom this Work is Focused

The audience for this dissertation is the undergraduate composer—or graduate composer new to working with sound outside of the musical grid—who has just begun their electronic music studies. I think it is important for these composers, after gaining a certain level of comfort with the musical grid, to begin working *off* of the grid. Here, you will use sound-objects as a teaching convention. Due to the ambiguity surrounding composing with *all* sounds, it is even more important to have a clearly defined idea of how to understand, organize, and manipulate sound-objects.

Overview

Prior to beginning my methodology for composing with sound objects, I will cover important concepts that introduce and elaborate on the understanding and uses of sound-objects. I will also discuss individuals who contributed to incorporating all sounds into contemporary music of the twentieth century. Then, I will formulate and explain my personal method of composing with sound-objects and, by extension, a modern approach to the compositional uses of the concepts of spectromorphology, which describes the sound spectrum of a sound-object that evolves, or morphs, over time.

The dissertation is divided into two parts. Part I will lay the foundation on which this methodology is built, and Part II will introduce my methodology for composing with sound-objects. Chapter 1 introduces and elaborates on my definition of a sound-object, which will help student composers better understand sound-objects. This is what I find to be the primary difficulty for students' comprehension of the compositional uses of sound-objects, versus the traditional approach of notes on a pitch and time grid. Additionally, *Modular Voices*—a piece that uses the recorded voice and a modular synthesizer—serves as an example throughout the chapter of my definition of a sound-object as a template. Concluding Part I is Chapter 2; here I will discuss historical and theoretical factors that contributed to the creation of sound-objects, and beyond.

My methodology of composing with sound-objects in Part II will be divided into three working stages: the *onset* stage, the *continuant* stage, and the *termination* stage.[5] In Chapter 3, the *onset* stage, I will discuss a compositional approach to organizing a piece of music based on sound-objects as the motivic touchstone, introducing the organizational process that begins with a concrete sound or an abstract concept as well as other functional considerations. Chapter 4, the *continuant* stage, is the composer's playground where sound is transformed, which includes the technical and practical approaches to assessing the many parameters of a sound-object, and how the object informs the transformations. Additionally, it will include an approach to composition and improvisation—which is

[5] Smalley, *Spectromorphology and Structuring Processes*, 61. These three working stages are an homage to the terminology used by Denis Smalley to describe the spectromorphological states of the amplitude envelope of a sound-object.

informed by the sound-object—that uses acoustic instruments. Chapter 5, the *termination* stage, will bring all the elements together in order to complete the piece. This chapter includes an approach to how the sound-object can inform the structure of the piece at the subsequent levels of event, phrase, section, and overall form. I will also discuss my approach to mixing and sculpting the final recording to make it ready for live and recorded presentations.

Part I.

In Search of Sound-Objects:

The History and Creation of Objectified Sound

Chapter 1 - What is a Sound-Object?

This chapter introduces my definition of a sound-object and shows how that definition can inform the understanding and ways to use a sound-object as the centerpiece in a composition. I will demonstrate an exploration of this definition using my piece, *Modular Voices* (2019), which uses a recording of the voice in order to create a modular synthesizer improvisation.

How will we define a sound-object? This seemingly simple and straightforward question became, for me, difficult to articulate. In this chapter, I will endeavor to answer the question, “What is a sound-object?,” as well as explore how sound provides a template to compose music that is based on sound-objects.

While there are many different types of music that include non-traditional sounds, I will focus on music that is based on sound-objects as its primary musical unit. It is therefore important to start by defining what a sound-object is. This definition will create a framework from which we can continue to examine and define the sound-object.

A Simple Definition of a Sound-Object

A sound-object can come from any *sound* source (e.g., live, recorded, downloaded, or synthesized) and is *objectified* into the format of a single audio recording. It is chosen, defined, and/or created as the primary musical material around which a piece is composed; sound-objects can be contextualized, or framed, within a musical experience. In order to be memorable, a sound-object is bound in time, meaning that each sound is relatively short and has a beginning, middle, and end. Each object can be characterized by its amplitude envelope, the shape of the sound, and its unique blend of frequencies that move in time (spectromorphology). While every sound has a context, which implies movement or gesture, it can be separated from the context through transformations.

Initially, composer Pierre Schaeffer created tape loops with sound-objects, which transformed a real-world sound into a musical sound. Nature does not usually loop sounds, so this repetition is an important aspect of the production of sound transformations. A sound-object, like a motivic touchstone, can also inform the organizational structure of a piece at the subsequent levels of sound-object, event, phrase, section, and overall form.

Modular Voices

Modular Voices, a piece for voice and modular synthesizer, uses my definition of a sound-object as the text of the source material from which the work is comprised. The definition also serves as a template for how the voice is objectified into a sound-object and transformed. The text is organized into five phrases that are read, recorded, and then edited as a live improvisational performance. The five phrases are:

1. A sound-object is a recording.
2. To be memorable, it is bound in time.
3. Characterized by its amplitude envelope and its unique blend of frequencies that move in time.
4. Every sound has a context which implies movement or a gesture.
5. A sound can be separated from its context through transformations.

Figure 1.1. Make Noise Black and Gold Shared System.

The instrument used for this piece is the Make Noise *Black and Gold Shared System*, which is an analog modular synthesizer that includes ten modules, but the focus of this piece is on a single module, the Morphagene (pictured on the bottom right in Figure 1.1). The following six sections will further explore the text of *Modular Voices*, which examines the definition of a sound-object more in depth.

A Sound-Object is a Recording

By the 1920's, the phonograph was a commercial item but the problem with phonograph technology was that it could not be edited. Magnetic tape, appearing in 1928, was the first real solution.[6] In addition to the superior sonic quality of this new recording (medium) technology, music was able to be recorded, spliced, and manipulated in ways that were never before possible. There was no device prior to magnetic tape that could edit music in this way. Schaeffer pioneered the use of magnetic tape by splicing and looping, and introducing several of Jacques Poullin's new inventions. These include a three-track tape recorder, a 10-head delay and loop machine (the Morphophone), and a keyboard-controlled device capable of replaying loops at various speeds (the Phonogene). This elevated the analog tape machine from a recording device to a musical instrument, which allowed the user to isolate sound and perform a number of never-before-possible operations in order to manipulate, or transform, sound.

Today, recording sounds is as easy as pushing a button, which does not require a recording studio or expensive gear. We can locate thousands of sounds on the internet, which are easily downloaded or extracted from a video. We don't have to fly to Paris to record the Notre Dame Cathedral's bell, it has already been recorded and posted online, waiting to be downloaded. Literally millions of sounds are desperately vying to become the object of our affection. However the composer collects or finds sound, composing with sound-objects uses the medium of recorded sound.

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[6] Joel Chadabe, *Electric Sound: The Past and Promise of Electronic Music* (New Jersey: Prentice Hall, 1997), 23.

Figure 1.2. Make Noise Morphagene: Synthesizer module.[7]

Modular Voices pays homage to the original techniques and instruments that were used by Schaeffer in the 1960s. The Make Noise *Morphagene,* shown in Figure 1.2, is named after the original Morphophone and Phonogene. While this musical synthesizer module records digitally, the controls of every parameter can be manipulated by CV (Control Voltage)—where a DC electrical signal is used to manipulate the values of components in analog circuits.[8] Sound is recorded into the Morphagene's audio buffer, called a reel, and stored on a microSD card where it is ready to be played back.

[7] Rolando and Farrell, *Morphagene Manual* (Asheville: Make Noise Music, 2017), 1.

[8] Ibid., 6.

The interpretation of the first phrase, *a sound-object is a recording*, becomes realized when the listener recognizes that the previously read text has been recorded. A live recording is quickly revealed when any mistake, cough, or "uhm" is uttered and becomes part of the recorded source material.

Once the sound has been recorded, the next step is to objectify the sound.

Chosen and Objectified

Dadaist artist Marcel Duchamp would produce art that he called *Readymades*. These pieces could come from any found object. An example is Duchamp's piece, *The Fountain* (1917), which presents a men's bathroom urinal as a piece of art.[9] This seemingly normal life-object is a functioning piece of regular life, but placed in a museum, it becomes a piece of art. What transforms it into art is that the object is chosen by the artist and presented or "framed" as a piece of art. This is an important distinction. It is the artist who chooses and objectifies the object as the subject of a piece of art.

The same concept applies to a sound-object. The source of the audio can come from any live or recorded sound, but what is important about a sound-object is that it must be framed or chosen as the primary motivic material of a piece. This distinction is critical in the transformation of a sound into a sound-object; a sound that is objectified by the composer and contextualized, or framed, as a musical experience.

[9] Chadabe, 23.

Figure 1.3. Morphagene: Creating splice markers to organize source material.[10]

The process by which the source material in *Modular Voices* is chosen is by creating splice markers on the Morphagene, as shown by Figure 1.3. While the source material is playing back, the splices can be created "on the fly" so the listener can hear the creation of sound-objects being selected and thereby objectified.

Once the splices are created, the sound-objects can be further adjusted by two parameters: gene-size (Figure 1.4) and slide (Figure 1.5). The size of a loop, which the Morphagene calls gene-size, determines how much of the splice is selected. The starting point of the loop, called slide, determines which portion of the splice is selected. Both of these parameters can also be easily modulated by CV.

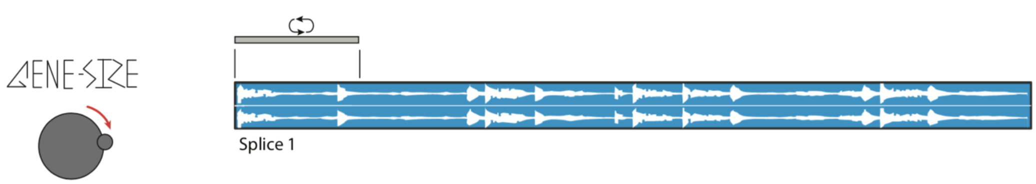

Figure 1.4. Morphagene: Gene-size control to adjust loop size.[11]

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[10] Rolando and Farrell, 13.

[11] Ibid., 16.

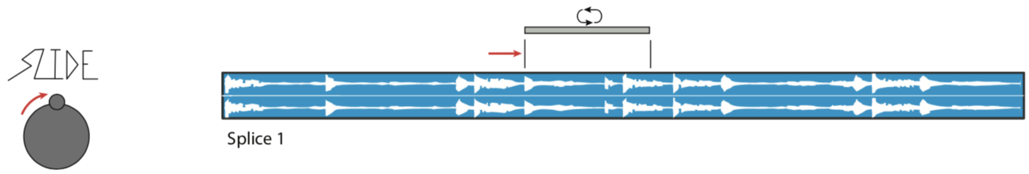

Figure 1.5. Morphagene: Slide control to adjust the loop starting point.[12]

The splices that are created for *Modular Voices* are made in the meso time scale (phrases). Using the gene-size and slide, Morphagene controls allows for the improvising composer to fluidly choose sound-objects from the source material. The next part of the definition explains that a sound-object belongs to its own time scale, which is shorter in duration.

To be Memorable, it is Bound in Time

The phrase "to be memorable, it is bound in time", implies two things. First, the object needs to be of a reasonably short duration. In composer and educator Robert J. Frank's 2000 article, "Temporal Elements: A Cognitive System of Analysis for Electro-Acoustic Music," he refers to the term "psychological present", which refers to a short interval of time in which the mind groups together related materials as a single unit.[13] This research states that roughly 2-4 seconds is the normal maximum for the psychological present.[14] Frank also notes that a shorter event, which is consistently repeated within the 2-4 second window of the psychological present will be grouped into a unit that is

[12] Rolando and Farrell, 16.

[13] Robert J. Frank, *Temporal Elements: A Cognitive System of Analysis for Electro-Acoustic Music* (Proceedings of the 2000 International Computer Music Conference, Berlin, Germany), 2.

[14] Ibid., 2.

perceived to be a continuation of the pattern.[15] This research reinforces the concept that a musical motive must be short in length in order to be memorable. A sound-object as explained by Curtis Roads in *Microsound* (2004), is on a short timescale which lasts from a fraction of a second to several seconds.[16] The concept of time scales and specifically the time scale of a sound-object will be discussed further in the next chapter.

The second implication suggests that a sound, or an event, will be more memorable if it is repeated. The use of repetition is one of the most important concepts and works on many different organizational levels from recurring sections of a large structure, down to the repeating of a smaller structures like internal attributes of sound-objects, or events and phrases. Looping is a subset of repetition and an important technique used by Schaeffer to transform sound, which will be discussed below.

In regard to sound-objects, I have observed that the amount of repetition needed to create familiarity of motivic material is dependent on the type of material. Some traditional material is easily recognized and as a result, less repetition is necessary to be accessible to a listener, while other non-traditional material would require more repetition for the listener if accessibility is a goal of the piece.

During this section of *Modular Voices*, the chosen sound-object is repeated manually by a CV controller before it begins to loop and be transformed. Looping on the Morphagene is normalled, meaning that when nothing is patched into the Play CV input, the default is set to loop. Prior to this point in the piece, playback has been controlled through the Play CV input.

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[15] Frank, 2.

[16] Roads, *Microsound*, 3.

Characterized by Amplitude Envelope and Unique Blend of Frequencies That Move in Time

All real-world sounds are an accumulation of stacked frequencies, each with their own envelopes that move in time. This phrase is a direct reference to the ideas presented by Denis Smalley's writings on spectromorphology, which build upon Schaeffer's typology and morphology, and which emphasize decoding the movement, or sound shapes, of spectral content over time. Smalley creates a theoretical framework—both spectral and morphological—that creates a set of tools with which to analyze sound-objects, including terminology to describe the three spectramorphological states of the amplitude envelope of a sound-object (*onset*, *continuant*, and *termination*).[17]

Joseph Fourier, in his book *The Analytic Theory of Heat*, first published in 1822, asserted that "...any function of a variable, whether continuous or discontinuous, can be expanded in a series of sines of multiples of the variable."[18] This breakthrough led to the understanding of additive synthesis, which is a process that stacks sine waves of increasing frequency and decreasing amplitude in order to create/author sound.

Smalley's note-to-noise continuum terminology introduces a semiotic way to think of the non-quantized nature of frequencies. James Tenney, in *Meta-Hodos*, refers to this continuum in a similar way.

> There is thus a continuous "spectrum" of composite sound-elements, ranging from simple chords whose constituent tones can be analyzed by the ear—through more complex and opaque sounds whose pitch-characteristics are

[17] The theories of Pierre Schaeffer's Typomorphology, and Denis Smalley's Spectromorphology will be elaborated upon in Chapter 2.

[18] Joseph Fourier, *The Analytic Theory of Heat* (Cambridge: Cambridge University Press, 2009), 9.

> more or less indefinite, or only partially perceptible—to sounds without any definite pitch, which we characterize as noise.[19]

However the continuum is described, it seems to distinguish how pitch is perceived, which will determine its placement between the three organizations of a sound's spectra: harmonic sounds, inharmonic sounds, and noise.[20] With this knowledge we can analyze the spectra of a sound, filter the sound to accentuate particular frequencies, and/or cut others in order to create an interesting and more useful sound-object. Chapter 4 will further discuss these techniques along with examples.

One of the synthesizer modules used in *Modular Voices* was a dual purpose VCA/Ring Modulator. The technique used to generate a richer overtone series was achieved by connecting the sound of the voice from the Morphagene to an oscillator (by multiplying the two signals) to create a rich spectrum. This pitch modulation helped demonstrate the previous point from the text; that each sound has a unique blend of frequencies.

Every Sound Has a Context Which Implies Movement or a Gesture

Understanding how sounds move and create context and gestures is important to composing with sound-objects. This is the connection between the work and the listener, which gives meaning to what is heard.

Denis Smalley states that the morphology of a sound creates a relationship between physical gestures and/or breath to make a spectral and dynamic profile, which articulates

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[19] James Tenney, *Meta-Hodos: A Phenomenology of 20th-Century Musical Materials and an Approach to the Study of Form* (Oakland: Frog Peak Music, 1988), 6.

[20] Perception is an important concept and will be explained further in Chapter 2.

spectral change.[21] He organizes the spectral morphology of sound into three morphological archetypes: attack-impulse, the attack-decay, and the graduated continuant.

1. Attack-impulse is modelled on a single detached note (sudden onset which is immediately terminated).
2. Attack with decay is modelled on sounds whose attack-onset is extended by resonance (plucking a string or a bell). The closed/open attack-decay is dependent on the onset.
3. Graduated continuant is modelled on sustained sounds, where the focus is on how the sound is maintained rather than its initiation.[22]

Smalley also categorized five basic motion analogies that represent the range of possibilities: unidirectional, bidirectional, reciprocal, centric/cyclic, and eccentric/multi-directional. These motion categories may be applied at a variety of structural levels and time scales.[23] As Smalley states:

> Motion always implies a direction. A sustained, linear ascent is implicative because the line cannot continue indefinitely. It may fade into oblivion, it may reach a stable ceiling, it may attain a goal, or its implied motion may be interrupted or excised by a new event.[24]

According to Smalley, it is important to make the connection between hearing the sound and its gestural process; to understand that the sound was produced by a gestural motion (real or imagined) to a sounding body, which creates an energy-motion trajectory. This gestural motion is what the listener can connect to the cause-source-spectromorphology and its inverse of spectromorphology-source-cause.[25]

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[21] Smalley, *Spectromorphology and Structuring Processes,* 68.

[22] Ibid., 70.

[23] Ibid., 74.

[24] Ibid., 73.

[25] Smalley, *Spectromorphology: Explaining Sound-Shapes,* 111.

To create gestural movement in *Modular Voices*, it was necessary to patch an envelope generator to the Morphagene. The vari-speed controller plays back the sound at original speed, but when turned clockwise, the playback speed is faster as well as pitched higher. Likewise, when the control knob is turned counterclockwise, the playback speed is slower with the sound pitched lower. Through the CV input, the vari-speed can be controlled by an external voltage source. By connecting an envelope generator to the vari-speed control, motion analogies can be created.

Can be Separated from its Context by Transformations

One of the most important concepts in music composed with sound-objects is timbral development, or the concept of transformation that can be applied to several parameters, which is similar to variations in Western traditional music. In the Classical period, composers like Mozart or Haydn would use the development section to create variations of motivic material. Development in music is an important part of composition methodology, which supplies the composer the tools with which to expand ideas over time.

One of Pierre Schaeffer's early experiments, which he calls the "cut bell," presents an example of sound transformation in which Schaeffer splices off the transient—the initial attack of the sound—of a recorded bell sound. By removing the portion of the sound that we recognize as a bell, the remaining sound is no longer associated with the original sound; it is transformed. In a second sound transformation example, Schaeffer changed the speed of playback, which turned a previously familiar sound into an unidentifiable one. Schaeffer realized that playing the same sound at 33rpm and 77rpm created a completely different sound identity. Playing train sounds slower than half-speed sounds like a "foundry" or "blast furnace."[26] Speeding up or slowing down the playback speed can drastically transform the sound.

Transformation in electronic music works the same way. Curtis Roads, channeling Varèse's language, refers to transformation with the terms "mutation" and "transmutation," which references how far away the developed sound is from its original context. Mutation refers to sounds that are still connected to the original context, while transmutation refers to sounds that are no longer audibly connected. I will use the term "transformation" as an umbrella-term for sounds that have been manipulated to create variation in relation to the original sound-object.

Smalley also makes an important distinction between the cause and effect transformations of Acousmatic music, and spectromorphological transformations.[27] The former allows the listener to follow a narrative by tracking the sound's cause, or source. The latter changes the sound's spectral makeup. *Wind Chimes* (1987) by Denis Smalley, is an example of how a collection of sounds for the piece was derived by the spectral transformations by the striking of wind chimes.

Once the sound has been transformed to where the original sound-object is no longer connected, then a new sound-object has been created. The sound has been transformed from a recognizable sound to an unrecognizable sound. The new sound will have its own context that is imagined by the listener. Chapter 4 will address further transformations of sound-objects.

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[26] Pierre Schaeffer, *In Search of a Concrete Music* (Berkeley: University of California Press, 2012), 14.

[27] Acousmatic music challenges the listener to distinguish sounds based on their sonic quality, not on their source; the source is intentionally unseen.

The core of Schaeffer's work relies on his theory of reduced listening; to hear a sound and focus on its musical aspect. In my opinion, it is nearly impossible for a listener *not* to try to connect a sound to its original source. Although repetition may take a sound away from its natural state, the listener still connects the sound to its original source. Furthermore, it is nearly impossible not to be aware of, or imagine how the sound is connected to human gesture. While it is important for composers who are exploring composition with sound objects, it is folly to expect a listener to only hear the musical aspects of a sound. The responsibility of disconnecting a sound from its source lies on the shoulders of the composer, through the process of transformation, mutation, and transmutation. This transformation continuum allows for a composer to choose how transparent the sound is to its source. It is therefore possible for a source to have multiple levels of context, or transcontextuality, which not only acknowledges the intent of the composer, but also acknowledges that each listener has a unique and personal textual connection to the sound and its source depending on their personal level of connection and understanding.

One of the many transformations in *Modular Voices* was created by adjusting the Morph control, which allows for further manipulation by shifting the gene offset, meaning the loops can overlap. Figure 1.6 shows that by turning the morph control, the size of the loop, or gene, is not affected, just the starting point of the next loop. This overlap capability can create up to four overlapping loops at a time, when the knob is fully turned clockwise. This control can be used to minimize audio gaps between sound-objects or can be used to also create transformations by causing multiple overlaps.

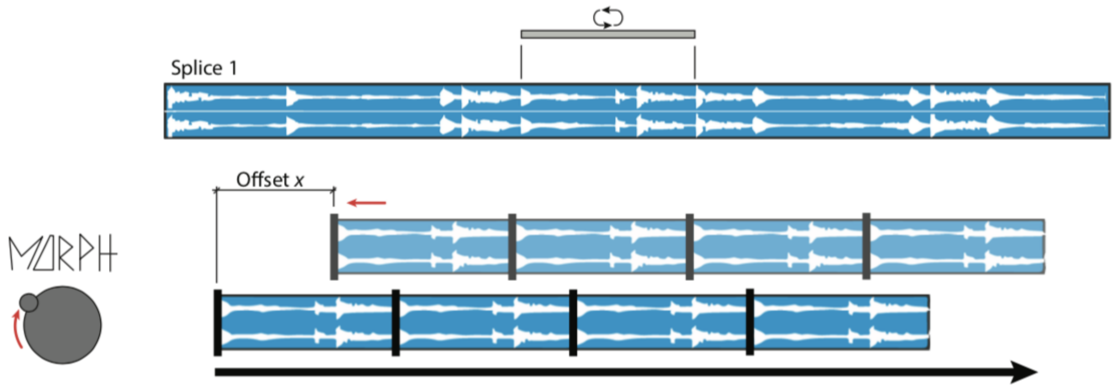

Figure 1.6. Morphagene: Morph offset to overlap loops.[28]

The definition and thorough examination of the core concepts of a sound-object presented in the Chapter 1 explains and illustrates; how a sound-object is a recording; that it is objectified and used as motivic material; how it is bound in time; how the spectra is a collection of envelopes; how the sound-object has more than one level of context; and how the sound-object can be transformed to create a musical work. The next chapter will provide an historical and theoretical background of sound-objects.

28 Rolando and Farrell, 18.

Chapter 2 - A Journey To and From the Sound-Object

Since the beginning of the twentieth century, forward-thinking composers began attempting to inject non-traditional sounds into the musical landscape. This trend connects to the following influential circumstances: the historical concept that noise—a concept that evolved into the inclusion of all sounds—can be included into the musical landscape; the influence of Dadaism, which came from experimental art and influenced music thought; the need to create or use "found" musical instruments to perform the new sounds; and the development of technology resulting in new electronic musical instruments, which afforded composers the tools with which to create, control, and manipulate new sounds. These four concepts helped set the groundwork for creating electronic music that used sound as its foundation. I feel it is important to trace the historical progression of musical thought that set the foundation which allowed for the conceptualization of the sound-object. It is also important to focus on the different ways that composers have worked with sound-objects; how sound-objects have been categorized, perceived, and transformed.

With this in mind, this chapter is organized into two sections. The first section will consider the historical circumstances that led to the conceptualization of a sound-object, by exploring the contribution of four composers: Luigi Russolo, Edgard Varèse, John Cage, and Pierre Schaeffer. The second section will investigate the post-Schaefferian thoughts concerning sound-objects, which include the following composers: James Tenney, Denis Smalley, Trevor Wishart, as well as current points of view from composers Curtis Roads and Adrian Moore.

Toward a Schaefferian Sound-Object

Music that is based on all sounds continues to evolve and become more widely accepted. This ranges from Luigi Russolo's *Art of Noises* manifesto, through the tape machine experimentations of the early electronic music studio pioneers, like Pierre Schaeffer and John Cage, to the computerized sonic experimentations of today. While not completely commonplace, music that uses non-traditional sound has become more established in today's musical language.

At the beginning of the twentieth century, Luigi Russolo called for the sound of the industrial age to be reflected in the music of the day, not the "mewing of violins" but everyday noises.[29] Artists of all mediums were using found objects and juxtaposing them with other found objects, like (Figure 2.1) Pablo Picasso's[30] *Still Life with Chair Caning* (1912), or Marcel Duchamp's[31] *Readymades* (Figure 2.2). Similarly, composer Erik Satie employed found sounds in his 1917 piece *Parade*, and George Antheil used an airplane engine in *Ballet Mecanique* (1923-24).[32] It was during this period of change that the use of all sounds began to make its way into compositions. Today, over 100 years later, using all sounds in musical works is not considered shocking. This chapter will highlight a few key composers/theorists who have used sound as their primary tool for composition.

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[29] Luigi Russolo, *The Art of Noises: A Futurist's Manifesto* (A Great Bear Pamphlet, 1913), 4.

[30] Picasso, through his unprecedented number of styles, was a huge influence on the 20th century. This piece incorporates oil cloth that is stretched over canvas and framed by rope.

[31] Duchamp's *Readymades* would revolutionize the art world by taking a commonplace item out of its functional context and designate it as art.

[32] Chadabe, *Electric Sound*, 23.

Figure 2.1. Pablo Picasso: Still Life with Chair Caning (1912).

Figure 2.2. Marcel Duchamp with one of his Readymades.

Luigi Russolo (1885-1947)

In 1913, Luigi Russolo, an Italian futurist painter and sound enthusiast, wrote *The Art of Noises: A Futurist's Manifesto*, which is a document that urges the reader to consider the inclusion of all sounds into the language of music. The influence of Russolo and his forward-thinking document is inestimable to the world of sound. He states:

> In antiquity, life was nothing but silence. Noise was really not born before the 19th century, with the advent of machinery. Today noise reigns supreme over human sensibility. For several centuries, life went on silently, or mutedly. The loudest noises were neither intense, nor prolonged nor varied. In fact, nature is normally silent, except for storms, hurricanes, avalanches, cascades and some exceptional telluric movements. This is why man was thoroughly amazed by the first sounds he obtained out of a hole in reeds or a stretched string.[33]

Russolo traces the progress of music from Pythagoras and the ancient Greeks through the Middle Ages and polyphony, to the complicated dissonances of contemporary music. His call-to-arms announces that the noise-sound revolution of music has arrived due to the increasing spread of machinery.[34] He reminds us that the eighteenth-century man could not understand the current discordant intensity of the modern orchestra, yet the orchestra is limited to a handful of sound varieties: "rubbed string instruments, pinched string instruments, metallic wind instruments, wooden wind instruments, and percussion instruments."[35] He continues:

> We must break at all cost from this restrictive circle of pure sounds and conquer the infinite variety of noise-sounds… This is why we get infinitely more pleasure imagining combinations of the sounds of trolleys, autos and

[33] Russolo, 4.

[34] Russolo's use of "noise" and "noise-sounds" are historical terms that created contrast between what was and was not considered music during the writing of this document. Today, we define noise, a subset of all sounds, as the exclusion of any perceivable pitches.

[35] Ibid., 6.

> other vehicles, and loud crowds, than listening once more, for instance, to the heroic or pastoral symphonies.[36]

Russolo categorizes noises into six seemingly random categories (rumbles, whistles, whispers, screeches, percussive noises, animal and human voices) for the futurist orchestra to include.[37] He concludes his passionate rant with a categorical list: to enlarge the domain of musical sounds, replace the limited variety of orchestral timbres with noises, explore diverse rhythms that noise will make possible, build microtonal instruments that can produce new timbres, create a variable speed instrument that can adjust the tension, produce instruments that can make the changing of pitches possible by making the resonator larger or smaller, and use machinery to make thirty-thousand different noises in order to combine them according to their artistic fantasy.[38]

With this in mind, he created Noise Intoners (*Intonarumori*), which were instruments designed to each of the specifications of the six categories described in *The Art of Noises*. By turning a crank that rotates a wheel inside a large wooden sound box with a connected metal horn, a string was vibrated.[39] By manipulating the crank, the volume could be altered, and by manipulating the lever on top, the tension of the string. This lever altered the pitch of the string by small microtonal amounts, as well as creating a glissando effect. There were as many as twenty-seven varieties of instruments of this nature created between the years of 1910 and 1930.

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[36] Russolo, 6.

[37] Ibid., 10.

[38] Ibid., 11-12.

[39] Thom Holmes, *Electronic and Experimental Music* (New York: Routledge, 2016), 16.

On April 1914, under the leadership of Filippo Marinetti and Luigi Russolo, the noisy futurist vision described in Russolo's manifesto premiered. This group, which included an entire orchestra of roarers, whistlers, whisperers, screechers, and howlers, created such an audience disturbance that scores of rotten fruits and vegetables were hurled at the performers for the entire duration of the concert. Marinetti and Russolo were arrested after the concert for having incited a riot.[40] Twelve more concerts were performed in London in June 1914, but with a more formal staging. Marinetti said it was like "showing the first steam engine to a herd of cows."[41]

During World War II all of Russolo's scores and noise-instruments were destroyed, but in the 1970's there were several efforts to reconstruct them in homage to this pioneer of noise music. While there have been percussive sounds that were introduced into the orchestra centuries earlier, it is Russolo who passionately demanded that all sounds become the focal point of a piece of music. His message was influential for many composers, including Varèse, Cage, and Schaeffer, and his manifesto set in motion three important ideas: the inclusion of all sounds into the language of music, an early attempt to categorize sounds, and the creation of new instruments in order to perform the new sounds.

Edgard Varèse (1883-1965)

Edgard Varèse was born in France and emigrated to the United States in 1915. In a similar fashion to Russolo, he called for new instruments and new music. While Russolo

[40] Holmes, 16.

[41] Ibid., 17.

was inspired by noises of everyday life, Varèse's work was inspired by the metaphors from astronomy, cartography, chemistry, and geology.

In 1929, Varèse organized the final Paris concert for Russolo and between the years of 1929-1931, he composed *Ionisation*, which was written for thirteen percussionists. It was one of the first percussion-only ensemble pieces within the Western art music tradition and premiered at Carnegie Hall on March 6, 1933. It was composed in rhythmic cells that expanded and varied in ways inspired by the ionization of molecules. He acknowledged the influence of Russolo and Marinetti in the composition of this work. Apart from the commonly used percussion instruments, the instrumentation also included novelty instruments such as sirens and a lion's roar.[42]

The use of a hand-cranked air raid siren, such as the one used in *Ionisation*, allowed for the performer to control the speed and direction of the pitch. Varèse used this "found" instrument as a way to sweep through pitches to create a "continuous flowing curve" in a way that was not possible by traditional instruments. The use of the siren also serves as a possible homage to the hand-cranked noise instruments from Russolo's *intonarumori*.[43]

Varèse also offered a new definition of music called "organized sound," which avoided the conventional binary view between music and noise. His music focused on the matter of sound: timbre, texture and musical space. Varèse gave distinction to the role of timbre by stating that, "the role of color or timbre would be completely changed from being incidental, anecdotal, sensual, or picturesque; it would become an agent of delineation like

[42] Lion's roar is a percussion instrument that makes sound when the user pulls a cord which passes through a drumhead. The sound of the instrument resembles a lion's roar, which is how the instrument gets its name.

[43] Daniel Warner, *Live Wires: A History of Electronic Music* (London: Reaktion Books Ltd, 2017), 55.

the different colors on a map separating different areas, and an integral part of form."[44]

Varèse also mentions that transmutations (transformations) resemble music of masses like a body of water instead of traditional melodic constructions. As Varèse states:

> When new instruments will allow me to write music as I conceive it, the movement of sound-masses, of shifting planes, will be clearly perceived in my work, taking the place of the linear counterpoint. When these sound-masses collide, the phenomena of penetration or repulsion will seem to occur. Certain **transmutations** taking place on certain planes will seem to be projected onto other planes, moving at different speeds and at different angles. There will no longer be the only conception of melody or interplay of melodies, the entire work will be a melodic totality. The entire work will flow as a river flows.[45]

The electronic recording studio, equipped with tape machines and modular synthesizers, afforded Varèse the opportunity to work with the "new instruments" of which he conceived. It was under these conditions that Varèse composed two early masterpieces of electronic music. The first was *Déserts*, which was created in Pierre Schaeffer's studio in Paris between the years of 1950-54. But, after being turned down by the Guggenheim Foundation, in 1954, Varèse was able to return to visit Schaeffer in Paris to complete the tape parts to *Déserts*, a work combining orchestral and taped sounds. In 1957, he gained access to the Philips Laboratories in Holland, where he was able to compose *Poème Électronique*. It was here that Varèse met Xenakis, which led to the introduction to Le Corbusier and their collaboration at the Brussels World's Fair in 1958.

The sounds of *Poème Électronique*, many of them the result of electronic processing, are derived from percussion and melody instruments, bells, sirens, electronic tone

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[44] Chadabe, 58.

[45] Edgar Varèse, "Liberation of Sound," in *Audio Culture: Readings in Modern Music*, eds. Christoph Cox and Daniel Warner (New York: Continuum International Publishing Group Inc., 2004), 17.

generators, machines, and voices. They are simple sound-objects, consisting of single sounds such as a percussive stroke. There are extended rhythmic figures, articulated in percussion; smooth hyperbolic curves, contrasted with buzzing, shaking, and fluttering sounds; and staccato, pitched sounds, combined in short melodic phrases. In 1958, Varèse was in his mid-seventies, he was a mature musician whose ideas and style had developed through the first half of the century. *Poème Électronique* was the ultimate statement of tape music as *musique concrète*.[46]

John Cage (1912-1992)

As the son of an inventor, John Cage was born with the predisposition to create. He drew inspiration from Russolo and particularly Varèse's post-war compositions, as well as the Dadaist artist Marcel Duchamp and his *Readymades*. Whereas Duchamp started discovering *Readymades* in his studio, Cage started by defining concepts of musical structure that were independent of any particular sound: "Structure in music is its divisibility into successive parts" (Construction in Metal 1939). Both Cage and Duchamp would create controversy, by design, due to the experimental nature of their work.[47]

Cage studied with Henry Cowell (1933) and Arnold Schoenberg (1935-1937). Studying with Schoenberg left him feeling unimpressed with the traditional language of music which is organized from pitch and harmony. Cage said that he didn't have an ear for harmony.[48] From Cowell he developed an interest in percussion instruments as the non-

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[46] Chadabe, 59.

[47] Ibid., 24.

[48] William Duckworth, "Sonatas and Interludes: John Cage," in *20/20: 20 New Sounds of the 20th Century*. (New York: Schirmer Books, 1999), 83.

pitched instruments of the future. Non-pitched percussion instruments were a means to compose for noises. He was also influenced by Cowell's *The Banshee* (1925), as seen in Cage's *Bacchanale* (1940), where he took the inside-the-piano extended techniques and expanded upon them to create "prepared piano" music. His exploration into silence led him to create the piece *4'33*", which allowed the composer to realize that there is no such thing as absolute silence.[49] The piece also demonstrates that all sounds are music.

> I believe that the use of noise... to make music will continue and increase until we reach a music produced through the aid of electrical instruments... which will make available for musical purposes any and all sounds that can be heard… Whereas, in the past, the point of disagreement has been between dissonance and consonance, it will be, in the immediate future, between noise and so-called musical sounds. (excerpts from The Future of Music: Credo 1937).[50]

For a brief period, *Studio di Fonologia Musicale*, in Milan, was the vanguard of European studios, with nine oscillators and other state-of-the-art equipment. It was here that Cage created a tape realization of his graphic score *Fontana Mix* (1958), which was composed using indeterminacy, a set of random numbers, as a guide to cutting and splicing the tape from several different reels.[51]

Cage's highly influential contribution spanned across many facets of music. His prepared piano served as a precursor to extended instrumental techniques, which asks musicians to play their instruments outside of their intended use. The electronic music experimentations from his early turntable works to the later electronic studio works that included oscillators and magnetic tape, reinforced by his methods of chance operations in

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[49] Cage, *Silence,* 14.

[50] Ibid., 3-4.

[51] Ibid., 51.

this new medium. His writing and sonic exploration into silence, including his piece *4'33"*, which is the key philosophic piece that hypothetically includes all sounds. And of course, indeterminacy in music, used as an example in *Fontana Mix*, which substitutes the strict serialist order that is imposed on notes for a less rigid aleatoric process that takes the ego away from the composer. John Cage's contribution has continued to serve as an ideological touchstone for many composers—including Pierre Schaeffer—throughout the remainder of the twentieth century.

Pierre Schaeffer (1910-1995)

Pierre Schaeffer, the inventor of *musique concrète*, originally worked during World War II in the Studio d'Essai of occupied Paris.[52] He used magnetic tape machines to create methods of manipulation, which could transform the musical material called sound objects, and used them in his own early etudes, such as *Cinq études de bruits* (1948). He was able to isolate a sound and focus on texture and the essence of its character.

Without the technology of the magnetic tape recorder, there would not be the advances in *musique concrète*. Prior to creating GRMC (*Groupe de Recherche de Musique Concrète*) in 1951, Schaeffer, a French radio engineer, experimented with recorded sounds using phonographs and turntables. That new technology was so vital to the development of this new artform, a modern studio needed to be built. Once the new studio was created in 1951, Schaeffer was able to use tape machines to work on what he called *musique concrète*.

While the equipment available to the early composers of *musique concrète* was fairly primitive—by our standards—they managed to come up with a number of creative

[52] *Musique concrète* is defined as the transformation of sound-objects by using tape machine editing methods.

methods for sound manipulation and creation. There are a number of ways that Schaeffer was able to manipulate the sound objects. A list of these includes:

1. Splicing (to change the order of the material, or insert new sounds within a recording)
2. Variable-speed playback (changing the speed of the tape to change the pitch of the sound)
3. Reverse playback (playing the tape backwards)
4. Comb Filtering (by playing a sound against a slightly delayed version of itself various resonant frequencies are increased or decreased)
5. Tape Loops (in order to create loops and grooves out of otherwise non-rhythmic material, composers would repeat certain portions of a recording)
6. Filtering (to increase or decrease different frequencies of a sound and change its quality and texture)
7. Layering (either done by recording multiple sources down to a new reel or by mixing them together in real time via a mixing board)
8. Reverberation/Delay (used to create a sense of unity, or fusion between sound sources coming from different origins, and a great way of superimposing a new sense of space on an existing recording)
9. Panning (allowing the composer to place the sound within a stereo or multichannel environment)

These basic operations greatly expanded the possibilities of musical composition with sound-objects. He also used repetition and loops to turn the sound into music, because a sound from nature "never repeats the same thing twice."[53] Schaeffer's groundbreaking early experiments into transformation—"closed loop," "cut bell," and "playback speed" as introduced in Chapter 1 and explained below—demonstrates essential compositional techniques for the creation of music using sound-objects.

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[53] Schaeffer, *In Search of a Concrete Music*, 13.

Transformations

After two years of working with concrète techniques, Schaeffer became discouraged because he felt trapped in what he thought was a “gimmick” or sound “effect” of a closed groove (loop), but then realized that beyond being an effect, it can become a “cause for a means of discovery.”[54]

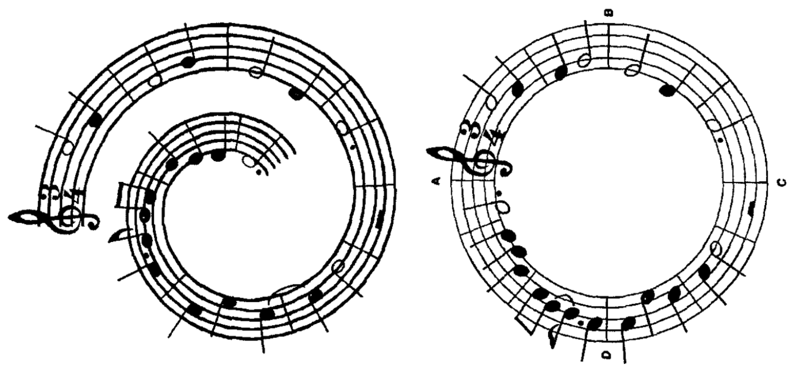

Figure 2.3. Symbolic recording spiral (left) vs. the symbolic closed groove (right).[55]

His closed loop experiment compared the cutting of a recording disk on a lathe to the passing of musical time without repetition (Figure 2.3). If an operator deliberately raises the cutter once the groove has “bitten its tail,” he has isolated a “sound fragment” without beginning or end.

> A sliver of sound isolated from any temporal context; a clean-edged time crystal made of time that now belongs to no time. When played, the closed groove can start at any point, but where it began is soon forgotten and the sound object appears in its entirety, with neither beginning nor end.[56]

[54] Schaeffer, 32.

[55] Ibid.

[56] Ibid.

His experiments into playback speed, as introduced in Chapter 1, in which he changed the speed of playback, turned a previously recognizable sound into an unrecognizable one. Speeding up or slowing down the playback speed can make even a recording of a human voice unintelligible.[57]

Schaeffer also compared two sounds, a bell and train. Both at first seem unique in their manipulated state, but the bell after being separated from its attack becomes unidentifiable, while the train is less easily separated from its "train" element.[58] The bell is easily identified as a note (or collection of notes), which can be used traditionally in a composition, but the train sound fragments are composed of complex sounds that are not easily separated as sound fragments.

This implies the two different approaches to sound—in Schaeffer's words—between a *concrète* musician and a classical musician; complex sounds are not part of a classical musician's traditional sound palette. Therefore, the term *musique concrète* refers to a composition that used "given" experimental sound in order to emphasize the dependence of sound fragments that exist in reality, considered discrete and complete sound objects.[59] Schaeffer's conclusion was that complex sounds do not fit into elementary definitions of music theory.

Once Schaeffer was able to start working at a more refined level, he was able to go beyond transformation; beyond the form at the macroscopic level (mutation: where

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[57] Schaeffer, 14.

[58] Ibid.

[59] Ibid.

identity to the source is still intact).[60] His manipulations at the microscopic level, which he called the atomic level, allowed him to create transmutations and create an end result that is unrecognizable given the original sound source. Schaeffer considered this to be the stumbling block of *musique concrète*.[61] He felt that the sound, if processed in such a radical way, would lose its connection to its original identity. I believe this is the crux of Schaeffer's acousmatic method of transformation.

Suitable Sound-Objects

For Schaeffer, the sound-object is the main focus of musical research, and through reduced listening, the sound-object will become apparent. This puts the focus on both the creation and the listening of the sound-object. Therefore, in an acousmatic setting, the taxonomy of sounds depends on how they are perceived. Schaeffer's aim of typo-morphology was to define different types of objects into subject matters by their musical intention. He created three sonorous categories: traditional language, noise, and music. Each of the three categories are separated by different listening intentions.

Figure 2.4 is the *Tableau récapitulatif de la typologie* (TARTYP), which is Schaeffer's attempt to classify all sounds. This chart is organized into boxes that chart stages of typology and morphology. There are three criteria that this chart measures: mass (an early version of the note-to-noise continuum), sustainment (the duration of the sound, which is focused on the continuant), and execution (the perceived source-to-sound connection that exists along the mutation-to-transmutation continuum). The horizontal axis defines the

[60] Schaeffer, 41.

[61] Ibid., 41.

quality of duration through time (starting in the center and going out in either direction) and the vertical axis charts mass and variation. According to Schaeffer, the most suitable musical sound objects are located in the center of the diagram.[62]

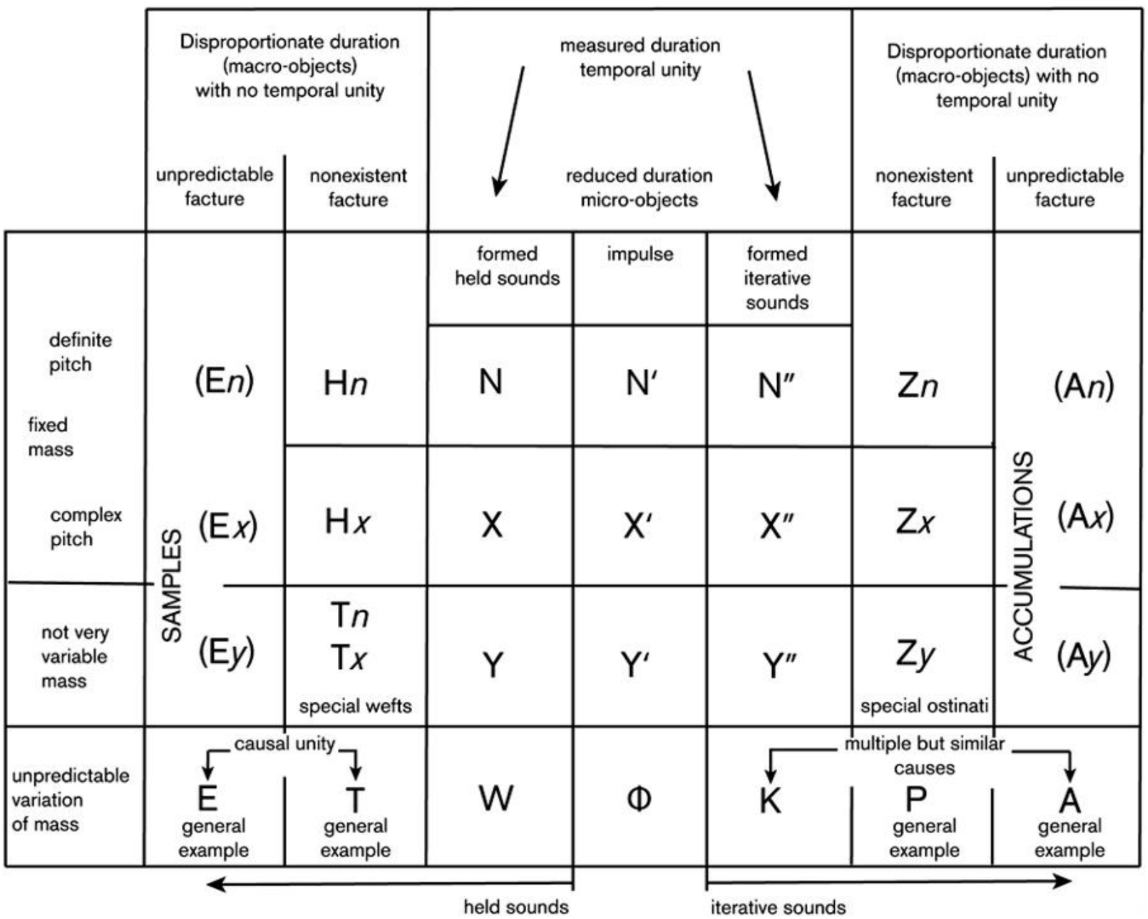

Figure 2.4. ***Tableau récapitulatif de la typologie*** **(TARTYP).[63]**

Where typology of a sound fulfills the need to identify sound, morphology describes the sound. In order for a composer to make use of all sound, it becomes necessary to

[62] Pierre Schaeffer, *Treatise on Musical Objects: An Essay Across Disciplines,* trans. John Dack and Christine North. (Oakland: University of California Press, 2017), 366.

[63] Ibid., 364.

analyze the contents as well as understanding the way it is structured. Due to the limited electroacoustic laboratory that Schaeffer had to work with, it became necessary to limit the selection of sounds into a suitable list of musical criteria. While it is still important to identify and describe sound through analysis, it is no longer necessary to discard sounds due to their lack of suitability. Sounds that were considered too elementary or basic by Schaeffer's standards, today, can be made interesting through processing, modulation, or combinations with other sounds to create a balanced, more useful sound. Complex sounds can be edited into useable units with the aid of advanced filters and spectral analysis, which is available to everyone through computer software. For the modern composer, all sounds must still be organized and analyzed by their unique list of sonic attributes, but no longer discarded due to a lack of suitability.

A Post-Schaefferian Lineage

Russolo, Varèse, and Cage laid the theoretical and practical groundwork for Schaeffer to create *musique concrète* and begin to define the sound-object. Due to their focus primarily on the use and transformation of sound, this music gained prominence in the mid-twentieth century.

This next section will focus on five composers who have composed and written about their process using sound-objects in their work. These composers include James Tenney, Denis Smalley, Trevor Wishart, and more recently, Curtis Roads and Adrian Moore.

James Tenney (1934-2006)

James Tenney, an American composer who made many early contributions to electronic music, studied with many teachers including Edgard Varèse and John Cage. For three years, Tenney worked at Bell Labs as the first composer in residence. The first piece that he completed upon his 1961 arrival was *Analog No. 1: Noise Study*. On his daily commute from New York to Bell Labs in New Jersey, he imagined ways to create sounds on a computer. He experimented with a noise generator, filters, and amplitude modulation to create a piece that featured "continuously changing, organic bands of noise."[64]

Meta-Hodos

James Tenney's master's thesis, titled *Meta-Hodos* (1961), introduces a method of analyzing music based on Gestalt psychology.[65] He states that a piece of music is a hierarchical network that is divided into sounds, motives, phrases, sections, movements, etc. An important part of understanding *Meta-Hodos* relies on becoming acquainted with his use of analytical terms. I will highlight a few of the terms.

Tenney's Temporal Gestalt Units, which he refers to as TGs, occur on various structural levels. The lowest of these levels is an Element, defined as a pitch or sound. Two or more elements can create a Clang, which can also be defined as a motive. Two or more

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[64] Tenney, 139.

[65] Gestalt is defined as a configuration or pattern of elements where the unified object cannot be described merely as the sum of its parts. Meta-Hodos (1961), and META Meta-Hodos (published in 1975 that clarifies and updates the original work), were both published together in 1988.

Clangs can create a Sequence—also defined as a phrase. These three units are the lowest structural levels that create a piece.[66]

Tenney suggests that there are two primary factors of cohesion and segregation—proximity (Figure 2.5) and similarity (Figure 2.6)—that help determine temporal gestalts.[67] Proximity means that elements group themselves together in relation to their closeness to each other, while Similarity will group sounds—in equally spaced phrases—with comparable Elements.

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Figure 2.5. Meta-Hodos: proximity factor.[68]

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Figure 2.6. Meta-Hodos: similarity factor.[69]

These concepts of proximity and similarity are confirmed by Robert J. Frank's research of the psychological present, as introduced in Chapter 1. Proximity and similarity are useful tools to analyze how we perceive relationships between sounds.

Tenney also identifies four secondary factor influences of TG perception: intensity, repetition, objective set, and subjective set. Intensity deals with the position of a parameter

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[66] Tenney, 101.

[67] Ibid., 103.

[68] Ibid., 28.

[69] Ibid., 29.

in respect to time. For example, when dynamics increase or decrease, when a filter is harsh or mellow, or when a melodic line rises or falls. The second perception is that of repetition, where the parameter divides portions of the sound through repetitions. Objective set refers to expectations created internally by the work, and subjective set refers to expectations that the listener brings to a work through their personal experience.[70] The ideas of Tenney's intensity can be seen as a precursor to Adrian Moore's concepts put forth in his theory of opposites, which will be addressed later with Moore's contributions.

Perceptual Versus Operational

Tenney tries to clarify the similarities and differences between Schaeffer's sound-object and his own clang as a matter of perceptual versus operational viewpoints. A clang—like the terms "motive" and "phrase"—is a musical event and perceptual situation, which have in common "their character as aural or musical gestalten'"[71] He also says that the distinction between clang and sequence is one of a "generalized functional distinction," and not always "clear-cut."[72] Tenney also thinks that a sound-object is an "object of perception not technical manipulation." *Meta-Hodos* (1961) did not have the benefit of the *Treatise of Musical Objects* (1966), in which Husserlian phenomenology, an influence on Schaeffer, explored how objects were perceived. Schaeffer's TARTYP, discussed in the previous section (Figure 2.4), is a categorical system that is based on perception.

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[70] Tenney, 35.

[71] Ibid., 24.

[72] Ibid.

Denis Smalley (b.1946)

One of Pierre Schaeffer's contributions was the concept of typomorphology, which was an approach to analyzing sound. “Type” refers to the spectral distribution of sound, and “morphology” refers to how the spectrum moves in time. This was the groundwork that Schaeffer laid, which later developed into Spectromorphology.[73] Denis Smalley’s writings on spectromorphology emphasize the movement of spectral content over time. In *Spectromorphology and Structuring Processes* (1986), and *Spectromorphology: Explaining Sound Shapes* (1996), Smalley creates a theoretical framework that explores the blending of the terms of Spectra and Morphology. It is essentially a collection of terms that is useful for the analysis of sounds that are part of the electroacoustic sound palette.

Spectral Framework

The spectral framework is organized into three sections: the note-to-noise continuum, the occupancy of the spectral space, and spectral density.

Smalley organized the note-to-noise continuum, shown in Figure 2.7, into three spectral types as reference points of identification: note, node, and noise. Notes are subdivided into note proper (focusing on the fundamental), harmonic spectra (harmonic spectrum is perceptible and featured), and inharmonic spectra (may contain intervals which evoke tonal references). He defines the nodal spectrum as a “band or knot which resists pitch identification”,[74] and is located near the noise boundary on the continuum.

[73] Schaeffer, 18.

[74] Smalley, *Spectromorphology and Structuring Processes*, 67.

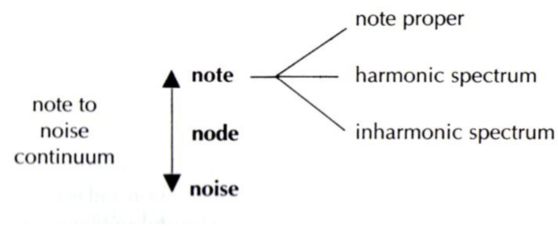

Figure 2.7. Note-to-Noise Continuum (1986).[75]

The note-to-noise continuum was updated, and the term "node" was excluded from the 1997 publication (Figure 2.8). He also adds two types of noise—granular and saturate—which describes the attributes of certain types of noise.[76]

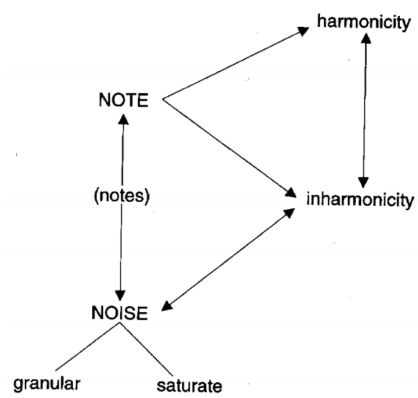

Figure 2.8. Note-to-Noise Continuum (1997).[77]

The term spectral space refers to the many sound qualities, pitches, and timbres that exist within the sound spectrum. He divides spectral space into three categories: canopy, center, and root. The outer two categories, canopy and root, "frame" the space and are

[75] Smalley, 67.

[76] Smalley, *Spectromorphology: Explaining Sound Shapes,* 120.

[77] Ibid.

considered "boundary markers."[78] These terms are designed to help understand the non-traditional spectral ranges that are different from traditional spectral ranges of orchestral instruments, which have known or fixed ranges. Smalley also introduced descriptive vocabulary to help define the "occupancy of spectral space" (Figure 2.9).[79]

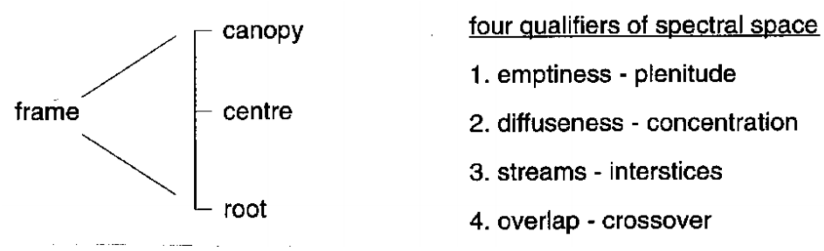

Figure 2.9. Occupancy of Spectral Space.[80]

Smalley also adopted the term spectral density to describe how sounds flow from one to another. The densities also consider their perceived distance and how it interacts with the masking of other sounds. Six more types of density describe how sounds can be blocked or not.[81] These terms of spectral density are shown in Figure 2.10.

[78] Smalley, 121.

[79] Ibid.

[80] Ibid.

[81] Ibid.

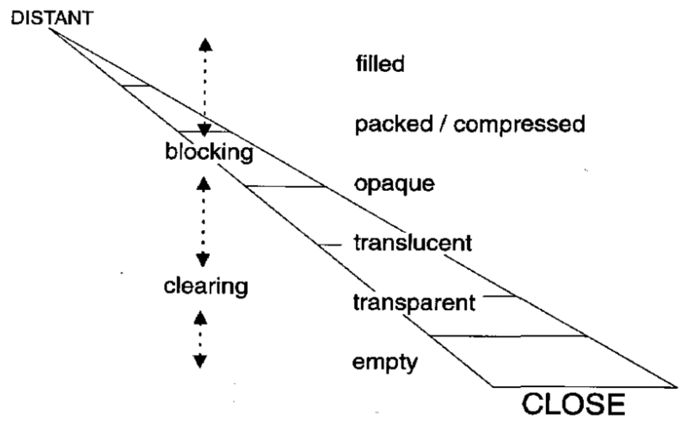

Figure 2.10. Spectral Density.[82]

Morphological Framework

As previously mentioned, according to Smalley the three morphological states of onset, continuant, and termination exist within an amplitude envelope and describe how a sound evolves. This concept of morphology explores how each note or sound, "must start in some way; some may be sustained or prolonged for a time and some may not; every note stops."[83] Each of these three "linked temporal phases"—onset, continuant, and termination—cannot be separated, but can possibly overlap. As described in Chapter 1, Smalley also connects these morphological states to three spectromorphological archetypes—attack, attack-delay, and graduated continuant—to gesture-texture combinations. Where either gesture-carried "framing" or texture-carried "setting" that can be applied to micro and macro levels of musical structure.[84] In other words, gestural

[82] Smalley, 112.

[83] Ibid.

[84] Ibid., 114.

motion can frame the texture, or texture can provide a basic framework or setting in which gestures act.[85]

Transcontextuality

Transcontextuality is a term that Smalley uses to express the idea that the listener is aware of two or more contexts of a sound simultaneously: the context of the original source, and the new musical context that is being created by the composer. Additionally, if the sound-object is transformed too far away from identification of the original source, then the composer is the only one who retains the knowledge of both contexts.

Whereas Smalley believed that the original source must be a real-world sound, I think that all sounds evoke meaning to the listener's imagination, and that the listener can bring multiple contexts to a sound—real or imagined—which is informed by the listener's life experience. This is similar to Tenney's *subjective set* from his Temporal Gestalt of Perception.

Trevor Wishart (b.1946)

Trevor Wishart is a composer who focuses primarily on sonic transformations of the human voice. In his two books, *Audible Design* (1994), and *On Sonic Art* (1996), Wishart explores compositional as well as technical ideas and processes about how to create a narrative through sound transformation using "real-world sounds." His focus is also on the perception of these elements outside of what he calls lattice sonics (musical grid).[86]

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[85] Smalley, 114.

[86] Wishart, *On Sonic Art,* 8.

Wishart declares three assumptions when working with and composing with sound. The first assumption is that any sound can be the starting material for a musical composition. As we have seen historically, Varèse demonstrates in *Ionisation* (1929-31) a degree of control over sonic substance through the use of found instruments, Cage declared that all sound is music, and Schaeffer explored new sounds using magnetic tape machines. The second assumption states that the ways of transformation are unlimited due to the processing power of computers. The third assumption is that structure depends on audible relationships amongst sound materials, as explained by Smalley's explanation of spectromorphology and structural processes.[87] These three assumptions acknowledge the historical progress of how noise was perceptually transformed into the sound-object, and how a sound-object can serve as the motivic touchstone by which a piece of music is organized.

Wishart also points out how the role of music technology has changed the perception and function of the relationships between an instrument, its performer, and the composer. He explains how a composed piece organizes well-controlled parameters (pitch, duration, instrument type) and the free-improvising performer still works within a framework of restrictions (sound world, the pitch-set, the articulation possibilities). By contrast, there is a difference for a computer instrument builder. The "instrument" is no longer a definable (if subtle) closed universe of sound possibilities.[88] The result is that computer technology has blurred the difference between the skill of the performer, and the

[87] Wishart, *Audible Design*, 1.

[88] Ibid., 6.

skill of the composer. Additionally, the roles of performer-improvisor, instrument-builder, and composer are also blurred.

Transformation

While Wishart references Schaeffer, it is Iannis Xenakis' (1922-2001) use of instrumental transformations that provided more influence over the direction of his initial work. One point that Wishart makes, which provides distinction from the writings of Schaeffer, is that there is no such thing as an unmusical-sound object.[89] Every sound can be used in a work of sonic art.

Wishart believes that musical gesture is part of the internal morphology of sound-objects. As an example, he believes that human gestures may be translated directly into the morphology of sound objects by the movement of the larynx or muscles and an instrumental transducer. Therefore, the translation of performance of gesture into that of the sound-object is most complete and convincing when instrument technology is not a barrier. He goes on to say that vocal music is the most sensitive carrier of gestural information.[90]

Explicit/Intuitive

Wishart also defines explicit and intuitive knowledge, pointing to "the interface between intuitive knowledge embedded in bodily movement and direct aural feedback, and explicit knowledge carried in numerical representation."[91] This creates two conflicting

[89] Wishart, *On Sonic Art*, 8.

[90] Ibid., 18.

[91] Wishart, *Audible Design*, 7.

paradigms. First is the instrumental paradigm, which through performance, can give a magical energy that creates music which is conjured up “right before your very eyes,” conveying intuitive knowledge to the audience.[92] This approach fits well into the traditional way of thinking. This disadvantages the composer who has a network of electronic processing devices around traditional instrumental performance, where they essentially are creating new and different instruments for performers to play and adopt. It takes time to master any new instrument.

The second paradigm does not entice an audience by being created “right before your very eyes,” but the advantage is the attention to details, explicit knowledge.[93] While the performance does not unfold in front of the audience, there is a level of performance that takes place in the studio during the recording and creation processes.

An explicit approach to composition uses a computer solely to follow an exact description of the task. On the other hand, electroacoustic composers “play” with the medium, often in real time, in order to explore the range of possibilities.[94] The role of composer and performer overlap, and the roles of intuitive and explicit knowledge in musical composition must find equilibrium.

These three composers, Tenney, Smalley, and Wishart all connected to Schaeffer through the proximity and similarity of their work. They stand on the shoulders of Schaeffer’s work and extend his ideas further. The next two composers, Roads and Moore, offer a more recent approach to composing with sound-objects.

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92 Wishart, *Audible Design*, 8.

93 Ibid.

94 Ibid.

Curtis Roads (b. 1951)

Curtis Roads is well known for his comprehensive surveys of computer music. The *Computer Music Tutorial* (1996) was an exhaustive resource for then current technologies, and *Microsound* (2004) is a book that focuses on the microscopic divisions of sound, which is the compositional specialty of Roads' work. In 2015, he released *Composing Electronic Music: A New Aesthetic*, which is a very broad book that introduces historical research, as well as many compositional ideas in which to continue to investigate.

Time Scales of Music

In the first chapter of *Microsound,* Roads introduces time scales of music which coexist and create overlapping measurements of time—a concept which also belongs to the study of economics in addition to that of musical time. These time scales are very useful for composers to understand overlapping and uneven temporal structure divorced from the musical grid.

The nine time scales are: Infinite, Supra, Macro, Meso, Sound Object, Micro, Sample, Subsample, and Infinitesimal. The largest time scale, Infinite spans beyond the life of earth and humans, and the three smallest time scales, Sample, Subsample, and Infinitesimal are incrementally minuscule measurements. These time scales seem to be more theoretical. While the focus of Roads' book is on the Micro time scale, this dissertation will focus on the four remaining time scales: Supra, Macro, Meso, and Sound-Object.

Roads' definition of the Sound-Object time scale ranges from a fraction of a second to several seconds.[95] The Meso time scale organizes sound-objects into phrases or sections.

[95] Roads, *Microsound*, 3.

The Macro time scale includes the overall form of a piece. The Supra time scale extends into months, years, decades, and centuries; beyond the life of a composition.[96] These four time scales are referenced in Chapter 5 as useful measurements alongside my terms for subsequent levels of temporal organization (sound-objects, events, and phrases).

Transformation, Mutation, Transmutation

Curtis Roads states that with computers, music information can be represented as data and be treated like computer science operations that allow for further transformation of the material.[97] For example, a string of MIDI numbers can be added, subtracted, multiplied, or divided, to transform pitch classes, which is similar to pitch modulation. Roads makes the distinction that applying these same transformative operations to "sample values in a sound file… are perceptually indistinguishable from one another."[98]

Transformation in electronic music can be compared to variation and development in traditional composition practice. Similar to a motive, a sound can be transformed into an entire collection of varied and developed sounds to produce a family of derived sounds.[99] This creates a lexicon of sounds, which can be the first step in creating a sound palette, and the listener can perceive these sounds as related. Transformations can be applied by using not only Schaefferian techniques like variable-speed playback, reverse, comb filtering, etc., but also modern techniques such as convolution (a method of cross-synthesis that

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[96] Roads mentions that these time scales are incomplete above the Macro time scale. I agree and I would also like to introduce a new time scale that should be inserted between the Macro and Supra, which is discussed in Chapter 3.

[97] Roads, *Composing Electronic Music: A New Aesthetic* (New York: Oxford University Press), 113.

[98] Ibid., 114.

[99] Ibid.

combines two audio sources and emphasizes the frequencies in common while minimizing the ones not in common), and granularization (a synthesis type that breaks down an audio file to minuscule grains and reorganizes them to make new sounds), to name a couple. Many composers can organize a piece by first introducing a sound and then slowly incorporating transformations that evolve over time. In contrast, a piece can start with transformations that aren't immediately derivatively identifiable to the original sound, until the original sound finally reveals itself, thus limiting the listener from focusing on the evolution of the sound throughout the piece.[100] Both approaches have their merits.

Roads further explores what he refers to as the identity continuum of mutation and transmutation.[101] Mutation (modification of identity) consists of a transformed sound that can be perceived by the listener as still connected to its original identity. A radical transformation, or transmutation (switch of identity), leaves the processed sound completely disassociated with the original source identity. A few of the techniques included are blending granularized sounds with a combination of other operations such as: pitch shifting, filtering, amplitude variation, grain size variation, spatial variation, etc.[102] Further still is the morphing or interpolation of two processed sounds. This technique is not crossfading, but the movement and shifting of a sound's spectral parameters with the spectral parameters of a different sound. An example is the morphing of two sounds with different pitches. The resulting effect sounds like a glissando while the sound is being

[100] Roads, 115.

[101] Ibid.

[102] Ibid., 119.

morphed.[103] The transformation of sound is fundamental to composition in the electronic medium. The transformation can become the theme or subject of the composition, which can also create the process that produces the musical structure.[104]

While Curtis Roads' book is an in-depth overview of electronic music, Adrian Moore is more focused on compositional techniques of electroacoustic music. Both composers' books include current approaches to composing with sound-objects.

Adrian Moore (b.1969)

Adrian Moore's book, *Sonic Art: An Introduction to Electroacoustic Music Composition*, addresses theory, aesthetics, context, and practical approaches to creating music based on using all sounds. It is a concise how-to text which targets his electronic music students at the University of Sheffield.

Theory of Opposites

The most compelling chapter, "Theory of Opposites," elaborates on an approach that allows the composer to create a set of descriptors as a means to label and then transform the different parameters of a particular sound.[105] Each descriptor then provides an understanding on the basis of which to prescribe a minimal and maximal range of manipulation. Once the parameter's range is set, then the composer can freely improvise and compose.

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[103] Roads, 119.

[104] Ibid.

[105] Adrian Moore, *Sound Art: An Introduction to Electroacoustic Music Composition (*New York: Routledge), 94.

I find this approach to be very useful for student composers to listen to and assess each sound's parameters. While this may be similar to the typomorphology "solfege" of Schaeffer, or the multiple spectromorphologies of Smalley, Moore's approach is more user-friendly. From a compositional point of view, it is not useful to attempt to label all sounds and categorize them.

My intention is not to imply that Smalley's spectromorphology does not have merit, because it is very useful in a musicological sense of having created a commonality of language for the purpose of analysis—as Smalley himself stated. I am merely stating that it is not as useful for the composer to be concerned with using categorical terminology during the composition process.

Conclusion

Before the following discussion of how I incorporate sound-objects into my own compositions, I will highlight the narrative threads that run throughout part one of this dissertation. There are commonalities between the composers mentioned in Chapter 2 as they were trying to incorporate either new sounds into the musical language or sound-objects into their work.

Noise

Writing in the 1910s, Russolo reminds us of a pre-industrial world without mechanical noise while heralding in a new era with new sounds. Russolo's manifesto *Art of Noises* sought to include all noise-sounds into the musical language. Varèse, in the 1930s, coined the term "organized sound" and referred to the elements in his own work as "sound-masses." Cage's experiments with silence in the 1940s led him to the conclusion that there is no such thing as silence. His composition, *4' 33"*, hypothetically demonstrated that all sounds are musical sounds. These three composers set the foundation for Schaeffer to coin the term sound-object. Since its emergence, composers have been exploring how to incorporate sound-objects into their work.

New Instruments

Composers during the twentieth century began using "found" instruments as well as incorporating new instruments in order to perform all sounds music, starting with Russolo and his noise intoners. Cage and Varèse wrote for percussion instruments, both traditional and found. Varèse used the lion's roar and the "found" air raid siren in his piece *Ionisation* (1929-31). Cage prepared the piano in homage to his teacher Cowell. Both Schaeffer and Cage experimented with turntables, but it was Schaeffer's early work with magnetic tape that proved to be the best new instrument to work with sound. Tenney composed noise-based music on the computer in 1961 and to this day, the computer continues to be the instrument of choice.

Categorization

In addition to his previous contributions, Russolo also started to categorize sounds. He created six categories along with a type of instrument for each category. Schaeffer categorized sound, too, by a system of typomorphology, and Smalley continued by offering spectromorphology. These categorical methods offer a terminology with which to analyze sound-objects. Tenney's categorical method of temporal gestalt went in a different direction, whereby organized sounds called clangs are perceived as motivic units. Adrian

Moore organizes his sounds through a system called a theory of opposites. This approach describes the parameters of a sound and then explores the range of each parameter.

Perception

Perception is an important thread that was inserted by Schaffer's acousmatic condition, which introduced the concept of reduced listening to hear musical sounds. Tenney also explored musical perception with a subjective and objective set of conditions wherein the internal structures of the music create an expectation, while the listener brings their own expectations from their life experiences. Smalley also comments on perception, called transcontextuality, where the context of the listener is different for each person, as well as the responsibility of the composer to set up an expectation of context. Wishart describes perception in terms of an explicit or intuitive situation. Perception exists on multiple levels, and as mentioned earlier, it not only acknowledges the intent of the composer, but also acknowledges that each listener has a unique and personal textual connection to the sound and its source depending on their personal level of connection and understanding.

Culmination

It is the culmination of these ideas, my personal explorations into composing acoustic and electronic music, as well as my years of college-level teaching experience of music theory, composition, and music technology that inform my work and have led me to create my own methodology that focuses on composing with sound-objects. Part II of this dissertation is divided into three sections that introduce and elaborate upon my process as a composer and teacher of electronic music.

Part II.

Composing with Sound-Objects:

Assessing, Transforming, Structuring, and Organizing Sound

Chapter 3 - Onset Stage

Starting a piece can be daunting, because the world of sound is so vast. There are innumerable options available to choose from, which can ultimately lead to feeling overwhelmed and turn into a barrier to continue, or a dreaded mental block. Due to the myriad of options, there is also a chance that the piece will lack focus or continuity. This situation is a problem that exists for composers writing any type of music, but it is especially prevalent for pieces in which the composer is forging new ground. With the world of computers and electronic music, options seem to be even more overwhelming—causing option-paralysis—because so many more processing, timbral, frequency, and temporal configurations are possible, and more new options are created every day.

In order to keep from getting overwhelmed, it is helpful to plan out the direction of the piece, or pre-compose, which includes not only making choices about what to do, but perhaps more importantly, what *not* to do. This approach is similar to the mission statement of a business, where all choices refer back to the mission's objectives in order to keep all decisions aligned in one direction. Pre-composing, in a subtractive manner, guides the direction of the piece by limiting the number of choices available. Committing to the process of narrowing down parameters helps define the piece. This chapter will focus on my approach to pre-composition when composing with sound-objects and, after discussing a general organizational approach, is divided into three general sections: "Starting with Sound-Objects," "Starting with a Concept," and "Functional Decisions".

Organizational approach

The moment I begin to write a piece of music, I immediately create a template or trajectory for the work. The completion of the work is influenced by multiple factors, but often this is a looming deadline or self-imposed timeline. While inspiration may come in many forms, in my experience, the work does not complete itself through inspiration alone. Instead, it is best when the start of the compositional process begins with a sound, concept, or a performance opportunity. However the piece begins, there are always a few parameters that should be decided upon in order to chart out the direction and stages of a piece.

The organizational chart below, Figure 3.1, reflects how I approach pre-composition. The workflow begins with either the source material of a sound-object, or the idea of a unifying concept. The sound-object (concrete) and concept (abstract) help inform each other, where the sound-object is a *concrete* recording and the concept is an *abstract* idea that unifies the piece. This balanced concrete/abstract approach is an important aspect in my methodology. After I choose the sound-object/concept, I then address the functional aspects, such as the duration of the piece. Ultimately, I derive musical decisions from this organizational approach.

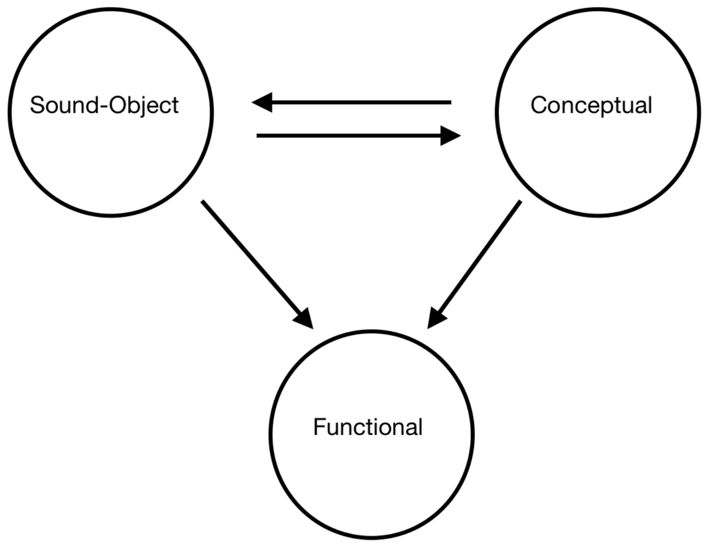

Figure 3.1. Pre-compositional organizational flow chart.

Starting with a Sound-Object

There are many ways to start a piece, but the most direct approach is by starting with an interesting sound that one likes, which has parameters that suggests a means of manipulation. Starting with an interesting audio recording is the most direct way to work on a piece that focuses on sound-objects. Once the sound-object has been decided upon, then it is important to actively listen to it and determine which parameters are interesting and will inform the rest of the piece.

As defined in the first chapter, the recorded source material for a piece comes from many places that originate as pre-recorded, recorded, or synthesized sounds. Sounds selected from pre-recorded audio—either downloaded from an online website like freesound.org, ripped from a CD, or digitized from vinyl—are the easiest method with which to start. Recording your own sound can present an added level of control; i.e. the choice of microphone as well as mic technique determines the focus and spatial placement of the sound. Depending on the type and placement of two microphones, the recorded sound can be placed within a stereo sound field. Another advantage to recording your own sounds is that you can choose the way the sound is activated—whether it is hit, tapped, bowed, etc.

Pre-recorded sound

From a teaching perspective, in order to understand how to compose with sound-objects, I believe it is important to begin with recording real-world sounds that have an immediately recognizable context. This helps when creating multiple variations so that students will compare the results to the original sound-object for its sonic connection. For example, during an Electronic Music class, I use an audio recording of various bird sounds and instruct the students to choose and isolate one sound-object, then create a few variations. At the end of the lab, each student will share the sound-object they choose, and then share their single favorite transformation. The discussion of each student's work will include the correct understanding of a sound-objects, and how the transformation is sonically connected to the original.

Gucci Concrète challenged me to write an entertaining demonstration piece that provides examples for my students for selecting source material, choosing sound-objects, and creating transformed variations of the sound-object while still retaining its sonic connection to the original object. *Gucci Concrète*'s source material came from an eight-second sample from a popular trap-style rap song, "Gucci Gang" (2017), performed by

Miami-born artist Gazzy Garcia (Lil Pump). From this eight-second sample, I chose five specific moments (sound-objects) to become the motivic material for this piece. I chose this song because it was immediately recognizable to my students. This piece is different from traditional composition with sound-objects because its sound-objects come from a popular song, rather than an isolated/singular sound like a bell or a train whistle.

In electronic music, instrument design is part of the creative process. It is important that the sound-object also informs the instrument choice and design. The rap genre relies heavily on sampler instruments, so using a sampler to trigger audio samples remains true to the sonic world that was informed by the sound-objects from *Gucci Concrète*. While a sampler uses recorded audio as its sound source, its functionality comes from MIDI information. Creating transformations to the sound-object via sampler is similar to the way tape manipulations occur, but it is much quicker because of the MIDI control.

Synthesized sound

In addition to finding or recording an existing sound, it is possible to create a sound-object. *Synthetic Objects* is a piece that used the recording of synthesized sound and objectified it as the centerpiece of the work. This piece focused on the timbre of sound that was derived from the recording of synthetic harmonic spectra. The source material for *Synthetic Objects* was created through automating and then recording an FM (Frequency Modulation) synthesis patch in Max/MSP.[106] The patch was exported as an audio file and

[106] Max/MSP is a visual programming language which allows the user to create patches by connecting objects together using simulated cables.

then analyzed in SPEAR for spectral pitch content.[107] Figure 3.2 shows the spectra of six sounds (the first and last are the same).

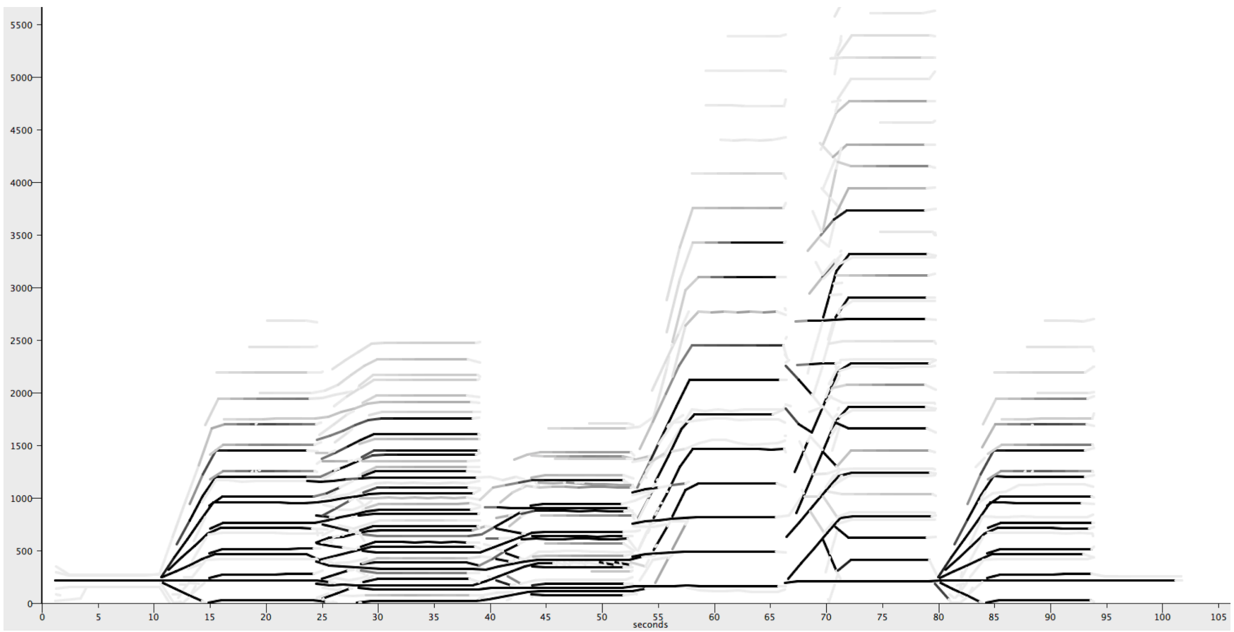

Figure 3.2. Synthetic Objects: SPEAR analysis of five sound-objects.

A selection of five sound-objects, from the original sound file, informed *Synthetic Objects*, not only in pitch content, but also in the interaction of the waveforms. The instrumentation of this piece—a fixed instrumentation for the California State University, Long Beach New Music Ensemble—was written for two violins, two cellos, two pianos, soprano and tenor voices, b-flat clarinet, and contrabass. The frequencies in this sound-object are very close, which create fluctuations from the strong frequency beating. There are also drastic glissandi in pitch between the five sound-objects. These fluctuations and

[107] SPEAR (Sinusoidal Partial Editing Analysis and Resynthesis) is a spectral analysis, editing, and resynthesis program that charts the frequency and amplitude of partials and allows for individual partial manipulation.

glissandi in pitch become contextual abstractions that inform the writing of the acoustic instrumentation which will be addressed in Chapter 4.

Starting with a sound-object first is one way to start working on a piece, but in the absence of a recorded audio file, it may be easier to start with an abstract concept that helps unify the work. The next section focuses on organizing the work based on a concept first, as a way to find a sound-object.

Starting with a Concept

Like a business that has a strong mission statement, all compositional choices refer back to the statement in order to keep the mission focused. I find this method especially helpful when collaborating with artists in other disciplines, such as dance choreographers. A unifying concept helps to establish a common goal while allowing each medium to be composed independently.

Depending on the circumstances and inspiration, I use an extra-musical concept to help generate material. It can be helpful to have a thematic or literary inspirational touchstone. For example, the concept for *Acoustic Memories* is based on my experience at the Mt. Baldy Zen Center in the San Gabriel Mountains, California. This memory was created over 15 years ago, but over time my memories continue to morph and evolve. While recalling this old memory, my brain pieces together various components to create a pattern that forms a cohesive narrative of things past. I remember waking before dawn and walking in the cold, through the darkness, to the Zendo for group meditation. We sat facing away from each other while a senior student brought warm green tea and administered the meditation stick. I remember the tranquility of that dawn on the mountain juxtaposed with my racing chaotic mind, all centered by the steady meditation bell. This concept will inform the selection of sound-objects, which will, in turn, continue to inform the rest of the piece.

Acoustic Memories is a hybrid piece that combines an acousmatic format with live acoustic instruments. Acousmatic music—from Greek *akousmata*, "things heard"[108]—is a form of electroacoustic music that is specifically composed for presentation using speakers, as opposed to a live performance. While the name acousmatic implies a listening-only experience, this piece intentionally evokes the acousmatic title *and* includes six live performers. The tape has priority and the live musicians are employed in the service of the recording. This is different than most situations with live players and tape playback; in most situations the live music is most important and the tape playback is in support of the acoustic instruments. In *Acoustic Memories* their functions are reversed; the acousmatic score is most important and the live musicians are supporting the tape playback. Their pitches and musical gestures are derived only from the sound-objects in the acousmatic sound. This deviation from a listening-only playback experience is meant to emphasize the function of both recorded playback and live performers.

The sound-objects include: a singing bowl, monks chanting, rain, rain falling on a singing bowl, and birdsong. These were selected from freesound.org, a website that hosts a collaborative database of creative-commons licensed sounds. These sounds were chosen for two reasons. First reason supports the extra-musical concept based on the experience of a Zen retreat. The second reason these sounds were chosen was for the interesting qualities of each sound-object, which meet the aesthetic needs of the piece, as described

[108] Brian Kane, *Sound Unseen: Acousmatic Sound* (New York: Oxford University Press, 2014), 54.

above. The technological goal of *Acoustic Memories* is to explore audio-editing software that performs morphing, convolution, extreme time-stretching, and spectral resynthesis.[109] Each sound was processed using the programs SPEAR, Paulstretch inside of Audacity, SoundHack, and the Alchemy plugin in Logic Pro.

It is the concept that unifies the composition and helps determine which sounds will work thematically for the piece. Without the concept, it is also difficult to decide which sounds to use, which wastes time and creates frustration. With both concrete and abstract elements recorded, chosen, and conceptualized, then it is time to move to the last section of pre-composition stage.

Functional Decisions

Once I determine the sound-object and concept, it is time to start writing/working on the piece and make decisions about its direction. It is always important to keep in mind that my initial decisions/settings are subject to change, but I do not let this prevent me from getting started. Parameters like time, timbre, venue, reason, audience, and goals for personal and professional growth all fit into the concept of functional decision-making. The only time I start a piece of music by considering functional design first is when I am in an artistic collaboration or hired to work on someone else's project. In this situation I start the piece by figuring out the piece's duration, or the type of sounds that a collaborator or commissioning body requests.

[109] Technological goals is another functional design element that is explained in the Goals section of this chapter.

Time

Music is an art form that unfolds in time, so this parameter is one of the most important to consider. I must consider the piece's length, and also the amount of time required to complete the work by the deadline. Because of this musical maxim, the duration of the piece is an important parameter to finalize. I will choose a duration and allow that to influence other decisions (e.g. the trajectory and unfolding of a five-minute piece is completely different from a ten-minute piece).

Absolute and Relative Time

The overall time, or duration, of a piece informs many parameters. The duration informs whether the sections are long or short, and how many sections will contribute to the overall form of the piece. This will also inform the amount of repetition and variation needed in order to satisfy the pacing and aesthetic of a section. The relationship between time and the musical material is a negotiation of sorts, because musical-time is an approximation, whereas the material fills the temporal space that is bookended by its duration. In slow pieces, musical-time is perceived to move more slowly, and the inverse is true of fast pieces.

Tempo

Tempo, when associated with beats per minute, is part of the traditional music language which belongs to the construct of a musical grid. It is also a contributing factor to the perception of time passing. Pieces with a slow tempo generally tend to be less busy and pieces with a fast tempo tend to be busier. But, sound-objects have their own internal rhythms which seldom conform to the musical grid—this is an important distinction when writing music that is informed by sound-objects. I do not intend to suggest that it is unsatisfactory when the internal rhythmic movement of a sound-object is ignored and anchored to an existing musical grid not associated with the sound-object (although interesting cross-rhythmic patterns can emerge). I am suggesting that when the internal rhythm of a sound-object is not considered to inform the rhythmic parameters of a piece, one risks missing a great opportunity for an organic rhythm.

Timelines and Deadlines

Deadlines are an important step in the organizational aspects of being productive. Without a deadline, it is possible to continue rewriting the same piece over and over again until it is never finished. Deadlines are a big reason why student composers are productive during school, then they lose motivation to be productive post-graduation; graded project deadlines provide motivation to complete the work. Setting self-imposed periodic deadlines will help productivity.

The composition timeline deserves its own designation. Curtis Roads places the time to create the work within the Supra time scale. More specificity is needed to express this important multifaceted process. Since the Macro time scale is the overarching form of the piece, then I suggest that Supra-macro time scale is the duration of the composition process, which may consist of days or months.[110] There is a correlation between the duration of the piece and the duration of the composition process; the Macro time scale

[110] The Supra-macro time scale is the duration of the composition process that consists of days or months; smaller than the Supra time scale and larger than the Macro time scales. The Supra-macro time scale contains three overlapping temporal morphologies called *Onset, Continuant, and Terminology*, which mirror the Macro time scale in regard to the unfolding morphological envelopes of a musical work.

with affect the Supra-macro time scale. Meaning, the longer the duration of the piece, the more time is needed to complete the piece.

Goals

Setting personal, musical, or technical goals provide opportunities to improve as a composer. Setting goals will serve as an additional way to limit choices by focusing on specific things. Each piece provides an opportunity to learn from the process of doing whatever the goal is. This section will provide a few examples that can be used as a way to learn.

There is no magic formula for composing well, it is a skill that needs to be exercised. The definition of a composer is a person who composes. Malcolm Gladwell's 10,000 hour rule, from his book, *Outliers*, says that it takes approximately ten years of intentional practice to become proficient at a task.[111] This is also true with composition; it takes time for technique and skills to develop, so it is helpful to use each piece as an opportunity to set goals and practice new techniques.

Technological Goals

As technology is constantly changing, it becomes necessary to stay current with new and updated software. By choosing a technological goal, I can create new works while maintaining a level of competence with the never-ending barrage of shiny-new products. Choosing a particular piece of equipment to focus on serves two potential goals: to learn

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[111] Malcom Gladwell, *Outliers: The Story of Success* (New York: Little, Brown and Company, 2008), 35.

the new equipment, and, to have continuity provided by the sound of the new equipment (since every piece of equipment has a possibly recognizable sound).

From a teaching standpoint, I find it helpful for students to focus on a new piece of technology in order to learn something new. This technological focus becomes the goal of the piece (assignment) and helps put another tool in their compositional toolbox. By working on a single plug-in, the student not only learns a new technology, but also creates a unified sound.

Interconnected is a piece that explored live saxophone and saxophone samples, which became objectified into the motivic touchstone of the piece. A current DAW that emphasizes live interaction is Ableton Live Suite. One of the beginning functional decisions, to use Ableton Live, was based on the desire to learn the program better through working on a piece of music.

Compositional Goals

Traditional compositional goals involve focusing the work on a new technique, like a new collection of pitches, or a contrapuntal process. For electronic music, there are many compositional processes that can be explored. Using each composition as a vehicle to try new composition techniques or methods will help the composer improve through focused exploration.

The organizational (pre-compositional) focus of my methodology helps focus the piece and limits choices by making the following musical decisions: choose a sound-object that will be the central motive of your piece; develop a musical or extra-musical concept that will be your guide in composing the piece; determine how much time you have to compose the piece (supra-macro time scale) and how long the piece itself will be (macro time scale); make a working timeline for yourself, with immediate deadlines within your total available composing time; and set goals for each piece regarding what you personally will learn from the experience.

Now that the pre-compositional aspects are decided, it's time to begin working on the actual sounds.

Chapter 4 - Continuant Stage

This chapter is organized into three sections. The first section will focus on assessing and categorizing attributes and parameters, the second section will focus on the electronic transformation of sound; the third section will focus on composing transformations for acoustic instruments that are informed by sound-objects. As mentioned in Chapter 3, every sound contains many attributes, of which the composer can manipulate parameters to create variation.[112] The more interesting the sound, the more potentially complex the parameters may be. There are parameters, elaborated by Smalley, that pertain to pitch and texture, rhythm, as well as the movement (envelopes) of these parameters. Additionally, the process of creating new hybrid sounds by means of processing and/or synthesizing will be addressed.

The two processes of assessing and categorizing, and the transformation of sound are introduced as two separate stages, but in practice they flow into one another. For ease of understanding I separate the two, which seems very sectional but the process in action is actually a very fluid task for each sound. While batch analysis and batch processing is possible, it is more likely that each sound is assessed then transformed consecutively. Each sound will repeat this process until there is a useful collection of sounds into which phrases and sections can be organized or composed.

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[112] The relationship between attributes and parameters should be defined. An attribute is a quality of the item. Parameter is a measure of the quality.

Assessing and Categorizing Attributes and Parameters

It is important to assess the musical or sonic attributes of each parameter by active listening or analysis. The most important tool we possess is our ears, which is strengthened through the process of musicianship training. This is important because the manner in which we perceive sounds, like the threshold between what is harmonic and inharmonic pitch information, is not quantifiable. In *Memory for Musical Attributes* (1999), Daniel J. Levitin states that music contains possibly eight perceptual attributes: pitch (frequency), rhythm, tempo (speed of a pulse), contour (shape or direction), timbre (spectra), loudness (amplitude), spatial location, and reverberant environment.[113] Each of these parameters exist in a sound-object, and any number of them—any combination of one to all—will become the motivic focus of the piece. Additionally, the manner in which we manipulate these parameters can also become motivic in its own right.

The creation of the sound-object initiates an effort to understand its many complex parameters. From this pursuit comes the understanding of two important factors that inform my methodology of composing with sound-objects: a balance of quantitative and qualitative approaches. These two factors both contribute to the understanding by which a sound-object exists in a piece of music, but it is the quantitative analysis that informs my qualitative perceptions. Quantitative measurement is precise and divides sound into discrete units, while a qualitative assessment measures our perceptions of the continua of sound; a continuum exists for each sound's parameters.

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[113] Daniel J. Levitin, "Memory for Musical Attributes," in *Music, Cognition, and Computerized Sound: An Introduction to Psychoacoustics, ed.* Perry R. Cook (Cambridge: MIT Press, 1999), 214.

In addition to the parameters of sound, there are perceptual parameters of the sound-object—the transformation continuum is the most important of these. Below are a few examples of how a continuum is both measurable (quantitative), but more importantly, how we perceive each parameter's attributes (qualitative), which is more valuable for working with sound-objects.

Assessing and Categorizing *Acoustic Memories*

For this section, I will use my composition *Acoustic Memories* as an example to demonstrate my methods of transformation through analysis and sound processing. As introduced in Chapter 3, *Acoustic Memories* is a piece for acousmatic sound and live chamber ensemble. The pre-compositional organization of the piece was based on a memory while on a trip to Mt. Baldy Zen Center. This concept informed the collection of sound-objects. After the pre-compositional choices were decided upon, then these choices informed the process of assessing and categorizing sound-objects.

As per the memory, the sound-objects were collected and organized into the three categories; meditations bells, human voice chanting/singing/talking, and the sounds of birds in the wind, which includes some general weather sounds with white noise characteristics.

To create a sound palette, I analyzed each sound object for its sonic attributes and parameters, which included pitch, rhythmic, timbral, as well as its motion content. Additionally, I analyzed the sounds in SPEAR to investigate their spectral content.

After analyzing the sounds, I observed the following attributes and initial processing ideas:

1. **Chord-like spectrum:** The sound of the Tibetian singing bowl has an inharmonic spectrum which resembled the sound of a chord. After analysis, the pitches fall mostly on the musical grid. Therefore, this sound-object can be pitch-shifted to simulate harmonic chord changes.

2. **Rhythmic beating**: The closeness of the inharmonic overtones in the recordings of the Tibetian singing bowl created beats that can be perceived as LFO-like internal spectral movement.[114] These pitches can be moved to increase or decrease internal tension.

3. **Half-step relationships:** As mentioned previously, the sound of the Tibetian singing bowl has an inharmonic spectrum. After analysis, a few of the perceived pitches are a half-step apart. This relationship will also be used motivically, especially when composing for acoustic instruments.

4. **Shape of the spectrum**: The spectrum of the Tibetian singing bowl shows that higher frequencies decrease in amplitude sooner than lower frequencies. Time-stretching and reversing the sound will highlight the overall shape of frequencies.

5. **Short material:** When material has a very fast envelope, it is difficult to perceive pitches, so time-stretching in order to hear the pitch material more easily, like birdsong for example.

6. **Complex sounds:** The recordings of meditative chanting create harmonic drone-like information, as well as internal rhythmic movement. Through convolution, this rhythmic impulse can give motion to a static sound source. Looping the sound will create interesting rhythmic patterns.

7. **Pitch clusters:** The birdsong sound-objects contain music motives or short musical phrases, depending on the recording. They tend to be microtonal in nature, so immediately they are more interesting. These short motivic sounds can be looped to create a more intentional music effect, or time-stretched and pitch-shifted to create drone-like melodies.

8. **White noise:** The sound of birds in the wind offers a filter-like motion of white noise as well as the other additional sounds that occur within the weather sounds. These complex sounds can be dissected to create and blend interesting moments.

9. **Increasing and decreasing density and volume:** The sounds of the rain go through waves of increasing and decreasing density and volumes, which can be used as a motivic gesture, especially when composing for acoustic instruments. The dynamic swells can be created by reversing the Tibetian bowl and placing them back to front for a large crescendo/decrescendo effect.

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[114] LFO-Low Frequency Oscillator, which was originally a component in a modular synthesizer, used <20Hz audio signal (below our perceivable frequency range) as a way to send control voltage to modulate a parameter of another sound (such as vibrato when sent to the parameter of pitch).

After the sounds were collected, analyzed, and categorized by their sonic attributes, I began to transform the sounds in order to create a rich sound palette. Before I explain the primary sound processing methods I used to create the *Acoustic Memories* sound palette, I would like to take a moment and introduce the concept of sketching and collecting variations, as well as organizing many transformed audio files that will be generated.

Organizing Transformations

Sketching: Experimentation and Discovery

Sketching is not an unfocused improvisation. It is a goal-oriented process that is focused toward an outcome that is informed by the concept of the piece. While the methods of transformation presented here, appear to be very precise and methodical processes, it is important to note the amount of experimenting and discovery (heuristic methods) that are present. While processing sound, there will be an expected and hoped-for outcome, but there may also be an unknown outcome, which is a welcomed part of the process—this is the essence of sketching. Similar to the improvisatory process of *Modular Voices*, as described in Chapter 1, allowing the process to organically move in its own direction—albeit unexpected—is a rewarding part of the process, which should not go overlooked.

Creating a collection of variations

For our purposes, let us assume that the intention is to guide the listener through a sonic journey and not just unfold a smorgasbord of unrelated fantastical sounds. In order to lead the listener through the piece, it is important to create variations, which will refer back to the original sound-object.

When organizing a composition that uses sound-objects as the primary motive, it is helpful to create a group of sounds that are transformed from the original sound-object. These sound-objects can be transformed and grouped into a collection of developed sounds so the listener can identify each iteration of the sound and its development. The connection of these sounds will create a sense of coherence. Sound-objects and their manipulated iterations can be strung together into phrases, phrases into sections, and sections into a piece. If a piece is created from a collection of sound-objects (like a traditional piece of music that can be built from a collection of musical motives) then multiple collections should be created and organized.

The next section elaborates a method for organizing many sound files which are created during the transformed variation process. I feel it is helpful to organize sound files outside of a DAW to facilitate using more than one piece of software on a sound.

Naming conventions

In the process of creating variations, there will be dozens, possibly hundreds, of audio files generated. It is important to create a naming convention, shown in Figure 4.1, which helps organize variations into folders in order to identify and locate audio files.

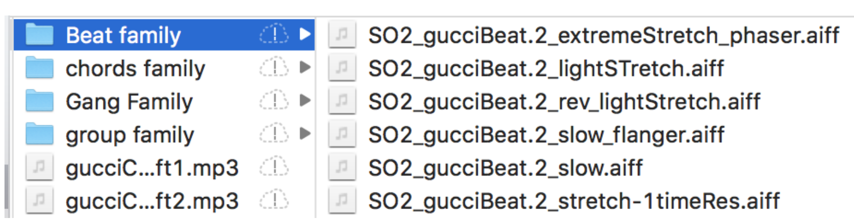

Figure 4.1. Example of creating a naming convention for variations.

Gucci Concrète uses five sound-objects and each are labeled as SO1_gucciNoise, SO2_gucciBeat, SO3_gucciChords, SO4_gucciGang, and SO5_gucciGroup. After a few manipulations, it can become difficult to determine what the original sound-object or its variant objects are. In the past, without a useful naming convention for audio files, I have spent much frustrating time searching and re-listening to many files in an attempt to relocate a specific processed sound. There have even been a few times when files have been lost. A useful naming convention facilitates the creative process by saving time, which helps focus on transforming sound, not locating sound.

Electronic Transformations

The next two sections, "Electronic Transformations" and "Composing Transformations for Acoustic Instruments," will connect the above assessed attributes and parameters with transformation. The first section will provide aesthetic and technical examples of methods of electronic transformations, and the second and final section will demonstrate composed and notated examples for acoustic instruments.

The subsection, "Destructive Edits as Transformation" focuses on two concepts, edits that permanently rewrite the audio file, and transformation methods that are applied to the spectral continuum. While there are other attributes to manipulate—which will be explored in later sections—this subsection will only focus on spectral attributes and parameters.

Destructive Edits as Transformation

The magnetic tape editing of Pierre Schaeffer was a destructive process, like tape cuts. If you made a mistake while cutting, the edit was permanent, so edits were well thought-out because there was no undo. Today, transforming sound in a digital audio workstation (DAW) refers to using digital signal processing (DSP). There are two types of DSP, destructive and non-destructive. There are advantages and disadvantages to both, but generally, non-destructive is the more commonly used form of DSP today because it can be non-destructively edited, automated, and processed in real-time.

For this section I want to focus on some destructive edits as an homage to Schaefferian transformation techniques.[115] I find it liberating to make permanent decisions—to commit to the edit—by making an edit that cannot be undone (and then moving on). I also feel it is an important thought process as well as productive teaching convention (to commit to thoughtful edits). Besides, if the outcome is not aesthetically effective, lacuna until it is.

Spectra Continuum

Each sound has a continuous range or series of frequencies—known as a sound spectrum—that is perceived as a single note, or a few notes, or an indistinguishable number of frequencies, where no pitch is perceptible, also called noise. Sounds are

[115] Please refer to David Huber's *Modern Recording Techniques*, 7th ed. For descriptions and examples of signal processing (Chapter 14).

collections of many frequencies with differing amplitudes and phases, which can be represented—through fast Fourier transform (FFT)—as a series of discrete sine waves.[116]

Any sound that has a perceived single pitch adheres to the harmonic system of whole-number integers as the overtones over a fundamental, which is known as the harmonic overtone series. Tonal musical instruments are built to produce single-pitched sounds with different timbres. Mixing and matching these instruments together is how orchestrators throughout history created new tone colors. Electronic instruments have contributed many new timbres that had never before existed. This in an important contribution to the music of the twentieth century. Music that is based on notes (sounds with a harmonic spectrum and one perceptible pitch) has been well-explored throughout all of Western music history, so I will not intently focus on that. Instead, I focus on sounds that do not have a clear harmonic overtone structure.

Usually pitch and timbre are analyzed as separate parameters, but I combine them together into a single perceptual parameter which l call the spectra continuum. This is an important distinction which combats the bifurcation of what is commonly seen as music versus non-music.

On one end of the spectra continuum is a sine wave, which is a synthetic waveform with no measurable spectrum above a single frequency (fundamental). On the opposite end of the continuum is noise (all frequencies with matching amplitudes) with no single measurable fundamental frequency. These two extremes—a fundamental with no spectrum, and a spectrum with no fundamental—act as bookends for three basic zones—

[116] Fast Fourier Transform (FFT) is an algorithm that is able to analyze the amplitude and frequency domain of an audio signal by taking a short sample of the sound.

harmonic, inharmonic, and noise—into which the continuum is divided. Each zone is defined by a combination of frequency and amplitude relationships.

When a sound is in the middle of each zone, there is no confusion about its spectral identification. However, there is no measurable location for the threshold between each zone. The precise location of the threshold will be perceived differently by each person. For example, deciding if a sound is harmonic or inharmonic changes from person to person depending on their aural perception.[117]

Spectral Analysis

Some parameters, like spectrum (timbre), may be difficult for even a musically trained ear to identify. It is helpful to utilize a spectral analyzer, like SPEAR, that uses FFT (Fast Fourier transform) technology, in order to reveal the complex blend of frequencies. Additionally, SPEAR is a powerful tool to help determine which notes an acoustic instrument can play in order to correspond with sound-objects, which will be discussed more in depth later in the chapter. In SPEAR, each sine wave component of a sound can be edited, which makes this software quite powerful for the editing and manipulation of sound at the spectral level. The red highlighted frequency in Figure 4.2 shows an example of how sound partials are isolated, time-stretched, and shifted to different frequencies.

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[117] For more information on psychoacoustic theories such as: timbre, loudness, and temporal perception, refer to Andy Farnell, *Designing Sound,* 77-114.

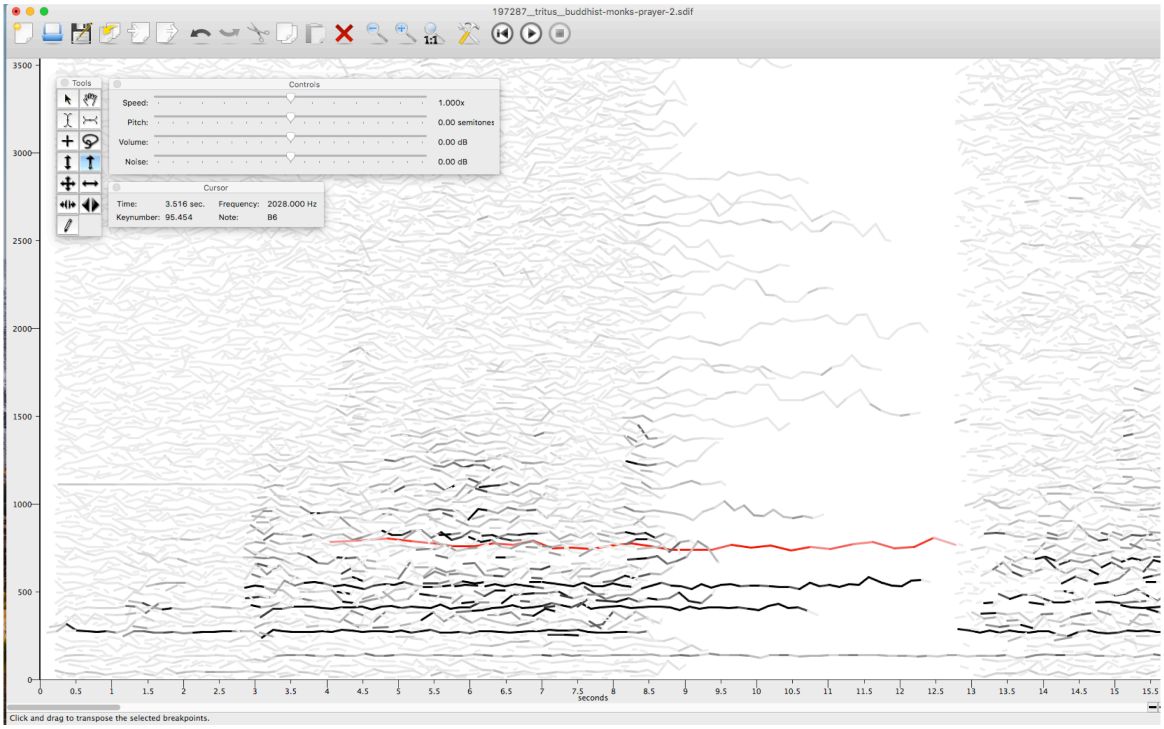

Figure 4.2. SPEAR software for analysis or editing sound partials.

Now that the technical goal of destructive edits, my concept of the spectral continuum, and spectral analysis—a useful tool to measure frequencies—have been introduced, I will connect some of the above assessment ideas from, "Assessing and Categorizing Attributes and Parameters" with their electronic transformations.

Acoustic Memories uses five sound-objects, on which the acousmatic portion of the piece is built. The first sound-object that we can analyze is the sound of a Tibetan singing bowl being struck, which have been assessed with four distinct motivic elements: a chord-like spectrum, rhythmic beating, half-step tension, and shape of the spectrum.

Chord-like Spectrum

In Figure 4.3 below, a spectral analysis shows that there are six frequencies that have a louder amplitude, six different human perceptible pitches present in this sound-object. These six frequencies create a sound that emphasizes more than one pitch. The different pitches, in order of loudest amplitude are [B5, B4, G5, C-sharp7, F-sharp 5, C6], give the sound of a chord.

In order to accentuate the spectral nature of this sound-object—the chord-like collection of pitches—the audio file was transposed down in pitch. This pitched-down audio better accommodates the live acoustic instruments in this piece, because it sits more comfortably in their range. Further application of this sound-object's attributes is discussed later in "Composing Transformations for Acoustic Instruments."

The opening sonic event of *Acoustic Memories* is the sound of this Tibetan singing bowl. This event consists of the original sound-object and two manipulated variations. The two transformed sound-objects that also appear in the opening sonic event feature iterations of the original bowl sound, both of which were reversed, and one also pitch-shifted down an interval of a minor third. The reversed-bowl variations slowly fade in to blend together and create a resultant more complex "chord" that emerged from this second pitch-shifted iteration of the sound-object that introduces G-sharp as its two loudest frequencies.

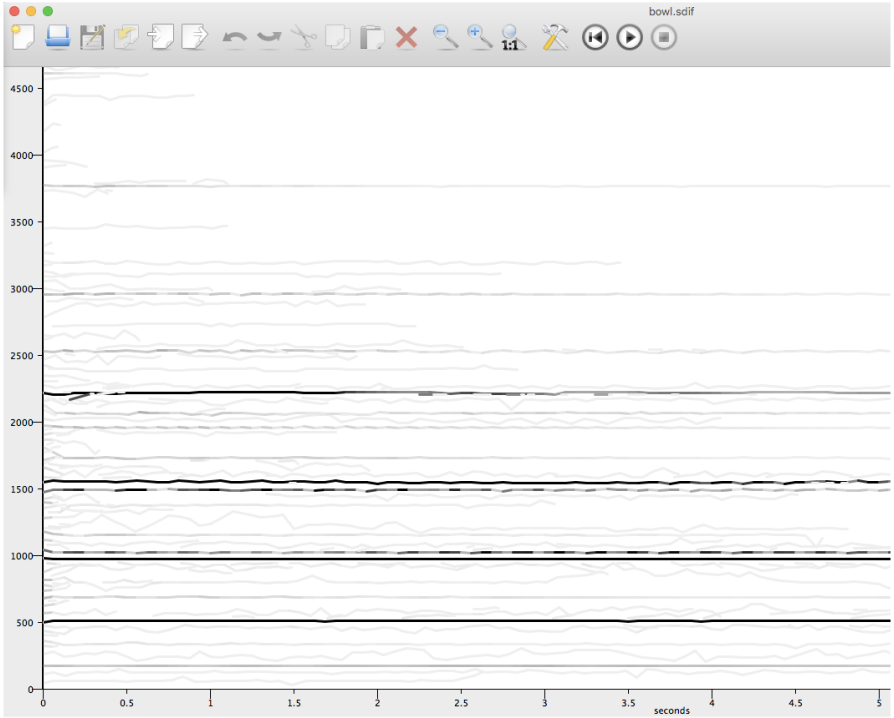

Figure 4.3. Spectral analysis of a Tibetan singing bowl.

Rhythmic Beating and Half-Step Tension

The spectrum of the bell sound also has internal movement that is created by the two pairs of frequencies [B and C] and [F-sharp and G], which create a beating pulse that give some tension and instability, and therefore, an interesting character to the sound. The half-step tension from the paired frequencies will also be addressed later in "Composing Transformations for Acoustic Instruments."

In Figure 4.3, the rhythmic beating is shown by a dashed-line—the amplitude is increasing and decreasing. The rhythmic beating is conceptualized motivically to inform pitch collections, but it was also used motivically as a rhythmic device. I also used SPEAR to analyze and manipulate the frequencies of the Tibetan bowl in order to increase and decrease the speed of the beating. The choice to manipulate partials in this manner came from the motivic attributes, listed above, where the beating sound of the bell was highlighted by varying the beating or consonance/dissonance texture within the sound-objects.

Shape of the spectrum

The envelope of the bell sound has a fast attack and a very slow decay. Figure 4.2 also shows that the upper frequencies' amplitudes decay faster than the lower frequencies. This envelope supports a known characteristic of how frequencies react in many instruments—there is a direct correlation between the appearance of upper partials and amplitude. I based motivic composition decisions on that phenomenon. The attributes of spectral phase and amplitude became a motivic element. I also time-stretched and reversed the audio file in order to accentuate the unfolding of the upper frequencies—the reverse of this sound is easier to aurally track the presence of a pitch as opposed to the subtle lack of its presence. This manipulated audio file is chosen and framed as the original sound-object, to which other variations relate.

Sound-object with a complex spectrum

Buddhist monks chanting—another sound-object that appears in the second section of *Acoustic Memories*—is much more complex because there are a few sounds that blend together. The monks are chanting on a single pitch along with a percussive metallic sound at a steady rhythmic pace. Figure 4.4 shows that the sound source does not have a clearly defined envelope, the beginning, middle, and end of each sound all overlap. In order to isolate a moment in time, to become more focused as a sound-object, I looped it and processed it. By looping the sound, it becomes rhythmic and therefore more musical. By adjusting the loop size and loop start and end points, interesting transformed variations can be created.

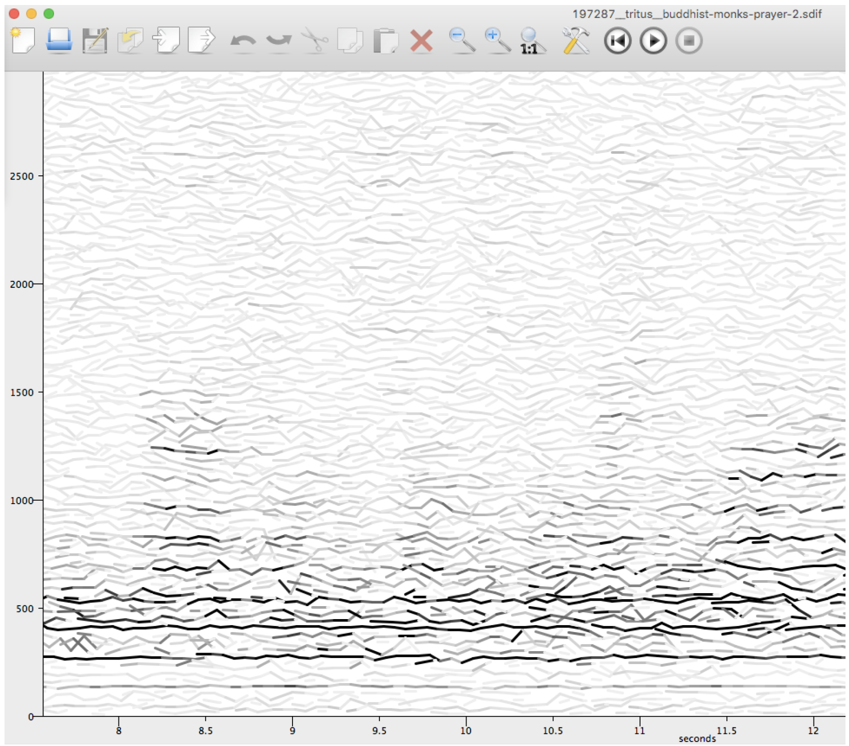

Figure 4.4. Spectral analysis of monks chanting.

This sound-object of monks chanting will be morphed with the Tibetian bowl sound-object to create a complex combined sound. The morphed process to create transitional material will be discussed below in "Transition Material: Convolution and Morphing."

Sound-objects with a cluster of pitches

In the middle section of *Acoustic Memories,* the sound of a robin singing presents another spectral configuration that appears in an analysis as a cluster of frequencies (Figure 4.5). This sound-object exists very high on the spectrum, ranging from 4 kHz to 10 kHz. For reference, the highest note on a piano is just above 4 kHz. This sound-object is similar in frequency range to cymbals and can function musically in a similar manner. The high frequency range allows for this sound-object to sit above any other sound and not mask anything. “Arranging Sound-Objects” is explained further in Chapter 5.

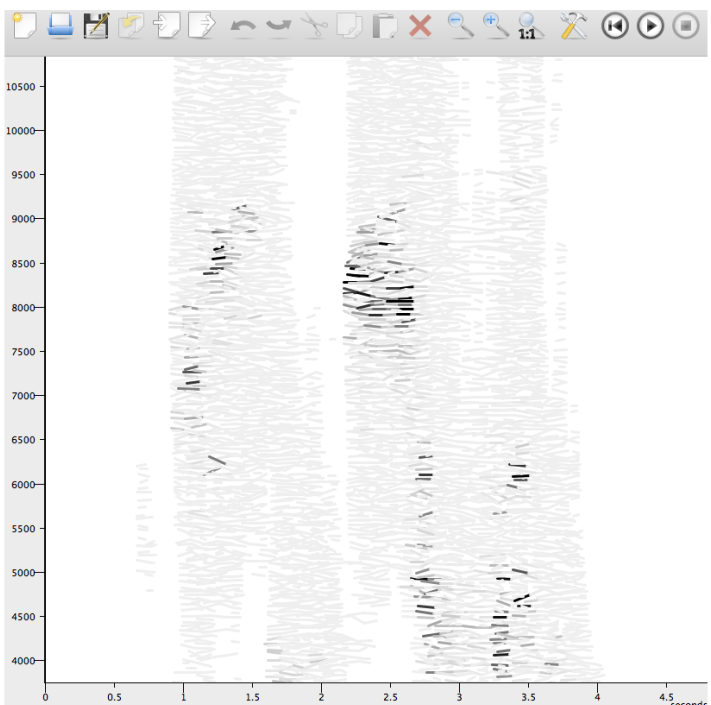

Figure 4.5. Spectral analysis of three-second birdsong.

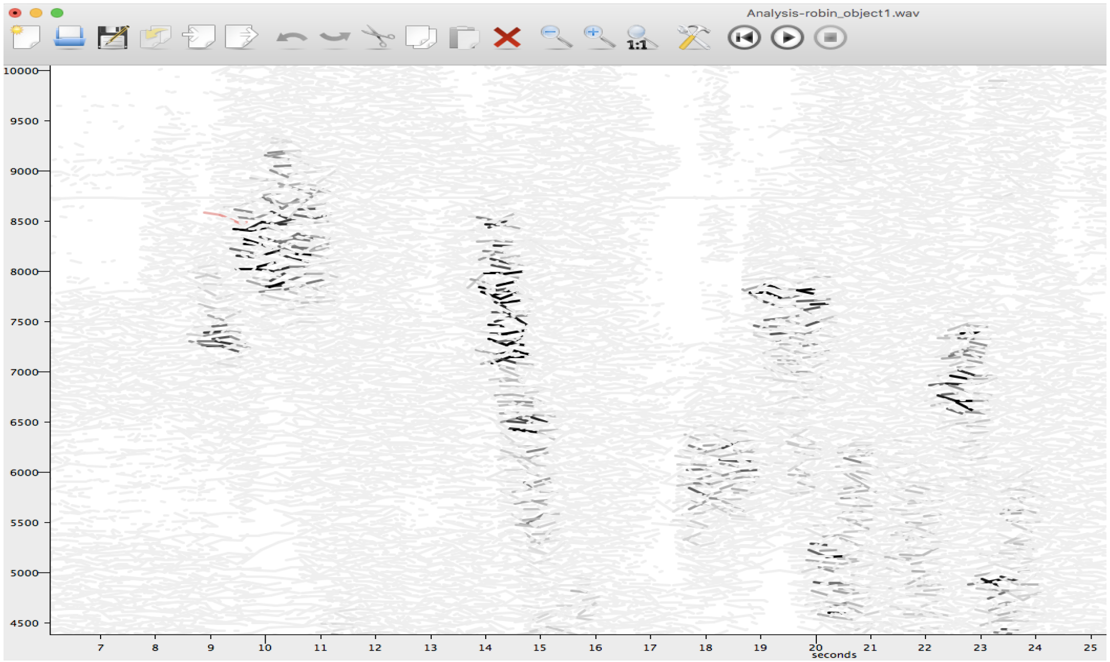

Figure 4.6. Spectral analysis of twenty-five-second time-stretched birdsong.

I transformed the bird sound-object by applying an extreme time-stretch (Figure 4.6), using Audacity, a freeware audio program for recording and editing sound files. One of the many features of Audacity is the signal processing method called Paulstretch, which was created by Romanian programmer Paul Nasca and incorporated into Audacity. It is useful for extreme time-stretching because Paulstretch avoids the usual residue of audio artifacts through smoothing.

I was able to process the three-second birdsong of a robin and stretch it to create a very interesting twenty-second, airy-sounding variation that is connected to the spirit of the singing bird without the immediate recognizability from the original sound file. This transformation—due to the process of extreme time-stretching—is not recognizable as birdsong, because the sound's envelope has been drastically changed. The spectrum is still stable and basically untransformed, so I placed the original sound-object next to the time-stretched variation and mixed one sound into the other in order to reveal the original context.

Without hearing the original birdsong, the listener is most likely unable to connect the identity of the transformed sound with its original sound-object. The listener, when hearing the two sounds together, changes their personal level of perspective from a transmutated sound into a mutated sound, to use Roads' terminology. This example further demonstrates that a sound-object can exist on multiple levels of perception.

Working with white-noise sounds

Some of the sounds from nature have no discernable pitch information. Many of nature's sounds are defined by their interactions. Rain by itself makes no sound, unless it interacts with something; rain on cement, rain on wood, rain on a tin roof, etc. The sound-object of heavy rain, as shown in Figure 4.7, comprises many frequencies, all at a similar amplitude. There is no sonic distinction, no memorable events in this current state. Additionally, Wishart points out that transforming this material by either shifting up or down in pitch produces unidentifiable results.[118] Similarly, the example is a full-range audio sample; it is not range specific. It is more useful if the sounds are filtered and if some existing frequencies are highlighted or boosted. Filtering a sound with no perceivable pitch by boosting a specific internal frequency changes its placement along the note-to-noise continuum; it changes from noise to an inharmonic sound, which is now more useful.

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[118] Wishart, *On Sonic Art*, 59.

Sounds without pitch content can also be mixed or convolved[119] with other sounds to create a rich sound-object.

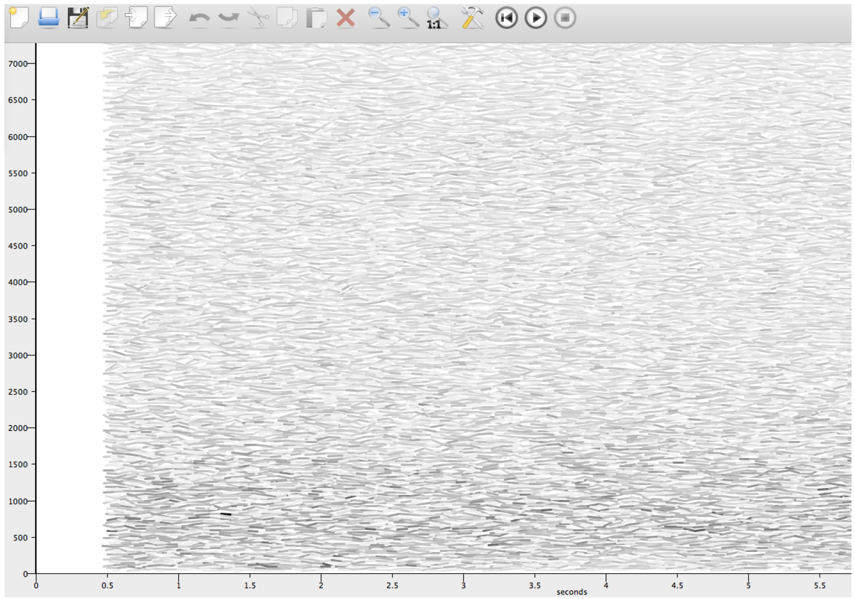

Figure 4.7. Spectral analysis of heavy rain.

To give an example for this subsection on working with white-noise sounds, I will introduce my student Claire Reedy's work as a case study. Her piece *Thunder* (2019) focuses on the sound of rain and thunder as the source material for a sound-object, which shows how white-noise sound is filtered and processed to become more effective as the motivic touchstone of the piece.

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[119] Spectral convolution is a type of resynthesis that creates a new blended sound from the spectra of two sounds. Examples of this form of synthesis are given below.

A Case Study by a Student

Claire Reedy, as a second-year electronic music student at Rio Hondo College, composed *Thunder,* while taking Electronic Music III. Her personal connection with lightning and the sound of rain and thunder led her to choose these sounds as the concept of her piece. She found source material on *freesound.org*—a 34-second audio recording—which included the sound of rain with multiple thunderclaps. From the source material, she chose five initial sound-objects before ultimately narrowing them down to a single two-second thunderclap, which served as the focus of the piece.

Additional organizational parameters of functional design, (assigned for the class project), included the duration of two-to-three minutes for the piece, a three-week deadline, and the technical design requirements which included the use of SPEAR, SoundHack, and Logic Pro X. A two-to-three minute piece limits the amount of variation or transformations of the original sound-object the composer can include. The three-week deadline also ensured that there was only a limited time allotted to the creation and manipulation of sound sketches, events, and phrases.[120]

Once all the pre-composition elements were decided, Claire started by analyzing the sound-object in SPEAR to look at the frequency make up. The original sound-object did not have any perceived pitches to work with, but there were a few frequencies with a much louder amplitude compared to the other sounds, so she boosted the sound with a center frequency of 172 Hz in order to create a more focused sound. Figure 4.8 shows not only the boost of the center frequency, but also the tight filtering from both the HP and LP filters.

[120] Sketching will be introduced below in the section "Sketching: Experimentation and Discovery."

This is a way to cut the high and low frequencies of both the full-range and white noise signal and create a more focused sound.

Figure 4.8. Equalizer to boost amplitude of existing frequency.

Claire imported the new sound-object into the Audacity>Paulstretch plugin to create three new files: 10-seconds, 20-seconds, and two minutes. With these three files, she was able to create sketches—or families of objects—on which the piece is built. Only 50% of the sketches made it into the final piece. This was a difficult compositional process to learn, because most students start composing a piece from the first measure and diligently work through the piece in a linear fashion. She learned that sketching allowed her to create moments and place them anywhere on the timeline, as well as have more control over the pacing of the piece. This approach fundamentally changed the way she approached the composition process.

Transition Material: Convolution and Morphing

Blending sounds together is another technique that I use to create cohesion in a work. When two sounds are synthesized together into a single sound, that new sound belongs to the both original sound-objects. This creates a familiar variation which can be used with both original objects, and it also creates transition material that leads the listener from one section to another. I used the software program SoundHack in *Acoustic Memories* to create transitions and variation material.

Convolution: Destructive Edits

SoundHack, first created in 1991 by Tom Erbe, is a powerful freeware audio processing program that can produce complex results. One of the many features of SoundHack is convolution: the process of taking two sound files and multiplying their spectra to produce a new sound file (destructive edit). The shared frequencies create a type of cross-synthesis.

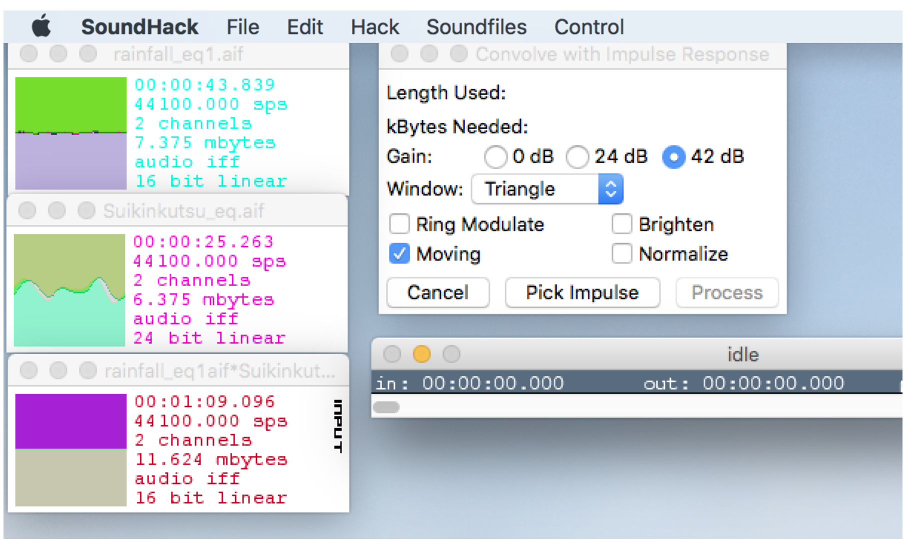

Figure 4.9. SoundHack: Convolution of two sound files.

The example from the piece *Acoustic Memories,* in Figure 4.9, shows a sound file of rainfall convolving with that of a *Suikinkutsu*, a Japanese garden ornament that drips water on a pot to create a relaxing and unique pitched sound. The result creates a transformed sound-object that has the sonic characteristics of both the rainfall and *Suikinkutsu*. In order for the convolution process to be most effective, it is necessary to sculpt the frequencies from both sound files, so that their spectra are similar. I imported the audio into Logic Pro X, to apply both HPF (high pass filter) and LPF (low pass filter), in order to prepare the two sound files for SoundHack's Convolution process. These results give the rainfall a more metallic sound and creates a more complex envelope to the convolved outcome. This sound is used as a transformation to move from a section of bowls into the transformed rain section.

Morphing: Non-Destructive Edits

Alchemy, a software synthesizer within Logic Pro, is a new morphing and granular synthesis tool that can perform many new types of resynthesis, which represents a twenty-first-century update to spectromorphology. There is an additive, spectral, granular, and formant synthesis engine in Alchemy, which helps analyze sound files and determines the synthesis engine needed to facilitate morphing. While it is possible to use sounds that are electronically generated, it is more interesting to me to start with sound-objects, which have complex spectra. When the sounds are imported into Alchemy, it is important to select one of the above synthesis engines so the sounds can be resynthesized. The resynthesis makes it possible to morph in Alchemy. At this point, it does not play the original file, but instead a resynthesized version, which is generated by an additive synthesis engine and allows for non-destructive editing.

Figure 4.10. Alchemy: Morphing between two sound files.

Figure 4.10 shows Alchemy's interface that allows for elemental morphing between two sound files. The leftmost column showing that only two sources are selected (A and B), as well as the blue tab labeled "Morph" to switch to the Morph section. It is possible to upload four sound files as source material for this software.

One example, from *Acoustic Memories*, I chose to morph between two sound files: a field recording of Tibetan monks chanting sutras while setting the tempo on a singing bowl, and a recording of a singing bowl alone that has a much more distinct harmonic spectrum. The blending of these two sounds functions as a transition between the first section, characterized by bells, and the second section, characterized by chant.

Non-Destructive Effects as a Transformative Function

This section briefly discusses non-destructive effects processing and not on the previous examples of destructive signal processing. Effects that are inserted into the signal path of a sound (plug-ins). I categorize effects into two functions, either as a real-world simulation, or as a way to transform the sound-object. This mention should bring awareness to the effects that transform sound.

There are many commonly used types of effect, which are organized into the following categories: pitch effects, dynamic effects, modulation effects, filter effects, time-based effects, and distortion/saturation effects. These topics have been covered extensively elsewhere, so I'll focus on only a few examples in which I use effects as a way to transform sound-objects. Please refer to the many resources that discuss sound effects and other processing techniques that are outside of the scope of this dissertation.[121]

In the previous section "Morphing: Non-Destructive Edits", an example of transformative morphing provided transitional material. I will show how sound effects, like modulation and filter effects can be used in order to create a sense of timbral movement within a sound-object, which is the essence of spectromorphology. These effects can further accentuate an existing morphing sound, or artificially create timbral movement in an otherwise static sound.

Figure 4.11. Alchemy: Modulation through filters, LFO, and a sequencer.

[121] Please refer to David Huber's *Modern Recording Techniques*, 7th ed. For in depth descriptions and examples of signal processing (Chapter 14).

It is possible to use envelopes to further shape the unfolding sound over time. (Figure 4.11). Similar to any synthesizer, it is possible to create periodic movement through the use of a VCA[122], LFO, or sequencer, when routed through assignable destinations in the patch. For this situation, in order to give internal movement to the morphed sounds, I used a sequencer to modulate the pitch and filter to create a pulsing timbral change. The modulated pitch effects are also informed by the rhythmic beating which was assessed above in the previous section, "Assessing and Categorizing Attributes and Parameters," which provided examples of how to motivically determine elements to manipulate.

Motivically informed processes can create a sense of coherence by collecting similarly processed sounds together to build a group. These groups of similarly processed sounds can be organized in such a way as to help create a collection of variations. The section, "Creating a Collection of Variations" will focus on creating a collection of sounds.

Composing Transformations for Acoustic Instruments

The previous sections have introduced sound-objects as recordings with electronic transformations informed by assessing the attributes of sound-objects. This next section will focus on the creation of music that is notated for acoustic instruments, also informed by assessing the attributes of sound-objects. This way of thinking about musical sound can and does inform composers' thinking when composing for instruments. The techniques and sounds of electronic and concrete music, can give many inspirational ideas about how to achieve new sounds through instrumentation and orchestration.

[122] VCA-Voltage Controlled Amplifier, which was originally a component in a modular synthesizer, controls change in amplitude.

As mentioned earlier, *Acoustic Memories* is a piece that uses both an acousmatic recording and six acoustic instruments. The list below is revisited from the section, "Assessing and Categorizing Attributes and Parameters," but only these six assessments, which fit the unique needs of acoustic instruments, apply to the following examples:

1. **Chord-like Spectrum:** Pitch collections informed by the frequencies of the Tibetian singing bowl.
2. **Rhythmic Beating:** the internal rhythmic movement also informed by the close beating frequencies of the Tibetian singing bowl.
3. **Shape of the Spectrum:** the scaling effect of amplitude on the duration of frequencies also informed by the Tibetian singing bowl.
4. **Dynamic swells:** crescendo and decrescendo dynamics, informed by the reversed bell, which is placed back to front to create the gesture.
5. **Pitch Clusters:** the closely associated frequencies of birdsong are contextualized motivically as pitch clusters.
6. **Increasing and Decreasing Density:** contextualized the increasing and decreasing intensity of rain creates a gesture of increasing and decreasing density.

The opening gesture of Acoustic Memories (Figure 4.12) is composed of four motivic gestures which are informed from the list above. The following examples will connect the attributes of this list to composed transformations below.

Chord-like Spectrum

The opening notes that start the piece, in Figure 4.12, are the same pitches of the sound-object of the Tibetian singing bowl that are analyzed by the spectral analyzer [B5, B4, G5, C-sharp7, F-sharp5, C6], shown earlier in the chapter (Figure 4.3). In the acousmatic score of *Acoustic Memories*, the opening sound-object is presented in its original form, then the first of two variations are introduced pitch-shifted down, while the second variation is reversed from its original form. This is reflected in the notated score and located on the second beat of the third measure (Figure 4.12). The opening pitch collection is transposed down a minor third, which is similar to the pitch-shifted variation.

Figure 4.12. Acoustic Memories: Opening gesture (mm 1-9).

Shape of the Spectrum and Dynamic Swell

The opening musical gesture of the piece, notated at the beginning of this section (Figure 4.12), begins with a slow crescendo into an accented note and then slowly decrescendos into silence. As the dynamic level increases, the number of partials also increases, and as the dynamic level decreases, the number of partials also decreases. This opening musical gesture informs the dynamic crescendo and decrescendo.

Dynamic swells are a gesture that is used frequently in *Acoustic Memories*. As mentioned before, it is informed by the sound-objects, as described in “Assessing and Categorizing Attributes and Parameters.” Figure 4.12 shows the first example of the orchestrated dynamic swell composed for acoustic instruments. The dynamic marking of the opening gesture is a very slow crescendo that climaxes at the downbeat of measure six, also resembling the reversed dynamics of a bell sound. Beginning on the second beat of measure six is the simulation of the pitched-down bell which, as the dynamic markings indicate, is loud at the onset and slowly gets softer in volume.

Rhythmic Beating

Also, in Figure 4.11, starting on the sixth measure, there are simulated pitch beatings that are notated in the first violin and first cello parts. The inner rhythmic movement of these two lines pulse at two speeds. The violin pulses in a constant rhythm, notated by the slurred-tenuto eighth notes. The cello part's slurred-tenuto eighth-note-triplets are less rhythmically periodic, but pulse at a faster speed in relation to the violin. These two markings were an effective way to notate inner rhythmic movement of the sound-objects' beating.

Figure 4.13 shows an example where the first and second celli create an effect which simulates the beating of close frequencies. In this instance, the second cello's notation has a glissando that very slowly descends from F to F-quarter-flat, and then slowly returns to F. This bending of the second cello pitch causes beating with the first cello, which is itself modulated by a bow marking of slurred *tenuto*—similar to a *portato*, but with less space between each note within the drawing of a single bow.

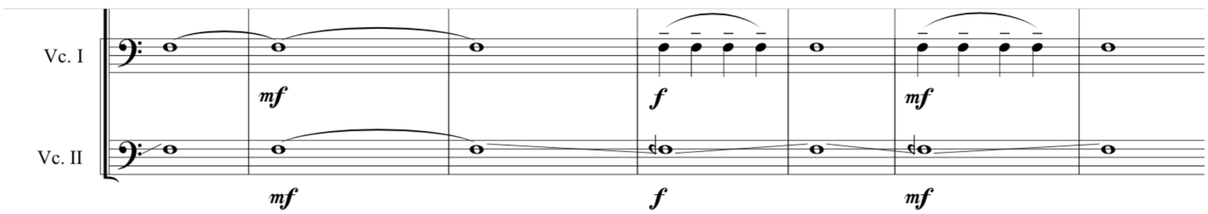

Figure 4.13. Acoustic Memories: Simulation of beating frequencies (m 16).

Increasing and Decreasing Density and Pitch Collections

Figure 4.14 shows a score excerpt from the rain section of *Acoustic Memories.* This section's pitch collection was informed by the *Suikinkutsu* sound file. The pitches from this sound (Figure 4.15) were analyzed by SPEAR and orchestrated into pointillistic events.

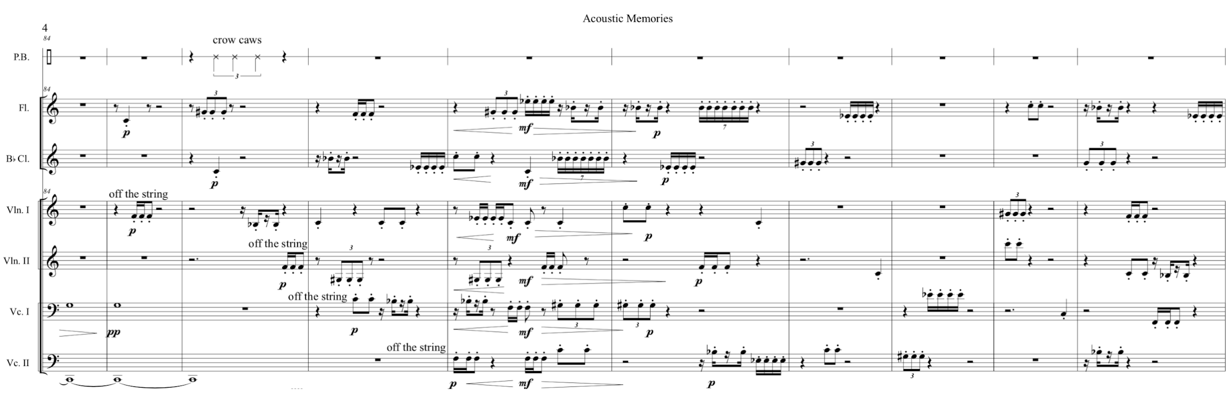

Figure 4.14. Acoustic Memories: Example of pitch collection and density (mm 84-93).

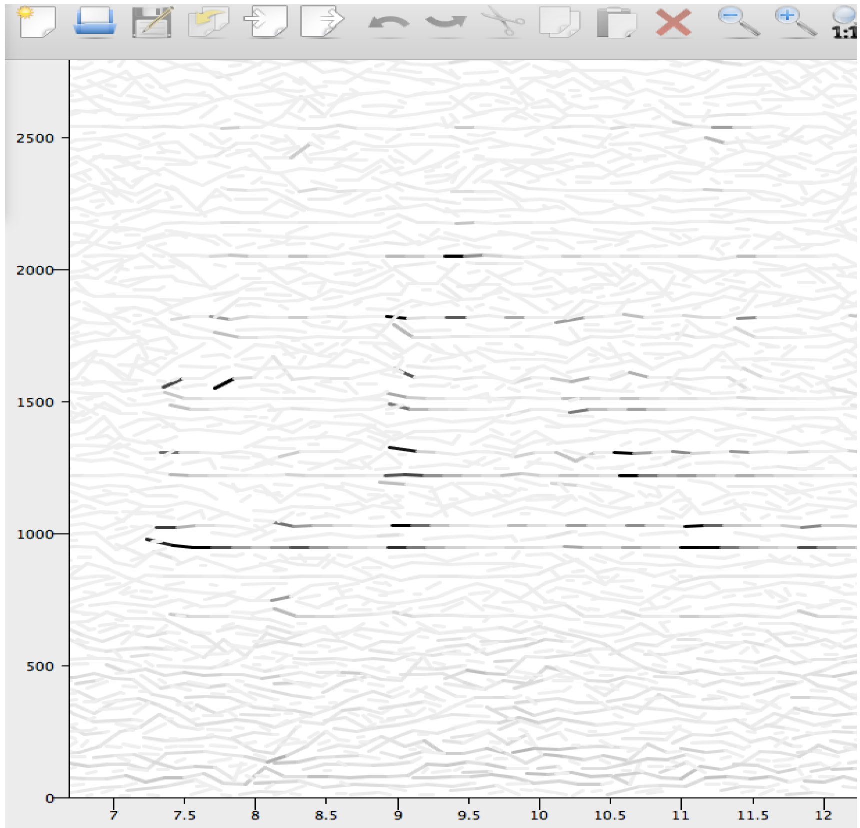

Figure 4.15. Acoustic Memories: Suikinkutsu sound file.

As shown in Figure 4.14, the increase and decrease of the rhythmic density of the pointillistic phrase simulates the sound of increasing and decreasing intensity of rain. It is another example of how the acoustic instruments were informed by assessing the attributes of sound-objects.

Pitch Clusters

The use of birdsong creates interesting collections of frequencies. As shown in Figure 4.16, the upper four voices of the flute, clarinet, violin one, and two are creating a dynamic swell—a previously introduced motivic gesture—from the following pitches [G, G-sharp, A, and B-flat]. The motivic concept of pitch clusters, informed by sound-objects, were introduced above in "Assessing and Categorizing Attributes and Parameters."

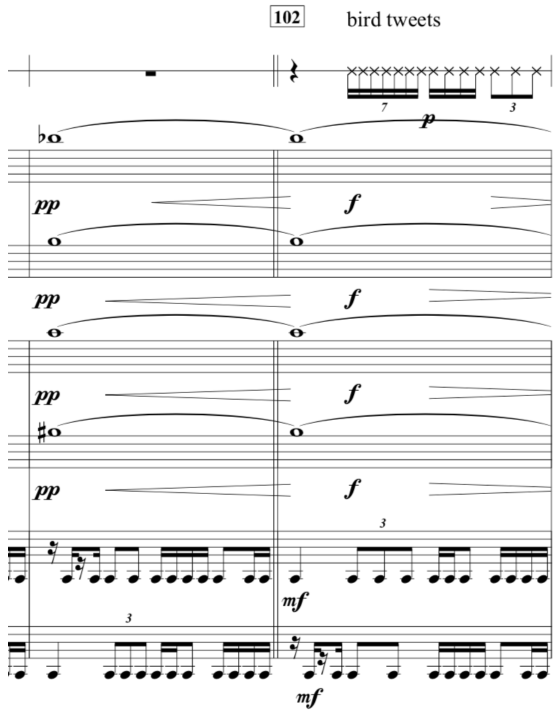

Figure 4.16. Acoustic Memories: Pitch clusters of "birdsong" (mm 101-102).

Transformation Continuum

The final and most important thread of this dissertation is transformation. where the sound-object is transformed through analog or digital processing to create a group or collection of transformed variations. As mentioned in Part I, starting with Schaeffer, transformation and a way to classify sound (typomorphology) was a large focus of his work, as well as Smalley's much more thorough contribution of Spectromorphology. Curtis Roads channels Varèse and Schaeffer's terminology—in his Identity Continuum—of mutation and transmutation to describe the condition or state of the transformation in relation to the original source or context. Tenney's Objective and Subjective Sets of Perception focuses on expectations that are created by the work or perceived by the listener's expectations. Adrian Moore's Theory of Opposites describes the full range of parameters that can be explored.

This chapter has shown a process by which sound-objects can be assessed and categorized as a means to organize and inform methods of electronic and acoustic transformation. The next chapter focuses on a larger timescale; how pieces are structurally constructed by phrases and sections, and how to bring it all together. What defines the form of the piece is not so much how sections are similar, but how they are different. It is important to find the balance between similarity and contrast.

Chapter 5 - Termination Stage

The final stages of the composition process bring all the elements together into one cohesive work. It is divided into two sections, "Structural Design," and "Orchestrational Mixing of Sound-Objects." This final stage will describe an approach to the sketching process, compiling phrases and sections into a piece of music, and the artistic and technical aspects of mixing sound-objects through the focus of orchestration.

Structural Design

Large formal structures of traditional Western music compositions have traditionally been organized harmonically, primarily through key relationships. The tension and release of tonic/dominant relationships are what drive phrases and sections in tonal structures. It is the handling of harmonic tension and release on the micro to macro level on which tonal music functions. Most sound-objects that come from real-world sounds do not adhere to key relationships. In order to create large-structure relationships for music with sound-objects, it is necessary to organize the structure by other means such as attributes instead of traditional harmonic relationships. What defines the form of the piece is not so much how sections are similar, but how they are different. It is important to find the balance between coherence and contrast.

Spectral and temporal relationships are the two primary methods that I use to structure a piece of music composed with sound-objects. Sections that are bound together sonically through the journey of a sound-object and its transformed variations creates coherence. Sections are perceived when there is a contrast between spectral identity relationships (transformation continuum). Temporal relationships can create motivic elements, and define how time is perceived, either fast or slow (time continuum). It is the combination of these two aspects that determines how the form is structured by the composer and perceived by the listener.

Interaction of Sound-Objects

Creating Coherent Events and Phrases

It is important to define how I am using the terms "event" and "phrase", and to explain how events may be organized into phrases, which are composed of interacting sound-objects. While sound-objects and phrases are defined and perceived by their timescale, I define events as a motivic construction that focuses on the interaction between sound-objects; the interaction of frequencies and temporal parameters. Robert J. Frank refers to an event as a single sound, silence, or series of sounds occurs within a period of the psychological present.[123] This is similar to what James Tenney described in *Meta-Hodos* as clang, elements, and sequences; perceptions of sounds that are connected by proximity or similarity.[124]

After a group of variations—or just a few—are created, then it is time to start sketching an event. Sketching is an important compositional process for any type of music, which allows for the fleshing out of ideas and freedom to place the sketches anywhere along the timeline in order to affect the flow of the piece and help create more effective musical moments.

[123] Frank, *Temporal Elements,* 3.

[124] Tenney, *Meta-Hodos*, 23.

Two or more sound-objects placed together—either concurrently or consecutively—with similar timbres, for example, will create an event and will be perceived as coherence. Two dissimilar sound-objects that are placed together, will create musical expectations by the perceived juxtaposition. Coherence can be achieved by consistent motivic interplay between similar and contrasting sound-objects. In both these situations, the relationships of the interacting sound-objects will create musical expectations, which can be used motivically and continue to inform other relationships.

Figure 5.1 shows the opening fourteen-second phrase from *Gucci Concrète* which is composed of three events. The three green regions show the MIDI information from a sampler instrument which trigger the original sound-objects—SO1_gucciGang, SO2_gucciBeat, and SO3_gucciGroup. The three blue audio regions are transformed variations of these three sound-objects.

The first event introduces the first sound-object and its transformed variation. Together, they produce an interesting effect which isolates the timbre of the sound from the context of the sound-object. All three events are created in this manner to produce a coherent phrase composed of three events.

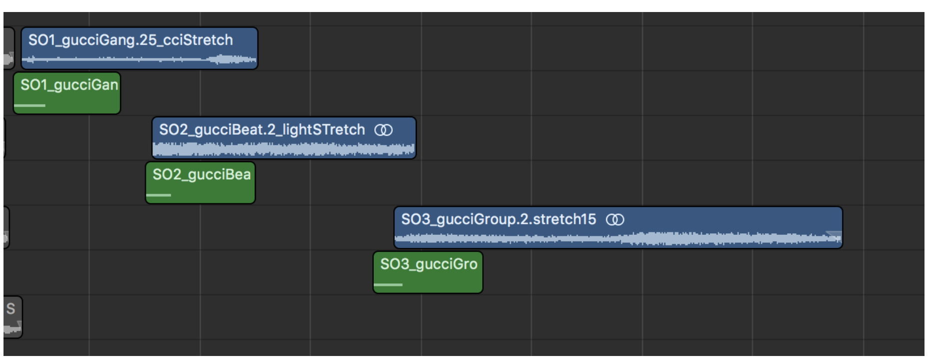

Figure 5.1. Gucci Concrète: Three events of the opening phrase.

Figure 5.2 shows another example of a three-second event that consists of three variations from two convolved sound-objects—SO2 and SO3—which interrupt a phrase that is composed of two pitched chordal sound-objects (SO4). This event is not part of a separate phrase, it is a welcomed interruption to an existing phrase.

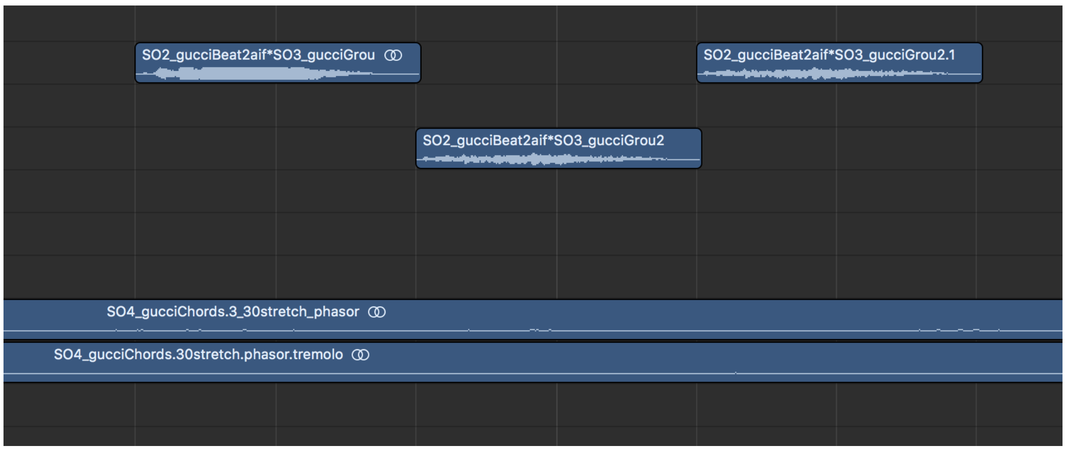

Figure 5.2. Gucci Concrète: A phrase that was interrupted by an event.

Repetition as a Unifying Element

Since before the Classical era, there have been techniques that allow for the connection of ideas, to help create a perceived unified work. An opening motive/rhythm, sound, or texture serves as the unifying element, to which all other material refers.

The perception of how music unfolds in time for a listener is determined by the piece's formal or structural organization of the materials. This temporal aspect brings more focus to the importance of repetition in relation to the unfolding of time. Even if the piece is constructed with moments of indeterminate elements—improvisation, random choices or probabilities—these moments usually occur in smaller sections that are still organized upon a larger timeline. In regard to sound-objects, it is also important to consider repetition and variation as a unifying device.

Many musical ideas can be strictly repeated or continuously developed depending on the intention of the perceived outcome. Ideas that function as the middleground of a composition—which may not be perceived upon first listening—are what will bring the listener back for repeated listenings of new discovery or appreciation.

For example, in an eighteenth-century contrapuntal sequence, it is common to begin with the rule of three; the first iteration is an introduction of the material to be sequenced. It is at this moment that the listener is unaware that a sequence is about to happen. It is in the second iteration where most acknowledge that a sequence is underway. This is when the material is modulated (usually up or down by a second or third interval) or changed in some way to create listener interest. The third iteration will become predictable to most listeners so either a truncation or some other type of new attention-grabbing technique is applied, depending on the material. Generally, short sequential material needs to be extended in a different direction; conversely, longer sequential material is usually truncated. Ultimately both of these manipulations of the sequential material are designed to keep the listener's attention.

Creating Contrasting Sections with a Coherent Overall Form

Once I have a collection of transformed variations *and* I have created a few events, and organized them into phrases, it is time to place this sonic material in time. Figure 5.3 shows the layout of the audio regions that are placed in time.

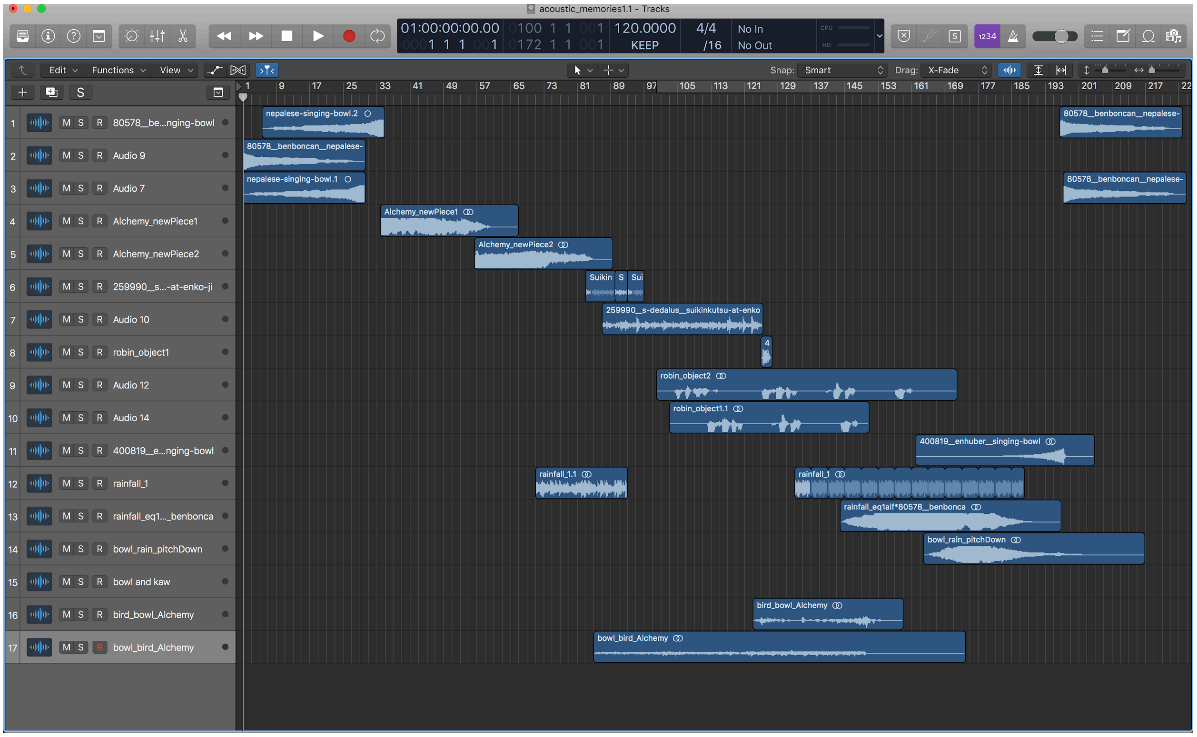

Figure 5.3. Acoustic Memories: Overview of compiled sound regions.

The relationships of sonic material with and against each other determines how the pacing of the music unfolds in time. Similar sounds that are collected from the transformed variations create a section of coherence. Transitional material—like the examples in the section named, "Blending Sounds Together" in Chapter 4—create pathways and bridges from one section to another. The contrast of one group of sounds against another creates sectional variety. It is the pairing of contrasting sections that create the overall structure of a piece. The sections create the macro form of the piece; the sonic narrative from one section to another.

Orchestrational Mixing of Sound-Objects

There is an interesting irony that I discovered while teaching electronic music: as students progress, their work becomes more complex and explores much more interesting sounds that are completely authored by the student, but while the work is categorically better, the mix, or sound of the project, becomes categorically worse. It is for this reason that I include this section in order to focus on allowing the project to sound better.

Once the creation of sounds is complete, sketches are made, and the collections of phrases are compiled into sections to create a sonic narrative, then it is time to bring all those elements together to a final mix. This section will focus on arranging, orchestration, and mixing issues that are specific to sound-objects. There are many resources that focus on mixing techniques, but my intention is not to deal with mere technical aspects. A good mix, in my opinion, allows the mix—which is analogous to orchestration and arrangement—to lead the listener through a sonic narrative; to focus on sound-objects.

The mixing stage is about finding balance between musical sonic elements, and the balance of frequency content. Musical sound elements are brought together through the arrangement of musical phrases. It is important not to forget that the listener should feel the emotion of the work, and it is during the mixing stage where this is most effective; mixing must be in the service of the work and its connection to the listener. This is achieved by orchestrational mixing.

Technical aspects of mixing, which involve level, panning, equalization, compression, and spatialization, are just as important as directing or guiding listener interest. This section will concentrate on three elements of mixing through the lens of orchestration that are specific to composing with sound-objects. The three elements of orchestrational mixing are: dynamics, the three dimensions of space (frequency range, stereo field, and depth), and listener interest. Before these three elements of orchestrational mixing are discussed, it is necessary to acknowledge the importance of organization.

Organization First

When starting a mix, it is important to organize each track, so the creative process flows more smoothly and quickly in order to avoid mental and listening fatigue. Making sure that each track is as clean as possible, with no excess noise or distortion is an important first step. It is important to listen closely to each track and scan for any mistakes, as well as unwanted noises. When I am manipulating audio to create a group of variations, it is possible to destroy the sound to the point where it just doesn't sound good anymore, where the quality of the sound has been compromised. Many of these decisions can be made while altering the sound, but it is also important that the quality of the sound is checked during this final stage of the production. This is the time to fix any mistakes or extra noises by either using a noise gate or editing out any extra sounds or noises. This also includes using low and high pass filters to cut any unnecessary frequencies that will make the mix less clear.

All sounds—sound-objects that are synthesized, or created, in the computer, as well as real-world sounds that are recorded with a microphone—need to be set at an optimal sound level for proper gain staging.[125] In the analog realm, proper sound level is important to maintain a strong enough signal throughout the signal chain. In the digital realm, the

[125] Gain staging is the process of keeping relative levels correct in the audio chain in order to avoid noise or distortion.

sound volume has been less of an issue for digital signal processing (with the exception of peaking/clipping), but now that many plugins are modeled reproductions of analog outboard gear, gain staging has become important again; it has come full circle.

Mixing is a complex matter; a great mix is not separate from a great sounding sound-object, and a great sounding sound-object is not separate from a well-orchestrated arrangement.

Mixing for Dynamics

Mixing is generally thought of as a blending of musical elements through the adjusting of volumes to create a balance of sounds. From a musical perspective, live performers deal with volume through a system of dynamic markings, which can be translated to technical operations of sound pressure and perceptions of loudness as described below.

From a musical perspective, it is more useful to think of dynamic markings more as an attitude and less as a volume level, because dynamic levels are relative not absolute. For example, a whisper is a quietly-spoken airy sound that we perceive as soft. If that sound is compressed and/or boosted louder into the mix, then we still perceive the sound as "soft," but the distance from the sound getting closer.[126] The dynamic marking of *piano* (*p*) works the same way. It should be thought of as a "soft" attitude not a low volume. Understanding how we perceive volume (loudness) will help us understand how to mix sound-objects in order to make musical decisions.

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[126] There is a spectral component to the perceived distance as well, which is mentioned below.

Loudness Continuum

In a similar way to spectrum, loudness is also a term that is both measurable and perceptual. As Andy Farnell states,

> The intensity of a sound is an objective measure of energy received by the ear. It is proportional to amplitude, either in terms of absolute sound pressure level or sound intensity level in power per unit area. The loudness of a sound is a subjective value which depends on frequency and other factors. Our perception of loudness isn't the same as sound pressure level or sound intensity level, which can be confusing.[127]

Our ears are unable to perceive small intensity changes, especially in low-frequency ranges.[128] In the range from 1-4 kHz our ability to perceive amplitude change improves, but above 4 kHz, it drops off again. We also hear changes in loudness best at a volume around 60dB - 70dB.[129] While it is possible to measure loudness at different frequency ranges, we are not always able to perceive and quantify what these changes are. This is a more significant example of how quantifiable measurement is not helpful for the composition of sound-objects.

While most conversations focus on the outer ranges of the frequency spectrum—a deep bass and clear highs—the midrange, especially between 1-4 kHz, is the most important range of which to be aware. This range is not only where we are most sensitive, but also where the frequency spectrum of most instruments exist. Additionally, the midrange is where the frequency range is most consistent across most speakers. This range should be the focus of your mix in order for our ears to perceive dynamic changes.

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[127] Farnell, 81.

[128] Ibid., 83.

[129] Ibid.

Three Dimensions to the Space

There are three dimensions (X—Y—Z-axes) that exist at any moment in a mix, from top to bottom (Y-axis), which is the frequency range, from side to side (X-axis), which is the stereo field, and front to back (Z-axis) which is the depth of the mix.

Four Frequency Ranges Along the Y-Axis

The full-range of frequencies can be organized, generally, into four sections: the low-frequency range exists from 20 Hz to 200 Hz, low-mid range is from 200 Hz to 1kHz, the high-mid range is from 1kHz to 5kHz, and the high frequency range spans from 5kHz to 20kHz.[130] These four frequency ranges can help organize and balance a mix. Figure 5.4 shows the four ranges along with common terminology to help describe what sonic attributes are associated with different frequency bands.

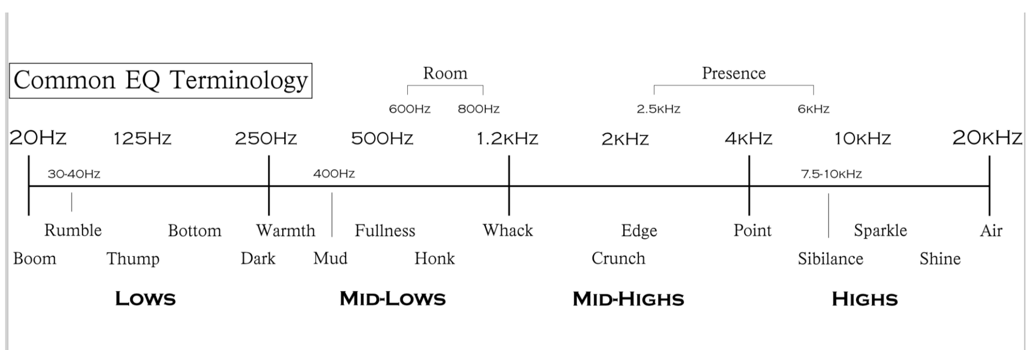

Figure 5.4. Four frequency ranges and some common terminology.

[130] David Miles Huber, and Robert E. Runstein, *Modern Recording Techniques* (Amsterdam: Focal Press, 2010), 484.

When working on traditional music, acoustic instruments have a specific function in relation to the four frequency ranges. For example, a bass or cello will function in the low-frequency range (note: while the string noise of the bow will have a high-mid frequency, which allows us to hear the articulation of the instrument, the function of the instrument is in the low-frequency range). A guitar will function in the low-mid frequency range. Although the body of the voice and snare drum have a low-mid frequency resonance, the presence of these instruments are perceived and function as a high-mid instrument. Cymbals mostly sit comfortably at 4000 Hz and above, function as a high range instrument. Sound-objects exist and function in these four frequency ranges.

Sound-objects have their spectrum intact as part of their recording, but they can be arranged, not necessarily with the harmonic overtones in mind, but in a similar way. It is possible to accentuate (orchestrate) certain pitches of a sound-object, by using a filter, for example, to boost specific frequencies, or emphasize particular pitches with a synthesizer or live instruments, as demonstrated in *Acoustic Memories* (Chapter 4).

When arranging sound-objects, I refer to orchestrating instruments as a reference. For example, acoustic instruments are grouped together to create interesting colors or emphasis to bring out musical lines. Many orchestration choices of arranging sound-objects can be compared to how the harmonic overtone series is emphasized in instrumental orchestration by unison or octave doubling, harmonization, or accenting interesting rhythms or contours. Another aspect of orchestration is the use of a combination of instruments of different ranges to fill in the entire range of the orchestra.

Full-Range Sounds

Many sound-objects have a full frequency range, which can be problematic to a mix when other sound-objects are meant to blend together. The full-range sound objects will mask other objects with similar amplitudes. In order to work with these full-range sounds, either it can be mixed into the background at a low amplitude or, as shown earlier in Chapter 4, it can be sculpted by a filter to allow space in the mix in order to let the other objects be heard.

Masking and Focus

There are two types of masking. The first comes from the critical band theory of psychoacoustics, where we only hear the loudest frequency in a given frequency band. This is a technical part of the mix that is important to understand when shaping sounds so that they work together. The second type of masking deals more with how listeners focus on particular elements of the piece, which has more to do with repetition of a sound and how it functions within a foreground, middle-ground, and background structure.

Mixing in mono first is a helpful way to ensure that there are no frequencies that are masking each other. Once the mix is balanced and the important sound-objects are audible in the mix, then panning the sounds in a stereo mix will add clarity and a sense of openness to the sound.

It is also important to arrange the sound-objects in a way so they don't sonically overlap and cover, or mask, another sound-object. This is achieved by placing sound-objects together that do not occupy the same frequency ranges. These will determine the efficacy of the piece as well as how it will be perceived by the listener. When sound-objects are arranged creatively, the need for fixing problems during the mixing stage will be minimized.

Placing Sounds in a Stereo Field (X-Axis)

Since sound-objects with similar frequency ranges can mask each other, placing them in different places in a stereo field can help avoid this problem. Thinking about the stereo field helps the piece live in a real space—not just in a mono world—in the same way that the sounds of many instruments of an orchestra come from different places on the stage.

Depth (Z-axis)

Depth is the most difficult to contend with, because it deals not only with ambience content (reverberation), but also amplitude and frequency content of the sound. For example, when a sound gets further away, the volume goes down, the upper frequencies diminish, and the reflected sound (reverb) gets more noticeable. I find that it is important for me to understand these three dimensions in relation to how the sound-objects will function. Sound-objects that are a priority in the piece will be placed more prominently in the mix.

Listener Interest

When we listen to a piece of music, our attention focuses on elements that are changing. We constantly notice change, and we enjoy it. It is this natural sense that helps us determine what to change in the mix. By subtly (or not subtly) making changes, we can lead the listener through a sonic narrative, by drawing attention to the sound-objects of focus. This final section will highlight a few ideas about encouraging listener interest.

Vary the Variety

A way to maintain listener interest is by bringing attention to a sound-object through the varied use of a process. For example, the use of a dynamic swell will create listener interest through the increase and decrease of volume, but if the swell is the same every time, it will not stay interesting. The listener will lose interest by the lack of changing stimulation. A way to remedy this is by creating a swell that has a new contour. Perhaps a swell that only increases and immediately stops. In technical terms, the volume swell could be modulated by a sine wave in the former example, and then a sawtooth wave in the latter. In modular synthesis terms, we will modulate the modulator.

Panning for Interest and Gesture

It is important not to let a static mix ruin a sound-object that has a sense of motion. The same is true for where sounds sit in the mix—where they are situated in the stereo field. Figure 5.5 shows that subtle changes of panning can generate listener interest. The change may not be understood or recognized, but the perceived change will encourage the listener to continue listening so as not to miss another change. As mentioned in Chapter 1, every sound has a context that implies gesture or movement, so using panning creatively will also assist the listener to hear the implied motion of the sound.

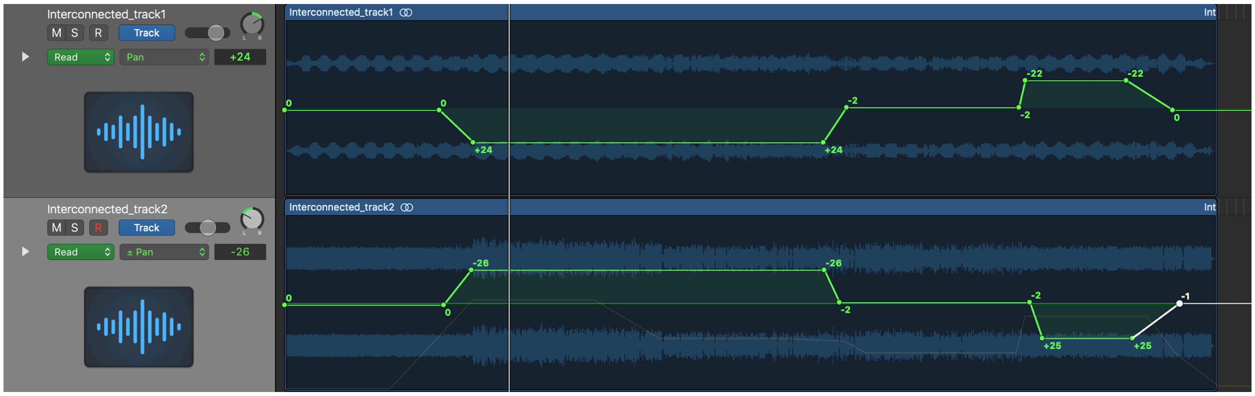

Figure 5.5. Panning for listener interest.

Give an Unexpected Gift at an Unexpected Time

The final piece of advice I wish to impart is how to reward your listener. One of the best ways to have a listener return for continued listening is by encouraging them to enjoy their experience. While some pieces, to my mind, seem like a constant barrage of "ear-candy," I feel that something more substantial is needed to satisfy the long-term loyalty of the listener. I believe that this is achieved by giving an unexpected gift at an unexpected time.

As I mentioned previously, "Form is built from spectral and temporal relationships between contrasting sections, yet pieces are held together by coherence. One must find the balance between similarity and contrast." While this is all well and good, what is also needed is something unexpected to challenge the listener's expectations.

The use of the word unexpected implies that there *is* an expectation to begin with. The expectation is created out of a series of repeated actions—three is the magic number here. The first iteration is just an event, the second iteration creates a pattern, which elicits a perceived expectation, but the third iteration will confirm or deny the expectation. It is at this time that a gift should be well-received, meaning that an "unexpected" time is not just any time—something must be expected first to be successfully unexpected.

The gift must be an appropriate gift. It has to be both earned and appropriate for the amount of listening. Special gifts are special because they are rare. Anyone with children knows that frequent gift-giving sets up an expectation, making gifts not a gift anymore. Gifts should be given sparingly and appropriately, perhaps only one per piece. Unexpected small gifts are also welcomed. This lets the listener know that you are a gift-giver, which also sets up the expectation for the one big gift. So, use it well, and I hope that you surprise your listener.

Conclusion

All arranging, orchestration, and mixing decisions must refer back to the concept of the piece, which stems from the essence of the sound-object. If the conceptual focus of the piece is clear, then the final stage of composing will be in the service of the piece. The final section of this dissertation is an overview of my methodology.

It is the accumulated ideas of all these composers mentioned here, plus my own experiences and tastes, that inform my methodology to analyze sound-objects—not only for their available parameters and to assess the attributes as a way to transform sound, but more importantly, for a means to create a motivic touchtone that informs all decisions.

Methodology Overview

1. Choose a sound-object that will be the central motive of your piece.
2. Develop a musical or extra-musical concept that will be your guide in composing the piece.

3. Determine how much time you have to compose the piece (supra-macro time scale) and how long the piece itself will be (macro time scale).
4. Make a working timeline for yourself, with immediate deadlines within your total available composing time.
5. Set goals regarding what you personally will learn from the experience in order to continue limiting choices.
6. Assess and categorize attributes and parameters of sound-objects.
7. Sketch material which is focused and goal-oriented toward an outcome that is informed by the concept of the piece.
8. Create collections of transformed variations informed by attributes and parameters of sound-objects.
9. Organize sketched sound-objects and their variations in folders.
10. Try destructive edits to commit to transformation choices.
11. Create transition material through convolution, morphing, and other blending processes.
12. Create or compose events and phrases.
13. The relationship of sound-objects to create phrases can inform the relationship between sections. (meso structures can inform macro structures)
14. Phrases and sections are held together with similar sound-objects (or consistent juxtapositions), their transformed variations, and consistent processes.
15. Form is built out of spectral and temporal relationships between contrasting sections, yet pieces are held together by coherence. One must find the balance between coherence and contrast.
16. Arrange and orchestrate phrases to create a sonic narrative built on the focus of sound-objects.
17. Place sonic events in time by using transition material to connect sections.
18. Mix from a musical perspective to create an Orchestrational Mix.
19. To maintain listener interest, create changes in the mix to focus on a sonic narrative.
20. Give an unexpected gift at an unexpected time.

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