Theorizing the Augmented Reality Orchestra: A reflexive analysis of an original film score for chamber orchestra and electronic effects

by

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Abstract

My thesis explores the relationship between orchestral instruments and digital sound processing in a film scoring context, with particular emphasis on the analysis and development of composition and orchestration techniques. I analyze the results of various electronic effects, when applied to acoustic instruments of the orchestra, both individually and in ensembles. My project incorporates the composition of an original film score that utilizes orchestral instruments being processed through digital effects to create a unique sonic landscape. I have named the concept 'The Augmented Reality Orchestra', and much of my study analyzes Augmented Reality Orchestration Theory, which identifies the impact of digital sound processing on traditional orchestration practices, and ways in which it can eliminate limitations and expand the expressive scope of the ensemble. My experiment explores processing the effects in real time, as they are being played and recorded with a microphone, as well as adding digital effects to virtual instruments. The ensemble will be used to write and record film music, a field undergoing changes from a notation-based approach to a DAW-based approach, exploring expanded tonal and performance opportunities.

The first phase of my methodology involves testing individual instruments through a variety of effects, and documenting the results. I then experiment with the effected sounds in a creative, compositional context, eventually leading to the development of composition and orchestration techniques. I begin small, writing for solo instruments, then duets, quartets, quintets, a chamber ensemble, then finally score a film with the techniques that I have collected.

The primary goal of the study is to reinterpret and recontextualize the instrumental palette of the orchestra, in the age of digital technology.

Opsomming

My verhandeling ondersoek die verhouding tussen orkesinstrumente en digitale klankverwerking in ’n filmkomponeringkonteks, met klem op die ontleding en ontwikkeling van komposisie en instrumentasietegnieke. Ek ontleed die resultate van verskeie elektroniese effekte wanneer dit op akoestiese orkesinstrumente toegepas word, beide individueel en in ensembles. My projek het die komposisie van oorspronklike filmmusiek behels wat orkesinstrumente deur digitale effekte verwerk het om ’n unieke klanklandskap te skep. Ek het die konsep *The Augmented Reality Orchestra* (die aangevulde realiteitsorkes) genoem en baie van my studie ontleed die teorie van aangevulde realiteitinstrumentasie, wat die impak van digitale klankverwerking op tradisionele instrumentasiepraktyke identifiseer, en maniere waarop dit beperkings kan uitskakel en die uitdruklike omvang van die ensemble kan uitbrei. My eksperiment ondersoek die intydse verwerking van die effekte soos wat dit met ’n mikrofoon gespeel en opgeneem word, asook die byvoeging van digitale effekte na virtuele instrumente. Die ensemble sal gebruik word om filmmusiek te komponeer en op te neem, ’n veld wat verandering van 'n ideegebaseerde benadering na ’n digitale oudiowerkstasie-benadering ondergaan, en uitgebreide tonaliteit- en uitvoeringgeleenthede ondersoek.

Die eerste fase van my metodologie behels die toetsing van individuele instrumente deur ’n verskeidenheid effekte en dokumentering van die resultate. Ek het daarna in ’n kreatiewe, kompositoriese konteks met die effekte klanke geëksperimenteer, wat uiteindelik tot die ontwikkeling van komposisie- en instrumentasietegnieke gelei het. Ek begin klein deur vir solo-instrumente te komponeer, dan duette, kwartette, kwintette, ’n kamerensemble, en uiteindelik filmmusiek deur die tegnieke wat ek versamel het.

Die primêre doel van die studie is om die instrumentale palet van die orkes in die tyd van digitale tegnologie te hervertolk en herkontekstualiseer.

Sleutelwoorde: Instrumentasie, digitaal, effekte, film, musiek, komposisie

Isifinqo

Ithesis yami ihlola ubudlelwano phakathi kwezinsimbi ze-okhestra kanye nokucutshungulwa komsindo wedijithali kumongo wokuthola amaphuzu wefilimu, ngokugcizelela kakhulu ekuhlaziyweni nasekuthuthukisweni kokwakheka kanye namasu okucula. Ngihlaziya imiphumela yemiphumela ehlukahlukene ye-elekthronikhi, uma isetshenziswa kumathuluzi e-akhscoustic we-orchestra, ngawodwana nakuma-ensembles. Iphrojekthi yami ihlanganisa ukwakheka kwesikolo sangempela sefilimu esebenzisa amathuluzi e-okhestra acutshungulwa ngemiphumela yedijithali ukuze kwakhe indawo yesonikhi eyingqayizivele. Ngiqambe lo mqondo ngokuthi 'I-Augmented Reality Orchestra', futhi ingxenye enkulu yocwaningo lwami ihlaziya i-Augmented Reality Orchestration Theory, ekhomba umthelela wokucubungula umsindo wedijithali ezinkambisweni zokucula zendabuko, nezindlela ezingasusa ngazo imikhawulo futhi zandise ububanzi obucacile beqoqo. Ukuhlola kwami kuhlola ukucubungula imiphumela ngesikhathi sangempela, njengoba idlalwa futhi irekhodwa ngombhobho, kanye nokwengeza imiphumela yedijithali kumathuluzi abonakalayo. Iqoqo lizosetshenziselwa ukubhala nokuqopha umculo wefilimu, umkhakha obhekene nezinguquko ukusuka endleleni esekelwe kumanothi ukuya endleleni esekelwe ku-DAW, ukuhlola amathuba anwetshiwe ethoni nawokusebenza.

Isigaba sokuqala sendlela yokusebenza yami sibandakanya ukuhlola amathuluzi ngamanye ngemiphumela ehlukahlukene, nokubhala imiphumela. Ngibe sengizama imisindo eyenziwe ngomongo wobuciko, wokuqamba, ogcina uholela ekuthuthukisweni kokuqamba kanye namasu okucula. Ngaqala kancane, ngibhalela labo abasebenzisa izinsimbi zomculo wesolo, bese kuba amajuwethi, amakhwathethi, amakhwinthense, itshemba ehlanganisiwe, bese ekugcineni ngikora ifilimu ngamasu engiwaqoqile.

Umgomo oyinhloko wocwaningo ukuhumusha kabusha nokuhlanganisa kabusha iphalethe yezinsimbi ze-okhestra, eminyakeni yobuchwepheshe bedijithali.

Amagama Abalulekile: I-Okhestresheni, Idijithali, Imithelela, Ifilimu, Umculo, Ukwakhiwa

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Introduction

Background and rationale

The field of orchestration focuses on arranging the instruments of the orchestra to maximize the expressive impact of a composition by enhancing depth, dimension, and tonal color. This process involves selecting instruments, registers, and dynamics, often with the goal of achieving balance and clarity in the sonic result. Increasingly, especially in the context of film music, elements of orchestral music are processed through digital effects to modify the sound of the music. The consequence of the implementation of these effects changes the way we think about traditional orchestration processes in part by removing some of the limitations of the instruments in the context of their functional roles within orchestration. This paradigm shift requires a new way to think about the field of orchestration in the context of digital sound processing and a supplemental theoretical approach to the practice. Across the history of film music there have been a multitude of evolving approaches and styles that have been interwoven with the progression of technology and culture. This history began in the silent film era, pre-1927, which incorporated no music or sound in sync technologically with the films, outside of rare instances of experimentation. During this period of time between the late 1800s and 1927 films would commonly feature live performance accompaniment by piano, organ, or orchestral ensemble. Next between the late 1920s and early 1960s came the Hollywood golden age of film scoring with composers like Max Steiner, Erich Wolfgang Korngold and Franz Waxman, adding to the complexity and depth of the scores so that they popularized recurring themes and supported narrative arcs and contributed significantly to the storytelling. During this period, specifically in the 1940s the incorporation of jazz into scores became more common, and the style and instrumentation became more diverse and varied. In the 1960s and onward the soundtrack score became a common practice, incorporating existing songs into films alongside underscore. Starting in the 1970s composers like John Williams re-introduced the neo-Romantic scoring style, then in the 1980s and onward the incorporation of synths into scores, either as the primary instrumentation or supplemental to the orchestra became common and popular. Film scores also emerged after the 1980s in the style of orchestral arrangements with a pop aesthetic featuring riff-like harmonic structures and pop rhythms. After this long evolution of instrumentation, style and approach, contemporary practice blends synths, rock/jazz band instrumentation, orchestra and pop aesthetics with sampled instruments sometimes replacing traditional orchestration techniques. Digital effects are applied supplementally to further manipulate the sounds. This lineage of musical evolution leads to my project, which aims to analyze film scoring in contemporary practice with the intention of updating and asking new questions about its relationship to traditional orchestration theories. In this project I intend to use a practice-led methodology and rescore L'Age d'Or to experiment with different approaches to scoring and orchestration with an orchestral ensemble being processed in different ways through digital effects. The hands-on application of scoring a film with this palette of instruments and processing aims to more clearly inform and support my theories about how an expansion of our traditional rules and perception of orchestration roles and limitations can enhance the expressive potential of a composer's work. The aim is to help develop an understanding of the problems that composers attempt to solve during the process of writing film music. The answers to these questions are the target at which Augmented Reality Orchestration Theory will point, with the aim of finding varied and creative approaches to enhancing the craft.

Problem statement

How can we expand the existing knowledge base in the field of orchestration for traditional acoustic orchestra by exploring the ways in which it is impacted using digital sound processing?

In the domain of film music, some composers have explored the interaction of effects with orchestral instruments, but have not explored its full potential, more commonly aiming for plausibly 'realistic' timbres instead of considering the full and novel potential of the orchestral/digital effects combination. Further, conventional orchestration, or the orchestration style that evolved over the course of Western Art Music history, is no longer foundational to film music. Film scoring orchestration is as commonly a DAW-based[1] process as it is notation-

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[1] DAW stands for digital audio workstation and is a software system that allows users to record and edit audio.

based.[2] One negative consequence of this shift from the written page to the DAW is the ability to create 'orchestral sounding' music with minimal knowledge of conventional orchestration theory and the history of the craft.[3] The positive aspects of this paradigm shift include an expanded tonal palette by way of the application of effects and expanded performance possibilities such as second-order performance, which offers the ability to automate performance and processing parameters over the course of a piece of music. Additionally, the expansion of the traditional film network from cinema-based to streaming services-based[4] has resulted in a larger and more extensive pool of storytelling styles, which has resulted in the opportunity and necessity for new and varied film-scoring styles to be explored.[5] Some series have already begun venturing into what I have elected to call the 'Augmented Reality' orchestral scoring landscape (e.g. *The Watcher 2022, dir. P. Barclay*), but this new trend has yet to be extensively explored. This has led me to focus my work on the construction of a formal theoretical framework for exploring a select part of this terrain. Augmented reality, as it is understood colloquially, refers to the integration of the real world with computer generated content. My project is exploring the sounds of the acoustic orchestra as they are augmented by digital sound processing for use in the film scoring environment. I will discuss this concept in more detail in Chapter 4. The augmented reality component of film scoring can expand the narrative possibilities of a score, offering a diachronic effect to influence how a score is affected across a period of time. I will also explore

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[2] Current music notation software such as Sibelius, Musescore and Dorico offer applications that allow the user to create and edit musical scores and hear audio playback of the various instruments/parts. They are also capable of receiving MIDI files from a DAW and translating them into notation. This creates a mode of translation between notation, a more rule-based and theoretical approach, and DAW-based musical creation, which typically involves performing, layering and auditioning parts over one another.

[3] Seminal works on orchestration that have greatly influenced practice to date include Rimsky-Korsakov, Berlioz-Strauss, Adler, Piston and Del Mar.

[4] There are a number of factors that influence why streaming entertainment has become the central mode of entertainment consumption including "content, price, flexibility, convenience (perceived ease of use), perceived usefulness, perceived enjoyment (hedonic motivation), desire to be freed from any constraint, entertainment value, socialization, culture inclusion, binge-watching, and self-efficacy that leads to the adoption of OTT streaming platforms." (Mulla, 2022)

[5] As the result of this shift there are more genres of shows and films, and consequentally genres, style and approaches to music. Additionally, television series in the streaming era have become more cinematic as the result of investment in the medium and increased interest in long-form television. (Lavik, 2024)

the influence of some of the 'art music' repertoire such as music that has descended from musique concrète or elektronische music in the following sections.

Research objectives

Aims:

My primary research aim is to develop a theoretical foundation and data set for the application of effects to orchestral instruments in an applied context.

Objectives:

One of my ideological aspirations with this project is to suggest a solution to the problem of the modern acoustic orchestra losing relevance in contemporary music and society. I hope that the study of these concepts will expand the expressive capabilities of future film composers by eliminating limitations set in place by traditional orchestration practices through the use of digital effects and processing. My objective is to develop a framework for understanding digital processing in the context of orchestration that results in a toolkit for composers to assist in solving orchestration problems, expanding the three-dimensionality of the music, and opening doors to new sound worlds.

Research questions

My primary research question is:

What techniques and concepts can assist in the development of the expressive palette and narrative possibilities of 21^{st}-century orchestral film music processed through digital effects?

This is supported by the following secondary research questions:

1. What are the expressive, aesthetic, and ideological implications of processing orchestral music in the 21^{st} century through digital effects, and what technical and conceptual techniques lend themselves to achieving this processing?
2. What challenges are presented when monitoring effected instruments in a performance setting, and what solutions are there?

3. What theoretical foundation can be developed for the application of effects on orchestral instruments in a film composition context?
4. How do the electronic effects change the impact and nature of the tones created from these instruments?
5. Could the Augmented Reality Orchestra become a live performance tool for film composers?
6. What are the expressive and tonal limitations of traditional orchestration practice, and how can effects expand upon those limitations?

Overview of chapters

In chapter 1 I present my literature review and explore the history of effects in the context of the orchestra, both live and recorded. I then present my ideological framework and outline the practice-led research model and reflexive approach used during this project. These provide a historical and theoretical foundation to contextualize my methodology and findings.

Chapter 2 focuses on my research design and methodology, outlining the architecture of the project in terms of how the experimentation is structured. This project involved many different phases of experimentation and analysis and was designed specifically and strategically to answer the questions that I set out to answer at the outset of these experiments. This chapter functions as a roadmap for those intentions.

Chapter 3 analyzes each composition in the context of the tenets of Augmented Reality Orchestration Theory and film scoring. This analysis is the bulk of my composition research and offers insight into the choices that were made and the logic behind how the new orchestration processes evolved and settled into a pattern of applicable techniques, generalized into an overarching theory.

Chapter 4 elaborates on the findings in Chapter 3 by categorizing the common orchestration and composition techniques that were used in multiple pieces of music. The categories include effect application theory, master and sub-bus processing techniques, arranging in multiple dimensions, and Augmented Reality Orchestration Theory.

The conclusion section reviews the research questions and sub-questions and answers them. It explores implications of the study, relationship to the field, limitations of the study and suggestions for future research.

Chapter 1
Literature Review and Theoretical Framework

1.1 Introduction

This chapter will begin with a history of the tools and instruments that inform the project. It will then explore ideological concerns around film music, and will end with a discussion of the theoretical and conceptual frameworks for the project. I will therefore first review some historical information about the relationship between electronic music and the orchestra. An understanding of how this relationship evolved is an essential foundation on which I develop a theory regarding how the two worlds could further evolve in tandem. I begin by discussing the origins of the interaction of electronics and the orchestra in Section 1.2, exploring how their presence evolved in the 1950s and 60s as the pairing became more common. Section 1.3 completes this historical contextualization by exploring some contemporary examples of the interaction of electronics and orchestra.

Section 1.4 addresses my ideological framework for the project. I begin with a discussion of my ideological approach to orchestral recording technique. I then discuss a selective overview of the function of music in the context of film and the role it plays, before applying this more specifically to an exploration of the history and vision for the film *L'Age d'Or*. I conclude this ideological contextualization by exploring the theoretical context within which this work operates, discussing postmodernism and post-postmodernism.

Sections 1.5 and 1.6 focus more intensively on the project's relationship between theoretical and practical work by elaborating on the practice led and reflexive approaches that inform this relationship. I will end with a general overview of the individual effects that form the core investigation of this project, exploring what each individual effect does and sounds like, and reviewing their common parameters.

As music has evolved from the late 19^{th} century to present, and technology and electronics have become a central piece of many types of music composition and production, the relationship between electronics and acoustic instruments has become increasingly more significant, for instance, Dufourt (2016: p.22) observes that,

> The new instrument, whether electromagnetic, electroacoustic or computer, is in fact the result of a combination of theoretical and experimental – and therefore artificial – procedures. The musical instrument no longer belongs to the realm of conventional instrument building (that is, organology), but rather to that of technology. Mechanical invention is no longer a part of the universal organization of matter by life.
>
> (Dufourt, 2016)

There are many instances of orchestral, Western art music instruments being influenced by digital effects across many genres of music, one of which is film music, as noted in my problem statement. In the last 50 years, post-production effects have increasingly made their way into orchestral film scores. Many of the most commonly used orchestral film techniques involve reverbs, saturation/distortion, or digital delay.[6] For example, the scores of Hans Zimmer often utilize large room reverbs on low orchestral drums in films like *Inception*, *The Dark Knight*, and *Pirates of the Caribbean*. Zimmer also uses synths and effects processing on many of his scores like *Dune, Gladiator, Inception, Batman and Pirates of the Caribbean,* among others. This manipulation of acoustic instruments can add harmonics, textures, and dynamic range that the instruments themselves cannot achieve. As music technology has continued to expand, so have acoustic and sonic theoretical ideas, as well as the nature of instrumental tone and timbre, as Dufourt (2016:p.25) notes below.

> Descartes, who based the theory of music on the model of the science of motion, made it possible, later on, for Fourier, then Helmholtz, to approach gradually the physics of sound waves, the mathematics of continuous functions and music based on the spectrum. The new concepts that transformed acoustics and the theory of music were developed through phases that can be considered as turning points in history. Among them we have frequency, beats, resonance, elasticity and distortion. The nineteenth century added other concepts, such as torsional oscillation, the Doppler effect, interference and diffraction.
>
> (Dufourt, 2016)

The next step in this evolution of acoustic theory is an expansion of the manipulation of timbre by using effects to pitch shift, add reverb, modulate in different ways, and change the essence of

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[6] I will define these terms in section **Error! Reference source not found.** below.

any given sound. This evolution paired with the dynamic modulation of all these listed components and processes by way of automation are the foundations of my Augmented Reality Orchestration Theory.

Augmented reality “places digital objects and sounds into the physical world” (Clement, 2021, p. 26). There is a wide variety of applications in music performance, acoustics, music education and music composition. In composition, there are several applications that allow you to interact using markers and gestures to build and shape music. For instance, Kishan Poddar explores this terrain in *Enhancing Music Composition with Marker-Based Augmented Reality Technology*:

> The application's basic idea is simple yet creative: users interact with a series of physical markers each of which are connected to a certain musical rhythm. The marking of a gadget sensed by its camera corresponds with the beat. Stacking many beats by scanning different markers allows users to build complicated rhythms and compositions. Physical movement of these markers-moving them closer together or farther away, orienting them, or scanning them in various sequences-offers a dynamic and participative approach to make music directly impacting the musical output.
>
> (Poddar, 2024, p. 11)

This example of using augmented reality to influence the composition process and the results of the sound align with my project in several ways. Another example of how augmented reality can intersect with music involves an acoustic concert hall that is designed to be very dry, or have very few acoustic reflections, paired with microphones and processing technology that can capture and amplify a performance with EQ and reverb designed to emulate different physical spaces. The result of this pairing is the ability to make a space sound like a different one or have different acoustic qualities depending on the style of the performance. This idea also intersects with my project, as one of my central goals is to change the nature of the acoustic space of a production, to contextualize the composition. My project relates to the concept of augmenting reality by exploring ways that our perception, sounds and experience of an orchestral ensemble can be changed and manipulated by digital effects.

1.2 History of the live orchestra and electronics

The earliest instances of electronic instruments being incorporated into the orchestra occurred in the 1920s and early 1930s with the rising popularity of the Theremin,[7] Ondes Martenot[8] and the Trautonium.[9] Orton & Davies (2001) note that, "[t]he first orchestral work with a solo electronic instrument was Pashchenko's *Simfonicheskaya misteria* ('Symphonic Mystery') for Theremin and orchestra, which received its first performance in Leningrad on 2 May 1924, with (Lev Sergeyevich) Termen as soloist" (Orton & Davies, 2001). Four years later, the Ondes Martenot premiered with the orchestra.

Otto Luening and Vladimir Ussachevsky were among the first composers to incorporate recorded tape into symphonic works in the early 1950s. Before Luening and Ussachevsky's work was French composer Edgard Varèse, who was considered the "Father of Electronic Music" by many for his use of electronic instruments and his theories of sound and composition. (Market House Books, 2003) Composer Elliott Schwartz elaborates on these early electronic compositions:

> At first, live and recorded materials were presented in alternation, with virtually no overlapping of the two – e.g., in the pioneering music of Otto Luening and Vladimir Ussachevsky, who were ground-breakers in the creation of music for orchestra and tape. Three works in particular – *Rhapsodic Variations* (1953-54), *A Poem in Cycles and Bells* (1954) and *Concerted Piece for Tape Recorder and Orchestra* (1960) – exemplify the strength of their unique collaboration. The last of these pieces is especially interesting, in that the two composers contributed separate sections. Luening's part (the first half) uses concrete sounds exclusively and alternates orchestra with tape, while Ussachevsky's half has moments of synchronized integration, exploring electronic as well as natural sounds.
>
> (Schwartz, 2001, p. 31)

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[7] The Theremin is an electronic instrument that makes sound without any physical contact by tracking the movement of hands around the antennae.
[8] The Ondes Martenot is an electronic instrument that is controlled by a ribbon controller with the right hand for making glissando sweeps and changes in pitch, and a separate control for the left hand that controls attack and dynamics.
[9] The trautonium is an electronic instrument invented in 1930 that uses a resistor wire gliding over a metal plate to make sound.

In the 1960s synthesizers[10] began to develop and become more practical and portable, and were occasionally integrated into orchestral works. Among these are Mario Davidovsky's *Contrastes No. 1 for String Orchestra and Electronics* (1960), Charles Wuorinen's *Orchestral and Electronic Exchanges* (1965), Milton Babbitt's *Correspondences* (1967), and Morton Subotnick's *Lamination* series (1967). In Babbitt's *Correspondences*, the score indicates that the tape loops are notated on a grand staff. The RCA Mark II synthesizer was used for this composition, as it focuses on timbral relationships. The orchestral portions of the piece sound more abstract than melodic or harmonious and feature diverse/contrasting elements of the orchestra woven together in small fragments to create a unique soundscape.

> At the start of the piece, the timbral and articulative variety here can be a trifle overwhelming, presenting a kaleidoscopic, refracted effect. Gestures of repeated pitches in the same register—echoing from one instrumental part to another—and the recurrence of rhythmic cells create surface cohesion. Long-term shifts in texture—the thinning out in the middle of the work and the rather remarkable coalescence of the string parts toward the end—result in a sense of a goal attained.
>
> (Kirzinger, 2013, p. 6)

Morton Subotnick's *Lamination* series took a different approach, using sound effects heard in the real world, recorded to tape loops. He then played them back and had an orchestra play along with them (Rosenbloom, 2011). This incorporated sounds from everyday life, rather than synthetic sounds that manipulated but ultimately imitated acoustic instruments. The composition for orchestra is more thematic and more similar to a film score than Babbitt's, akin to underscore for a thriller or horror movie. My approach is different from both of these in the sense that the origin of my sounds is exclusively acoustic instruments, rather than tape loops or synthesizers.

Since the 1960s there have been many other examples of collaborations and experiments involving the orchestra and electronics.[11] I have chosen to highlight this limited selection of representative examples, as these sources are directly relevant to my approach. As previously

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[10] The first programmable electronic synthesizers were the RCA Mark I and II synthesizers, built in 1955 and 1957 in Camden New Jersey. They had twelve oscillator circuits that could be shaped by various filters, modulators and resonators.

[11] Some notable examples include the London Electronic Orchestra, EarthQuaker Symphony, and L(oo)ping.

noted, contemporary film score practice incorporates effects to embellish the different timbral characteristics of orchestral instruments, but the craft has yet to be explored thoroughly.

1.3 Contemporary examples of live orchestral instruments and electronics

1.3.1 Introduction

There are several live orchestral performances that are accompanied by digital effects in the last thirty years, and I will review a selection of them in the following sections. Most of these however involve pre-recorded tape being either manipulated or played back in different contexts – fewer involve real time processing of an acoustic instrument, and a performance component to the application of effects. I arrange the discussion of these according to instrumental forces, from solo instrument to full orchestra. For my project I intend to adapt the approaches and techniques from contemporary classical/classical-crossover works listed below for use in the film scoring environment.

1.3.2 Individual solo performance processed through effects

Several projects exist that involve individual solo performances of various orchestral instruments being digitally enhanced/modified and/or looped[12] live. There are individual studies of, for instance, the oboe or the flute being digitally processed and amplified in different solo and group performance contexts. One such instance is a piece called *Insomnia* composed by Brian Topp in which a bed of ambient textures is built out of multiple layers of pitch-shifted tape recordings of a bowed waterphone,[13] and then a solo flute performs along to it. From my observation of the performance, the solo flute appears to be processed in real time through delay and reverb to mix well with the tape loops (Topp, 2015). One difference between this piece's approach and my own is that the work introduces previously recorded material in the form of the waterphone, while my approach also leaves open the possibility of incorporating sounds generated from live orchestral instruments.

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[12] Looping refers to capturing a recording of a sound or performance and replaying it repeatedly, often changing its sound over time, or layering it with other loops or live performance.
[13] A waterphone is an instrument with steel prongs attached to a bowl with water inside that is typically struck like a percussion instrument or bowed to create eerie, ethereal sounds.

Another example is *Violin Phase* by Steve Reich, which features a solo violin performer playing into a microphone, and a second person processing the signal using tape loops before it is played back through the speakers. In this instance, the violin performance involves the shifting in time of one part in relation to the other. While this does not fundamentally change the timbre of the instrument, the repeating delays and textures provided by the phasing creates a unique soundscape.

A work by Emily Hopkins features harp and cello processed through a Moog M32 synthesizer, being processed in real time by two effect pedals called Context and Particle (Hopkins, 2022). The result is a variety of different reverbs, delays and granular processing that creates textures. My project aligns with this experiment in the sense that one facet of it is the search for modifying the sounds of orchestral instruments, but additionally my aim is to develop strategies for arranging and orchestrating these effected sounds.

Another example is *Phonosaxis* (Warrington, 2022b), which is a piece for live soprano saxophone and electronics with two others using laptops to modify the sound. The resulting soundscape includes the creation of some interesting trills and drones that are warped and modulated creating sci-fi style overtones. There are many instances of interesting granular textures and pitch shifting, in the spirit of avant-garde noise creation. Similar to this is a piece called *Façade* (Warrington, 2022a) for horn in F and live electronics which features a horn looped and harmonized. It integrates phaser effects and some moments where extremely high-pitched harmonics are created and emphasized.

As I find dozens of examples of individuals making ambient or abstract sounds with an acoustic orchestral instrument and various effects, (see for instance Belle Reid 2021, Flaherty 2008 and Keeling 2020), I find that less frequently the effects are used to integrate into an orchestration context, or a film scoring context, and more commonly are exploring the timbral domain. As this is a piece of my study, this research has been illuminating, but I have processed and categorized it with the goal of implementing it into a broader theoretical context of integrating and arranging these sounds into melodic film music rather than avant-garde sound. There is a certain amount of subjectivity in what I personally interpret as being a candidate for film music, as one could argue that any sound or music could fit into the right film.

1.3.3 String quartet with live digital effect processing

I found several string quartets that use multi-effect units to modify their live sound. Included among these are the Kronos Quartet[14] and the Noise String Quartet.[15] In the interview excerpt below, the sound engineer for The Kronos Quartet, Mark Grey, outlines his microphone placement techniques and theories. This research was specifically useful for learning mic techniques specific to navigating the process of engineering an acoustic ensemble and processing the signal through various effects.

> The way I get that acoustic quartet sound, to get that sweet natural sound, I use the KM150s[16] for the body of the quartet and then I use the Isomaxes[17] to function in a lot of different ways. The first way is that they get the initial attack of the instrument, so I blend that with the KM150s and you get a very bright attack with a warm body. The second is to feed the processors, because it's a very direct signal. So I can push the processors; I can get maximum headroom on the processors and get maximum usage out of the processors. If I used the KM150s through the processing, you're more susceptible to feedback, and this [way], you can really push it, especially when we're going through distortion boxes, flangers, phase shifters, echoes – because they are a contemporary string quartet, there are certain pieces that we do live effects on.
>
> (Benzuly, 2002, p. 1)

This approach lends insight into the challenges of managing feedback[18] while trying to obtain the richest sound possible. It is valuable to have the option of using an Isomax-style mic that perhaps does not have the richest, or truest representation of the acoustic instrument, but can be a source signal to feed into effects if it is paired with a microphone that is covering the high fidelity,

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[14] The Kronos Quartet was formed in 1973 and performs across many musical genres and collaborates with a variety of artists and composers. Their aim is to expand the otherwise traditional Western European conventions of the string quartet to incorporate the modern age and a diverse community of artists and technology.

[15] The Noise are an Australian experimental string quartet formed in 2006 that perform notated music but use effect pedals and improvisation to expand the pieces.

[16] KM150s are miniature small diaphragm condenser microphones made by Neumann.

[17] Isomaxes are small microphones that are less than one inch in size that can be used with different capsules to record a variety of styles of high quality audio.

[18] Feedback is a loop of sound that occurs when a speaker plays a sound and it is then picked up by a microphone that transmits it to that same speaker. This is an issue in the context of performing with effects because in instances where a microphone is necessary to capture the initial sound of an acoustic instrument, the relationship between the positioning of the microphone and the speaker system can create an unwanted feedback response.

authentic recording of the instrument. This is used in the context of a string quartet in this instance, but would be equally useful when tracking instruments that have the capacity to play loudly like trumpet or trombone, which would be candidates for risk of feedback.

1.3.4 Chamber orchestra featuring a subset of players processed through digital effects

Boulez's *Répons* is a clear example of a work that manipulates live instruments with electronic effects in the context of a chamber orchestra (Boulez & Uploaded by Ensemble Intercontemporain, 2015). This piece features a twenty-four-piece chamber ensemble which is not sonically influenced by effects, and six additional soloists that are run through live electronics, most prominently delays. Stockhausen's *Mikrophonie* is another example, where tam-tam is recorded and undergoes effects processing . Multiple performers strike the tam-tam in different ways, and with different implements to achieve a variety of sounds, while another controls the effects. One difference between these compositions and my own is the ideological positioning. These fall under a starkly Modernist ideology, whereas my compositions are developed from a (post-) postmodern framework of thought. The ubiquity of technology in the early 21st century plays a role in the shifting of ideologies in contrast to these compositions, written in the latter part of the 20th century. I will discuss this framework in more detail below in the section on postmodernism and post-postmodernism.

1.3.5 Contemporary orchestra performing live with electronic instruments

One project that is similar to my own is Kate Simko and London Electronic Orchestra – Self Titled (Simko, 2016). This ensemble features a string ensemble with an additional assortment of orchestral instruments mixed with analog synthesizers, drum machines, and other electronic instruments. In an interview with Simko about her writing process, it became clear that the orchestral instruments were not being processed and manipulated live (Cory, 2019). This album has a lot of interesting components and processes that inspired experiments in my project including the development of rhythm-sections, textures and tones that are comprised of interwoven organic and synthetic components. The foundation of these songs is beats made by electronic drum machines, and then orchestral parts are processed and layered over the top and then mixed with additional electronic sounds.

1.3.6 Composition for orchestra and turntable

Another approach that falls into an interesting and parallel style is *Concerto for Turntable and Orchestra* by Gabriel Prokofiev (Prokofiev & Constandinou, 2011). This performance features Prokofiev using a turntable to manipulate samples of a prerecorded orchestra while a live orchestra performs along with him. The live orchestra is not manipulated, so this is more aligned with the earlier examples of implementing pre-recorded material into a live performance context.

1.3.7 Composition for orchestra in which playback is manipulated to change the audience's perception of the music

Another contemporary composition that relates to this project is *Spin for Symphony Orchestra and Live Effects* written by Krzysztof Wolek (Wolek, 2017). This composition has several different dimensions to it, one of which is the digital manipulation of live orchestral sounds, which makes it the most relevant reference to my project that I have found. Pre-recorded tape loops that sound like digital circuitry and electronic humming and buzzing function as a harmonic bed. A live orchestra plays into microphones, and the playback emanates from eleven speakers dispersed circularly around the famed NOSPR concert hall in Katowice, Poland. The playback is then designed to move in circles around the audience using the eleven speakers, creating a constantly moving, spinning effect. Additionally, there are six speakers dispersed evenly from floor to ceiling to add a dimension of vertical movement, integrated with the spinning effect. In addition to this, effects are applied to the mix, and presumably individual sections and instruments including reverbs, convolutions, pitch shifting and delays. Much of this process is discussed in a short documentary released about the piece(see Meacci, 2017). My project has a similar aim, as it uses effects on orchestral instruments, along with panning and rotary effects, for instance, to manipulate the tone and quality of the sounds. The fundamental difference is that this is a concert work while my project applies and adapts these processes in the context of film music.

1.3.8 Musique Concrète

Pierre Schaeffer established the concept of Musique Concrète in 1948. The experimental technique uses recorded sound artifacts both synthetic and natural and weaves them together into a composition. Concrète refers to the use of 'concrete' sounds, rather than collections of musical notes made by instruments independent of the real world.

> I have coined the term Musique Concrète for this commitment to compose with materials taken from "given" experimental sound in order to emphasize our dependence, no longer on preconceived sound abstractions, but on sound fragments that exist in reality and that are considered as discrete and complete sound objects, even if and above all when they do not fit in with the elementary definitions of music theory.
>
> (Schaeffer, 1952, p. 27)

This approach to analyzing sound outside of the bounds of music theory and notation establishes a new language and perception of sound, music and notation.

1.3.9 Spectralism

Spectralism,[19] or composing with overtones, was first introduced in 1979 by Tristan Murail. This theory addressed the concept that each instrument has a distinct musical color that is determined by the nature of its overtones. For instance, a trumpet has a full spectrum with high frequency overtones, and a flute has a sparse spectrum with fewer high frequency overtones, making it sound more pure and less bright. *The Cambridge Companion to Percussion* describes the essence of the fundamental pitch and overtones:

> All sounds are the result of complex modes of vibration that include a fundamental tone and overtones. The relationship of the fundamental to its overtones determines the timbre of the sound. The purest sounds contain relationships that are related mathematically by low number integers (1,2,3,4, etc.). This means that the fundamental tone (f1) vibrates at a given frequency while its overtones vibrate twice as fast, three times as fast, four times as fast, and so on (f2, f3, f4…). When these relationships exist, the overtones are considered to be harmonic and belong to the natural harmonic overtone series
>
> (Kvistad, 2016, p. 11).

[19] Spectralism is defined as "music composed mainly in Europe since the 1970s which uses the acoustic properties of sound itself (or sound spectra) as the basis of its compositional material." (Anderson, 2001)

In his ongoing exploration of spectralism, Murail composed *Les Courants de l'espace* (Murail, T.2016) in which he uses an Ondes Martenot to create a single sine wave, and then doubles it with strings and sends it through a ring modulator[20] to add complexity to the overtones. The orchestra then doubles those resulting overtones. This process of creating a sound using a digital instrument, and processing it through effects, and finally emulating the resulting soundscape aligns with the aspirations of my compositions, specifically regarding the reactive and collaborative nature of the sounds and effects. My approach is novel in that it introduces these processes to the domain of film scoring, while they have mostly been previously constrained to the contemporary classical domain.

Other instances of spectralism use extended techniques to emphasize the spectral harmony like *Sept Papilons* by Kaija Saariaho (Saariaho, 2021). Another example is Georg Friedrich Haas' *String Quartet No. 2* (Haas, 2015), which begins with a cello playing a low fundamental sound, and then its natural overtone series is added on top with the remaining instruments of the quartet. As I explore different elements of this project including the use of synthesis,[21] equalization (EQ)[22] and modulation,[23] I will experiment with the concept of spectralism, using the effects to strategically manipulate different overtones in the harmonic series of an instrument to modify its sound.

1.3.10 Spectromorphology

Denis Smalley's concept of Spectromorphology is relevant to this study in the way that it challenges how we interact as listeners with music that includes electronic sounds. His research establishes the noise-note continuum, stating that each instance of sound falls somewhere

[20] Ring modulation is a function that mixes two frequencies together.

[21] Synthesis is the process of creating and shaping sound that originates electronically (Devine, 2014)

[22] Equalization is the process of manipulating the balance of different frequency components (see Davies, 2001). Equalization is typically used as a way to filter out unwanted frequencies as an instrument is being recorded, and then in both the mixing and mastering phases to further refine which frequencies are present and emphasized both on individual tracks and on the master bus.

[23] Modulation is "a term originating in telecommunications usage describing the superimposition of characteristics of one signal ('programme') upon another ('carrier'); it later entered the terminology of electronic music, where it is frequently used in a broader sense, sometimes as unspecific as 'a process of change'"(see Roberts, 2001).

between noise and a note, and listeners should calibrate how they analyze and perceive of collections of sounds based on this reality. Smalley's ideas take as their point of departure Pierre Schaeffer's concept of musical objects.

> How are we to explain and understand electro-acoustic music? Music is not created from nothing. If a group of listeners finds a piece of electroacoustic music 'rewarding' it is because there is some shared experiential basis both inside and behind that music. We need to be able to discuss musical experiences, to describe the features we hear and explain how they work in the context of the music.
>
> (Smalley, 1997, p. 26)

These systems help analyze different sound phenomena and establish a foundation for terminology and understanding relationships between sounds and noise. This has significant influence over my analysis of work in this project. In his book *Living Electronic Music* (2007), Simon Emmerson responds to and elaborates on Smalley's idea of Spectromorphology in discussion of the sound and our understanding of what makes a live performance. He establishes three historical phases or paradigm shifts to date that have changed the way we interact with live performance through technology.

> I would designate three paradigms to date. The first was enabled by the steady miniaturization of circuits following the adoption of the transistor and the subsequent development of voltage-controlled synthesis and processing in the mid-1960s. Musically it has two focuses: signal processing of live instrument or voice and/or their combination with pre-recorded material (sometimes referred to as 'mixed' electronic music). The second paradigm centres on the revolution of the small personal computer and the invention of the Midi standard in the early 1980s. This enabled 'event processing' in so-called 'real-time' (via Midi), driving usually synthetic sounds with relatively little signal processing, any acoustic instrument or voice becoming progressively optional. The third was a consequence of a quantum leap in processing power for personal computers (and the emergence of the laptop) in the mid-1990s, to allow real-time signal processing as well as eventually absorbing most aspects of both studio and performance systems. This encouraged the combination of all the previous possibilities in an open mix of event, signal and pre-recorded sound processing but usually omitting any live production of acoustic sound.
>
> (Emmerson, 2007, p. 3)

This assessment of the main technological advances that changed the nature of live performance provides a historical foundation for my discussion of blending digital effects and electronics with orchestral instruments. Though my project primarily focuses on mixed or recorded arrangements of these sounds, future research could further explore the possibilities of implementing the techniques in a live context.

1.3.11 Incorporation of effects notation into traditional sheet music and score following technology

Milton Babbitt was among the pioneers of the implementation of notation for digital effects on traditional scores with his 1961 composition, *Vision and Prayer* for soprano and synthesized tape, setting of a poem by Dylan Thomas. Since this time there have been numerous collaborations incorporating musical ensembles and effects, and many that include the effects in the written notation. Additionally, score following technology, which has been around since the early 1980s, "is the synchronization of a computer with a performer playing a known musical score" (Orio et al., 2003). Imagining a future application of ARO theory in the context of triggering digital effects live would rely on these technologies for implementation. If live score following technology could track the status of a performance, it could trigger the effects at the appropriate time. Similarly, notation that includes instructions for turning digital effects on and off could have ethe same result but would be controlled by the performer.

An interesting study of this technology is Jean Penny's *Performing the ecstasis: An interpretation of Katharine Norman's Making Place for instrument/s and electronics*. In the section about rehearsal processes, the author discusses the ways in which the sounds, text and audio interact:

> The piece is interactive, in that the performer's actions influence and in many cases trigger texts and other visual animations. These in turn influence the left/right panning of various sounds or sound processing, and when sound processing is switched on or changed. Audio 'triggers' from the performer are through amplitude (volume) levels and none are defined by pitch. There is no need to try and co-ordinate with or respond to audio processing in any 'direct' manner. More often it's a case of building textures by varying materials and increasing or decreasing your activity — in particular in sections 2 and 4 of the piece.
>
> (Penny, 2022, p. 61)

This example of a performer triggering electronic effects using amplitude levels is informative as to an approach for how score following technology can be implemented into performance. This study doesn't experiment with this approach, but future research on the topic could benefit from its implementation. Antescofo, developed at IRCAM is a revolutionary piece of technology that allows a program to follow along with a piece of music, and to enact real-time synchronization of electronic or pre-recorded sounds with the live ensemble. Many contemporary performers use

Ableton Live as an interface for triggering and performing synthesized sounds in live performance settings as well. Many additional sound tools and plugins in the realm of music technology have come from Groupe de Recherches Musicales (GRM) in Paris, which is considered the birthplace of musique concrète.

Another interesting example of creative notation for live performance involving orchestra and tape/processing is Dai Fujikura's work *Swarming Essence for Orchestra* (2232, 4220, 4perc, strings) and electronics (Fujikura, 2007). In the score, there is a staff for electronics which in one case notates two dense chords with seven to nine voices and then notates a glissando for each that is written across four bars, one with +3 semitones and the other with +4 semitones notated. Additionally, there is a note that reads "more and more dense and violent (grain size gets smaller and smaller)" (Fujikura, 2007).This is a good point of reference for existing approaches to notating effects like granular synthesis.

Jonathan Harvey's *Speakings* is another example of creative use of electronics with live orchestra. The performance involves close micing orchestral instruments and reamplifying them for the audience but before they are reamplified they are processed to sound like the human voice using a variety of electronic effects.

> Timbre is particularly important for speech perception: "When we describe the acoustic attributes necessary for a sound to be perceived phonetically, we are, in general, describing characteristics associated in music with timbre" (Jones, 1987, p. 147) Harvey leverages this important perceptual cue to create voice-likeness through real -time spectral processing of the 11 soloists using the visual programming language Max/MSP. This software imposes the spectral envelopes of various vocal recordings onto the solo instruments during live performance, molding and shaping the instruments' timbres to resemble the complex timbral structures of speech.
>
> (Bolaños, 2021, p. 2)

This example of live processing sounds to change the timbral quality by filtering and changing pitch and speed, for instance, is exactly aligned with my project's aims. My project seeks to explore approaches to orchestration and composition in the context of these technological possibilities.

Similarly relevant is Philippe Manoury's composition *Echo-daimónon for piano and electronics* (2011-2012). This live performance piece involves live processing of an orchestral ensemble and a piano, all of which is processed in real time to create echoes and effects that swarm around and create interesting subdivisions and textures. This process uses close micing techniques, multiple interfaces, midi controllers and laptops for live electronic integration.

Kristof Penderecki composed work for unconventional ensembles including strange percussive instruments and typewriters, and his work was beloved by David Lynch and used in *Twin* Peaks. He also was known to use unconventional notation.

> In addition to lines and staffed notation used to direct pitch in *Threnody*, a wealth of articulation signs, idiomatic expressions, and special signs are employed by the composer in order to further direct the performer. Traditional dynamic markings such as *forte* and *pianissimo* are used, along with *arco* and *pizzicato*, since the piece is for strings. The vast majority of the piece is notated through many new signs Penderecki invented, including, but not limited to: note stems which indicate bending the pitch up or down a quarter pitch, note heads indicating that the performer play the highest possible note of indefinite pitch possible on their instrument, wavering lines indicating a slow vibrato bending the pitch a whole quarter tone, and markings which indicate the performer should play arpeggios beyond the bridge of their instrument. There are markings as well that indicate various ways in which the performer must strike their instrument, which does lead to concern about instrument damage.
>
> (S. Gilbert, 2015, p. 1)

Composer George Crumb wrote for electrified, or amplified instruments, using close micing techniques paired with extended techniques, for instance on strings. The close mic technique created interesting changes in timbre and expression.

> My music really depends on a live situation and includes what I call the "danger element." That is the element that comes from the live situation. There are precarious things in the music, and the audience is waiting to see how performers will conquer those difficulties. Pieces can be treacherous things, fragile things that can break. And the composer depends on the performer for a certain kind of bravura. Whereas in a purely electronic piece there is no danger or bravura element. You can't just admire the machine-it's bound to work if the electricity doesn't go off. You know the piece is there. It exists but there is no "danger element."
>
> (Riis & Crumb, 1992, p. 4)

This approach to the danger of using amplified instruments adds an interesting dimension to the already innovative compositions and performance instructions.

1.3.12 Concluding remarks

Digital and analog technology have played a central role across many other genres of contemporary music, as noted by Dufourt.

> The technology of sound production replaces instrument making, logical machines guide thought, and programming seems to be the dominating concept of musical composition. The science and technology that are associated with it have given the music of the second half of the century its cultural flavor.
>
> (Dufourt, 2016, p. 19)

As a dominating concept of musical composition, the technology of sound production and programming are relevant topics to explore.

1.4 Ideological framework

This project does not fall into a rigid ideological framework, but rather is situated as part of a network of influences (inputs) and aims (outputs). Among these are the concerns that are presented with contemporary Western art music, contemporary orchestral performances, postmodernism, post-postmodernism, and Augmented Reality contributing to the 'cyborgization' of humanity. By this I mean a cultural cyborgization in which our cultural artifacts are increasingly technologized. I will address each of these influences regarding their influence and impact on this study.

1.4.1 Western art music and the contemporary orchestra

My project falls under the category of contemporary film music from the US, which is heavily influenced by Western art music (WAM). One of the problems that is concerning with the current state of WAM is the attitude that the art form is culturally and musically superior to other forms.

> This music has been troped through the past 200 years as the cultural doxa (Kingsbury 1988, Nettl 1996, Nooshin 2013) in spite or because of its hidden and deeply embedded histories of cultural imperialism and racial oppression.
>
> (Kawabata & Tan, 2019, p. 4)

This is a form of cultural imperialism that has largely been acknowledged in other spheres of artistic practice but remains in the classical music environment. In response to this, some composers do concern themselves with ideology, while others do create work with the intention of it existing in and of itself, solely to demonstrate new techniques or timbres.

One of the central problems with this field of artistic practice is that as often as not there is no ideology, but instead merely a concern with the technical, and sometimes with the emotionally expressive. This refusal to engage with ideology is a problematic ideological position, resulting in a form of neo-colonialism and neo-imperialism through its inability to recognize its own political and socio-cultural context. The luxury of imagining one's work to be free of ideology is the outcome of a position of privilege, where that privilege remains critically unexamined and thus stems from ignorance of one's broader socio-cultural context. This unacknowledged position is a contributing factor to the ongoing struggle of contemporary WAM to remain relevant.

In addition to these concerns, the orchestra in the United States continues to lack ethnic and gender diversity. A report compiled by the League of American Orchestras that surveyed race and gender data between 1980 and 2014 found that in 1980 the orchestral musicians were made up of 96.6% white musicians, and 3.4% non-white musicians (Doeser, 2016). Though this trend has been moving in the direction of becoming more diverse over the years, its progress has been slow. By 2014 the average American orchestra was made up of only 12.1% non-white musicians. The same study found that between 2010 and 2014, the board members of the orchestras remained 92% white. I will later discuss the phenomenon of orchestras in the last twenty years transitioning from being businesses that were kept afloat by subscriptions and ticket sales, to being funded primarily by donors. This gives the decision-making power to the board members, and further reinforces the primary concerns with an elite group controlling the programing, repertoire, and outreach. Another study compiled by the League of American Orchestras found that in 2014 the average American orchestra broke down its income as 40% earned, 43% contributed and 17% investment income (Voss et al., 2016). Finally, the race and gender study gave insight into the number of women in leadership positions, revealing that in 2006 only 8.5% of music directors were women, and in 2016 that number had only grown to 9.2%. These inequities across the musicians, the board, and the music directors paint a picture of the orchestra as lacking diversity.

In addition to lacking ethnic and gender diversity, the contemporary orchestra has also struggled to bring in young audiences, which has influenced the decline in subscription and single concert sales. In a study of the 15 biggest orchestras in the US, the data suggests that the majority of those who attend concerts regularly are older and wealthier.

> About half of subscribers across the 15 markets are 65 or older, and 17 percent are 75 or older. Subscribers are almost twice as likely as single-ticket buyers to be retired (45 percent vs. 24 percent, respectively) and are significantly more likely as single-ticket buyers to have incomes above $150,000 (25 percent vs 16 percent, respectively). Moreover, subscribers are half as likely as single-ticket buyers to have children in the household (12 percent vs 23 percent, respectively).
>
> (Brown, 2002, p. 3)

In addition to these trends pointing toward a very narrow and diminishing slice of the population attending and supporting orchestras, data compiled by the National Endowment for the Arts shows that the number of total adults who have attended a classical music concert continues to decline each year. In 2002 the total number of classical concert attendances throughout the US was 72.8 million, compared with 60.4 million in 2008 and 53.1 million in 2012 (Silber & Triplett, 2015). Another study put together by the National Archives of Arts found a similar trend when surveying attendance to classical concerts focusing on the 81 biggest metropolitan markets in the US. The study found that in 2003 these markets saw 20,521,290 attendees, which then steadily declined to 14,491,862 by 2008 (Kushner & Cohen, 2010).

One of the primary struggles is engaging a young audience. One solution has been the introduction of orchestras performing symphonic versions of pop music and film scores. The New York Times published a story about the integration of more popular style of music.

> There is a fundamental challenge facing pops orchestras and series, which tend to have audiences older than classical ones. As music directors and administrators try various approaches to connect with new audiences – adding film screenings with live orchestral accompaniment, video game soundtracks, theatrical circus spectacles and 1990s rock acts – are they abandoning the large repertory that drew so many listeners in the first place? A similar tactic has been used at the Nashville Symphony Orchestra, which has a history of championing contemporary American music. Last year, its pop series sold at 85 percent capacity, compared with 73 percent for its classical series.
>
> (Wise, 2016, p. 5)

There is much evidence that points to the decline of the traditional orchestra, for instance many seasonal programs have transitioned to regularly screening popular films with the orchestra playing the score, and pops concerts in which the orchestra accompanies pop music acts. A 2024 report form the Royal Philharmonic Orchestra (RPO) reported:

> Five-year peak: The number of people who would like to experience an orchestral concerto rose from 79% in 2018 to 84% in 2023…Different orchestral formats: Six orchestral concert formats have grown in popularity since 2018, including music from musicals, film soundtracks, pop/classical crossovers, TV soundtracks, family-friendly concerts, and video game soundtracks concerts… James Williams, Managing Director of the Royal Philharmonic Orchestra commented: 'Our new report clearly indicates that the landscape of orchestral music is not merely growing; it is transforming and being shaped by technological innovation. The trend we have observed with our tracking data continues to build, with more people seeking out orchestral experiences and with a greater openness for diverse and changing genres. The distinction between audience segments – such as 'core', 'new', or 'niche' – is increasingly becoming blurred, as overlaps between them become more common.
>
> (Bellamy & Follettt, 2024, p. 2)

Additionally public attendance to orchestral performances in Europe have declined in recent years. "Attendance at major concerts in the United States and Europe has declined. Charitable gifts to institutions of classical music are shrinking. Orchestras are closing their doors" (Balio, 2025).

In South Korea, a study shows that though classical music remains a small percentage of total concert sales at 6.3% in 2023, it rose from 6.1 % in 2019 (Kim & Song, 2025). This data confirms that a generalization about the decline of western classical music does not apply globally, but is accurate in the US and Europe, among other parts of the world.

To summarize the data presented above, we are in a moment of crisis in the classical world. The acoustic orchestra appears to be less and less relevant to contemporary music and society. My project suggests a new approach to the acoustic orchestra, supporting its adaptation into the digital age, and bringing new sonic aesthetics and experiences by way of augmented sounds and performances. I have been focusing on the realm of film composition, but I could also envision an Augmented Reality Orchestra approach to classic works in the WAM canon, perhaps intriguing and engaging a younger audience as with Wendy Carlos's *Switched on Bach*, or Isao

Tomita's *Snowflakes Are Dancing*, featuring synthesized arrangements of popular classical works.

1.4.2 Recording orchestral instruments and ensembles

Part of this study involves recording orchestral instruments. Initially the thesis was focused on the orchestra being played through effects in a live performance context, which is a complex task from the perspective of an audio engineer given the nature of monitoring and the high gain nature of some effects like saturation. While the project transitioned to being more focused on composition techniques and theories more than performance, I still maintain that the ideal way to use the effects is to record live instruments, even if they are captured one at a time, and then the effects can be applied in post-production. If there are multiple musicians performing a piece, and it is logistically possible to capture their performances live, rather than multitracked, that too is preferable. For my film scoring work I use real instruments and performers as the sound source rather than samples whenever possible. The following section maps out some fundamental approaches to engineering orchestral instruments and small ensembles.

When I record small ensembles, I record in stereo to capture an audio image of the stage. One technique that I employ is the coincident pair, which is two directional microphones mounted together, at a forty-five degree angle to ensure that the instruments on the left side of the stage are louder in the left headphone ear, or the left speaker, and the same goes for the right side. *The Cambridge Companion to the Orchestra* explains how stereo is an illusion:

> To achieve stereo, however, there must be two discrete signals. Stereo is an illusion. We hear the sound of two loudspeakers, but when both produce an identical sound each of our ears hears an identical sound and we perceive it as emanating from a point midway between the two sources. Comparing sounds between two ears is how we locate sound in nature and our brains are capable of interpreting minute differences in amplitude, time, phase and frequency.
>
> (Lawson, 2011, p. 311)

All the live instruments recorded for this project were recorded in mono, not stereo, because I was only recording a single musician at a time. That being said, all of my compositions are mixed and arranged with thoughtful consideration of the stereo field, as it functions as one of the pillars of balance in my Augmented Reality Orchestration Theory (see Chapter 4 section 4.2

below). For future research I am interested in the relationship between recordings that capture live sound in stereo, and ways that effects could manipulate the stereo field in post-production.

During the process of engineering a recording session with live orchestral instruments, there are a few other aspects to consider as elaborated on by Rushby-Smith:

> Besides a clear stereo image, three other elements must be considered: Perspective, Proportion, and Quality. Perspective is the apparent distance of the performers from us, the listeners. Proportion is the relative balance between performers. Quality defines whether the performers sound as they should sound or, more subtly, as they hope they sound.
>
> (Rushby-Smith, 2003, p. 6)

These characteristics align with the central concepts of the Augmented Reality Orchestration Theory. Perspective, or the distance from the listener can be manipulated using reverb or delay and can reinforce the sensation of an instrument sounding like it is in the background at extremes, which is an essential tool for placing sounds on the continuum of near-to-far. This might be more easily understood in the context of axes as per a three-dimensional graph on which left-right is the x-axis, up-down is the y-axis and forward-back is the z-axis. In the realm of engineering, a microphone could be placed far away from the performer, creating the same effect. The volume of an instrument creates this effect as well, louder instruments feel closer, and quieter ones feel further away. EQ can contribute as well considering low frequencies travel further than high frequencies. In addition, sounds with a more abrupt attack and transient will feel closer to a listener, while a more rounded attack feels further back in the mix (Mastering.com, 2023)Proportion relates to the stereo field and how instruments are placed on a spectrum from left to right, which is controlled with panning in a DAW, or within the effect settings. In the realm of engineering, if there are multiple performers and microphones, placement will determine the proportion, for instance if a cello has a microphone pointing toward it, it might also pick up some bleed from the musician sitting a few feet away. Some microphones are intentionally placed in between performers or above their heads to capture a blend of the instruments. Often strategies are employed to have a microphone pointed slightly toward one of two instruments, to increase their presence in the mix, or to soften the attack or presence of the other. Quality relates to the tone or timbre of the instrument itself.

These considerations and strategies are more relevant in the context of recording live ensembles with the intention of processing them through effects. The composition techniques in this project and the Augmented Reality Orchestration Theory could help a film composer with some basic strategies for producing music that is recorded live and later processed through effects.

1.4.3 Film Music

This project is centered around composition for film music. It is thus necessary to discuss some of the tools and approaches to the craft as well as goals for making an effective score. One approach to film scoring frames its central goal around aiding in the suspension of disbelief and acting as a translator between the viewer and the fictional world of the film. Claudia Gorbman describes this sensation in *Unheard Melodies*:

> Music lessens defenses against the fantasy structures to which narrative provides access. It increases the spectator's susceptibility to suggestion. The cinema has been compared to hypnosis, since both induce (at least in good subjects) a kind of trance. The trusting subject (trusting the hypnotist, the system of cinematic narrative) removes defenses to access to unconscious fantasies. The hypnotist has his/her induction methods: soothing voice, repetition, rhythm, suggestion of pleasantly enveloping imagery, and focusing the subject's attention on one thing to the exclusion of others. Narrative cinema has its own 'induction methods'- including the harmonic, rhythmic, melodic suggestiveness and channeling effects of music. Film music lowers thresholds of disbelief.
>
> (Gorbman, 1987 Pg. 5)

In addition to drawing the viewer further into the narrative, musical motifs and themes can recur and represent characters or places. There are numerous functions of film music, but one rule that is generally agreed upon is that the music should be secondary to the narrative, it should essentially be in the background. Gorbman solidifies the reason behind this:

> If music plays in a film - "secondarily" to the register of language, or narrative – if it is in the background, it works on the spectator-subject most effectively, fusing subject to film body, bypassing the usual censors of the preconscious. In practical terms this means a deeper sleep, a lowered threshold of belief, a greater predisposition for the subject to accept the film's pseudo-perceptions as his/her own.
>
> (Gorbman, 1987, p. 5)

The implications of playing secondarily are complex. A film composer should be mindful of making space for dialogue, not demanding attention upon itself, and evoking emotion in the viewers' subconscious mind without drawing their attention directly to the music. As inspiration for the process of writing my film compositions for this project, I took Howard Shore's advice on how to navigate the first phase of writing from *On the Track*:

> That phase is very nontechnical, it's very dreamy, there's a lot of napping involved, frankly. And it's kind of putting yourself in a noncomplex situation in terms of allowing yourself to breathe a little bit…you need to get inside your own subconscious, so I don't allow a lot of extraneous kind of noises.
>
> (Karlin & Wright, 2004, p. 289)

This kind of openness inspired the aspects of my composition methodology that encouraged creative freedom and space to explore. One of the most functional and common types of film music is textural underscore, which consists of layers of instruments creating a drone or pad that moves with the film and adds rhythm, energy and emotion to a scene while staying in the background. This kind of atmospheric music has different colors or essences, with the potential to evoke a variety of emotions, places and memories. Thinking about music in terms of color, and what kind of place or character it suggests, is an important perspective to consider in the process of writing film music. *Film Music A Neglected Art* elaborates on this:

> Music can create a more convincing atmosphere of time and place. There are a variety of ways of achieving an atmosphere of time and place, or, musically speaking, "color". In a broad sense, musical color may be taken to represent the exotic or sensuous aspects of music, as distinct from musical structure, or line, which might be considered the intellectual side. Although admittedly an oversimplification, this distinction has a good deal of validity in terms of film music. Film music is overwhelmingly coloristic in its intention and effect.
>
> (Prendergast, 1992, p. 41)

Though in my experience timbre and structure cannot be so neatly separated, as they both inform the expressive meaning of a musical moment, this description of the associative power of color with time and place inspired me to focus my energies on color and emotion. I pair this with the rule that film music must be secondary to language and narrative as central concerns of my composition methodology architecture. In stating that film music is secondary to narrative I mean that it functions primarily to support and enhance the narrative, as film music plays a central role in constructing the expressive contour of any narrative. This idea goes beyond simply perceiving music as serving an emotional function in the context of the narrative arc of the film. Music can communicate ideas to the audience that can change their perception of the plot or characters. Ann-Kirstin Herget unpacks this in her study: *On music's potential to convey meaning in film: A Systematic review of empirical evidence:*

> Beyond the purely emotional level, however, instrumental background music can convey information on a semantic and therefore content-related level, which can evoke predictable supra-individual associations among recipients (e.g., Hung, 2001;Shevy, 2008). If these associations are projected onto the film, music can influence the perception and interpretation of film plot and protagonists and can, therefore be classified as an instrument of non-verbal communication.
>
> (Herget, 2021 pg.21)

Another aspect of this idea that music functions to communicate is the subjectivity of the interpretation of music for each individual, and how music has more agency in manipulating perception because the average audience member is not a trained musician who can analyze every musical gesture. Phillip Tagg discusses this in *Music, moving image, semiotics and the democratic right to know:*

> Music may be just as important as words or pictures in communicating how we should value, despise, admire, fear, love or hate other people or ourselves, other cultures or our own. The only difference is that while education may help us, if we are lucky, to reflect upon and criticize messages that come to us through visual and verbal media, we are not trained to reflect upon or criticize musically mediated ideology. We are in this sense more open to manipulation through music than through most other channels of mediating meaning.
>
> (Tagg, 2006, pg. 169)

One example of a modern score that incorporates a fusion of organic sounds with digital effects and processing is the HBO series Chernobyl scored by Hildur Guõnadóttir. For this score Guõnadóttir gathered field recordings from a deactivated nuclear power plant and mapped the reverb of a giant metal tank on the site. Those recordings were then mixed with vocal recordings and synths to create fusion textures that represented the spirit of the series. The specific approach to processing on the cue "The Bridge of Death" is explored in *Radioactive Music: The Eerie Agency of Hildur* Guõnadóttir's *Music for the Television Series Chernobyl*:

> We can hear how Guõnadóttir molded the field recordings using the compositional logics of tempo, rhythm, harmony, and registral spread. In the low-frequency zone, a slowly pulsating bass creeps upwards in a steady rhythm. In a higher register, a series of pitches spell out harmonic directionality in a minor key. These enter like bursts of sound, with their sharp attack piercing the soundtrack like electrons. The timbral

> characteristics are trembling or unstable…There is a similar eeriness in *Stalker* to that found in *Chernobyl*, and both instances of the eerie are achieved with the aid of experimental soundtracks that blend sound design and music, and that make evocative use of anthropomorphic sounds detached from their sources to lure the audio-viewer into labyrinths of strange presences and absences.
>
> (Storvold & Richardson, 2021, p. 1)

This score to Chernobyl is a clear example of contemporary scoring integrating digital effect processing and technology with sounds from the organic world including metal percussive sounds, cello and the human voice, and augmenting them to achieve an expressive goal that enhances the story.

Another relevant film is *No Country for Old Men* which uses ambient sounds from the real world, processed and mixed into a musical arrangement that support the character arc and flow of the story. In his video essay *Active Ambiance in No Country for Old Men*, Miguel Mera explores this approach:

> It is also possible to identify a range of other detailed sonic strategies in relation to timbre, the balance between sound-design elements, and punctuation as fundamental drivers of the narrative arc. The sophisticated management of spectral energy shapes narrative intensity with the sounds of room tone, whistling wind, car engines, guns, footsteps, and the pulsing of a tracking device controlling tension and release…The ambient sound in the film represents more than just the stasis of landscape or location. It is active, meaning that it is not purely an environmental, background, or an 'unheard' element, to use a foundational audiovisual term, but rather is used in carefully constructed phrases that are dynamically engaged in shaping narrative, in a state of progress, motion, and musical flow. Using several graphical representation approaches, I open a methodological door to an understanding of long-form processes of sound mixing *as* musical phrasing.
>
> (Mera, 2023)

This approach ties into my idea of building and supporting long-form narrative arcs through processing over time. It also ties into the idea of capturing organic sounds in the real world that connect the film with a geographic place and then process them to either support the tension of a scene or mirror the perspective or the intention of a character.

Another relevant topic is that of sound design. Increasingly sound design has become more prevalent in the sonic landscape of contemporary films and consequently shares space with film music. This evolution toward more elaborate sound design compositions has changed the aesthetic of music scores for visual media making aspects of electroacoustic theory increasingly relevant. To further this point, it is worth discussing *Forbidden Planet* (1956), which was the first electronic score for film. The creators, Louis and Bebe Barron were initially hired to supply the film's sound effects but the director was so taken by the sound world of the electronics that he hired them to do the score as well. This film introduced a groundbreaking new approach to sound and score. The technology and electronic music sounds and effects used in this film became essential parts of the digital signal processing toolkit that we use today.

John Cage's Fontana Mix (1958) is another important work that experiments with some of the alternative approaches to performance and notation that this study explores. Fontana Mix uses chance procedures derived from I Ching to randomize and change different parameters in the musical performance, resulting in a different iteration each time. The notation for Fontatna Mix is a graphic score with curved lines and transparencies. Cage's innovative approaches to variation and notation are pillars of the history of experimental performance.

Another important point of discussion on the topic of film music is orchestration. Orchestrators are typically involved in film score productions and have a close creative relationship with composers. In contemporary film scoring it is not uncommon for the composer to fulfill multiple roles in the score production team with the continued prominence of virtual orchestration through DAWs. In *Virtual Orchestration: A Film Composer's Creative Practice* (2019), Boris Furduj analyses the ways that contemporary film composers shift mindsets and practices through the various stages of creation and production:

> I argue that professional film composers are effective because they exercise their skills through a compositional process that involves a complex set of relationships between different compositional states of mind and compositional activities in which they experience music and interact with musical materials and media in many different ways. During this continual process of composition, composers are often mostly in one stage or another, even if for a short time as they are repeatedly going back and forth between stages and can be in multiple stages performing different activities at the same time.
>
> (Furduj, 2019, p. 8)

Another study by Vasco Hexel entitled *Understanding Contextual Agents and Their Impact on Recent Hollywood Film Music Practice* (2014) explores the impact of the structures within the film industry paired with evolving technology that influence protocols and methodologies, which have an impact on the scores themselves:

> Through the course of my research, I discovered a multifaceted and complex network of creative processes inherent in contemporary Hollywood filmmaking, which have caused new phenomena and trends in film music. In the Hollywood realm, film music is always a means to a commercial and affective end, mediated by the films it accompanies, not an end in itself. Composers understandably feel pressured and challenged when they contribute to, and work within, a multi-agent creative environment of whose outcome they are not solely in control. Numerous musical and non-musical factors influence aesthetic considerations and creative choices that are ultimately settled by filmmakers and executives rather than composers. Prevalent creative practice has shaped the nature of recent Hollywood film music. Conditions can require or render obsolete, help construct or destruct, nourish or starve film music.
>
> (Vasco, 2014, p. 18)

Another relevant topic is the role of the orchestration in contemporary film scoring practice. With the development of modern technology surrounding the procedures of producing musical charts and notation using software with playback capabilities, the roles of the orchestrator and copyist have changed. In some cases, the copyist has become obsolete because the software can extract the individual parts automatically, and in other cases, the unique skillset of the orchestrator has narrowed to more creative skills such as voicing, harmonizing, and layering. It is common in contemporary film scoring for composers to receive a lump sum for their services and bundle in these various roles into a single budget, and as budgets have been shrinking regularly, many composers choose to absorb the tasks of the orchestrator and copyist to preserve a livable wage. Also, samples are improving as technology develops, which gives a composer the ability to bypass live acoustic performers entirely if the budget is small enough. This is discussed in Ian Sapiro's book *Scoring the Score: The Role of the Orchestrator in the Contemporary Film Industry.*

> The consensus is that the principal driver is finance. Currently in the industry 'budgets are decreasing generally and expectations are increasing' (Dannheisser), and as a result there is 'a downward pressure on everybody involved in any aspect of production to provide more for less' (Anthony). Joe Kraemer identifies 'a certain devaluing of the artistic side of it because the technological side of it has become fairly affordable', and this may stem from the way that film-music budgets are often structured in the contemporary industry…composers salaries are not going up and the pressure on them has been that they should work more and more for less and less and that impacts everyone downstream from the composer…Julian Kershaw observes that 'if it's a low

> budget film and a set fee, I might decide to do the copying myself so that I don't have to pay a copyist', since if the costs rise 'a copyist can take all my fee', emphasizing the knock-on effects of a fixed music budget.
>
> (Sapiro, 2016, p.184)

As music technology advances, the shifting methodological landscape shapes the craft in many ways. For instance, a composer can audition different voicings within either a DAW or a notation software, listening to playback to find the version that best suits the passage, whereas a pre-technology orchestrator would rely on their theoretical/contrapuntal expertise that had developed from years of engaging with orchestral voices in a live setting. Alternatively, there is value in the role of the orchestrator as a specialist, focusing solely on one specific aspect of the music, and an artistry and expertise that comes from repetition of that unique skillset. These changing conventions certainly change the nature of these practices and influence contemporary film score production procedures. My paper aims to explore the ways in which a deeper understanding of modern digital effects can influence the approach to orchestration, and how that contrasts with previous models of orchestration practice. Throughout this study there is discussion of 'traditional orchestration practice' which refers to the modes of operation for an orchestrator before the existence of notation and digital production technology that changed this process. Historically, orchestral composers outside of film music composition typically orchestrated their own music, and as the cannon of Western Art Music has had a foundational influence on orchestral film music, the skills of the orchestrator have been deeply influenced by seminal texts on the topic including: *A Treatise on Modern Instrumentation and Orchestration* by Hector Berlioz, *Principles of Orchestration* by Nikolai Rimsky-Korsakov, and *The Study of Orchestration* by Samuel Adler, among others. These essential texts on orchestration establish a groundwork for standard practice and theory on the topic in a pre-notation/production technology context, and this body of knowledge is the basis for my references to 'traditional orchestration practices', which are contrasted with contemporary approaches that integrate technology and effects.

1.4.4 *L'Âge d'Or*

The practical component of this project consists of a rescoring of the film *L'Âge d'Or* with the Augmented Reality Orchestra to experiment with the sounds and effects in an applied context. This section will discuss the film's history and the artistic approach to its existing score. I will provide context through a discussion of surrealism during the 1930s, as well as cinema and film scoring during that era. I will explore the ways in which film and music critics have analyzed the original score for *L'Âge d'Or*, and argue for why the film aligns with the stylistic concept of my compositions.

L'Âge d'Or was released in 1930, directed by Luis Buñuel, and written by Buñuel and Salvador Dali. It is a French surrealist satirical comedy, and is regarded as one of the key works in surrealist cinema. It was released at the dawn of film sound being integrated into films, and had a controversial release due to being perceived as explicit, graphic, and morally corrupt.

> A contemporary right-wing Spanish newspaper published a condemnation of the film and of Buñuel and Dali, which described the content of the film as "…the most repulsive corruption of our age…"
>
> (Morris, 1980, pp. 28–29)

The original score features work of the Western art music canon, primarily using music from the German opera *Tristan und Isolde* by Richard Wagner. A brief discussion of the tenets of surrealism during this era is necessary to understand the influence Buñuel had on the movement. This history is discussed further in *Surrealist Sounds: Film Music and the Avant-Garde*:

> Surrealism, in the words of Andre Breton, one of the movement's founders and spokesmen, is "pure psychic automatism, by which one proposes to express, either verbally, or in writing, or by any other manner, the real functioning of thought. Dictation of thought in the absence of all control exercised by reason, outside of all aesthetic and moral preoccupation. The term *surréalisme* was coined by Guillllaume Apollinaire in 1917 to describe Erik Satie's ballet *Parade*, but the official movement formed in 1924 with the publication of Breton's first surrealist manifesto. It became the first major visual art and literary movement to take cinema seriously as a medium.
>
> (H. Lewis, 2018, p. 6)

This concept of acting outside of reason and logic, but rather in a dreamlike subconscious state is what drew me to surrealism. My project supports and encourages moments of improvised creativity, and the music that I tend to write for films can be categorized as dreamy, hypnotic, impressionistic and surrealistic. Additionally, the result of applying effects to orchestral instruments functions to blur the lines between reality and that which lies outside the realm of reality. We have the interaction of three different realities: objective reality (insofar as there is such a thing), the realm of dreams, and augmented reality. Augmented reality uses technological tools to enhance our objective reality to manipulate it, while the reality of dreams occurs as a natural phenomenon wherein our subconscious manipulates our interpretation of objective reality and shifts our perspective. With the ability to creatively control augmented reality, one could manufacture a mode of augmentation that mirrors their perception of a dream state. As our dreams are the only place where our perception of reality is altered without the means of technology, any modified version of our objective reality would imitate or be reminiscent of a dream state. Buñuel aimed to mirror our natural dream state with his film. Among the many forms of surrealism, cinema proved to be a central vehicle for its ideals and philosophy. Lewis notes:

> They also saw in cinema a potential for blurring the boundary between reality and dreams, a central tenet of the surrealism philosophy. Furthermore, the surrealists found that, according to Short, "movies were a perfect 'anti-culture' and their mass appeal was a distinct plus". These would become the central components of surrealism cinema: visual representation of the irrationality of dreams, the unconscious (particularly thoughts that are violent, grotesque, or sexual in nature), the liberation of repressed desires, and the rejection of societal norms that served to repress these unconscious desires.
>
> (H. Lewis, 2018, p. 6)

Buñuel was actively involved in the surrealist movement, and was a pioneer in the way that he integrated music into surrealist cinema. Lewis elaborates on the ways in which Buñuel defied the conventions of surrealism and invented new directions for the movement in the realm of cinema:

> While surrealist cinema had flourished in the late 1920s, its future in sound cinema was uncertain. Music's role in the surrealist movement had been fraught and contested since the movement's beginning in the early 1920s. The stance of the "official" surrealist writers was staunchly antimusical, and to many surrealists, music seemed to violate the surrealism's philosophical and aesthetic principles. This antimusical stance made the very concept of surrealist sound film problematic. Could music play a role in this new audiovisual form? How would the dream logic established in silent surrealist cinema remain with the heightened realism of synchronized dialogue and the presence of a recorded musical soundtrack?
>
> (H. Lewis, 2018, p. 7)

In addition to simply choosing to incorporate music into *L'Âge d'Or,* Buñuel's approach uniquely used the popularity and prominence of Wagner's music to contrast in creative ways with the absurdist imagery. Buñuel's central philosophical guiding principle was his disdain for social and cultural hierarchies. He expresses this sentiment as is captured in *Surreal Symphonies: L'Âge d'Or and the Discreet Charms of Classical Music*:

> Buñuel could never completely depart from that underlying sense of social and cultural hierarchies that informed his choice of music in *L'Âge d'Or*. In his memoirs, Buñuel writes: "Most Surrealists came from good families; as in my case, they were bourgeois revolting against the bourgeoisie. But we all felt a certain destructive impulse, a feeling that for me has been even stronger than the creative urge. The idea of burning down a museum, for instance, has always seemed more enticing than the opening of a cultural center or the inauguration of a new hospital.
>
> (Barlow, 2001, p. 11)

It is essential to understand the motives of Buñuel when interpreting the application of music in his film. It is also important to know that Buñuel spoke of his love for music in many interviews, and specifically the music of Wagner, so while he uses music to point out inequities between classes, his approach is not a critique of the music itself. Most of the techniques that Buñuel used in this film involve some sort of juxtaposition. A juxtaposition between the familiar and popular classical works and the grotesque imagery of the film creates a distinct relationship, both by heightening the value of the grotesque images and taking away from the prestige and sophistication of the compositions. Sometimes these juxtapositions are used as ironic counterpoint, other times they are a method for drawing attention to certain aspects of the film. Torbin Sanguild adds:

> The ambivalence towards Wagner spawns burlesque gags and ironic counterpoints together with clear correspondences and loyal adaptations, often in the same sequence. Buñuel is able to deflate the solemn and metaphysical aspects of Wagner without giving up important aspects in the realm of love, desire, transgressiveness and the power of music.
>
> (Sangild, 2015, p. 3)

This concept of elevating the elements of Wagner's composition that Buñuel connects with, and devaluing or disrespecting the elements that he dislikes, is the bridge between his love for the music and his distaste for the hierarchical nature of Western art music and metaphysical concepts. To elaborate on the idea that the imagery brings down the value of the music and the music elevates the imagery, Lewis writes:

> If we consider the scene from this perspective, Buñuel's pairing of the "Liebestod" with the couple's profession of desire legitimates the actions of the couple. Instead of

> mocking Wagner, it makes their lust for each other sublime, almost mythicizes it… Perhaps that is part of what makes its soundtrack so unsettling: Buñuel both brings the music down into the realm of the mundane by juxtaposing it with the film's images, and elevates the images and narrative through the musical works. The music serves to *familiarize* the otherwise alienating images. Buñuel shows how irony alone is not as disturbing as an audiovisual aesthetic that simultaneously, and contradictorily, embraces *and* critiques musical meaning. The revolutionary politics of surrealism found in this film are thus not enhanced by the score, but shaped by the manner in which it interacts with the image.
>
> (H. Lewis, 2018, p. 7)

Instead of using preexisting recordings, Buñuel decided to record all the music with a chamber orchestra specifically for the film. This was done so that he could have more flexibility with when cues started and stopped, to better synchronize them with the picture. Below is a list of places in the film where Wagner's *Tristan* appears, and a brief description of the context, and additionally the other pieces of classical music that were featured in the film. This list was created by Torben Sangild for his paper *Buñuel's Liebestod – Wagner's Tristan in Luis Buñuel's early films: Un Chien Andalou and L'Âge d'Or*.

Figure 2 – Tristan in L'Âge d'Or

A - 14:32-17:40 Prelude. The Man and Woman have interrupted a ceremony with their ecstatic screaming while rolling erotically in the mud nearby. As they are separated Wagner begins. The Man looks with sad longing after her. Cut to toilet scene and lava (Wagner interrupted briefly by the flushing). The Man is taken away and behaves aggressively. The ceremony continues.

B - 22:49-23:10 Second motif twice The Man looks at a poster. Correspondence and intimations of contact between him and the Woman lying ecstatically in the same position as the image on the poster.

C - 43:36-52:34 Transfiguration The orchestra performs the music (which then becomes diegetic). The lovers are alone nearby, trying to make love. They go through various phases. They are interrupted by a phone call. During the indoor phone conversation (47:26-48:36) the music is absent. The lovers continue. At the ecstatic climax the conductor interrupts the music and leaves the site of the concert.

D – 55:04-55:40 Transfiguration The Man back in his room cries in his bed after the Woman has left him for the conductor.

Other music

Mendelssohn: The Hebrides (0:49-3:13);

Mozart: Ave Verum (3:15-4:28 + 11:42-14:04);

> Beethoven: Symphony no. 5, third movement (5:15-7:25);
>
> Mendelssohn: Symphony no. 4 (“The Italian Symphony”), third movement (17:42-20:05 + 21:30-22:24);
>
> Beethoven: Concerto for violin and orchestra op. 61, first movement (20:05-21:23); muted strings (25:59-27:08); unidentified classical music (28:14-28:43);
>
> Schubert: Symphony no. 8, first movement (30:03-34:16);
>
> Wagner: “Träume” (Wesendonk-lied no. 5) (39:3041:32);
>
> Catalan drums (54:10-55:03 + 55:41-1:02:10); unidentifed light music (1:02:111:02:19).
>
> (Sangild, 2015, p. 2)

During the process of writing an original score to this film, I used some of the insights gathered during this literature review as starting points to experiment with juxtaposition between the music and image. In a way, the Augmented Reality Orchestra could be interpreted with a similar spirit of rebellion as Buñuel’s score, using the sacred and highly respected instruments of the orchestra, with all their history and familiarity, and then applying effects to them and shifting the way they sound. There are several moments in my compositions where the effects overwhelm the sound and the composition with distortion or dissonance, which could be interpreted as a philosophical statement on the death and destruction of the orchestra, or at least as a critique of the orchestra. This interpretation is parallel to a scene in the film where a high-class man in a fancy suit is walking down the street kicking a violin while a solo phrase from Beethoven’s Violin Concerto plays in the background. At one point the man stops and smashes the violin with his foot, at which point the music is silenced. Lewis notes:

> The crushing of the violin is symbolic of the film’s attack on the bourgeoisie and its values; the casualness of his vacation makes it all the more shocking.
>
> (H. Lewis, 2018, p. 8)

This section aimed to give a review of surrealism and its application in cinema both before and after Buñuel. I discussed different interpretations of how Buñuel used music to enhance *L’Âge d’Or*, and the controversies surrounding the score and the film in general. Buñuel used his film to manipulate perception of reality and invite the viewer into an altered reality. Once that suspension of disbelief occurs, the potential emotional impact of the film is increased. This was achieved by breaking conventions and disrupting expectations. This transition to perceiving a film as or from a dream state is mirrored in the goals of the augmented reality orchestra which aims to create unfamiliar, otherworldly sounds and arrangements of sounds through digital processing as a tool to move film music toward a dream state.

1.4.5 Post-Postmodernism

One of the influences on this project and these compositions are ideas in the realm of post-postmodernism or metamodernism. While postmodernism comes from a multiple-truth framework, post-postmodernism functions in a post-truth framework. Postmodernism ‘allows’ other traditions to engage with the ‘high art’ tradition on supposedly (though not actually) an equal footing. Post-postmodernism overthrows the ‘high art’ tradition and exposes its ‘truth’ or permitted truths as an inherent inability to function as a mirror for anything but a tiny fragment of humanity. The postmodern orchestra encourages aspiration as the highest pinnacle of musical culture. The post-postmodern orchestra is arguably a self-parody of its former importance as it struggles to motivate for maintaining its position of privilege in relation to other cultural forms. Yet it seems unable to convince anyone but itself of its ongoing position of primacy.

In *Notes on Metamodernism*, the authors add insight to the definition of metamodernism by discussing its approach to idealism.

> Indeed, if, simplistically put, the modern outlook vis-à-vis idealism and ideals could be characterized as fanatic and/or naïve, the postmodern mindset as apathetic and/or skeptic, the current generation’s attitude – for it is, and very much so, an attitude tied to a generation – can be conceived of as a kind of informed naivety, a pragmatic idealism.
>
> (Vermeulen & Akker, 2010, p. 14)

There are several ways in which my project will use these philosophies as an ideological influence. In accepting that ‘high art’ is merely a construct that elevates and reflects the ideologies of only a small population of humanity, as a composer there are fewer pressures to fit neatly into any specific box, and yet pragmatism can remain a central tenet of the process. One of my central aims in this project is to suggest a style of orchestral music that has the potential to spark an interest with a new generation of listeners, so this pragmatic goal factors into my calculus, and yet I have no conception of these compositions as being superior to any other piece of music from any other culture. In this sense, art is liberated from the idea that it points to an ideal, and is rather a reflection of an individual's point of view.

1.5 Practice-led research

Practice-led research is the generation of new knowledge through the creation of artwork. Knowledge is developed both through the artefact of the work itself, and the insights gained through the process of creating the artefact. There are a number of theoretical frameworks in support of practice-led research, and in the following section I will review several of them as they relate to my project. Carole Gray defines practice-led research as:

> Firstly, research which is initiated in practice, where questions, problems and challenges are identified and formed by the needs of practice and practitioners; and secondly, that the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners.
>
> (Gray, 1998, p. 14)

Practice-led research is conducted across a variety of different art forms. In reviewing the literature, I explore multiple artistic media to get a sense for how the theoretical framework has been applied in different contexts. In the field of visual arts, Graeme Sullivan presents a philosophical argument in defense of practice-led research which revolves around the function of understanding:

> The process of theorizing is a basic procedure of inquiry and hence a core element in research…Some theories are based on how knowledge is applied to help solve problems. This kind of theorizing involves explanation, which is a logical process whereby observations are linked so that some are seen as causes and others as effects…In other situations, theories are based on experience, which helps us understand more complex things. This kind of theorizing involves understanding, which is a cognitive process whereby who we are and what we know shape interactions and transform awareness. In these instances, intuition and intellect, grounded in context-specific circumstances provide an experiential base for constructing new frameworks of understanding…Central to my argument is the premise that to better appreciate how visual arts can contribute to human understanding, there is a need to ground visual arts research within the theories and practices that surround art making.
>
> (Sullivan, 2005, p. 19)

The concept of understanding as distinguished from knowledge is a recurring piece of the argument in support of practice-led research. Many theorists make this distinction and argue that understanding is central to the development of the human mind, knowledge, and the history of cultures. Sullivan goes on to further qualify his argument.

> If a purpose of research is to increase awareness of ourselves and the world we live in, then it seems plausible to argue that understanding is a viable outcome of inquiry… It can also be argued that the process of making art and interpreting art adds to our understanding as new ideas are presented that help us see in new ways. These creative insights have the potential to transform our understanding by expanding the various descriptive, explanatory, and immersive systems of knowledge that frame individual and community awareness. These forms of understanding are grounded in human experiences and interactions and yield outcomes that can be individually liberating and culturally enlightening.
>
> (Sullivan, 2005, p. 19)

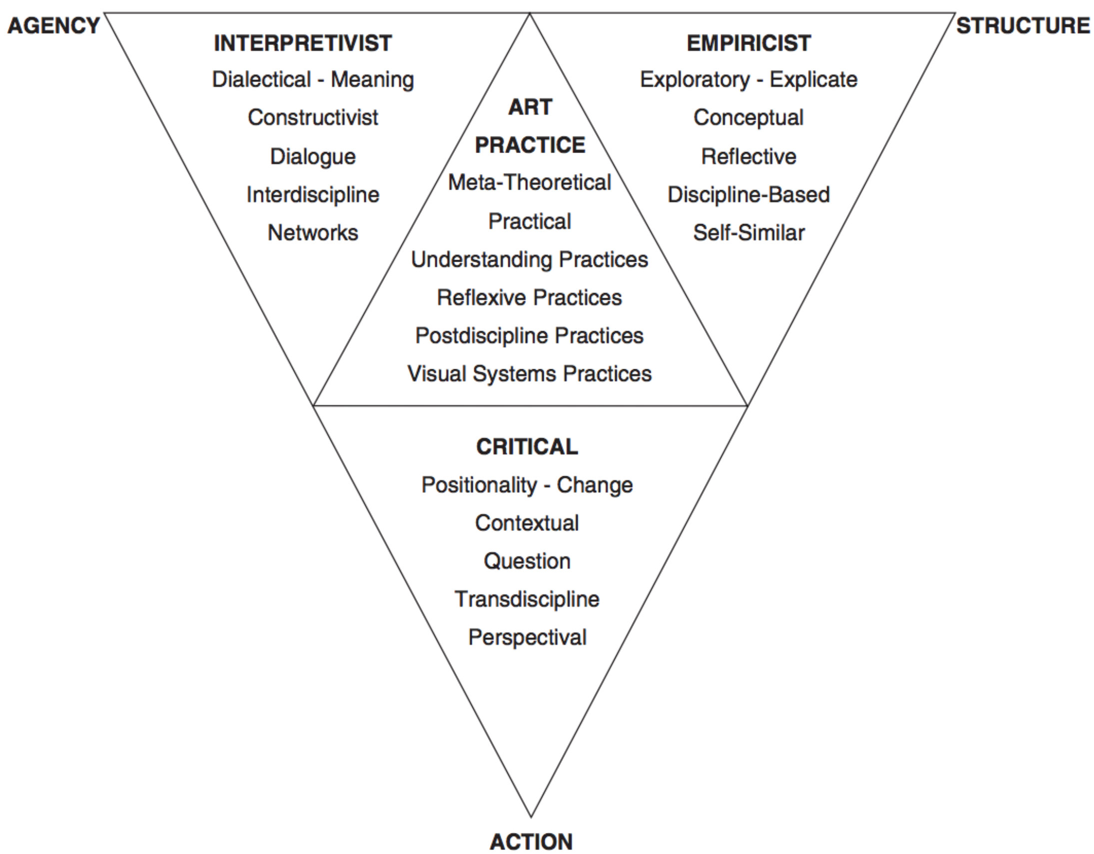

Figure 1.1: Framework of visual arts research (Sullivan, 2005 Pg. 21)

Figure 1.1 above places the concept of art practice in relation to approaches to research, highlighting its connections to a variety of theoretical frameworks. My project situates at the intersection of art practice and research. In Section 1.6 below, I will unpack this image and expand on its application to my project. Many of the theoretical arguments in support of art practice address the connection between practice and theory, suggesting that the combination of the two elements into one research design results in a more effective system of knowledge production. The argument tends to center around the idea that objective calculation is not the only goal of research, but rather the gaining of understanding can be an equivalent goal.

> An understanding from which it follows that the 'advancement of knowledge' in relation to the arts 'is not subject to objective measurement, it is subject to understanding.' The importance of negotiating between these two positions is rarely acknowledged or openly discussed but its execution is central to art as research if it is to engage with the dynamics of contemporary visual culture as it intersects with the dominant epistemology. In this respect art as research continues to develop the critique of the higher education system.
>
> (Biggs, 2006, p. 178)

Another interesting perspective on practice-led research is Robyn Stewart's idea of Neonarratives. Neonarratives take into account that interpretation of experiences and events can differ from person to person, and from a storytelling perspective, different storytellers can present vastly different versions of the same thing, all of which add up to a more complete account of the cultural scene and inquiry. The researcher's point of view is among those that are considered and factored into the data, weaving their perspective among those of the subjects. The methodology uses phenomenography by way of reflection, description, and interpretation to collect data that can reveal broader trends and insights. Steward elaborates on the power of neonarratives in saying:

> The approach is useful in that it moves beyond individual facts to perceive general patterns, among existing links, from which to infer broad characteristics. Such an interdisciplinary approach offers a way to link art, teaching and life by taking into account current knowledge in relevant and related fields… Neonarrative method can be used to create as a third space, a storying place that links practice and theory. It is there that the experiences and knowledge of the practitioner can be compared and positioned among the theories from the field that frame the actions of the people involved.
>
> (Stewart, 2014, p. 16)

After describing her unique experience as a quantitative researcher for many years, followed by many more years conducting qualitative research, Stewart developed this middle ground philosophy. Included is a suggested outline for applying this theory to research, which includes five phases. The first phase is identification of the research method, followed by establishing the collaborative process. This leads to the collection and transcription of the data (theoretical, visual, biographical, case studies, or other forms) before the final phases of analysis and synthesis into Neonarratives. This concept is relevant to my approach at incorporating new sonic tools and techniques into the realm of film scoring. Film scoring itself is very open to interpretation, and often processed in different ways by different audiences. Film music can change how an audience emotionally interprets a story that is being told as it functions to help the viewer understand what they are supposed to be feeling from scene to scene. As a musical artist in the field of film composition, I am aware that my personal style has developed as the result of all the music that I have listened to, and all the films that I have seen. Over time, as I study scores in depth, I listen more thoughtfully to film scores, and my style changes yet again. Rather than ignoring the obvious impact of my ever-changing personal musical style on the outcome of my compositions, I embrace autoethnography as a method, weaving this element into the methodology. This is addressed in *Autoethnography: Understanding Qualitative Research*:

> Rather than deny or separate the researcher from the research and the personal from the relational, cultural, and political, qualitative researchers embraced methods that *recognized* and *used* personal-cultural entanglements.
>
> (Adams et al., 2015, p. 32)

Among the debates about the merits of practice-led research is the political dimension within the university setting about whether arts professors should be required to have a doctorate to teach, and if so, how restrained their methodologies should be. This is discussed at length in *Art as Research, Doctoral Education and the Politics of Knowledge*, in which Biggs notes:

> It remains the case that teaching in universities inevitably becomes tired, derivative and increasingly dogmatic unless staff are actively and freely engaged in all the many and various kinds of enquiry formalized by the words 'scholarship' and 'research'…Good doctoral education surely needs to be both training and education, but the preservation of the open-ended, educational element, particularly at a time when the pressures for rapid production of 'research outputs' in the arts and humanities sideline other concerns, may need defending if democracy is to safeguard itself against its own erosion.
>
> (Biggs, 2006, p. 1)

To Biggs' point, if I were an undergraduate college student, I would be more interested in hearing the intuitive processes of a film composer that had developed by way of experimentation and curiosity than regimented and restrictive rules for how to properly score a film. In creative fields, there is perhaps more to learn and to teach in a free and open experimentation space.

Another interesting perspective comes from Barrett's interpretation of Michel Foucault's essay 'What is an author', in which he explores the transition away from art criticism toward a practice-led, critical discourse that views the artist as the researcher.

> A key aspect of Foucault's conception of discourse is that it refers not only to language, but to language *and* practices that operate to produce objects of knowledge. (Foucault, 1972) Foucault was concerned not only with understanding the particular historical contexts that allow certain regimes of truth to prevail at any time, but also with the apparatuses or discursive formations – webbed connections that link knowledge, power, institutions, regulations, philosophical and scientific statements, administrative and other practices – that regulate conduct, and support or determine what counts as knowledge. Foucault contends that whilst things may have material existence in the world, they cannot have meaning outside of discourse.
>
> (Barrett, 2010, p. 5)

Foucault's idea of 'author function' paves the way for the literary framework of the artist/researcher. It moves art criticism away from the traditional functions of establishing whether a piece of art is 'good' or 'bad', and instead analyses the form that the art takes, and the institutional contexts that allow it to take these forms. Barrett elaborates on Foucault's theory by creating a chart that applies the essences of author function to the field of practice as research, which will function as a central piece of my methodology.

1. Foucault's Author Function: Groups together and defines a certain number of texts/works according to their homogeneity and filtration. (Foucault, 1991) Application in Practice as Research: The researcher identifies and assesses methodological, conceptual and other links in works produced in the current and previous projects.
2. Foucault's Author Function: Differentiates and contrast works from works of others in order to authenticate and show reciprocal explication. (Foucault, 1991) Application in Practice as Research: The researcher traces the genesis of ideas in his/her own works as well as the works/ideas of others; compares them and maps the way they inter-relate; examines how earlier work has influenced development of current work; identifies gap/contribution to knowledge/discourse made in the works.
3. Foucault's Author Function: Establishes relationships amongst texts in terms of concomitant utilization. (Foucault, 1991) Application in Practice as Research: The researcher assesses the work in terms of the way it has extended knowledge

> and how his/her own work as well as related work has been, or may be used and applied by others.
>
> (Barrett, 2010, p. 17)

These parameters laid out by Foucault, and analyzed and situated by Barrett provide a framework for making methodological choices as an artist/researcher. Barrett continues to interpret more of Foucault's theories in the context of the artist researcher.

Another reference for relating art practice to theory comes from Nicholas Davey's essay 'Art and theoria' in which he suggests that the relationship between the two concepts needs to be rethought. He references the hermeneutic notion of *theoria* as a model for finding a relationship between practice and theory. Essentially *theoria* is a Greek concept that fills the gap between theory and practice, which is in its nature dialogical. Davey argues that there is an unavoidable, and essentially creative tension between thinking and making that defines that space that *theoria* operates in.

> The central claim of this chapter observes that *theoria*, art practice and hermeneutics are all disciplines which neither rest on pure sensibility nor upon a science of pure concepts but upon a Kantian synthesis of concepts and intuitions. Arguably, Kant's most potent point about the intelligible content of art is made in the *Critique of Pure Reason* and not in the *Critique of Judgement*: 'Without sensibility no object would be given to us, without understanding no object would be thought. Thoughts without content are empty, intuitions without concepts are blind.' (Kant, 1970)) The import of the remark is clear: art cannot remain art If it becomes a purely theoretical contemplation of ideas for it would lose its relation to the sensuous whereby it becomes art (*poiesis*), art in the first place… *Theoria* is not theory. It is not an exercise in pure concepts but a reflective practice which engages with meanings as they appear in particular incarnate form. Thus *theoria* can modify over-theoretical stances toward art and demand that practice recognize and engage with the intellectual notions which inform it.
>
> (Davey, 2006, p. 178)

Davey goes on to present a twelve-step outline for effectively relating the theory of *theoria* to art practice. This outline will function to test the integrity of my methodology and my literary framework, which will be discussed in section 2.3, below.

Practice-led research presents itself as an artefact, and a written, or mixed media explanation of the process of making the artefact. In my project, the artefact will be a recorded piece of music, which has been performed live. It will include reflexive observations about the process of creation, and more importantly, insights and techniques about the process of introducing digital processing to live orchestral performance. Within the theoretical framework, the role of the artefact, or the piece of music, is one that should be clarified.

> Michael Biggs, one of those who has been engaged in developing the field of practice-led research, states that the principal feature of practice-led research is the desire or need to create artefacts and to present them as part of the 'answer' to research questions posed at the outset. In this way, the practice-led enterprise is different from many other approaches, since it does not simply use objects as evidence, but attempts to present the objects created during the research process as arguments. This implies the notion that the artefact can embody the answer to the research question.
>
> (Mäkelä, 2007, p. 72)

As I consider the central thesis of this project, which aims at applying contemporary digital effects to acoustic orchestral music in the context of film scoring, for the purpose of opening it up to a wider audience, I try to imagine the impact of the project if it were to be presented in exclusively written text form. For this specific research goal, I believe that the artefact will provide understanding with regard to the research question, as Biggs suggests. In *Knowing Through Making*, Mäkelä provides an interesting position on the role of the artefact:

> Within the frame of practice-led approach, artefacts have been conceived both as answers to particular research questions and as argumentation on the topic concerned. What I suggest is that an artefact can embody a greater range of roles: as an object made by an artist–researcher during the process of research, it can also be seen as a method of collecting and preserving information and understanding. Thus, the process of making and its products are strongly connected with the source of knowledge. In this sense, we are facing the idea of knowing through making.
>
> (Mäkelä, 2007, p. 73)

The processes described in the next section follow Mäkelä's ideas about the role of the artefact. If the goal of the artefact is to collect and preserve information and understanding, my methodological structure will aim at that end. The design will reflect the intention of finding processes and techniques for future research and artistic expression.

Another study that I used as a foundation for my methodology is by David Fenton, who studied the relationship between the live performer and the mediated screen images in contemporary interdisciplinary theatre. His study was conducted over three creative periods of time in 2004, 2005 and 2006, and resulted in an original theatrical work called *Unstable Acts*. During the process of designing and executing this project, Fenton developed four methods for gathering data including 1. Enquiry Cycle from Action Research 2. Reflective Practice 3. Post-performance Reception Study and 4. Action Tracking and Fixing. (Haseman, 2010). I modeled my methods of data acquisition and reflection after this general structure.

Another interesting discussion on practice-led research comes from Mareli Stolp in *The creative practitioner in South African higher education: practice and scholarship in conversation and Flux (Stolp, 2021)*, which examines and critiques the 2017 Policy on the Evaluation of Creative Outputs and Innovations produced by South African Public Higher Education Institutions.

> For music specifically, under the designation 'Music Composition' reference is made to the 'research-informed or scholarly, discursive intent' of the output…The use of these terms in connection with notions of 'quality' as initially stated in the policy – its stated purpose being 'to reward quality creative outputs' - has interesting implications. Bearing in mind the several indications of scholarly pursuit in relation to creative outputs one could argue that the definition of 'quality', as recognised in this policy, is viewed in terms of the potential of creative outputs to constitute research and generate new knowledge. The emphasis on 'scholarliness' of creative output seems to suggest that the DHET does not wish to reward 'pure practice' outputs; rather, the approach seems to connect to practices employed in for example the UK.
>
> (Stolp, 2021, p. 12)

This project approaches the composition process from the perspective of an experiment, documenting the steps and outcomes at each phase, rather than engaging in 'pure practice'. The debate about the different approaches to practice-led research as it intersects with creative work prove that it is an ever-evolving area of discourse. My project will add to the field practice-led research, providing a survey of existing research and an application of that theoretical foundation in the context of composition and live performance.

1.6 Reflexive approach

As the primary format for this dissertation I use a reflexive approach. This process facilitates a balance between creativity and data collection and falls under the category of auto-ethnographic research design. I kept a daily journal, logging insights and observations as I composed and arranged different pieces with the Augmented Reality Orchestra. I then analyzed and interpreted these observations, and developed a set of techniques for composing, improvising and performing for live orchestra and electronic effects. Sullivan offers four practices within reflexivity that lead to a more effective research design, which I apply to my methodology:

> First, within the visual arts, a self-reflexive practice describes an inquiry process that is directed by personal interest and creative insight, yet it is informed by discipline knowledge and research expertise. Second, in responding to empirical understandings, an artist-researcher will reflect on information gathered so as to review conceptual strategies used and consider other approaches...Third, the plausibility of an interpretation of research findings will be determined in part by the capacity of the reflexive researcher to openly dialogue with the information. This means that significance of meanings derived from a process of inquiry is subject to debate and discussion, initially within the research project itself, and eventually among the research community. Fourth, a reflexive practitioner will question content and contexts as problematic situations are revealed within particular settings. Issues-driven inquiry of this kind not only identifies problems but also opens up areas whereby participants become responsive to potential change. This emancipatory interest offers opportunities for those most directly involved in a common cause to enact artistic, social, political, educational, or cultural change.
>
> (Sullivan, 2005, p. 18)

Sullivan's first practice, regarding an inquiry process that is directed by personal interest and creative insight, is a pillar of my approach. This practice influenced my composition methodology, specifically my decision to implement periodic intermission compositions between the more structured and rigorous collections. For these intermissions I used the tools and techniques that I had been studying and allowed myself to have a blank canvas, composing with any instruments that I choose, and focusing on no specific aspect of composition. One example of this is from Quartet One, I found myself looking for rhythmic subdivisions halfway through the piece, which was a creative desire that had developed in response to the other parts that I had already written. I ended up experimenting with trumpet run through tremolo and EQ, which produced an electronic arpeggiator style tone, which added dimension and character to the composition. In my previous interactions with tremolo, I missed this dimension of its functionality, then later found it by having the freedom to experiment and a creative problem to solve. Additionally, I had not planned on using EQ in the earlier stages of the project, but its function in this context shifted my perception of it, and I then implemented it as an additional tool moving forward. This relates to Sullivan's fourth practice of issue-driven inquiry as well. Had I not had the freedom and openness as suggested in the third practice to explore my specific creative direction, I would not have discovered these new tools and approaches.

My decision making and preferences evolved throughout the project, and would have evolved in a different, more limited way had I stuck to a regimented methodology. This concept is supported in *Creative Practice as Research*:

> We create art to connect with others, to connect with ourselves, and often just for the sake of it. We experiment with our art in order to push boundaries, to ask questions, to learn more about our art and our role within it. This is nothing new. What emerges, then from this methodology, is the *exegesis* that accompanies the creative work: that knowledge that has remained implicitly within the artist, made explicit and seated within the context of the scholarly field.
>
> (Skains, 2018, p. 5)

Often film composers find their cues by auditioning different sounds to picture and looking for an interaction between the two media that creates emotion. This process requires flexibility and experimentation and intuition based on previous scoring experiences. The motivation behind the choices being made in this domain are equal parts 1. general knowledge and assumptions about the emotional effect of certain instruments and themes, 2. random auditioning of various music over picture, and 3. An improvised musical piece that is born out my personal emotional reaction to the narrative on screen, based on my personal musical style. The film scoring process often is a collaborative one, involving exchange and discussion amongst several team members. The exploration in this thesis of the composer's process is investigating in the initial composition process, not the revision and collaborative aspects of a typical film scoring protocol. Designing a methodology that supports these three processes inevitably falls into the category of autoethnography, as I the researcher am intertwined into the cause-and-effect nature of the methodology. Findlay-Walsh touches on this in *Sonic Autoethnographies: Personal listening as compositional context*:

> As methodology for understanding culture, autoethnography explores the position and perspective of the researcher as the central subject of study, presenting the researcher's personal experiences often through layered writing practices which generate interwoven self-narratives.
>
> (Findlay-Walsh, 2017, p. 23)

To elaborate on the importance of having a methodology that accounts for personal style and improvisation as a process, I consider the nature of jazz music, and how it integrates culture and the experience of the individual through improvisation. In this regard, George E. Lewis notes that one of its distinct characteristics is that:

> It's welcoming of agency, social necessity, personality and difference, as well as its strong relationship to popular and folk cultures…the development of the improviser in improvised music is regarded as encompassing not only the formation of individual music personality but the harmonization of one's musical personality with social environment.
>
> (G. E. Lewis, 2004, p. 44)

The choices that I make are based on preferences that I have, and those processes are in a constant state of being influenced and evolving, which results in the evolution of the choices made. The same relationship exists between the artist and the culture, they influence and change one another in a progressive and dynamic way, and were the processes static, that growth would not be possible. Peter Knight elaborates on this connection in *Creativity and Improvisation*:

> In this sense a musician's development as an improviser in the jazz tradition...is about gradually allowing one's personality and culture to speak through music. The comparison between jazz improvisation and autoethnography is too obvious not to be touched up here, though I am not the first to draw such a parallel.
>
> (Knight, 2009, p. 5)

Musical style is closely related to personal narrative, which I captured through reflective journaling over the course of my project. The confessional style of autoethnographic research leads to inward self-reflection, which can provide a framework for identifying issues in the researcher's thought process or methods and correcting them. This is discussed in in *Autoethnography as Method*:

> Confessional/self-critical/self-evaluative writing tends to expose self-inequities, problems, or troubles-providing a vehicle through which self-narrators work to come to resolution or self-learning. Spiritual memoirs, personal journals, and diaries may be friendly to this type of writing.
>
> (Chang, 2016, p. 18)

Another way of thinking about the source and value of creativity as a composer that I particularly relate to is explained in *Finding a Voice*:

> In more concrete terms, a composer's function is to create an account of his or her own imagination in a comprehensible form – that is, in an explicit notation or medium. It is

> a straightforward undertaking to learn and develop the skills necessary to notate musical sounds and rhythms accurately; however, it is a serious challenge to discover a unique method for encoding the abstraction of a subjective mental landscape.
>
> (Becker, 2016, p. 9)

Composers manifest an internal, imaginative world into music, and my project seeks to use the composition process and methodology as a mode of inquiry to help reveal different composition techniques.

1.7 Concluding remarks

To summarize the collection of studies referenced above as it relates to my own project, the central idea is that a certain amount of creative freedom is necessary and supportive of my process in this artistic domain. The ability to explore different avenues has helped the creation of a collection of compositions that represent and support my evolving personal musical style. Looking back on the choices that I made from an autoethnographic perspective, the experimental processes and techniques emerged from the exploration, and became working theories and techniques that will inform my future decisions and processes in film scoring.

Chapter 2
Research Design and Methodology

2.1 Introduction

In this chapter I begin by presenting an overview of my research design, then move on to the methodology for the project, explaining my rationale and logic behind the overall architecture of the work, which falls into three sections:

1. Phase one: experimentation with instruments and effects
2. Phase two: composition experimentation and reflection
3. Phase three: final composition, film score and interpretation of data.

After mapping out this sequence I discuss the conceptual framework and a few supporting concepts to the general direction of the project, including a journal sample from a live recording session, and the idea of applying effects to groups of instruments. The next phase of this chapter involves breaking down the concepts within these experiments into categories to explore the ways in which music can evolve through this lens. I introduce tone and timbre, rhythm, texture, dynamics, and balance as initial parameters to explore. I go on to introduce Augmented Reality Orchestration Theory and synthesis theory as central parts of the work before delving into the details of the composition methodology and the thematic and artistic concept. Chapter 1 explored the role of music in film. This chapter discusses the ways in which I strategically designed the project to look for new ideas and sounds with the development of the timbral and expressive resources of film music as the end goal.

2.2 Research design

This project uses a qualitative approach to research, combining data collection and observation. Within the category of qualitative research, I experimented with orchestral samples through different effects, searching for new sounds and approaches to the sonics of orchestral instruments. Additionally, I composed a collection of pieces using the resulting sounds from my initial research and applied a reflexive approach during the composition process, relying on journaling and self-reflection as a data collection source. This process falls into the category of arts-based research, specifically designed so that the artistic practice is both the content and the method of inquiry, which means I will be making art, and there will be no outside participants engaging with the study. Patricia Leavey says arts-based research "occurs along an art-science continuum" (Leavey, 2017). On the art side, processes that involve 'making' and 'experiencing' are valued as essential to the discovery of certain types of knowledge, while on the science side, processes that involve objectively quantifiable data, and more structured analysis methods are preferred. My project falls somewhere in the middle of the continuum as it embraces the value of the creative process in finding artistic techniques, styles of orchestration and thematic musical material, while also using data collection in regimented ways to analyze each instrument as it is processed through each effect. The writing process also pivoted back and forth on the continuum, going from structured composition exercises to free-writing opportunities, and repeating this process. The study focused on an inductive approach, as it is designed to compile data and generalize patterns from the particulars.

2.3 Research methodology

There have been three phases of research for this project, spanning thirty-six months. The first involved experimentation with individual instruments and effects over twelve months. The second applied this information, using the resulting insights to help guide arrangement and composition choices for various small ensembles, lasting twelve months. The final phase involved interpreting the analysis from the study and writing and performing a piece for a live eight-piece orchestral ensemble, using the techniques gathered from the first two phases. This took an additional twelve months, concluding the project. This section will discuss the methodology developed for each of these three phases.

2.3.1 Phase one: experimentation with instruments and effects

In the book, *Handbook of Instrumentation*, author Andrew Stiller lists all of the instruments in the orchestra and has developed a system for identifying their availability.

> The availability of each instrument is indicated by one of five terms (ubiquitous, common, usually available, rare, very rare). All the information in this book is based

> on U.S. and Canadian practice, and although in most respects European practice (or Australian or whatever) is not significantly different from that described here, the availability of many instruments abroad is not the same as in North America. It is, unfortunately, impossible to generalize about this.
>
> (Stiller, 1994, p. 288)

I used Stiller's characterization of the availability of different instruments to help guide my choices as to which ones are common and essential. In my selection process I included all the ubiquitous, common, and usually available instruments as a foundation, and then added the more obscure instruments into the study where possible. This includes strings, woodwinds, brass, and percussion as the fundamental sections of the orchestra.

I experimented with 29 instruments and will list them by section. Strings include violin, viola, cello and double bass. Woodwinds include piccolo, flute, alto flute, bass flute, oboe, English horn/cor anglais, clarinet, bass clarinet, contrabass clarinet, bassoon. Brass includes horn, trombone, bass trombone, trumpet, tuba. Finally, percussion includes celesta, crotales, desk bells, glockenspiel, marimba, timpani, tubular bells, vibraphone, xylophone, piano and harp. After establishing all the instruments, I moved on to the preliminary experimental phase that involves pairing digital samples of instruments with electronic effects, including chorus, delay, granular synthesis, panning, phaser, pitch shifting, reverb, saturation, tremolo, vibrato and wah. I chose to use sample sets made by Spitfire Audio recorded at Air Studios in London with top orchestral players, specifically I used their 'Complete Symphony' collection for this project. There are many different orchestral libraries, many of which I have experimented with, but Spitfire offers the most realistic sounding samples, and a thorough collection of extended techniques with each instrument, which is why I chose them. Some alternate sample libraries that are of a similar caliber include Eastwest, Vienna, Native Instruments, 8dio, and Cinesamples. This yielded slightly different results than an experiment with live instruments, but it was a practical, cost-effective, and necessary means to collect data before testing with real players. For each of the 29 instruments I tested multiple articulations, for instance, legato, staccato, pizzicato, vibrato, tenuto, flutter-tonguing, among others. The number of articulations varied per instrument, but I captured between 7 and 9 articulations processed through every effect on most of the instruments.

Instruments		Articulations
Woodwind	Piccolo Flute Alto Flute Bass Flute Oboe Cor Anglais Clarinet Bass Clarinet Contrabass Clarinet Bassoon Contrabassoon	Legato Long Long Cuivre Marcato Tenuto Staccato Multitongued Rip Fall
Brass	Horn Tenor Trombone Bass Trombone Trumpet Tuba	Legato Long Long Cuivre (Tenor, Bass Trombone)/Long Stopped (Horn/Tuba)/Long Muted (Trumpet Marcato Tenuto Staccato Rip/Fall (Tenor, Bass Trombone, Tuba) Trill m2, Trill M2 (Horn, Trumpet)
Percussion	Celesta Crotales Desk Bells	

	Glockenspiel Marimba Timpani Tubular Bells Vibraphone Xylophone Piano Harp Snare Drum Tam Tam Wood Block Wind Chimes Cymbals Tambourine Triangle Shaker	
Strings	Violin Cello Viola Double bass	Legato Con Sordino Spiccato Short 0.5 Pizzicato Col Legno Tremolo Trillm2 Trill M2

Appendix A has a link to a twelve-hour long audio reference YouTube video with samples of all of the instruments being processed through every effect, playing every articulation. This includes 29 instruments, each with 6-8 articulations being processed through 10 effects, totaling over 2,000 samples for reference. This data set is not structured as the ideal method for a composer to experiment with these varieties of articulations or effects but is included as supplemental materials in the case a composer or researcher is interested in hearing a specific pairing in an isolated context that perhaps is included in the film score and identified in Appendix B, explained below. The suggested approach is for a composer to do the hands-on experimenting themselves using plugins and effects in their DAW. That said, the included data set can also function to give a sense for the ways in which the effects interact with each instrument and articulation to contextualize and offer concrete isolated examples of the different components that are discussed in the composition and orchestration approach in this paper. This concludes the first phase of the project. In addition to Appendix A,. Appendix B contains a table that maps out which effects and settings were used on each instrument. This body of raw data explores and documents different assortments of sounds, serving as one of the fundamental contributions that this project makes to this specific field of research, allowing other researchers to draw on the data as the basis for their own studies, potentially furthering composition and research projects in this domain and contributing to a broader stylistic resource pool within film music.

After building a database of narrative descriptors and adjectives documenting the relationships between these instruments and the various effects, I moved onto the second phase of the study.

2.3.2 Phase two: composition experimentation and reflection

The next phase of the study focused on systematically composing with the different sounds, using different instrumentations, and journaling and analyzing the outcome between composition sessions. I will elaborate on the specific composition methodology in the next section, but the goal was to develop an understanding of the function of these effects in the context of composition, and catalogue the various techniques.

Appendix B includes definitions of the effects used in this study, appendix C includes an explanation of the specific effects and their parameter settings used on each film score cue, and appendix D includes written sheet music for all works in the study, and audio references for all of the pieces referenced can be found in Chapter 3.

Between composition phases of the research, I listened to the various sounds and compositions, and made observations about ways in which the effects were expanding the expressive capabilities of the instruments. I focused on the process of orchestrating the pieces, and drew insights about how the effects helped or impaired the process of blending the instruments. As I established theories and hypotheses about different approaches to orchestration and sound design, I then referenced them again during my next round of composition to continue my inquiry in a different context with different sized ensembles and combinations of instruments and effects. This process involved structured time set aside to listen to the work and journal, making observations about the outcome of my research.

As I progressed through the project, I narrowed my focus to specific subgroups of effects and instruments, and refined my thematic approach. The project focuses stylistically on film music, so I selected *L'Âge d'Or,* a public domain film to score using these tools. In addition to focusing on film music, I have a passion for surrealism and my experimentation with the Augmented Reality Orchestra led me to a realization that its sonic palette pairs well with the genre. As I went through the experimentation phase I auditioned different pieces to the film, and when I became stuck as to what to write, I selected a scene and wrote to the film.

2.3.3 Phase three: final composition, film score and interpretation of data

For the final phase of my project, I wrote two original compositions for octet, and then scored the sixty-minute *L'Âge d'Or* using the Augmented Reality Orchestra. Much of the score includes placements from phase two, and then additional effect processing and treaments of those cues. This gave me the opportunity to apply the theories that I had developed in a hands-on way to the film scoring environment. After finishing the film score, I revisited my questions about the limitations of the acoustic orchestra, and the goals of film scoring, and drew conclusions about whether the Augmented Reality Orchestra pushed past these limitations with the appropriate techniques and strategies implemented. Then in the conclusion section I present my findings developed through interaction with and practical application of these tools.

2.4 Conceptual framework

This section will reference sources from my literature review that offer methodological suggestions and goals for practice-led research projects. Throughout the process of this study, I will refer to a selection of studies in the field of practice-led research that present a framework for how to successfully integrate theory and practice. The first study that I will reference is by David Fenton, who studied the relationship between the live performer and the mediated screen images in contemporary interdisciplinary theatre. Fenton developed four methods for gathering data including 1. Enquiry Cycle from Action Research 2. Reflexive Practice 3. Post-performance Reception Study and 4. Action Tracking and Fixing (Haseman, 2010). I used this structure as a starting point for my methodology, beginning with step one, asking questions and reflecting on my conceptual goals for the project and then experimenting with the effects in a composition context. I then moved to step two, reflecting on the compositions, and analyzing the effectiveness of the methods. I did not use step three, as my research did not involve outside participants, but I did use step four to brainstorm solutions for the methods that could be improved, and modified my structure accordingly.

The other study that I reference for my methodology is Hamilton & Jaaniste's *A Connective Model for Practice-Led Research Exegesis* (2010). This study surveys 59 practice-led PhDs, and analyzes their content and form for similarities. The resulting analysis provides a large sample of submitted exegeses, and establishes patterns and relevant consistencies among the sample. Functionally, this serves as a foundation for developing the structure of my methodology. In terms of the architecture of most of the surveyed projects, the following pattern emerged:

> Introduction
>
> First main section: Situating Concepts
>
> Second main section: Precedents of Practice
>
> Third main section: Researcher's Creative Practice
>
> Conclusion
>
> (Hamilton & Jaaniste, 2010, p. 14)

The study also breaks down the 59 projects surveyed into a few thesis types, including the 'Context Model' in which:

> The researcher develops a topic related to one or more of the wider contexts of the creative practice, such as a theoretical or philosophical framework, a historical or critical analysis of related practitioners and precedents, or a review of professional and industrial conditions of the practice…while the context model offers the

> reader/examiner useful insights into the broader field of the practice, it provides a limited perspective.
>
> (Hamilton & Jaaniste, 2010, p. 14)

Another thesis type is the ‘Commentary Model’ which is described as,

> A personal, self-reflexive account by the researcher who speaks as an insider and who draws on what they uniquely know and have experienced in relation to their creative works and processes. While the commentary model is insightful, and appears to solve the problems of an externally oriented objectivity and dissociation from the practices that are inherent in the context model, when used in isolation it…does not connect the research project and the creative practice to wider fields that precede or surround them.
>
> (Hamilton & Jaaniste, 2010, p. 15)

The final model for practice-led research presented in this paper is called the ‘Hybrid, Connective Model’.

> The approach that we have observed incorporates these discrete and seemingly dichotomous models of the exegeses, which are respectively underpinned by academic objectivity and personal reflection upon the creative practice. The model we have identified is not simply a conjoining of these models, however. It has a distinct form and purpose: it adapts and integrates the context and commentary models to overtly connect the creative practice and its processes with its broader theoretical and practical contexts. For this reason, we call the model of the exegesis we have observed a connective model.
>
> (Hamilton & Jaaniste, 2010, p. 15)

As my project has developed, I have contrasted the goals and functions of the research with the various models presented in this study to situate it appropriately. By the end my project clearly falls into the Hybrid model. These models, and the research gathered across 59 practice-led studies function as a foundation for my methodology.

2.5 Individual instrument and electronics experimentation

The first phase of this project involves testing a variety of articulations with individual orchestral instruments through different effects. For this experiment I have selected the most commonly used orchestral instruments and their standard articulations. I have chosen not to include advanced or obscure articulations and bowing techniques for this project to maintain a reasonable scope, though later in the composition process I enact a compositional exercise to incorporate a limited number of extended techniques. I selected a list of effects to apply to all of the instruments:

1. Modulation processing: chorus, phaser
2. Dynamic processing: tremolo, distortion
3. Spectral processing: wah, EQ, granular
4. Pitch processing: pitch shift
5. Temporal processing: reverb and delay
6. Spatial processing: panning

My experimentation process had three phases. First, I loaded the virtual instrument and the effect plugin and spent some time experimenting with the different parameters. I auditioned the various articulations on each instrument and explored the depths of each effect by exploring each parameter and auditioning them at their extremes to get a clear sense for how they functioned. I investigated the different preset options for each effect, and as a thought experiment brainstormed similar uses of each effect in existing film score compositions, then tried to recreate those parameters. After the initial exploration phase I moved onto step two, in which I set the effect back to the default setting, refined the parameters of the effect to my taste, and found a balance on the mix parameter that created a balance of roughly 50 percent dry signal and 50 percent wet signal. My motivation for this choice was that I wanted the acoustic sound of the instrument to be retained to some degree, to help give context for the implementation of these effects in an orchestration context. If the effect mix parameter were set closer to 100 percent, I can imagine the instrumental sound source being obscured to the point of not being identifiable. Similarly, I did not want the application of the effect to be so subtle that it was a challenge to hear its impact on the acoustic sound. I used my own discretion to find the ideal mix percentage for each effect, but generally the parameter ended up around 50 percent. I took a similar approach to the other various parameters: since I had explored the extreme application of these in step one, I decided on capturing the effects at a middle ground parameter, with the same ideals in mind as I just explained regarding mix parameter. I was motivated to capture the sounds in this way because I knew that later in the project, I would have the opportunity to explore the variations and extremes of each parameter during the composition phase. Step three was to record the instruments processed through the effects. I recorded my voice saying each articulation per instrument in between the processed audio samples to keep things organized, then sorted them into folders based on the instrument and effect being captured. After playing and recording each instrument, with each articulation, through each effect, I analyzed the database of sounds to observe the similarities and differences, discussed further in the following section.

2.5.1 Live recording session journal sample

One portion of my research involved testing the application of effects to live orchestral instruments in a live performance/recording situation. I had one session with three musicians and focused on experimenting with different approaches to engineering and monitoring. I did not end up using any of the audio recordings in my project, but the journal entry identifies the key takeaways from the research. This was written immediately after the session ended, and I provide it as an example of the style and depth of journal writing that was central to every step of this project. Additionally, the insights drawn from this could inform decisions for future research. Below is the journal entry.

Live Session on 10.18.22

This live session explored the variables in processing live orchestral instruments through effects and used different engineering and monitoring techniques to identify strategies and barriers to live performance in this context. The instruments tested were trumpet, trombone, flute, clarinet, cello, violin and piano. I processed the sounds using guitar pedals and plugins to explore the differences between the two approaches, and I tried a method where the musicians trigger their own effects, and where I trigger their effects. For this experiment I individually recorded each musician, playing each part, after several attempts to record multiple players at once. The challenge of sound bleeding into other microphones took away from the control of the effects and shifted the methodology for this session. The effects in use were - distortion, delay, reverb, chorus, vibrato, tremolo, pitch shift, modulation, freeze and various types of synthesis (filters, oscillators, ADSR, etc.). I had microphones on the instruments and tried four varieties of microphones per instrument - large diaphragm condenser, small diaphragm condenser, piezo and dynamic mics. This microphone signal was being routed into Universal Audio 610 analog preamps to control gain, phantom power, and to have some EQ control. That signal was then routed into the pedalboard and then into the UA Apollo interface. The UA Apollo interface has the capability to add effects with real-time processing, so I could add effects in that way to each instrument, or to the group of instruments. I also tried a close microphone technique on the instruments with clip on mics.

Monitoring proved to be a challenge, especially with instruments that produce more decibels of gain acoustically like the trumpet, trombone, violin and cello because even with noise canceling headphones to monitor the effects, the sound of the acoustic instrument cut through to some extent. With the inherently quieter instruments like the flute, this was more approachable. It was possible to monitor the affected tones with the speakers in the room without producing too much feedback, but the monitors needed to be quite loud to counteract the volume of the acoustic instruments in the room - also this is not a practical approach for recording because the bleed of the monitors would be captured. With the monitors off and headphones on there was a certain extent to which the musicians were able to interact with the effects and play into them, but generally I think the challenge of isolating the musicians' ears from the acoustic sound of their instrument is too large to replicate that methodology.

I found that the musicians had no problem triggering their own effects, and it was also easy for me to do it. The more practical approach would likely be to have an engineer trigger the effects so that the musicians can focus on performance, but if the effects were more easily monitored by the musicians somehow, I could imagine an improvisational setting in which the musicians take a creative approach to searching for their sounds in relation to each other, controlling the effects on their own and collectively and collaboratively building a soundscape. I tried this approach, and it resulted in interesting and unique sounds and combinations. Another possibility is to use score following software, such as IRCAM's Antescfo, which is now common for live concert performances with electronics.

I found it interesting to run multiple instruments through the pedals at once. I used loopers and also used auxiliary buses to achieve this on the computer. This added to the uniformity of the full soundscape in effective ways. I could imagine the benefit of recording multiple people in the same acoustic space, and then adding a specific reverb plugin to the auxiliary bus, adding a uniform ambience to all the mics, gluing together the sounds.

Ideal implementation of these sounds, in my opinion, would be one of two approaches. One approach where the musicians trigger their own effects and improvise to build on drones together, resulting in a soundscape. The other approach would be to have the musicians play a written piece of music and either have them or the engineer trigger the effects as notated in the sheet music without the need to clearly monitor the effects. This would presuppose that the musician had some sense for how to perform their instrument in a way that interacts as intended with the respective effects, for instance, digging into the dynamics more to produce a fuller reverb tail. This could all be notated as dynamics and articulations, so perhaps no new nuanced skills are necessary. The hybrid approach that lies between improvisational and written would be to have the musicians perform their parts as written, and then applying the effects on a separate pass of the song, so they can focus solely on the application of the effects, this would involve the musician in the performance of the effects. This approach is equivalent to recording an ensemble, and then later adding effects to the dry performances. The bleed of the other instruments in the room playing acoustically adds to the ensemble feeling more integrated as the effects from each microphone/instrument are also picking up sounds from the other instruments in the form of bleed. This is also the case if you were to record a dry ensemble and add effects after the fact. This might be one benefit of recording people together live in a room rather than using completely isolated and clean MIDI sounds. Motown records benefitted from this bleed. It creates more pressure to capture a performance rather than rely on editing and multitracking, and there is a quality to the sound that is unique.

Findings

- It is possible for musicians to trigger their own effects, but not necessary.
- An interesting improvisational approach would be to allow musicians to control their own effects and build upon each others' ideas.
- Bleed might be interesting in capturing a performance because adding the effects to the bleed will create unity in the mix.
- Aux bus effects help glue things together, and with the addition of multiple effects to multiple instruments the textural results were emotional and expressive.
- Acoustic instruments are too loud to monitor effects in the headphones.
- Speakers will bleed into recording.

- The ability to use an equalizer in DAW to shape the sound is an asset.
- Specific acoustic space ambience brought new dimensions to the sounds, rather than the sounds being dry to start with.
- The imperfections of the sounds of the valves/bow/musician in the room for example, add to the character of the recording.

2.5.2 Applying effects to groups of instruments

One other key aspect of this inquiry is the application of effects to not only individual instruments, but to sub-busses and master-busses as well. An example of where this might get complicated is to imagine that an effect is being applied to all the individual instruments in an arrangement, and additionally the sounds of those instruments are being sent out and processed in three groups, each of which is adding an additional layer of processing, while the master bus has its own effects that process the entire group. I have found that a clear understanding of how the effects on each layer function and impact one another is essential to strategizing about their implementation. By the end of my composition process, I altered my decisions about which effects to process individually, and how much to affect them, based on an understanding of how the additional layers of processing would interact with the resulting sounds. This concept comes back repeatedly, as I used sub-busses and master-busses in several compositions.

2.6 Analysis of experimentation

Throughout the process of this experimentation, I kept a journal of observations about the different resulting timbres with each instrument through the various effects. One of the biggest challenges of documenting and analyzing timbres is using words to describe the timbral quality of the sounds. In studying orchestration, I came across several different descriptors and adjectives used to describe different tonal characteristics and have collected a number of them for use in this project. These descriptors are intended to help communicate the essence of the sound, but are subjective, imperfect tools. I quite enjoy the way that Rimsky-Korsakov prefaces his use of descriptive words in *Principles of Orchestration*:

> *Note:* It is a difficult matter to define tone quality in words; we must encroach upon the domain of sight, feeling and even taste. Though borrowed from these senses, I have no doubt as to the appropriateness of my comparisons, but, as a general rule definitions

> drawn from other sources are too elementary to be applied to music. No condemnatory meaning however should be attached to my descriptions, for in using the terms thick, piercing, shrill, dry, etc. my object is to express *artistic* fitness in words, rather than material exactitude. Instrumental sounds which have no musical meaning are classed by me in the category of *useless sounds*, and I refer to them as such, giving my reasons. With the exception of these, the reader is advised to consider all other orchestral timbres beautiful from an artistic point of view, although it is necessary, at times to put them to other uses.
>
> (Rimsky-Korsakov, 1964, p. 3)

This led to a distinction about how to categorize the outcome of the effects into categories including textural, tonal/timbral, and rhythmic. This categorization was inspired by a distinction made by Samuel Adler in 'The Study of Orchestration' between foreground, middleground and background tones:

> 1. *Foreground*: the most important voice, usually the melody, which the composer wants to be heard most prominently;
> 2. *Middleground*: countermelodies or important contrapuntal material;
> 3. *Background*: accompaniment, either chordal or using polyphonic or melodic figures.
>
> (Adler, 2002, p. 17)

Initially I had planned to create categories to research based on these three layers, assuming that the foreground is focused on tone/timbre, the background is focused on texture, and the middleground is focused on counter melody and rhythm. Then I realized that any of those places in the sonic spectrum can be effectively occupied by a texture or rhythm/counter melody, and that tone/timbre should be an object of inquiry for all three layers. Nevertheless, I needed different categories to help structure my inquiry, so I chose tone/timbre, texture, and rhythm. I expand on the influence of Adler's foreground, middleground, background concept in section 4.2 of Chapter 4 where I discuss Augmented Reality Orchestration Theory. As I imagined composing with these tones, I found these three categories to be central applications of the effected sounds in an arrangement. Additionally, I considered the conventional wisdom about the timbral nature of each different orchestral instrument and their function in orchestral arrangements based on that timbre.

> The art of instrumentation consists in the employment of these sound elements: either to give a particular color to melody, harmony and rhythm; or - independently of these great musical forces - to produce special effects (which may, or may not, serve some purpose of expression).

(Berlioz & Strauss, 1991, p. 1)

This quote identifies four functions for sound in the context of orchestral arrangement, which further supports my selection of tone/timbre, representing the melodic, textural, harmonic, and rhythmic as my primary categories.

I have used this model of orchestral sound as the foundation for construction of a theory governing the use of effects to manipulate these organic timbral characteristics, allowing greater versatility and interchangeability in arrangements. The last concept that developed out of my journaling was the relationship between the effected orchestral sounds and synthesis theory. I considered the function and signal path of synthesizers, and used that mode of thinking to apply to the shaping of organic instrumental tones in section 2.6.6 below.

2.6.1 Timbre

This category investigates the different ways that effects can change the timbre of the organic orchestral instrument, and the impacts that those changes have. I explore the common instance of instruments playing harmonically together to create blended timbres or to enhance a melodic line by experimenting with different combinations of instruments and effects, looking at how they can expand upon this common orchestration strategy.

2.6.2 Rhythms

This category focuses on rhythmic grooves in an arrangement rather than melodic elements. This can be, for instance, a string section playing spiccato parts to establish the pulse of a part, or a percussion section playing a groove or rhythmic part. Observations about the impact of effects on an orchestra’s rhythm section will likely fall heavily on the category of delay, but there are other ways in which effects can impact the rhythm of an arrangement.

2.6.3 Textures

I interpret the term texture in this context to refer to long, sustained notes, or groups of notes blending to create textural chords and pads. Additionally I explore repeated textural figurations, e.g. a rapid repeated semiquaver string motif, as well as ostinatos. This part of an arrangement typically functions as the background or backdrop for the rhythmic and melodic parts, while other times arrangements are purely textural and rely on the different ways in which instruments blend to create complex soundscapes. The effects change the timbre of each instrument, and can also create dimension and movement using panning, filtering, tremolo, chorus, and others. I investigate the different functions of these effects and the impact that they have on the pads and textures within an arrangement. Additionally, I explore combinations of instruments resulting in characteristic blended timbres. For instance, the Triton Fountain movement of Respighi's *Fountains of Rome* (Respighi, 1916) features a trill across the entire orchestra, tremolos in the wind, brass and string sections, rolls on percussion and harp glissandos resulting in a textural effect. I explore ways to use digital effects to enhance these kinds of arrangements, or to achieve similar results, and expand upon the expressive limits of the acoustic orchestra in developing textural soundscapes.

2.6.4 Dynamics and balance

Another crucial element of my project is the exploration of dynamics and balance as it relates to writing and orchestrating parts to be paired with effects. I look at the way that the effects enhance or subtract volume and energy from the instruments and explore the ways in which these changes impact the overall dynamics of the compositions. As the intended application of these theories involves recording real acoustic instruments and then adding the effects in post-production, a clear understanding of how the effects impact the dynamics of the dry signal of a given instrument is crucial and informs the gain structure of the incoming signal during recording. I explore the function of balance in orchestration and expand upon the ways in which it is achieved using digital effects in the next section.

On the topic of dynamics and balance, it is worth discussing 21st century surround sound technologies like Dolby Atmos. This technology allows sound mixers to place sounds in an immersive sonic field that is either experienced in headphones or in rooms with seven, nine or more speakers surrounding the listener. This is an area of exploration that might be a candidate for future research as it relates to this study, but I chose to establish the basic parameters in a stereo environment instead, as it is more commonly used, and has a smaller financial barrier to entry. This sonic landscape changes the placement of instruments, and consequently alters the balance and dynamics of the ensemble.

2.6.5 Augmented Reality Orchestration Theory

The fundamental concept behind Augmented Reality Orchestration Theory is that orchestrators have an opinion about the essential role, color, and character of each instrument in the orchestra based on the timbral quality of that instrument. Through effect processing across entire ensembles Augmented Reality Orchestra Theory examines how the rules of traditional orchestration are changed and adapted with this new expressive palette. The theory holds that the timbre, loudness, and range of an instrument is limiting in the sense that it predetermines its role in the arrangement, but with the addition of effects, any instrument can function in any role. For instance, an overly generalized example would state that low-register flutes are delicate, and consequently blend well in the background, whereas violins, though they have a wide expressive range, have the potential to create more harsh and abrasive tones, and can cut through a mix because of the nature of their tone. In the case of playing a horn, which is round and soft and warm, at the same time as a trumpet, which has a more dominant and sharp tone, assuming the articulation and dynamics were equal, and each was playing in a conducive range, the trumpet would be in the foreground and the horn would contextualize the trumpet by sitting in the background. *The Cambridge Guide to Orchestration* goes into depth about the capabilities and characteristics of each string on each instrument in the string section, noting:

> Viola
>
> A-string: fairly penetrating, though not as much so as the E-string of the violin; has a nasal quality; good for solo passages
>
> D-string: fairly weak and uncharacteristic; mostly used for accompaniment figures
>
> G-string: also fairly weak, not as powerful as the G-string of the violin; also used for accompaniment
>
> C-string: typically powerful, dark, raw and hard
>
> (Sevsay, 2013, p. 211)

This description makes suggestions as to the strings' strengths and optimal uses, but it also maps out their limitations and flaws. For instance, ‘fairly weak and uncharacteristic’ are traits that could be changed and improved by effects. The traits of the C-string, ‘powerful, dark, raw and hard’ are descriptors that could all be attained with the right sequence of effects. The combination of understanding the qualities of the acoustic instruments, and then having a toolkit for expanding beyond their limitations, is the goal of the Augmented Reality Orchestra. These kinds of patterns and trends exist within traditions of orchestrators, and dictate and inform the choices that are made when arranging. Adler touches on this in describing the tone color of each instrument:

> The goal of this book is to acquaint the reader with the distinctive, particular sound each instrument makes alone and in combination with other instruments, as well as with the techniques used to produce these sounds. Acquiring this knowledge will enable a composer to write down a particular tone color in score for realization in performance when it is heard in the inner ear (or mind)."
>
> (Adler, 2002, p. 1)

In addition to studying and understanding the color and characteristic of each instrument, developing an orchestration theory around the use of the Augmented Reality Orchestra must consider the ways in which acoustic instruments blend with one another and change each other's tones. *The Technique of Orchestration* describes these kinds of relationships, for example:

> Unison Doublings in the Woodwinds
>
> Flute and Oboe – Oboe predominates but is 'softened' (in quality) by flute.
>
> Flute and Clarinet – Warm, round tone; not strong in the octave above middle C.
>
> Oboe and Clarinet – Mixing the oboe's tang with clarinet's mellowness.
>
> Clarinet and Bassoon – Rich; somber if clarinet is low.
>
> Flute, Oboe, Clarinet – Thoroughly mixed color.
>
> (Kennan & Grantham, 2002, p. 211)

These ways of describing the resulting sound of two instruments helped my search for ways in which the effects could modify orchestral sounds. 'Mixing the oboe's tang with the clarinet's mellowness' is a good example of blending two distinct colors to reach a hybrid tone. The description of 'oboe predominates but is 'softened' (in quality) by flute' is a perfect example of the function of the Augmented Reality Orchestration Theory, but presented in the context of traditional orchestration.

Another aspect of my theory is how it integrates into film music. One characteristic of film music is its insistence upon staying in the background. This is noted in *Unheard Melodies*:

> In general, music should understand that in the cinema it should nearly always remain in the background: it is, so to speak, a tonal figuration, the "left hand" of the melody on the screen, and it is a bad business when this left hand begins to creep into the foreground and obscure the melody.
>
> (Gorbman, 1987, p. 16)

This idea that film music can only function in the background is a common trend, but there are certainly composers like John Williams for whom attention-grabbing melodic themes occur over montage sequences and become iconic film music moments while taking center stage. Most film music transitions back and forth between the foreground and background at different times of a film. After identifying one of the central goals of film scoring, and the limitations that it entails, composers might consider the realm of the textural and the use of orchestral colors rather than complex melody, harmony, and rhythm. Augmented Reality orchestration aims to focus on these kinds of colors that result from combinations of instruments and effects. My stylistic focus for this project is on French composers like Claude Debussy and Maurice Ravel, both of whom are known as master orchestrators and compose with a focus on the sounds and colors of the orchestra. *The Orchestral Composer* reinforces this idea:

> Outside the realm of Austro-German practice the situation was somewhat different, a view cogently expressed by Boulez: 'If we are thinking in terms of characteristics rather than of tradition, then one of the constant features of French musical expression since the eighteenth century…has been a preoccupation with sound itself.' With the advent of the *Märchen* world of German Romanticism and its manifestation in the theater, particularly in the hands of Weber, orchestral color and effect began to take on a life of their own.
>
> (Saxton, 2003, p. 34)

This transition to thinking about the blending of the orchestra as a textural dynamic color palette in the context of creating film music highlights one of the central aims of my research. Augmented Reality Orchestration Theory identifies the essential roles of the orchestral instruments, and then explores how the effects change the nature of these tones so that they can be more versatile within an arrangement. Adler also adds, "The more a composer knows about the tonal, registral, and technical characteristics of the instruments, the more successful and colorful his or her score." (Adler, 2002, p. 231)

2.6.6 Synthesis theory

Synthesis theory refers to the tone shaping process of synthesizers and relates it to the possibilities of shaping the sound of organic orchestral instruments. For instance, a typical synthesizer signal chain starts with a generated tone, created by an oscillator, and then is shaped and modified by additional components including filters, arpeggiators, drive, sequencers, attack, decay, release, sustain, and other modes of tonal manipulation. This concept inspired the idea of using a similar signal chain and conceptual approach in the development of orchestral tones. The application of this signal chain in the context of this project would technically be considered sample-based synthesis, as the tones do not originate from an oscillator, but rather from a sound source, sampled by a microphone. This theory aims to identify the logic of synthesis routing and processing as it creates sounds and explores the ways in which they can inform and enhance the Augmented Reality Orchestration Theory. Synthesis theory relates to the orchestra in many ways, one of which is the concept of frequency. In synthesis theory, filters are used to eliminate or enhance certain frequencies to achieve balance or effect across an arrangement, which also applies to orchestration. Synthesis theory uses concepts of depth, and different types of effects to create the illusion of near and far. Additionally, synthesis uses modulation and effects that can be performed to add additional dimensions of movement and variation to the mix. My Augmented Reality Orchestration Theory aims to integrate all these dimensions of movement and depth, and the basic principles, tools and routing of synthesis offers a structure for experimenting with sound-modifying effects in a thoughtful way.

Below I present a general overview of the different aspects of basic synthesis necessary to understand how the concepts could be applied to orchestral instruments by way of effects.

- Sound sources – Sound generation via oscillator, noise generator, recorded samples, wavetables, sound-generating algorithms, etc. or MIDI input, through a virtual instrument.
- Filtering – The carving out specific frequencies to change the sound.
- Amplification – The concept of a signal being amplified and shaped.
- ADSR filter – Represents the way a sound emerges, how long it stays and how it leaves. The acronym represents attack, decay, sustain and release.

- Modulation – Modulation is essentially the idea of changing or controlling a sound through LFOs, envelopes, step sequences, etc.
- Effects – Many synthesis signal paths include effects like the ones featured in this project including reverb, distortion, saturation, phase, chorus, delay to name a few.

Types of Synthesis

- Additive synthesis – This is essentially the idea of adding sounds on top of other sounds.
- Subtractive synthesis – This concept involves filtering and carving out aspects of an existing sound.
- FM synthesis – Frequency Modulation synthesis uses one oscillator to modulate another oscillator creating timbral variety.
- AM synthesis – Amplitude modulation – This is more of an effect, it uses one oscillator to modulate another oscillator like FM synthesis, but creates ring modulation where amplitudes of a waveform dip to zero occasionally, causing additional frequencies to be created and sounding like tremolo, depending on the frequency of the modulator. If the modulator is below 20Hz you hear a tremolo, frequencies a little above this provide a grainy timbre, but not tremolo. Higher frequencies for the modulator create different complex timbres.
- Wavetable synthesis – Generates sound by scanning through a pre-recorded wave table.

2.7 Composition methodology

In this section I will map out the structure of my compositional process, and the rationale behind the decisions made. My primary research question is: What techniques and concepts can assist in the development of the expressive palette of 21st-century orchestral film music processed through digital effects? I kept this question in mind as I proceeded through the decision-making process, reminding myself that the objective is to uncover concepts and techniques to expand the expressive palette, specifically in the context of film music. This influenced many decisions along the way and shaped the nature of my inquiry. I will show specific choices that I made and how they led to the formulation of my Augmented Reality Orchestration Theory and other techniques. By the end of the composition process, I had a focused and purposeful approach to using these tools, and had developed a creative style with this palette, as the result of my experimentation (see chapter 3).

2.7.1 Thematic and artistic concept

I am inspired by orchestral music that sounds like a dream, specifically influenced by compositions and orchestrations by Debussy. Some of Debussy's most revered music accentuated a tonal ambiguity, and hypnotic rhythmic patterns that feel like dream-sequences.

> We know from searching statements in Debussy's letters that he was concerned with the power of memory, the functioning of fantasies, the interpretation of symbols and the new significance of dreams, in particular the dream within a dream, the labyrinth dream…We have a valuable source, however, in the conversations between Debussy and his former master Ernest Guiraud which took place early in Debussy's career, and which were meticulously recorded…Debussy explained to Guiraud not so much a system but an approach that should allow for an expression of the ambiguous. He had worked out the use of ambiguous chords, the aim of which was to undermine the rigidity of the tonal system and thus, as he believed, to enlarge the range of harmonic experience.
>
> (Lockspeiser, 1962 pg. 50)

Some of the stylistic implications of sounding dreamlike include use of temporal effects such as reverb and delay. Specifically regarding composition, I like hypnotic arpeggios and ostinatos with overlapping rhythms and harmonies, creating textural sonic landscapes. There are many ways that dreams influence art and culture, and one example is in filmmaking, specifically the films of David Lynch. Chris Rodley describes the parallel between watching a Lynch film and dreaming:

> Conventional film narrative, with its demand for logic and legibility, is therefore of little interest to Lynch…Insecurity, estrangement, and lack of orientation and balance are sometimes so acute in Lynchland that the question becomes one of whether it is ever possible to feel "at home"…If Lynch could be called a Surrealist, it is because of his interest in the "defamiliarization" process and the waking/dream state-not in his frequent use of the absurd or the incongruous.
>
> (Rodley, 2005, p. 44)

This idea of using the disorienting and ever-surprising, unfiltered spirit of the unconscious mind is an artistic concept that I would like to target and strive for. I would like my music to create similar effects to Lynch's films in the domain of suspending disbelief and opening the viewer up to a less familiar narrative structure and expressive experience. There is evidence that the connection between surrealism, dreams and art extends to the domain of music, and that surrealist film and music are interwoven by their dream-like characteristics, as Fouse discusses:

> Many twentieth-century composers use references from familiar works to create the dream-like world of the surreal. In her Tell-Tale Fantasy (1982) for piano, Jane Brockman continually "becomes sidetracked in wistful thought" about earlier twentieth-century masterpieces. Each dream-like digression is inspired by a sonority in the original compositions. The ethereal paraphrases include the opening of Scriabin's Prometheus Symphony, juxtaposed with the similar chords found in the last of Schoenberg's Six Little Piano Pieces, op. 19, and the third movement of Schoenberg's Five Pieces for Orchestra, op. 16…The overall effect achieved by this work is very similar to that created by Salvador Dali in his paranoiac multiple images. Each image is identifiable but not clearly delineated. Because all these reflections occur in the same context and in a short period of time (the duration of the piece is approximately five minutes), the listener is drawn into an irrational, subliminal world of fantasy.
>
> (Fouse, 1992 pg. 39-41)

This passage links Dali to the dream-like, surreal qualities that have become central to my artistic concept. In fact, the description of this piece sounds very similar to the way that L'Age d'Or feels from a viewer's standpoint. This idea of blurring the landscape and weaving together different familiar melodies into the same sonic realm will influence my writing style. There are several papers that specifically address dream-like characteristics in music, or musical techniques that are evocative of a dream-state. Barcaro and Magrini explore the idea of ascending melodies and intervals provoking or opening a listener to a dream-like mindset:

> We hypothesize that a kind of triple psychological parallelism exists: pitch ascension perceived as vertical ascension, dream experience perceived as ascension to high territories, and pitch ascension in a musical piece unconsciously perceived as a dream-like experience. In other words, three phenomena, in addition to being important in their own right, appear to be interestingly and unexpectedly connected to each other…the psychoesthetic effect is logically accounted for by two steps: first, the pitch ascension in music determines a feeling of vertical ascension; and second, the vertical ascension evokes an idea of ascension of the soul while dreaming. Basically both steps are accompanied, and triggered, by emotion.
>
> (U. Barcaro & Magrini, 2020 pg. 79)

My study of Augmented Reality Orchestration Theory seeks to develop similar theories that draw connections between timbral and orchestration choices and the provocation of a dream-like response from the listener.

In terms of orchestration, I am inspired by Ravel and Stravinsky, and am inspired by their style and invention. Stravinsky's *Firebird* uses the orchestra in a spectacular way, in *Masterworks of the Orchestral Repertoire*, author Donald Ferguson discusses the music of the ballet:

> The music describes with an extraordinary wealth of suggestion the various weird figures of the drama, and is of a nature never allowing us to forget that it is fantasy and not life that we are witnessing.
>
> (Ferguson, 1968, p. 62)

This quality of being undeniably fantasy in style aligns with my artistic concept and one of the stylistic goals of my compositions. The Augmented Reality Orchestra has the potential to elevate this sense of fantasy with a thoughtful understanding of how to orchestrate the sounds in an effective way. I am particularly interested in orchestration techniques that utilize the entire orchestra making textures and color like in the *Firebird* and the introduction for Ravel's *Daphnis et Chloé Suite No.2*. In this introduction the flutes and clarinets play a repeated arpeggio very quickly and softly while the harp plays glissandos and the double basses play a simple sequence. This creates a whimsical, dreamy textural phenomenon in the music, and little additions are presented thereafter, the violin representing the sun, the piccolo as a singing bird, and so on. This kind of orchestration that so effectively evokes imagery, and emphasizes sounds and textures is among my stylistic directions.

I am also influenced by film music, as I am a film composer by trade, with specific interest in surrealist cinema. One of the aims of this project is to create resources for film composers who write in the realm of these stylistic preferences or write with the orchestra. Personally, my own composition goals include aspirations of integrating the Augmented Reality Orchestra theories and practices into my own film scoring career. I aspire to have multiple tiers of implementation dependent upon the scope and budget of the film, from multi-tracking and layering individual instruments and processing them in post-production to recording ensembles live and processing the effects in real time as they are being recorded. There is a spectrum on which the application of these effects runs which makes it applicable to a range of film genres. At the extreme end, a score that is heavily processed through effects could reasonably pair with an avant-garde or experimental film. On the other end of the spectrum, subtle application of the effects could enhance the aesthetic and flexibility of an acoustic orchestra and be applied in a wide range of genres. In general, the dreaminess aesthetic and concept tends to be enhanced the further a composition gets to the extreme end of the spectrum.

There are several films that use electronic effects and/or sounds with orchestral instruments and exist at various points across this spectrum, many of which interface with the concept of dreams as well. One example is John Corigliano's score to *Altered States*, which is a film about drug-induced hallucination and its implications for perception. Delay is used during drug sequences in extreme ways that have long decays and feedback, supporting the psychedelic visuals on the screen. Hans Zimmer's score to *Inception* features a traditional orchestra, but also has many layers of synthesizers that add bite and feedback and distortion to the otherwise purely orchestral ensemble. There are low drums that are processed through massive room reverbs to create an otherworldly soundscape. This film is about dreaming, and the fusion of the organic and synthesized sounds supports the narrative and story. The score for *Joker*, composed by Hildur Guõnadóttir heavily features an instrument called the halldorophone, which is an electric cello that provides effects through feedback, creating eerie overtones and original sounds. Part of the function of all three of these scores is that the sounds are not immediately recognizable, and like in a dream, that disorientation contributes to the suspension of disbelief and dream-state mindset.

Other soundtracks have combined acoustic and electronic elements in other ways, such as *A Clockwork Orange*, which features synthesized versions of recognizable orchestral music. *The Shining* is another example, which alternates between orchestral and electronic/effected components, and also has a story that revolves around altered perception of reality. All these films are influences in terms of my artistic approach to this project from a composer's standpoint.

2.7.2 Structure of composition methodology

First I wrote, performed and recorded an original short piece for each of the 29 instruments. This process happened after having processed each individual instrument through every effect, so I had some idea about how the instruments and effects interacted with one another. I knew that the process of writing with these combinations would be different from simply looking for changes in the timbre, as I did in the initial phase, so I wanted to start simple and focus on one pairing at a time. I decided to include those instruments that fall into either the category of ubiquitous or common in my project, according to Stiller's (1994) categorization above. The rationale is that I retained the possibility of the instruments being available as a piece of my ensemble for the final performance and composition, and I was interested in theorizing about ways that a modern orchestral ensemble can apply these effects to modify its sound.

One statement that supports my decision to start with smaller combinations of instruments before composing for larger groups is written by Strauss in *Treatise on Instrumentation*:

> I wish it were possible to force everybody desirous of attempting orchestral composition to start his career with a number of string quartets. These string quartets he should have to submit to the judgment of two violinists, a violist and a cellist. If the four instrumentalists declare, 'yes, this is well set for the instrument', then the disciple of the muses may follow his impulse to write for orchestra (at first preferably for a small one).
>
> (Berlioz & Strauss, 1991, p. 192)

The first compositions are 30 to 60 seconds each, and only feature a solo, effected instrument. I then engaged in an 'intermission' creative free writing session with the aim of writing three pieces for quartet groupings of various instruments, between 1 to 2 minutes in length each. The purpose of the intermissions is to periodically take a break from the limitations of only writing with a designated instrument set, and instead explore an open palette. I selected the instrumentation for these intermission pieces without limitations.

After completing the first intermission, I wrote 15 duets in each category, 1 to 2 minutes each, selecting pairings from the 29-instrument orchestra. This way, each instrument is experimented with in an applied context with another instrument, and solo. This was followed by another intermission phase, with identical conditions to the first. Next, I composed six compositions for quintet, 2 to 3 minutes long each, followed by one more intermission session. The final two compositions were written for a chamber orchestra ensemble. The project culminated with one final composition being multitracked with live instruments, and another written with MIDI instruments. I also scored the 60-minute film *L'Âge d'Or* using a collection of the pieces that I had written throughout my research process and several additional compositions. My intention was to present these compositions in an applied context, film score paired with video. After completing all of the compositions, I identified a few more avenues left to explore and wrote a quartet that focused on synthesis, and one that focused on adding effects to acoustic instrument effects like trills. Finally, I wrote a piece called *Multiplicity for solo cello* in which I process a single solo cello performance in several ways and build an arrangement out of the variations.

This breaks down to four sets of compositions with varying quantities of instrumentation, and five improvisational intermission sessions with quartets. Between each of the compositions, I wrote in a reflective journal, making observations about the emerging techniques and functions of the new sound palette in the context of composition.

The third and final phase of the project involved a reflexive analysis of the journaling from the first two phases, collecting and interpreting the results to provide raw data and analysis for future composers in this area. The format for my initial journaling, during the research, solo and duet composition phases, was primarily free-writing. I would spend 10 to 15 minutes journaling after each composition was written, reflecting on the specific things that had and had not worked, and then I would read through the free-writing and highlight and sort the insights into categories that began to emerge such as timbre, orchestration, texture, technical, master bus processing, etc. When I reached this final third phase, I went back through and selected the categories and insights that emerged repeatedly throughout the process and then searched for more examples and evidence to support those newly developed technical and conceptual techniques.

2.8 Concluding remarks

In this chapter I laid out the basic architecture of the project. First, I contextualized the research and then mapped out the structure of the data collection and composition process, rationalizing the choices based on my core research questions. The choices made when designing the structure focused on creating a balance between structured and thorough data collection and creative artistic freedom. I presented several original theories or ways to think about and organize the techniques and insights developed during the composition process. The creation of these categories and ways to organize thought about the interaction between orchestral instruments and effects is a step toward answering several of my research questions. I discussed my artistic approach, citing films that have incorporated effects and synthesis with traditional orchestral instruments, and specifically examples that center around dreams. Having established a structure for how I collected the data, and the creative and theoretical avenues that I explored, the next chapter will discuss the musical experiments and compositions that implement and challenge the theories thus established. As part of my reflexive approach, I will discuss the techniques that were used for each composition, and remark on how they support the artistic vision and whether there are patterns in orchestration techniques.

Chapter 3
Analysis and Interpretation of Compositions

3.1 Introduction

For the following section I will go through each of my compositions and describe how they were created. I will explore the tactics used to create the sounds, and note any techniques or insights gathered during the process of creation. All the scores, effect settings, virtual instrument settings and images of the sessions are in the appendices. I will include some of the relevant images in a selection of the following analyses to help grasp the approach and thought process. As I was composing, I kept a running journal of observations, insights, and strategies which I then used as the foundation for the following explanations. As I completed more and more compositions I clearly refined and developed my tool kit, resulting in more focused choices. These choices were orbiting around the goal of writing for film music in my dream-inspired, surrealistic style. The chapter starts with solo compositions, then duets, quartets, and quintets before moving into the small selection of miscellaneous composition approaches in the synthesis quarter, meta effects quartet and multiplicity for solo cello before finally getting to the large-scale works: the midi and live instrument chamber orchestra pieces and the film score for L'Age d'Or.

Throughout the analysis of these compositions, I consider the way that the processing impacts the instrument's ability to serve a compositional or arrangement purpose, specifically in the context of the background, middle ground, or foreground. Additionally, I consider how the effect makes an instrument more versatile as a piece of a larger arrangement, and finally whether the effect influences tonal, rhythmic, and textural aspects of the instrument and the part being played, which is the essence of my Augmented Reality Orchestration Theory. I retained some creative freedom in the process of choosing the pairings of instruments and effects. Having just completed the initial phase of research, systematically auditioning all the instruments with all the effects, I kept in mind interesting pairings, which informed my decisions during this first round of compositions. I made a point to use every effect at least once, and to use a variety, generally. Some, like delay (used for six of the compositions) were featured more heavily, along with chorus, granular synthesis, and reverb (each used for four of the compositions). The solo

compositions below are listed in score order. Initially I had set out to have the solo compositions feature a single performer, but soon lifted this limitation to open the possibility of experimenting with multiple layers. This category is still limited to a single instrument type, articulation and effect. For an audio reference, these compositions are uploaded to the following YouTube link, and the timecodes are listed next to each compositions title below:
https://youtu.be/grUSuYB6yRI.

3.2 Solo compositions

3.2.1 Piccolo (legato) 115 bpm 4/4 chorus 00:00

The chorus effect on this piccolo adds a subtle modulation which interacts with the vibrato on the flute performance. In this case it functions to obscure the perfect rhythm of the vibrato, making it sound more authentic and human while at the same time adding a tonal quality that makes it sound less human and more digital. This results in a few harsh frequencies that I found with an EQ and removed. The resulting tone sounds like it is being processed by slightly warped analog tape.

3.2.2 Flute (trill M2) 115 4/4 granular 00:54

This composition features the flute doing a slow Major 2nd trill and holding it for several measures, overlapping voices. This is being run through granular synthesis and the echoes are pitched down an octave and spliced into 1000 millisecond fragments. This adds a warm darkness to the tone of the flute. Again, the granular synthesis is a great tool for working with textural composition, and in this case the subdivisions created by the effect are sometimes discernable and calculable, and other times blur together into a single sound that bubbles and moves slightly. I will certainly take note of the added character provided by the echoes being pitched down instead of up. Additionally, the recycle parameter on the effect is turned down to 40%, so you can hear the ends of the decays which are musical and pleasant. The resulting tone sounds sampled or chopped in its abrupt nature, which is a useful tool to have and applicable across many genres, specifically hip-hop music.

3.2.3 Alto flute (legato) 115 bpm 4/4 saturation 02:10

This is a simple melody played on the alto flute and processed with saturation. The saturation is emulating a driven guitar amp and emphasizes some interesting harmonics after the attack of each note. I think that the moments when the melody moves a minor-second both ascending and descending are particularly compelling. The dissonance being embellished by the slight ambience inherent in the sample, processed through saturation evokes a pained and longing expressive/emotive quality. Additionally, the notes that are held out longer have a slow vibrato on them and the saturation brings life to them, adding a biting high frequency on top of the principal tone. I wanted to pair a mellow instrument like the alto flute with a more bright and exciting effect like saturation to create contrast.

3.2.4 Bass flute (long overblown) 80 bpm 4/4 reverb 03:08

This composition features long chords being harmonized and held by four bass flutes with a long, overblown articulation. The reverb has a twenty-second decay, and the mix parameter is set to 100%, so the actual fluttering sound created by the overblown articulation is obscured by the giant reverb wash. The wash is particularly interesting because of the character of the overblown articulation; it has a darkness and a dissonance that sounds unique. I will use this technique of designing extremely long reverb tails to color the background of an arrangement. I found that there were a few frequencies in the reverb wash that seemed to be feeding back and producing harsh overtones, so I added an EQ at the end and removed those troublesome frequencies, leaving a pleasant set of overtones, not lacking in darkness but no longer shrill.

3.2.5 Oboe (legato) 110 bpm 4/4 chorus 04:33

This is a meandering melody on the oboe that is being processed through a chorus effect. The warbly modulations give it dimension and more vocal qualities while also sounding a bit nauseating from the disorienting pulse. This is an exercise in tone modification, looking for new ways to approach the timbre of the oboe, and looking for ways to work with the vocal quality of the instrument.

3.2.6 Cor anglais (legato) 90 bpm 4/4 chorus 05:08

This is another exercise in augmenting the tone of a woodwind using chorus. The modulation adds dimension and movement to the tone, sounding underwater and obscure. There is also an element of old tape warble that comes to mind when I hear the chorus and slow vibrato of the performance interact with one another.

3.2.7 Clarinet (staccato) 90 bpm 4/4 delay 06:02

This experiment led me to find these shimmering and lively echoes that fade off the end of each clarinet phrase. The feedback parameter is set to 75% and the mix parameter is set to 45%, and I added a small amount of a low-pass filter to the tone. The delay plugin is set to a preset that emulates a Memory Man analog delay pedal[24] which features this characteristic shimmer at the ends of notes that sounds like vibrato being filtered through a delay.

3.2.8 Bass clarinet (legato) 90 bpm 4/4 phaser 06:45

The phaser tone creates a pulse within the melody of the bass clarinet. I set the mix parameter on the phaser to 13% so that it would not dominate the tone and obscure the nuances of the acoustic instrument. It sounds otherworldly and futuristic.

3.2.9 Contrabass clarinet (long) 90 bpm 4/4 reverb 07:50

This instrument processed through a deep reverb reminds me of Tuvan Throat Singing. The low pitch that drones beneath the melody has a slow vibrato which results in a meditative, hypnotic foundation for the arrangement. This also reminds me of ancient hymns being sung in a massive church. The low pitches created by bass woodwinds work brilliantly as a drone in the background. The overtone spectrum of this instrument is interesting, so I chose reverb with the intention of manipulating that spectrum. The higher tones that play the melody have a warm and inviting character which is enhanced by the reverb. As a final phase of experimentation, I added an EQ and manually swept the filter, gradually swelling the mid-high frequencies between 500

[24] A Memory Man delay pedal is a solid state echo analog delay pedal that was among the first of its kind to emulate tape delay.

Hz and 20 kHz up and down like ocean waves. This created very interesting depth and dimension to the overtones as the resonance moved, adding movement to sonic landscape I am curious about how this instrument would sound with saturation as well, given the unique character and register.

3.2.10 Bassoon (staccato) 112 bpm 4/4 saturation 09:15

This composition has an arpeggiated chord walking down chromatically. The saturation is very subtle, but adds bite to the attack of each note, making the rhythmic pattern punchier and livelier. Adding saturation to rhythmic accents or parts in general is a good strategy for making them cut through the mix of instruments in each arrangement, adding presence. In this case it's subtle enough that it doesn't completely obscure the warm rich tone of the bassoon, but instead augments certain dimensions of the tone.

3.2.11 Horn (long) 90 bpm 4/4 tremolo 10:04

This composition has long notes being played by a horn, processed through a tremolo effect with an eighth-note pulse. The robotic consistency of the tremolo pulse is hypnotic and pushes it stylistically toward the realm of electronic music. The new notes are presented on the off beats through the effect, even though they are performed on the down beats. This anticipation gives the arrangement extra tension. The tremolo could function in a similar way to an arpeggiator, adding a persistent repeating rhythmic figure to a composition.

3.2.12 Trumpet (staccato) 135 bpm 4/4 granular 10:48

This staccato trumpet melody is running through granular synthesis which is creating duplicates of the signal up an octave, reversing it, and then splicing it into tiny fragments. The mix parameter is set to 55%, so that the trumpet tone and beat placement is still audible, and the granular echoes create a texture of sparkles and dancing high frequencies. This is a nice way of creating a pad or drone that harmonically follows the piece. You can choose to increase the mix parameter to 100% and hear only textural echoes, and then process that signal through an EQ to decide which register you want the pad to emphasize. The echoes are blending but there is also an eighth-note rhythmic pulse to the echoes which adds energy and can be emphasized and used as a rhythmic device.

3.2.13 Tenor trombone (staccato) 90 bpm 4/4 delay 11:23

I added a delay to this staccato performance of a repeated trombone riff and then turned the groove parameter to 'dragging' so that the echoes land slightly behind the beat. This creates a syncopated reggae feel, and the slightly laid-back nature of the beat placement brings out some of that performance character that you might hear in a reggae performance.

3.2.14 Bass trombone (legato) 90 bpm 4/4 wah 11:56

This is a slow melodic performance with a bass trombone processed through a wah effect. The wah effect creates a pulse that feels imprecise and comes in and out like waves crashing. This could be an effective technique if one were to arrange a piece that required rhythmic ambiguity. The tone of the trombone processed through wah sounds like thin, digital lasers, which may be the filter sweep or the nature of the effect. This could tonally function to make an instrument sound more digital, perhaps to help it fit into an arrangement that had an electronic music aesthetic.

3.2.15 Tuba (tenuto) 135 bpm 4/4 wah 12:53

This up-tempo bassline played by the tuba through a wah effect has added energy from the wah's sixteenth-note pulse, driving the composition forward. Once again, the mix percentage is set at 50% so that the initial attack of the dry tuba is audible. There is a balance to be found that results in the initial tone remaining punchy and sounding acoustic, and then hearing the decay evolve into a different tone and rhythm, adding another dimension to the sound.

3.2.16 Timpani (normal) 112 bpm 4/4 delay 13:30

This delay effect creates two echoes from each timpani hit, one that is repeating in eighth-note triplets and another in quarter-note triplets. This creates an intentionally rhythmic decay at the end of each hit. For the final hit of the piece, I automated up the mix parameter and the feedback parameter to 90% creating a massive wash of decay. This was the first time that I performed the parameters of the effect during a performance. I will certainly implement this strategy more as I continue to experiment.

3.2.17 Crotales (normal) 112 bpm 4/4 delay 14:37

For this composition I tried to make a pad out of the crotale by playing as many notes as possible as quickly as possible and then sending it through a delay that multiplies the signal and adds a rhythmic syncopation to the echoes. This is a subtlety that can be heard as the final notes are decaying. The result is a unique sound that resembles hundreds of windchimes in a tornado, it is chaotic and yet pleasant.

3.2.18 Glockenspiel (normal) 112 bpm 4/4 wah 15:35

This slow wah interacts with the overtones on the glockenspiel beautifully, it draws attention to the openness and the air in the glockenspiel's natural tone, and adds a rhythmic dimension to the composition. I will be more inclined to use wah in a context similar to this than the more traditional applications of wah as it might be applied to a rhythm guitar tone to give it more attack and dimension. This effect sounds like a delay or vibrato, but the added filtering that comes with the wah adds musicality to the pulse.

3.2.19 Tubular bells (normal) 112 bpm 4/4 phaser 16:22

This composition features long and simple melodic phrases, the goal is to hear how the phaser can add movement and a different stylistic aesthetic to the overtones of the tubular bells. The filter sweep sound is engaging and musical in the way that it connects the tones and carries the decay of the notes.

3.2.20 Xylophone (normal) 96 bpm 4/4 tremolo 16:56

This composition features a strong tremolo pulse that makes the innocent, childlike progression feel even more young and playful. This is a Wurlitzer style tremolo, and the depth parameter is set to 100%. There is an underwater quality to the sound when this much tremolo is applied. It is worth noting that this signal has some room reverb on it, and without this the xylophone's decay might be too short to express the sound of the tremolo.

3.2.21 Marimba (Normal) 112 bpm 4/4 pitch shift 17:40

The pitch up effect adds a digital electronic texture to the tone of the marimba that resembles saturation and chorus. The part was intentionally played an octave lower so that the pitch shift effect could shift it back up a single octave to the intended range. It sounds like a synthesizer lead tone with the gritty overtones and the subtle portamento sound when changing quickly between notes. The tone also resembles the natural distortion built into the balafon.

3.2.22 Vibraphone (Normal) 96 bpm 4/4 reverb 18:20

These quick arpeggios with long reverb decays create an interesting sound. The mixture of the short and punchy attack played in quick succession and each series of notes making a different seventh chord creates a unique decay. The mix parameter is set to 100%, so we do not hear any of the original dry signal. Additionally, there is a 20 millisecond pre delay and a twelve-second decay on each note.

3.2.23 Celesta (Normal) 112 bpm 4/4 granular 19:37

This composition features a persistent harmony that drones on the downbeats and occasionally skips and falls out of time. The melody on top is meant to be whimsical and curious but dark. It also leans into an element of rhythmic unpredictability that keeps the piece exciting. The granular effect splices fragments of the tone into eighth notes, reverses them and repeats them with an eighth-note pulse. The reverse tone of these open celesta harmonics is compelling and interesting. This instrument and effect pairing allows for quick melodies to be conveyed clearly and articulately, which is a useful tool. For this composition I deviated slightly from my methodology because of creative inspiration and added a layer of short celesta arpeggios to accent the melodic moments of the piece, I then added a reverb to those arpeggios so that the higher harmonics could wash over the background of the piece.

3.2.24 Piano (legato) 112 bpm 4/4 granular 20:40

This combination of piano and granular creates a swelling and pulsing piece that makes the original piano tone almost unrecognizable. I play a simple chord progression and melody and processed the sound by splicing the sound at half notes, pitching it down an octave, reversing and delaying it. The conventional pop chord progression is underneath the heavily effected sounds and is obscured but familiar. This piece also has an underwater quality to it.

3.2.25 Harp (Normal) 96 bpm 4/4 delay 21:32

This composition is like a few others in the sense that it features a quick arpeggio of a chord that then rings out. This specific delay creates two echoes from the initial input, one that is an eighth note dotted figure, and another that is an eighth-note pulse. The resulting decay has the cadence of a heartbeat.

3.2.26 Violin (col legno) 120 bpm 4/4 saturation 22:59

For this composition I used the col legno articulation which instructs the player to strike the string with the stick of the bow. This creates a high-pitched percussive sound to which I added saturation. The addition of essentially a boutique guitar amplifier tone creates interesting harmonics from the high-pitched violin tone. It sounds like a guitar being played palm muted with a pick. The saturation enhances the attack of the notes and makes the sound of the violin more ominous or daunting.

3.2.27 Viola (pizzicato) 120 bpm 4/4 delay 23:40

For this composition, I decided to experiment with a delay effect to see how it interacts with different rhythmic figures. This specific delay creates echoes that emphasize a quarter-note pulse, while the rhythmic figure performed is an eighth-note ostinato. I intentionally turned the feedback up so that there were long decays on the echoes, resulting in a long tail at the end, but also making the first rhythmic figure to bleed over into the single-note figures that come next. With such a long feedback, the delay functions in a similar way to a looper. With this long decay in mind, I made tonal and compositional choices that work harmonically when one section bleeds into the next. The moments where there are dissonant harmonics sound ghostly and compelling, which is a noteworthy composition strategy. This composition sounds a lot like a ticking clock, and the delay makes the percussive pizzicatos sound like a drum arrangement, with the echoes repeating subdivisions of a pulse. The dynamics for each note were performed and captured, so there are certain notes that are accented, which create changing grooves depending on where the accents land. With such a high number of repeats, the different rhythmic figures overlap and create polyrhythmic arrangements. These arrangements eventually blend into a texture if enough notes are played in close succession.

3.2.28 Cello (long) 120 bpm 4/4 granular 24:38

The granular effect that I used on this piece pitches the tone up an octave, splices it into fragments 2000 milliseconds in length, and then repeats those fragments 850 milliseconds after the initial attack. I have the recycle parameter set to 75%, which is a significant delay, between 10 and 20 seconds, additionally the mix parameter is set to 100%, so we hear only the effect, and no dry signal. This creates an atmospheric and otherworldly shimmer of high frequencies and textures. In this case the high frequencies were quite shrill and unpleasant, so I used an EQ to carve out frequencies above 7 kHz. This presents a middle ground where the textural elements can work and add to the composition without becoming overwhelming. My instinct is to add reverb to this to soften and open the tone, but I am embracing the creative limitations of only one effect during this round of compositions. The textural nature of this granular effect will be useful for composing background elements in a composition and contrasting with other foreground elements.

3.2.29 Double bass (long) 90 bpm 4/4 reverb 25:37

For this composition I use reverb on double bass, playing long legato notes to explore the ways in which the reverb impacts the tone. There is a dark, four-second decay on the reverb, and the mix parameter is set to 100%. There is an ambient/textural quality that emerges with these long decays which could be useful in an arrangement. The reverb takes away some of the attack, so I might consider automating it to come in after each note if an arrangement relies on the bass having a punchy attack.

3.3 Duet Compositions

For this section of compositions, I set out to write 15 duets, each with a pair from the total selection of 29 instruments. I purposefully gave myself the option to select pairings of instruments that I imagined would create interesting results based on my experience having written the solo compositions and exploring the tones. These compositions are 1 to 2 minutes in length, slightly longer than the solo compositions which were closer to 1 minute in length. For this round I expanded my effect quantity per instrument to 2, as I felt that some limitation would be functional as I continued to familiarize myself with their characteristics and capabilities, but I also wanted to have the freedom to explore the outcome of combinations of effects if an idea arose. I incorporated all the effects into these compositions at some point or another, but selected the applied effects based more on my creative curiosities and taste than a rigid format. This resulted in a handful of my favorite effects being used more regularly than others. As the composition sections progressed, I intentionally loosened my restrictions, encouraging more choice and creative freedom as I became more acquainted with the tools. One example of a central tool is the application of automation to dynamics and effects which proved to be fruitful in the first round of compositions in terms of its expressive results. Consequently, I explored this technique more in this section as the automated parameters added dimension and movement to the orchestrations. For an audio reference, these compositions are uploaded to the following YouTube link, and the timecodes are listed next to each compositions title below: https://youtu.be/OBdzlkvBfJo.

3.3.1 Duet 1 Horn (long) delay and flute (legato) granular and reverb 96 bpm 4/4 00:00

The horn in this piece is holding long notes so I ran them through a Space Echo style delay, which creates two echoes from the initial tone, one of which occurs 300 milliseconds after attack and the other 500 milliseconds. This creates a warbly modulation characteristic to the tone and adds a longer decay to the ends of the notes. The effect of the delay is like a chorus in that it makes the horn sound slightly more ominous and adds moments of dissonance to the tone. The flute is the lead instrument in this composition, and it is being processed by granular synthesis, duplicating, splicing, and pitching up the notes an octave. This creates an interesting call and response dynamic in which the flute plays a melody, and the ambient decay follows shortly thereafter. The horn lives in the background and sets the foundation for this arrangement, the flute lives in the foreground, and these granular echoes live in the middle ground. To implement the concept of automation into this piece I performed the mix parameter and feedback parameter on both tracks individually, printing the performance of the effects. Printing refers to processing the dry acoustic instrument through effects and creating a new wave form with the mixture of the two as opposed to having the dry audio signal with a plugin applied to it that can be turned on or off. I increased the mix and feedback parameter on both around 00:35 seconds, gradually increasing until roughly 01:05, which is the climax of the piece. At their peaks, the mix parameter was at 90%, and the feedback parameter was at 75%, retaining the essence of the underlying parts. The goal was to have the effect be a dynamic, changing dimension of the piece, interacting with the dynamics and composition to further enhance the expressive capabilities of this crescendo. As the mix and feedback parameters increase, the melody is obscured by the blending repeats from the delay feeding back on themselves, and the high splices of the granular effect. This creates a wash of texture, featuring a high and low frequency element. After the climax the mix and feedback parameters are returned to their original position. Finally, I processed the flutes additionally with a reverb set to a four-second decay, with the mix parameter at 33% to soften the harshness of the high-pitched granular splices and to glue together the foreground and middle ground. The term 'glue together' refers to the concept of creating a singlular sonic entity that effectively balances elements in the foreground, middle ground and background, as well as timbres.

3.3.2 Duet 2 bass (spiccato) saturation and celesta (staccato) granular 96 bpm ¾ 02:08

I chose to apply saturation to the spiccato bassline to give it presence and change the tone. I added granular processing to the celesta which reverses, splices and repeats the signal. This adds an eeriness and a new dimension of mystery to the impact of the celesta tone.

3.3.3 Duet 3 violin (legato) saturation and delay and cello (spiccato) saturation and reverb 132 bpm ¾ 03:32

This is a simple string arrangement with the cello playing spiccato rhythm parts and a legato violin playing the main melody. The cello is processed through saturation to increase the attack of the notes, and to color the tone with some high harmonic saturation, then it is processed through reverb to catch the saturated decay and extend it. The reverb functions to sonically place the cello further back in the imaginary space, leaving room in the foreground for the violin. The violin is being processed through heavy saturation to make it sound like an electric guitar, and then some delay to add musicality to the ends of the notes and bring out the elegant character of the melody. The timbre of these string sounds is reminiscent of the 1966 film *The Good, the Bad, and the Ugly* (Leone, 1966), which also features other techniques parallel to this project including delay on percussion.

3.3.4 Duet 4 tenor trombone (long) **chorus and reverb** and alto flute (legato) **saturation and wah** 77 bpm 4/4 04:37

The tenor trombone is processed through a steadily pulsing chorus modulation which brings movement to the long notes and adds dimension to the tone. I performed the parameters of the effect, turning up intensity slowly throughout the melodic phrases from 20 percent to 100 percent, and following that increase with a similar increase in depth and rate from 30 percent to 70 percent. The resulting sense of movement and evolution throughout the piece adds dimension and energy to the composition. The alto flute is being processed with saturation to add bite and energy to the tone, and then processed through a wah effect which interacts most noticeably with the moments in which the notes change, adding the effect of a filter sweep which gradually cuts the highs or lows in the tone. Like the trombone, I increased the drive parameter on the saturation as the final few notes of each melodic phrase arrived. This resulted in a crescendo of distortion, and the emergence of high-end frequencies that were not previously audible, adding a textural dimension to the tone of the flute. This has a similar effect to the ends of notes that delays or reverbs have, the change in tone impacts the musicality of the note change and has the potential to make it sound more or less musical depending on the interaction. After finishing this piece I realized that the droning tenor trombone part would not be possible for a single player to perform because of breath limitations, so I separated them into two parts, each of which holds five whole notes and then rests while the other player picks up the part. After separating these parts I chose to explore a less static part sonically, even though they are holding a single note, and experimented with automation by performing a filter sweep on an EQ plugin with each. The first of the two has a rounded bell curve EQ that I am slowly moving across the frequency spectrum creating wavelike filter sweeps, while the other is a very narrow band of frequencies that is similarly moving across the frequency spectrum but because of the increased attack and resonance from the narrow band it manifests as individual notes rather than a pad-like texture. This strategy of getting two completely different sonic qualities, one emphasizing movement and harmonics and the other playing melodies, supplements the limitations of traditional orchestration and offers new ways of performing and writing.

3.3.5 Duet 5 bass trombone (long) **granular** and timpani (normal) **saturation and reverb** 77 bpm 4/4 06:15

The bass trombone part is playing three voices at once throughout this piece, and all of them are being processed through a granular effect that pitches up an octave, reverses the signal and splices it into tiny fragments. I have the delay parameter set to half-note, so the echoes begin a half-note after attack, and the recycle parameter set to 75%, so there are long decays on the echoes. The mix parameter is only set to 25%, so the resulting echoes sit in the mix and support the low harmonic foundation being established by the bass trombones. This is another example of using effects to create pads or drones in the background that move with the bass notes. The timpani is processed with saturation that is modeling a boutique guitar amp, which adds fuzzy high distorted harmonics to the room reverb decay of the drum hits. I added a reverb with a two-second decay and the mix parameter set to 40% to expand the distorted tone and open it up and bring air and wider space to the sound.

3.3.6 Duet 6 trumpet (legato) **delay** and oboe (legato) **granular and delay** 77 bpm 4/4 07:22

The trumpet in this composition holds long notes then performs quick articulate short notes. I added a delay with a stereo effect in which the duplicate echoes occur on the far left and right side of the mix, the left at 5 milliseconds, and the right at 270 milliseconds creating a stereo width effect as well as adding an ambient echo to the ends of the notes. The oboe is run through granular processing and pitched down an octave and reversed, the recycle parameter is set to 85%. The mix parameter is set to 100% so the effect is very prominent in the tone, you can just barely hear the high-pitched oboe cutting through. After the granular effect there is a delay that creates an eighth note echo and further widens the stereo field.

3.3.7 Duet 7 clarinet (legato) **tremolo and reverb** and marimba (normal) **saturation and granular** 120 bpm 4/4 08:50

This composition is essentially a single melodic line that is played by the clarinet and then doubled an octave down note for note by the marimba. I used this tactic to explore the method of layering exact performances with different instruments to find new sounds. The clarinet is processed with a tremolo effect pulsing in eighth notes with the depth parameter set to 100%. It also has a four-second reverb tail with the mix parameter set to 30%. With this light and airy tone as the highest voice, I wanted to complement it with a heavily saturated marimba tone to help punch the rhythmic and harmonic foundation and cut through the mix. I then took that signal and processed it through a granular effect that pitch shifts the echoes down an octave, reverses them and then adds an eighth-note pulse. My final step was to add an EQ that increases the 100Hz frequency 5 decibels to emphasize the interesting bass frequencies that developed.

3.3.8 Duet 8 xylophone (normal) **chorus and reverb** and harp (normal) **delay** 105 bpm 3/4 10:02

For this composition I processed the xylophone through a slow chorus and a reverb with a sixteen-second decay and the mix parameter set to 40%. My goal here was to preserve the attack of the xylophone but to modify and develop the overtones so I played the parts low on the instrument and then manipulated the parameters on the effects to keep those two elements separate. The harp is processed through a delay that is synced with the metronome at 105 bpm and pairs nicely with the short phrases as the delay completes each phrase.

3.3.9 Duet 9 piano (normal) **reverb and tremolo** and viola (legato) **saturation and granular** 110 bpm 4/4 11:13

This composition started with a piano chord progression processed through reverb and tremolo effect with an eighth-note pulse modeled after a Fender Vibrolux vibrato effect. This underwater piano tone pairs nicely with the solo viola processed through saturation and granular effects. The saturation gives it an otherworldly shift in tone while granular is set like a delay, there are no pitch changes, but the signal is reversed and the delay and splice set to eighth notes with the mix parameter set to 50%. The viola is being processed through heavy saturation, and then through granular synthesis. The mix and feedback parameters on the granular synthesis are being performed to swell up at the ends of phrases, adding to the sense of movement in the composition. The effect of these swells is an obscuring of the original sounds and then a sustaining of the textural mist that the viola turned into.

3.3.10 Duet 10 vibraphone (normal) **delay** and piccolo (legato) **pitch shift down and reverb** 102 bpm 4/4 12:34

This composition starts with a repeating rhythmic phrase on the vibraphone that I wrote while monitoring through the delay effect. Essentially, I was changing my creative choices based on how I was hearing the instrument through the delay. Once I found a pattern that was working for me, I then printed the performance through the delay. Then I removed the delay and printed a version of the performance dry and chose to start with the dry print and then fade in the polyrhythms created by the delay. This process works well because everything is based on the same performance, so the rhythms interact cleanly. It would be interesting to print a single performance through a multitude of delay settings and then have the varying subdivisions fade in and out as sections of the song change. The piccolo is performed at the top of the instrument's range, and then pitch shifted down an octave. I did this to change the tone of the instrument but not the intended register. I softened and obscured the effect of the pitch shifting with reverb as the final phase of processing.

3.3.11 Duet 11 tubular bells (normal) **granular** and crotales (normal) **granular** 102 bpm 4/4 13:23

This composition started with the intention of using heavy granular synthesis to design a sound that showed no resemblance to orchestral instruments at all. The tubular bells are being pitched down an octave, spliced into 2000 millisecond pieces and reversed with the recycle parameter set to 70%. I decided to pull back the mix parameter from 80% to 40% to preserve some of the initial tone because it started to sound irritatingly disorienting to have just the sweeping reverse echoes and no fundamental tone. The crotales are set to the same granular settings, but the mix parameter is set slightly higher at 50%. The interaction between the high and low echoes that are reversed and spliced creates a compelling textural background.

3.3.12 Duet 12 bassoon (legato) pan and desk bells (normal) delay 136 bpm 4/4

14:33– The desk bells are being processed through a delay that makes them have a swung sixteenth-note feel, and the performance is so fast that it all blurs together. I find it interesting to have these fabrics of rhythm that are so intricate and complex that drift into textural pad territory. Once the middle and background were established, I added the solo bassoon as the melodic voice because it lives so low in the mix and has enough presence to cut through the delayed desk bells. The bassoon is processed through reverb and a panning effect that makes it quickly bounce back and forth between the left and right side shallowly, only getting out to about 30% depth of the stereo-field but moving rhythmically in quarter-notes. This creates an effect that's hard to identify in the mix, but when heard alone it brings energy to the melody in a unique way.

3.3.13 Duet 13 tuba (legato) chorus and cor anglais (legato) tremolo 136 bpm 4/4 15:49

The goal for this composition was to use effects to change an otherwise conventional duet into an eerie and alien composition. I added a chorus effect to the tuba which modulates the low frequencies in such a way that makes it sound unstable and out of tune. I added tremolo effect to the cor anglais with an eighth-note pulse to similarly make it sound unnatural. Using the chorus effect to manipulate tuning to make an instrument sound unnerving is an interesting tactic.

3.3.14 Duet 14 bass clarinet (legato) saturation and reverb and contrabass clarinet (legato) reverb 88 bpm 3/4 17:14

For this piece I processed the main bass clarinet part through saturation and reverb, and then printed the performance both dry and with effects and fading in the processed version at 18 seconds and then once more around 52 seconds. My intention was to explore the idea of bringing in effects in a subtle and gradual way so that the listener does not realize they are present right away. Manipulating perception in this way is an interesting approach to subconsciously changing one's perception. The contrabass clarinet part is identical to the bass clarinet part, but one octave down, and only has reverb, functioning to establish a constant tone in contrast to the changing bass clarinet tone.

3.3.15 Duet 15 glockenspiel (normal) delay and reverb and bass flute (legato) chorus 126 bpm 4/4 18:38

The lead melody is played by the bass flute being processed by chorus which slightly detunes the instrument and gives it a rhythmic pulse. The glockenspiel is being processed through reverb and printed, and then additionally processed through a delay that creates complex subdivisions, and then processed through reverb after the delay. I printed both effect chains and faded in the complex subdivisions at eighteen-seconds and again at thirty-five-seconds, experimenting further with the idea of easing in different soundscapes.

3.4 Quartet compositions

For an audio reference, these compositions are uploaded to the following YouTube link, and the timecodes are listed next to each compositions title below: https://youtu.be/UocEVfehvH4.

3.4.1 Quartet 1 00:00

Bass flute (legato)
Trumpet (legato)
Vibraphone (normal)
Viola (legato)

80 bpm 4/4

This composition was intended to sound peaceful and whimsical. I started with the vibraphone arpeggios and added delay, changing the parameters until I settled on this combination of quarter-note echoes mixed with dotted quarter-note echoes which resulted in this slow march feel. I then performed the effect mix knob and saturation knob, lowering the mix parameter to 30 percent before each arpeggio started, then quickly increasing it to 90 percent after the attack. This created an interesting movement in the sound, but also allowed for the dry signal to be clear and audible when the notes were being initially played, then letting the effect take over, coloring the repeats. About halfway through the piece, I turned the feedback knob all the way up after each arpeggiated chord, creating an alien textural high end element that repeats through the climax of the piece. I then added bass flute, processed through reverb for the melody. Next, I panned that voice to the far left side of the stereo field and played a viola melody through saturation and delay, and panned that to the far right. I chose saturation for the violin so that it sounded distinctly different from the bass flute tonally. Both melodies wander around, occasionally interacting with one another. I then added the trumpet processed heavily through tremolo. This has the effect of sounding like a synth arpeggiator because the depth parameter is set to 100%. Finally, I added an EQ to the trumpet tone to carve out some of the frequencies that became abrasive or irritating after being processed through the tremolo effect.

3.4.2 Quartet 2 03:01

Violin
Viola
Cello (Legato)
Bass (Legato)

127 bpm ¾

The first phase of this composition was playing a simple bassline on the cello and then doubling it an octave lower on the string bass. For this composition I wanted to explore a different approach to processing effects, so instead of applying the effects directly to each track I created auxiliary channels that had the effects on them, and then controlled the send from the dry track so that I could essentially use a fader to control the extent of the effect and change it throughout the piece. I then added a lead high strings line with the violin and doubled it an octave lower with the viola. I was not satisfied with unison lead lines, so I added some harmonic variety to the violin part. I then printed the violin track through the effects and performed the feedback parameter on the quarter-note delay, resulting in a few interesting crescendo moments when I would back off the feedback after swelling it up. This was a stylistic deviation from what I had been composing, it sounds more like a contemporary pop song than a classical song or a traditional film underscore orchestration.

3.4.3 Quartet 3 05:12

Alto flute (long)
Horn (long)
Violin (legato)
Cello (legato)

80 bpm 4/4

This composition is an exploration in background tone and harmony. I started with the alto flute and played a simple two-chord pattern back and forth and processed the signal through a reverb with a four-second decay and the mix parameter set to 100%. Then I added a second layer of reverb that pitch-shifts the signal up an octave, adds slight modulation, a large room ambience and I set that mix parameter to 60%. The result sounds like a whole woodwind section playing together in a large room.

Next, the horn plays the same parts in the same register and with the same reverbs to place them in the same sonic space or imaginary room. The horns fill out the low end and add warmth to the alto flute pads, they also add a rich, warm, and slow attack as the chords change. I then added the violins playing the same chords but in a higher register and added passing tones between the two chords to add some harmonic character and movement to the drone.

The chords on the violin become dissonant and deviate from the two-chord pattern of the other instruments adding complex harmonic extensions to the otherwise repetitive progression. The violins are being processed through a reverb with a four-second decay and the mix parameter set to 40%. The final instrument is the cello which plays the main melody in the foreground. I added saturation to help it cut through the reverbs, though the mix parameter on the saturation is set to 5%, so the impact occurs less on the tone itself and more functions to place the sound in the mix.

3.5 Quintet compositions

For an audio reference, these compositions are uploaded to the following YouTube link, and the timecodes are listed next to each compositions title below: https://youtu.be/Nnz8zSd-Y-U.

3.5.1 Quintet 1

Piccolo (legato)

Horn (legato)

Celesta (normal)

Piano (normal)

Violin (legato)

80 bpm 4/4 00:00

This composition explores the possibilities of putting effects on the master bus and then automating them in and out throughout the piece. The first effect on the master bus is a granular effect with the mix parameter set to 100%, splicing the signal into eighth notes and then reversing and echoing them. The next is a reverb effect with a four-second decay and the mix parameter set to 62%. Then comes a delay effect set to emulate the sound of the Roland Space Echo. The mix parameter is set to 60%, and there is one echo that occurs 500 milliseconds after the signal, and another at 300 milliseconds. The feedback parameter is set to 50%. This chain grabs all the mids and highs and makes an atmospheric wash out of them with a shimmering modulation and some harmonic color from the notes smearing together. I chose to bounce the mix dry, with no effects on any of the instruments, and then bounce the mix with the effects, then I imported both bounces and faded the master bounce processed through effects thirty seconds into the piece, and again at one minute fifteen seconds. This creates an interesting change in tone and atmosphere for those sections when the master effects are audible.

3.5.2 Quintet 2

Flute (legato)
Tenor trombone (legato)
Crotales (normal)
Harp (normal)
Viola (staccato)

80 bpm 4/4 02:43

This composition explores the master bus effects in a few new ways. The effects applied to the master are saturation and tremolo emphasizing an eighth-note pulse, and an ambient reverb that pitch-shifts everything up an octave and creates pads and drones out of the shimmering high frequencies. Having the tremolo in line before the reverb takes away some distinction and clarity from the pulse, as opposed to if they were in the opposite position. I printed the whole mix with the effects and printed a version of the mix dry with no processing. At twenty-six-seconds I fade out the dry master and fade in the processed master, then at fifty-seconds I fade out the processed master and fade back in the dry mix. I did this two more times in the piece starting at one-minute-fifteen-seconds, and ending at one-minute-thirty-four-seconds, and then again from one-minute-fifty-three-seconds to two-minutes-ten-seconds. Finally I pitch-shifted the end of the dry mix at the transitions as they are fading out so that the mix slows down and the pitch steadily drops with the speed decrease. This sounds similar to changing the speed on a tape machine.

3.5.3 Quintet 3

Alto flute (legato)
Bass trombone (longs)
Desk bells (normal)
Cello (legato)
Bass (pizzicato)

116 bpm ¾ 05:16

This was another composition that explored the impact of processing effects on the master bus. All the individual instruments are dry and unaffected, but the master has a reverb plugin on it that duplicates and emphasizes high pitched shimmering harmonics and overtones from the mix by pitch shifting the entire mix up an octave and then processing it through a large room reverb and modulation. After this insert I added a panning effect that walks slowly back and forth across the full spectrum of the stereo field. It takes the panning 30 seconds to get from one side to the other, which gives the listener the impression that things are moving, but it is hard to identify what is moving and how fast because the panning is so slow, and it's being applied to the entire mix. It sounds like the mix is slowly spinning on a carousel around me when I listen in headphones. Next I added an EQ effect intended to interact with the panning effect, swelling different frequencies in and out strategically with the arrangement to create an elliptical position in the sonic landscape. The final processing is granular, pitch-shifting the entire mix up another octave, and splicing eighth-note fragments that repeat for a long time. The recycle parameter is set to 80%, and the mix parameter is set to 5%, so a dramatic effect is designed, but it's applied in a very subtle way.

3.5.4 Quintet 4

Bass flute (legato)
Oboe (legato)

Trumpet (legato)
Tuba (staccato)
Glockenspiel (normal)

116 bpm 4/4 08:07

For this composition I transitioned back to adding effects to individual instruments, and my intention was to focus on the way that effects interact with harmony. With that in mind, I wrote a piece that has a lot of long, overlapping notes with different instruments, and then added effects to them to expand the length of their decays, and added modulation, pitch-shifting, granular processing, and reverb to the instruments. The trumpet is the lead instrument and has a quarter-note delay, the bass is a countermelody to the lead and harmonizes with the trumpet in several moments, so I wanted a softer tone to compliment the trumpet harmonically. I added reverb to the bass flute to further push it back in the mix and added a four-second decay with the mix parameter at 28%. The section of the song starting at fifty-six-seconds features the trumpet and bass flute playing whole notes together in harmony and you can hear the tonal relationship between the two tones well. The glockenspiel is being processed through granular effects, splicing, reversing, and repeating the short and infrequent phrases. The first half of the piece features the glockenspiel dry so that it can cut through to the foreground and add dimension to the otherwise very reverb heavy arrangement. The mix knob on the glockenspiel granular effect is then increased gradually from halfway through to the end of the piece. The feedback knob on the granular effect is performed and increased to 90 percent by the final phrase of the song, creating a sparkly high feedback texture. This functions as a rare sonic ornamentation in this arrangement. The tuba is playing the bass line in short staccato notes and is run through saturation to help it cut through the ambient soundscape. The oboe is playing a slightly more complex version of the bassline, arpeggiating the chords and being processed through reverb that emphasizes the high frequencies and blends into the washy ambience.

3.5.5 Quintet 5

Cor anglais (staccato)
Clarinet (staccato)
Timpani (normal)

Marimba (normal)
Tubular bells (normal)

92 bpm 4/4 10:55

This composition began with a descending arpeggio ostinato on the marimba. I then added a cor anglais and clarinet both playing in unison with the marimba. The similar, but slightly different attack and tone of the two woodwinds blended to add the perfect presence and high-end bite to the warm, dull marimba tone. There are no effects processing this fundamental part of the piece. Next, I added tubular bells and timpani playing the same part as one another. I processed the tubular bells with saturation, designing a tone that sounds similar to a hammer hitting an anvil, which complemented the wide, warm thump of the timpani tone. I ran the master bus through a delay that has a quarter-note pulse, but also adds a dotted-quarter-note subdivision. This smears together the short arpeggios and adds the quarter-note pulse to their rhythmic fabric. It also makes the timpani and tubular bells ring out like skipping stones with the echoes overlapping one another briefly. The left channel of the delay effect is repeating the quarter-note echo and the right channel is repeating the dotted-quarter-note figure, which creates a stereo ping-pong effect. The feedback and mix parameters are both set to 60%.

3.5.6 Quintet 6

Bass clarinet (staccato)
Contrabass clarinet (staccato)
Bassoon (staccato)
Vibraphone (normal)
Xylophone (normal)

132 bpm 4/4 13:18

This composition is an elaboration on the previous in the sense that I started with a repeating arpeggio phrase, doubled it with another instrument with contrasting tonal characteristics, then layered parts over this foundation. In this case I started with bass clarinet and processed the arpeggio through a delay that has a quarter-note echo in the left channel and a dotted-quarter-note echo in the right. These subdivisions across the stereo field produce a groove. I intentionally switched registers on the bass clarinet between sections to emphasize the different tonal characteristics of the instrument. I then realized that this would not allow the bass clarinet player to breathe, so I changed the part so that the instrument rests for the second half of each phrase but increased the delay feedback parameter as the end of each phrase was approaching, so that the feedback continued the pulse of the ostinato. As the piece evolves, I increased the feedback more and more, so that the intensity and volume of the repeats increases as the song progresses.

This performance of the effect added a lot of energy and dimension to the otherwise hypnotic and repetitive figures. I then doubled this part on vibraphone, creating a background, soft, warm tonal foundation that pairs nicely with the reedy bite of the bass clarinet. The vibraphone has a different delay effect, echoing and emphasizing a sixteenth-note subdivision. As I was designing this rhythmic pattern, I was thinking about the different elements of grooves as they exist on a standard drum set. The high hats or ride/crash cymbals most commonly play the most persistent subdivision of the measure, most commonly sixteenth, eighth, or quarter-notes while the bass drum and snare play less frequently and have an interaction between them that establishes the feeling of the groove. I perceived this vibraphone part as an emulation of the high hats in a drum groove, and then imagined the bass clarinet as the bass drum and snare drum part. The contrabass clarinet is creating more of a tonal pulse as it plays a part similar to a bass line and is processed through the same delay parameters as the bass clarinet. This was done intentionally with the hope that their grooves could move and pulse together as it is easy to lose the rhythmic clarity if too many different delays are active. Finally, the xylophone and bassoon lines function as the floor and rack tom fills in this comparison, playing drum fill-type parts over the established groove. These parts are also the foreground lead melody for the piece. The bassoon is being processed through the same delay as the bass clarinet and the xylophone, but a separate dry signal of the bassoon was also printed, and I automated the fades so that the processed bassoon comes in and out every twenty-seconds or so and then returns to the dry recording. I did this because I wanted more movement of a different kind, and I wanted more parts in the foreground of the mix, so I decided to have the bassoon wander in and out of the foreground, accomplishing both goals. Finally, I processed the master through saturation and printed it, and then printed a dry version and faded in the processed master and faded out the dry in around twenty-seven-seconds. I brought the effect in and out through the piece and it feels like a shifting of the seasons or a scene change.

3.6 Synthesis Quartet

For an audio reference, these compositions are uploaded to the following YouTube link, and the timecodes are listed next to each compositions title below: https://youtu.be/UocEVfehvH4.

Alto flute (legato)
Horn (legato)
Cello (legato)
Double bass (legato)

94 bpm 4/4 07:43

This composition uses new terminology that I will review before analyzing the work. A low frequency oscillator (LFO) is an oscillator that vibrates below 20 Hz producing a tremolo or vibrato effect. An envelope is a type of automation that controls parameters over time such as filter cutoff. Resonance is a narrow band of frequencies where a particular sound is most amplified. A 16-step sequencer allows you to program a series of notes with varying rhythmic accents, articulations and dynamics.

This composition features the horn playing a lead melody and the tone is filtered through two LFOs that are modulating filters, pulsing at similar speeds, but alternating pulses. This creates texture and movement and the sensation that the sound is ducking out and reemerging constantly. The envelope is interacting with the resonance parameter, creating sweeps and a distinct resonance tone, focused on low mid frequencies. The drive is set to 7/10 adding some harmonic saturation to the tone. The alto flute also has drive added at 7/10, the sound is being sent through a 16-step sequencer that's bringing in the two LFO's at different times, which creates an unpredictable feeling of anticipation. The resonance knob is set to 7/10, defining the pitch and timbre of the high mid frequency that presents itself as the step sequencer opens up and releases the sound. This adds movement and harmonics to the alto flute tone. The string bass is playing a single note for most of the piece, but it's being sent through two LFO's, one that is pulsing in an eighth note pattern, and the other is slowly pulsing, creating a rhythmic pulse and a swelling drone overlapping each other. The cello is being processed through a fast LFO that creates a phaser effect, and another that adds modulation to the initial tone, pulsing slowly. The envelope is being sent to the cutoff filter, which is set to 500 Hz, and a resonance of 6/10.

During the middle section of the piece, I sent the whole piece through a synth plugin on an aux bus which adds drive 9/10 to the tone, and sends it through two LFOs creating an ebbing and flowing effect in which the sounds are pulsing in and out. The envelope has a slow attack at .25 ms, and medium release at 250 ms, which is being sent to the cutoff, which is set to 20 kHz with a sweeping slope and the resonance knob set to 5/10.

3.7 Meta Effects Quartet

Alto flute (long flutter)
Tenor trombone (long flutter)
Violin (long CS sul pont)
Violin (trill m3)

73 bpm 4/4 09:38

The purpose of this quartet is to explore the expressive limits of the effects by way of experimenting with adding effects on top of acoustic instrumental effects on a variety of instruments. For this quartet I chose to use two violins, tenor trombone and alto flute.

The first violin is playing long notes with *sul pont.* bowing, creating a buzzing, glassy sound from the bow sitting right on top of the bridge. This created a tense drone, to which I added a granular effect pitch shifted down an octave with eighth note splices delayed an eighth note, which created a low rumbling sound that persists but sounds erratic and unstable. The second violin is doing trills playing a major third interval. I processed these with chorus first which detuned them slightly and added a shimmer of modulation, I then added a reverb plugin with the mix parameter at 45%, and the width at 100%, delay is set to 300 milliseconds, and the feedback knob is at 50%, which changes the tone slightly, pulling out some high midrange frequencies that sound like a choir singing, and also adding tails to the ends of the notes by way of the feedback parameter. These two violins together create a thick, vibrating pad that fills the frequency spectrum. The alto flute is doing a long flutter and is being processed through a tape echo delay unit, adding a slightly detuned modulation and tails to the ends of the notes. There are two echoes activated, one at 500 milliseconds and a second at 300 milliseconds, while the feedback parameter is 50%.

The tenor trombone is also performing a long flutter articulation and is being processed with a granular synth pitch shifted down an octave, and spliced at 400 milliseconds, delaying 300 milliseconds with the recycle parameter set to 70%. There is also a distortion effect on the tenor trombone. The granular effect makes the sound unstable and adds movement and tension, while the distortion creates a menacing timbre that changes the character of the instrument, smearing together the flutters and sounding more like droning guitar feedback.

I wanted to explore different approaches to texture in this quartet using the vibrato/tremolo/flutter articulations as a foundation. When they're blended and arranged, the vibrato effect becomes a distinct sonic timbre as the instruments blend, creating a unique atmosphere and tension.

3.8 Multiplicity for Solo Cello

The purpose of this composition is to explore the ways in which a single performer can generate multiple parts. I process a single cello playing three parts through different frequency ranges and variations of effects multiple times, and then layer them all together. For an audio reference, this composition is uploaded to the following YouTube link and begins at timecode 11:09: https://youtu.be/UocEVfehvH4.

First, I played a two-note ostinato with the cello, and then sent it to a bus that has a high pass filter cutting out all of the frequencies below 500 Hz, then I used a granular synthesis effect with the mix parameter set to 100 percent, and the pitch shift parameter set to +400 cents, or a major third, harmonizing with the original two notes. I then added a reverb effect with a 4 second decay, and the mix parameter set to 66 percent to smooth out the tone.

I then sent the same two-note ostinato through a different bus with low pass filter cutting out all the frequencies above 750 Hz, then processing the sound with heavy saturation, and then granular processing with the mix set to 100 percent, the pitch shift set to -1200 cents (down one octave), and splice set to quarter-note. This creates an ominous low droning sound that shimmers as the notes change.

After sending the single performance to auxiliary buses and carving out specific frequencies to process in high and low end, I set up a third bus that cuts out all frequencies below 200 Hz and above 2k to focus on the midrange. I sent it through a tremolo effect with an eighth note pulse, then through a chorus effect to manipulate the timbre of the cello. Finally, I sent it through a delay effect that emulates a tape delay, with the mix parameter set to 50 percent.

This approach of splitting a single performance into multiple sounds for the background textural component of the composition demonstrates the way that the registers of a pitch, acoustic depth, and various modulation parameters can all be modified and then arranged.

The second part is a legato descending bassline played on cello that I captured dry, then performed an EQ sweep while printing the results. I then performed and printed the delay feedback and mix parameters, executing occasional crescendos at the ends of phrases and finally turning the feedback up at the end enough to create a harmonic feedback loop that decays over the end of the piece. I added a final layer of processing to the feedback loop ending which featured an EQ effect with a very narrow frequency band selected that I swept slowly across the spectrum creating an effect similar to howling wind, singing individual notes but almost with the quality of a Theremin.

The final part is a pizzicato melody that is processed through saturation to help it cut through the dense textural soundscape, and then reverb to soften the crunch of the saturation.

This piece could be executed live by a single cellist with multiple loop pedals by playing the initial part and capturing it with the loop pedal and then running that loop through an effect on which the cellist is performing the effect parameters which are then being routed to a second loop pedal that captures that performance. The processed new loop could then be fed through effects again and the double-processed tone could then be captured by the initial loop pedal. This process could be replicated to achieve the appropriate tones and textural movement and dimension for all three parts.

3.9 MIDI Chamber Ensemble Composition

3.9.1 Introduction

Conceptually this composition is my first attempt during this project to use a longer form piece as a way of auditioning mood changes and shifting narrative tone, as I would in the process of writing a film score. I reused compositions from the experimentation phase and processed and sequenced them creating transitions between each one. Analyzing the existing compositions to choose candidates for this piece aided in identifying the overarching stylistic continuities in many of the pieces and helped me conceptualize the scale and type of ensemble and their respective effects that would be necessary to perform a piece with several movements. I also wanted to maintain continuity in the sound and style of composition across the four movements while producing the feeling of a story arc. These are the types of goals that influence the process of scoring a film, so my creative aim for this piece was to emulate that process on a smaller scale. At the end of each movement, I feature a shorter, reversed version of the movement, mixed with some ambient tones. I will begin by describing the process of creating those transitions.

Initially I bounced the entirety of movement four and then imported it onto a new track. I then sent that track to an auxiliary bus and started with a tape echo style delay with the mix parameter set to 40 percent, with the intention of performing the feedback knob to create repeats. I then added a reverb effect that creates so massive a space that it morphs sounds into textures. The mix parameter of the reverb effect was set to 100 percent, and pitch-shifted up an octave. I then performed the feedback parameter on the delay effect starting at the final few seconds of the fourth movement and created a texture that would ebb and flow as it fed back on itself. I performed the feedback for around two minutes as a background ambience, which is then layered underneath each respective movement that plays in reverse.

Next, I bounced each of the four movements and reversed them. I shortened them so that they were approximately 30 seconds each and sequenced them meaning I placed the reversed recordings in a relationship to each other on different tracks of in Pro Tools. I auditioned the different parts of each movement in reverse and picked the most interesting portion. I then chose how much I wanted each movement to bleed into the other at each transition point, and once they were all sequenced, I layered the reverb feedback over the top of these fragments of reversed

movements. This created an interesting collage of the different parts, on movement one and three I added an EQ that carved out some of the high end to make room in the frequency spectrum for the reverb cloud. Each of these reimported sections were bounces of orchestral instruments that were processed, so the reverse effect added to their already processed timbre. For an audio reference, this composition is uploaded to the following YouTube link:
https://youtu.be/UhobFeQQjdg.

3.9.2 Movement one:

Bassoon (Reverb)
Cello (Delay)
Crotales (Delay)

136 bpm 4/4

This composition started with the crotales playing a repeating arpeggio being processed through a delay effect. The mix parameter is set to 40 percent, and there are two echoes happening, one repeating a dotted eight note figure and the other an eighth note. The resulting syncopation balances with the dry signal from the original performance, and the feedback knob is set to 70 percent, producing a long decay. I then added the bassoon to fill out the low end and processed it through reverb to give it the appropriate distance so that it felt like it was in a similar acoustic space as the delayed crotales, the mix parameter is set to 33 percent on the reverb. Last I added an ascending cello line that interacts with the bassoon figures. At the end of the cello figure, I performed a delay effect on the last few notes of the phrase, essentially increasing the feedback parameter so that a tape delay series of repeats sound swell out of the end of the phrase, helping the transition sound more musical. I did this both times the cello stops, and additionally with the final few notes of the crotales. This process of performing these swells has been extremely useful in controlling the decay of reverb and delay tails in intentional and expressive ways.

3.9.3 Movement two:

Flute (Reverb)
Horn
Tenor trombone

Crotales
Harp
Violin (Granular and Reverb)
Violin (Granular)
Cello (Saturation)

80 bpm 4/4

This composition started with the arpeggiated harp line, followed by the spiccato viola and cello parts, creating rhythmic accents over the harp part. The flute was then added as the main melody, and then the cello comes in to accentuate certain parts of the melody, being processed through saturation. This same part is doubled higher and played with the violins which are being processed through a granular effect with the mix parameter set to 60 percent, pitch shift set to +1200 cents, and the recycle parameter set to 75 percent. The result is a high pitch, heavily processed and slightly ominous tone that comes in to juxtapose the sweet flute. I also sent the violin and cello to a sub-bus and heavily processed them with a space echo style tape delay, and a reverb that emulates such a massive space that it turns sounds into textures. This reverb had the mix parameter set to 100 percent, and pitch shifted the sound up an octave. I sent the cello and violin through this bus, and performed the feedback knob on the delay effect, giving me control of the swells of sound and how long they would float in the air, and how they would decay. This was a challenge at first because the massive reverb changed the way the feedback reacted to being activated. Once I had swells that I was happy with I printed them. After I printed these effects, I then added granular synthesis, similar to the violin settings, just a lower mix percentage, only 20 percent, and then a reverb with a 16 second decay with the mix parameter set to 20 percent.

3.9.4 Movement three:

Alto flute (Reverb)
Horn
Violin (Saturation)
Cello (Saturation and Reverb)

132 bpm ¾

For this composition I first played a bassline with the cello and processed it through saturation and added reverb after the saturation effect to soften the harsh harmonics. I then added a legato violin melody and processed it through saturation as well. At the end of the violin performance, I sent the signal through a delay effect and performed the feedback parameter, then sent that signal to a new audio track and printed the result which was a big wash of ambient tone with the same timbre as the violin, to conclude the melody. I then added a horn adding a countermelody line along with an alto flute being processed through reverb with a 4 second delay and the mix parameter set to 31 percent.

3.9.5 Movement four:

Alto flute (Reverb)
Bassoon (Reverb)
Horn (Reverb)
Horn
Piano (Reverb)
Harp (Reverb)
Violin (Reverb)
Cello
Double bass

85 bpm 4/4

This piece is structured around the harp arpeggio and the violin melody. Most of these parts have subtle reverb or are dry. The purpose of this is to ground the ear back into hearing the acoustic orchestra before movement five which is a total deconstruction of the traditional sounds.

3.10 Multi-tracked real instruments chamber ensemble composition

3.10.1 Introduction

This composition was my experiment with recording real orchestral instruments and then processing them in post-production rather than using MIDI instruments. I wrote the composition initially with MIDI, and then wrote out the score and replaced the parts one by one with the real instruments. I had a chance to see how the effects interacted with the real instruments compared to the MIDI instruments, and how the complete composition compared as well. In general, the composition ended up sounding fairly similar to its MIDI counterpoint but had more character and human performance in the sound. I will analyze the effect application logic and discuss the different approaches and choices that I made.

I extended the piece by duplicating the entire composition and re-processing all the original raw material with different effects, essentially using the effects structurally to construct a narrative form. In this case the effects guided the stylistic and sonic direction of the piece more prominently than the recorded parts.

Flute (EQ, saturation, delay, reverb)
Horn (granular, saturation)
Horn (granular, saturation, reverb)
Cow bell
Maraca
Maraca
Conga
Conga
Conga
Snare Drum
Wood block
Piano (reverb)
Violin (delay)
Cello (delay, reverb)
Cello (delay, reverb)
Double bass
120 bpm 4/4
For an audio reference, this composition is uploaded to the following YouTube link:
https://youtu.be/PGyLZqqtnbw.

3.10.2 Part A

The first part I wrote was the repeated spiccato violin figure, which is being processed through delay with a dotted quarter note emphasis on the repeats. When I recorded these violins, the performer played a crescendo toward the end of each four-bar phrase which ended up being too dynamic because when the phrase reset it felt underwhelming as the momentum diminished so abruptly. To solve this, I ran all of the violins through the delay that creates a pulsing rhythm and performed an increase in the mix and feedback parameters toward the ends of the phrases, creating an echo of the most dynamic moment of the crescendo. This gave me control over the release of the note, which is a parameter in synthesis theory that is central to designing sounds. I then added reverb to the signal chain so that the repeats sounded less harsh and blended more musically.

I added the spiccato cello line next, which serves as the main melody of the piece. I then processed those cellos through a space looper style delay with the mix parameter set to 60 percent, and feedback set to 70 percent. The result is an interesting rhythmic syncopation in the echoes that functions as a call and response to the main melody. I also processed the cellos with saturation to give them an otherworldly tone. I also sent all of the cellos to an auxiliary bus and used the same delay but performed the feedback and mix knob so that they swell in and out between one minute ten seconds and one minute forty seconds. They add a textural dynamic and movement to the end of the section, creating even more significant juxtaposition to the dry percussion that is about to begin. The double bass is dry in this section creating a solid tonal foundation for the higher notes to build upon.

The horn is being processed through a granular processor with the pitch shifted up an octave, with the splice parameter set to eighth notes and the delay parameter set to half notes. This creates a high texture that sounds like a violin section playing a sustained single pitch. I printed this effect, so that I could also keep the dry horns tucked in the mix as a part of the tone. I followed the same process with the portion of the horn that runs from forty seconds to one minute and twenty seconds, printed the original sound through effects and then blended them with the original. For these I ran them through granular processing that pitch shifted the sound down an octave, and then processed them through a saturation effect and finally reverb. The main horn performance is copied twice, each with different effects and then blended with the original.

The flute is processed through EQ which is essentially a low pass filter that starts declining around 2 kHz and ends at 10 kHz. This emphasizes the mid-range frequencies in the flute tone and removes the higher frequencies. The sound is then run through a saturation effect, a delay and reverb, making it ambient and airy, yet menacing. The piano is heavily processed with reverb with a four second decay and the mix parameter set to 37 percent.

I then decided to have a percussionist layer a rhythm section of dry instruments to come in around one minute ten seconds. I intentionally kept these dry to contrast with the other processed sounds. At two minutes ten seconds I processed the entire percussion ensemble through a granular effect, pitch shifting them down two octaves with the mix parameter set to 100 percent. This created a sub-bass style drum part that fills in the low end but still moves in time with the more high-frequency-centric percussion ensemble. I printed that effect and then added it for a short segment toward the ending.

3.10.3 Part B

At this point I duplicated the entirety of the first half of the piece, disabled all the effects and started the processing process over. I decided to mute the main cello motif in order to try to find alternate pieces of the arrangement to feature. I processed the single note piano motif with a granular effect, splicing and reversing eighth-notes and having the recycle parameter at 25 percent, creating little wispy trails at the ends of each note. I added reverb after this to make the sounds more airy and lighten them. I added a pulsing eighth-note tremolo effect to the low bass notes and ran the horns through granular processing, saturation and heavy reverb, making them ominous and dark. This created a tense, ambient sonic soundscape that sounded like the climax of a thriller sci-fi film. The final component was the percussion ensemble which I processed through various rhythmic delays to change the nature of the groove. One of the congas is being processed through a granular effect that is pitch shifting the tone of the drum up 1600 cents, creating a harmony with the other congas. I then additionally processed this through a delay with an accented eighth-note delay. The other conga is presented at the pitch at which it was recorded, but has a sixteenth-note tape delay effect. The cowbells are being processed through a delay that has echoes that repeat quarter-notes and dotted quarter-notes, creating an interesting polyrhythm. The snare rim sound and the woodblock are both being processed through tape delay that accents the sixteenth-note repeats. This creates a pulsing complex rhythmic fabric that feels like its pushing forward with perpetual momentum, but also features interesting subdivisions.

3.11 L'Age d'Or film score analysis

Structurally this film is highly non-sequential, and feels like a dream-sequence in a lot of ways. The scenes and characters leap around in time and space with only very tenuous narrative links. My scoring approach supports this surrealist structure in that the cues are mostly non-sequential, and typically do not repeat themselves.

The numbering for these compositions aligns with traditional film scoring standards of organizations. For every instance of music during the film, a number next to the letter 'M'(music) is assigned. I provide my cue sheet for the film in the appendix, which essentially has every cue listed in order with their respective start and stop points in timecode. For this section I will go through each cue and give some insight as to my logic in scoring it the way I did, and analyze how it works with the film, and compare it to the original score. Most of the pieces that were used to score this film were from my original research, so an analysis of the music by itself has already been done. This section will focus more on the interaction with the film.

For a video reference, the full film has been uploaded to the following YouTube link: https://youtu.be/bixu4gHx8V0.

3.11.1 M1 Title screen – 00:00:02 – 00:01:00 (4. Bass flute)

This composition creates an aura of mystery from the start, both from a tonal and harmonic point of view. In the original film the title credits are not accompanied by music. I decided that it was an opportunity to set the tone, so I leaned into this mysterious sounding cue.

3.11.2 M2 Scorpions – 00:01:00 – 00:03:31 (Quintet 1)

In the original score this portion is scored with Mendelssohn's *Hebrides Overture*, which gives this random fragment from a scorpion documentary drama and emotion, and makes it feel heroic and meaningful. The juxtaposition of these heroic and triumphant emotions in contrast with a description of the scorpion makes the viewer wonder immediately whether the scorpion is a character, or why we should care so much about this. I tried to match this emotion to some extent, but also tied the piece in stylistically with the first cue and kept the mystery and wonder intact. The result is still a contrast from what one would expect to hear as a score to a nature documentary. My cue leaves an impression of feeling like the scorpions are significant to the story, or that the vignette might hold more meaning than it really does. In this way it is effectively misdirecting our assumptions about the film at an early stage.

3.11.3 M3 Mountains – 00:03:34 – 00:05:54 (Quartet 3)

In the original score, Mendelssohn's *Herbrides* is still playing when the view of the mountains and the traveler are introduced. I decided to use that scene change as an opportunity to change the tone of the film. Quartet 3 feels like a new beginning, or a sunrise moment, and seemed to pair nicely with the images of the popes praying in contrast to the vagabond wandering the hillside. As the vagabond appears to be the protagonist in this scene, this accompaniment feels like he is our hero and that he is noble and respectable, while in fact he is just a bandit exploring the terrain. This aligns with the analysis from my literature review that the score can function to elevate despicable characters and take credibility from those who would otherwise deserve respect as part of Buñuel's anti-authority and hierarchical philosophies. In the original film, this portion is accompanied by Mozart's *Ave Verum* and you can hear the monks chanting. The emotional effect of this is akin to the music that I chose, pleasant and full of purpose and integrity. Similarly, my impression is that the bandit is the hero who is searching for the popes for a noble purpose.

3.11.4 M4 Barracks - 00:05:54 - 00:07:07 (Duet 14)

Once we settle into the barracks where the bandits are staying, this heavily effected bass clarinet and contrabass clarinet enter with a cue that means to depict them closer to how they really appear, slow and slovenly and somewhat despicable. In the original score, this portion is accompanied by Beethoven's *Symphony no. 5, third movement*, which gives a feeling of triumph and drama.

3.11.5 M5 Alarm - 00:07:06 - 00:07:48 (12. Trumpet)

This cue really introduces the effects as the trumpet figure is repeated and processed through granular synthesis. The high repeats create a textural swarm, and the melody of the trumpet feels inquisitive, or curious. Toward the end of the cue, I copied and pasted the ending and ran it through heavily processed granular synthesis and a textural massive room reverb to control the decay of the ending and help the cue finish in a musical way.

3.11.6 M6 To arms - 00:07:42 - 00:08:21 (29. Double bass)

At this point the double bass cue feels ominous as the bandits are looking around at each other and considering leaving the barracks. This feels like a suspenseful moment with high stakes. In the original film this moment does not have music and focuses on the dialogue.

3.11.7 M7 Hippopotamuses - 00:08:20 - 00:09:33 (2. Flute)

In the original score during this moment, we hear Debussy's *La Mer*. The swirling piano arpeggios make this moment feel magical and surreal, we feel like the protagonists are heading on a journey and might face treacherous opposition. Once again, the music functions to romanticize the bandits and make them feel noble and worth celebrating, even while they are making ridiculous gestures and stumbling around. I chose to use a flute cue processed through granular synthesis that also colors the scene with similar magic, wonder, treachery, and hope.

3.11.8 M8 Bandits climb - 00:09:33 - 00:12:02 (Duet 13)

Once the bandits leave the barracks this duet begins to play which makes their journey feel long and arduous, it also feels like the M6 cue that features the double bass and makes them look clumsy and aloof, as they are depicted. Instead of choosing to have the music function to always juxtapose the picture, I chose cues that go back and forth between relating to the picture and then departing from it to draw more attention to the contrast. Around 10:55 the cue gets heavily processed and the images of the bandits wandering the landscape feel especially dire and threatening. The unusual sounds of the Augmented Reality Orchestra pair nicely with a feeling of disorientation.

3.11.9 M9 Boats - 00:12:01 - 00:14:21(Quartet 3)

For this cue I returned to the same quartet that was featured in M3. We see boats arrive with people who will be attending the religious ceremony, and this music feels like it represents them as simple and good. I could have depicted them as intruders, but I think it serves the story better to give the impression that they are common folk attending a ceremony.

3.11.10 M10 Love mud - 00:14:30 - 00:15:30/ 00:15:41 - 0016:06 (Duet 3)

This scene features the first moment of shock in the film, where amidst the religious ceremony the crowd of people see and hear two individuals making love in the mud in a graphic way. The scene cuts away to the man's face. This music is their love theme, and feels tragic and heartbroken but confident and profound, which is intended to be a musical depiction of their desire for one another. This functions especially well in contrast to the more generic and pleasant music that precedes it as the boats arrive. In the original score, this moment is scored with the prelude to Wagner's *Tristan*, a theme that recurs throughout the film.

3.11.11 M11 Lava flow - 00:15:26 - 00:15:47 (Synthesis Quartet)

At this moment in the film, the lovers in the mud have just been broken up, and it cuts to a big mudslide momentarily. I decided to have the filtered and warped middle section of the synthesis quartet come in with those mudslide images to help integrate them into the scene. The mud slide is symbolic in the sense that it does not appear to be happening near the scene we are seeing, or even in the world of the film, but rather it is a flash of dream-imagery. Moments later there is an image of a toilet that functions similarly. This moment in the synthesis quartet sounds like a mud slide in the way the filter sweeps and moves, which seems to accompany the imagery well. It also comes out of nowhere and interrupts the cue that is playing in a parallel way to the imagery.

3.11.12 M12 Detained – 00:16:04 – 00:18:10 (Duet 1)

At this point the man that was making love in the mud is detained by authorities and there is a ridiculous sequence in which he breaks free, kicks a dog, then is detained again and the religious ceremonies continue. The tone of the music evokes tension, mystery, and intrigue. The pads that come from the granular synthesis sweep over the high end of the frequency spectrum. The result is a feeling of uneasiness and uncertainty about what is happening.

3.11.13 M13 Imperial Rome – 00:18:08 – 00:20:26 (Quintet 4)

In this scene we come to realize that the religious ceremony is the founding of Rome. In the original score we hear Mendelssohn's *Symphony no. 4 "The Italian Symphony", third movement*, which creates a feeling of elegancy and propriety, setting the scene for the extreme punch line at the end of the scene. As we see images of the city and its people unfold, this sophisticated music colors them perfectly as the joyful elite. At the end of the scene we see buildings exploding and the symphony is interrupted for the first time with the sound of explosions. The cue that I used here feels triumphant and monumental as well, as it pairs with sweeping images of the city. This is an example of a cue that is appropriate in tone and style for the visuals that we see in the film. The sequence is a montage of modern life in Rome and ends with an image of buildings randomly blowing up, accompanied by a card saying, "The diverse and picturesque aspects of the great city!", which appears to be the punch line of the sequence. To highlight the absurdity of this moment I copied a fragment of the cue and processed it through heavy reverb to pair with the dust spewing out of the destroyed buildings. This is my version of the explosions that happen in the original film. This use of effects to mirror the visuals in an onomatopoetic way is an important resource of the Augmented Reality Orchestra, greatly expanding film composers' sonic palette for expressive integration of music and visuals.

3.11.14 M14 Surrealist prison stroll - 00:20:30 - 00:22:39 (Duet3/Quintet 5)

This moment in the film transitions from the montage of Rome to an image of a man walking down the street kicking a violin along the ground in front of him. In the original film this moment is accompanied by Beethoven's *Concerto for Violin and Orchestra op. 61, first movement* in which we hear a beautiful solo violin play. This was intended to create a contrast between the absurd image and the historically beloved Beethoven. At the end of the scene the character crushes the violin with his shoe, at which point the music stops. In my score I decided to revert back to the violin and cello cue that we heard previously when the lovers were rolling around in the mud, because it creates the same connection to the image on screen, both hearing and seeing a violin. My violin is processed through saturation and sounds grittier and more distorted than lovely and beautiful, so the contrast is not the centerpiece of the cue, but rather the cue is more of a sonic representation of this violin being kicked across the ground.

The scene then transitions to a dreamlike montage of a man walking in a field with a loaf of bread on his head, and then it cuts back to the police escorting the love mud man through the streets. He sees several posters that arouse him on his walk. For this sequence I decided to lean into the dreaminess of the scene with quintet 5 which has a repeating woodwind phrase processed through delays that create a hypnotic effect. This is accompanied by loud percussive drums and metallic repetitions, which feel chaotic and unnerving, but the cue does not seem to feel serious at any point, as is also the case with the scene in the film.

3.11.15 M15 Chaise lounge - 00:22:37 - 00:24:52 (Meta Effects Quartet)

This moment features the man seeing a poster of a woman, and he immediately begins having sensual thoughts about his lover, the scene then transitions to the woman in her home speaking to her mother and features a variety of strange absurdities and subtle erotic gestures. In the original film this moment is scored with Wagner's *Tristan*, which solidifies the theme as a motif. In this version it is accompanied by the Meta Effects Quartet because it feels like a romantic but dreamy moment. The entrance of the quartet was too abrupt, so I added an EQ effect and performed a filter sweep to help the dynamics of the crescendo feel more animated. Initially the cue has most of the low end information carved out and then as we see the woman on the poster come to life the low end swoops in right as we see her move. This kind of specific scoring using the concepts and techniques discussed in this project adds precision and character to the interaction between audio and video.

3.11.16 M16 Cow in bed - 00:24:43 - 00:25:53 (Duet 8)

We see a cow sleeping in the woman's bed in this scene, which I accompanied with duet 8, a playful cue with xylophone and harp with large room reverb and delay. The effects add to the feeling that we are witnessing a dream state. The joyous and playful nature of the cue help to make it feel like the absurdity that we see is intentional, assisting in our suspension of disbelief.

3.11.17 M17 Longing - 00:25:46 - 00:27:28 (Duet 2)

In this sequence we see the man being continually escorted by the police, dreaming of the woman, while she sits at home and dreams of him. There are long shots of the woman making longing expressions and looking out the window, which I chose to accompany with duet 2, which features a spiccato double bass figure and celesta. This cue creates a feeling of time passing, and boredom, which seem to pair nicely with the scene. I think that one of Buñuel's statements in this film is that desire is not always perfectly proper and tame, as it often was depicted in films during that time.

3.11.18 M18 Blind man - 00:27:21 - 00:28:38 (Duet 7)

As the scene transitions back to the man being escorted through the streets, I change the cue to duet 7 with clarinet and marimba. The feeling is ominous and mysterious. The marimba is being processed in such a way that there are low echoes after each hit, which continually reinforce the strange and otherworldly nature of the scene and the plot in general. The transition felt abrupt and I considered customizing the transition musically between the two cues, but decided to use a technique to create a transition with effects. I added a large room reverb and a space echo note to the final pizzicato hit of the double bass in the previous cue and then pulled down the high mids between 1kHz and 5kHz about 6-8db, making the sound feel distant and hollow. I would typically use a volume fade here, but instead decided to experiment with changing the timbre of the sound to cue a transition.

3.11.19 M19 International goodwill society - 00:28:29 - 00:30:00 (Duet 11)

This cue features tubular bells and crotales. The man is speaking with authorities, and the music feels like a tense ticking clock. The echoes from the clock are reversing and prominent in the mix, creating a disorienting soundscape. At 29:13 the cue is processed through a tape emulator and heavy reverb, which makes it feel like it is sinking even further into the dream state. This layer of effects, like several others in this score was added in the master session after the music was imported as an additional layer of processing.

3.11.20 M20 Rome estate - 00:29:52 0 00:31:05 (Duet 10)

In this scene we see the man escape capture and then assault a blind man before stealing a car and driving off to find the woman that he has been pining over. The music that I chose to score this has a similar ticking clock feeling, with a repeated rhythmic phrase and a piccolo melody. It is intended to feel like a transition in the plot that provides tension and intrigue.

3.11.21 M21 Party - 00:31:02 - 00:34:33 (Quintet 2)

In the original score for this scene, we hear Schubert's *Symphony no. 8, first movement*, which oscillates back and forth between a feeling of tension and celebration. The man escapes from the authorities and arrives at a party at which the object of his desire is in attendance. We see the elegant guests arrive in fancy cars, dressed to the nines, and the music reinforces the elite nature of the group. Throughout this and the following scenes of the film, Buñuel shows a juxtaposition between elite, high class people, and vulgar, violent, and terrible people. As we are introduced to the party, we see the guests mingling, and then the camera pans out and we see a wagon of drunken men ride through the party. This seems like a classic commentary on the hierarchy of the bourgeois. For my score I chose quintet 2, which features a harp arpeggio with flute melodies that seems to fit the high class feeling of the gathering, but then every 30 seconds or so the whole cue is pitch shifted down into a warped and mangled version of itself, before then transitioning back to normal. The protagonist is looking for the woman in this scene as well, and the melody suits this feeling of mystery and searching. The back and forth nature between elegant and warped suits the dichotomy of what we see in the scene, and frankly represents the entire film's approach in some ways.

3.11.22 M22 Boy fire gossip - 00:34:33 - 00:36:38 (Quintet 6)

In this scene, the absurdity of the film continues as we see a man outside being pestered by a young boy. The boy is not doing anything particularly extreme or unusual, but the man decides to shoot him as punishment. The people from the party watch from a window above and whisper to one another, looking slightly concerned, but they appear to be more interested in the spectacle and gossip than the tragedy as they chat with one another. Eventually they shrug it off and head back to the party. I scored this with quintet 6 which has a momentum to the rhythmic ostinato that repeats and offers a tone of dark curiosity. In the moments when the gun fires at the boy, I used the processed and filtered moments from the synthesis quartet that were previously used in the mudslide scene to color the shots, drawing attention to them. This synthesis quartet sound has developed into a motif representing the especially surrealist moments of the film. At the end of this cue I made a transition out of processing the final fifteen seconds of the piece, first processing them through a space echo delay, then performing an EQ sweep into an effect chain that pitch shifted the sound down an octave before processing it through a massive room reverb, creating a crescendo. Additionally, I captured a layer that featured the EQ with a very narrow frequency band making quick movements while playing to the movement of the picture when the dress is thrown on the chair. I then used a pitch shift effect in conjunction with saturation and pitch shifted the sound up an octave, performing the pitch knob to create some tension and dissonance by lowering the pitch a few semitones and then resolving them back up to the octave before playing the saturation parameter and swelling it up to sound like a screaming tea kettle to mirror the anticipation and tension of the two lovers as they look for one another.

3.11.23 M23 Courtship - 00:37:12 - 00:39:54 (Quartet 1)

At this point in the party the man has entered and sees the woman across the room, they share longing glances, and the courtship has begun. Before the man can make it over to the woman, he is interrupted by her mother, who sits him down to chat. She offers him a drink, spills a drop on his hand and he gets annoyed and slaps her in the face. I chose quartet 1 for this moment as it feels like a romantic cue filled with whimsy and wonder. When he slaps the mother, I processed the cue with a high pass filter and a saturation effect, drawing attention the gesture. I then performed the feedback on an echo effect so that there would be a cloud of airy feedback to help the cue transition back to its normal state out of the EQ and saturation. This is an example of using the effects to highlight individual gestures and moments in the film. In this case it feels as though the air has been sucked out of the room when he slaps her, which adds drama to the gesture.

3.11.24 M24 Additional longing - 00:39:46 - 00:41:14 (23. Celesta)

In the original score this moment is accompanied by Wagner's *Träume*, which has a feeling of longing and attraction, and pairs accurately with the two lovers signaling to one another to sneak outside. The melody has a hint of sorrow in its long sweeping legato string phrases. In my score for this cue, I leaned into the sense of mystery and secrecy in the scene. It feels less ironic than the Wagner cue because in the Wagner, the man has just slapped this woman's mother and she seems to be unaffected by it, as the beautiful music continues to score the sequence, whereas in my score the music makes her flirting eyes feel more taboo and forbidden. At 40:38 I reverse the cue and add reverb to once again send it into a dreamier and more distant realm.

3.11.25 M25 Escape to the garden – 00:41:11 – 00:42:00 (27. Viola)

This cue features repeated pizzicato phrases that accompany the procession of the man and woman sneaking out to the garden. It continues the feeling of forbidden and sneaky escape, reinforcing the nature of their union.

3.11.26 M26 In the garden – 00:41:34 – 00:45:57 (MIDI Octet A – Duet 12/B – Quintet 2)

For the following scene I chopped up the four-movement MIDI chamber orchestra composition and sequenced it throughout the next three cues. The first shows them leaving for the garden to be alone and the orchestra getting ready to play for the group of people who were attending the party. The man and woman are being intimate in the garden, which at first seems conventional but is then accompanied by strange moments of absurdity, like biting each other's fingers, and eventually a shot that shows the man with blood all over his face. In the original score, we hear the orchestra start playing and we see the conductor cue them to start. At this point the music transitions away from score and becomes diegetic as we hear the orchestra that we are seeing in the film. I emulated this phenomenon and started the music with the conductor's hand gesture. At this moment we see the lovers startled momentarily by the sound of the orchestra, and then continue their lovemaking. The music in this portion is meant to help color their sense of desire for one another, while also expressing the tension of the moment and the fear that they could be caught or interrupted at any moment.

3.11.27 M27 Afar (in the garden B with effects) - 00:45:45 - 46:58 (MIDI Octet D - Master then reverse C - Duet 3) 00:46:48 – 00:52:13

This is the most famous moment in the film in which the man leaves to take a phone call and the woman erotically sucks the top of a statue. The cue that I chose for this contrasts with the image on screen by coloring it as a beautiful act. The music feels nostalgic, sentimental and makes the toe-sucking almost seem like a normal activity. In the original score we hear the orchestra playing Wagner's *Tristan*, and the tone and emotion of the piece is relatively similar to my cue; it has a longing and a sense of love and passion. At 47:50 in my score, the cue is reversed and has the same general emotion but feels like chaos as we see crowds of people rioting and running out of a burning building. This confirms the power and mysterious alchemy of the relationship between the image and the music, as it is essentially the same piece of music but it feels entirely different given the visual reference. As the cue develops, the combination of the long, performed feedback tails and the reverse effect makes things sound more and more unusual and distant and ominous.

3.11.28 M29 Conductor stops - 00:52:13 - 00:53:46 (Duet 4)

This is the scene where we see the man with blood all over his face and the surrealist essence of the film is especially pronounced. The lovers seem to be under a spell from the music, and yet there are vulgarities in the details as the woman exclaims, “What joy! What joy in having killed our children! My love…my love…” To pair with this dark and strange segment of the film I used duet 4, which has an ominous tenor trombone and a sweet alto flute melody, conveying the dark and the light in one composition. The music stops when the conductor in the film stops and walks away, but instead of having it be a hard cut I added some reverb and delay, so it stops in a more musical way. This also blurs the lines of the diegetic music in a way that feels like I am letting the viewer in on the joke. It clashes with the idea that the music we are hearing is diegetic, but not entirely, as it does at least stop on cue. In the final few seconds before the stop, I process the audio through granular synthesis, a reverb effect that pitch shifts the audio down an octave, and a space echo to create a long musical decay on the note. This points to the relationship between the diegetic music and the embellished score, I then take the same cue and reverse it and have it slowly fade in while being processed through the same signal chain as the final few seconds which softens the character of the timbre and makes it mellower and slightly other-worldly as we see the two lovers in the courtyard, this creates a nice contrast with the upcoming abrasive tone of the instruments in the transition with the conductor entering the garden.

3.11.29 M30 Betrayal - 00:53:38 - 00:55:05 (Duet 6)

The conductor, overcome with emotion from the music, walks into the garden where the lovers are sitting and the woman stands up and inexplicably starts kissing him, throwing the other man into a jealous rage. The music feels triumphant and dark, with a pulsating eighth-note rhythm in the background. The music sounds like a betrayal is happening as the man walks away and leaves the conductor and woman to themselves in the garden. The cue ends with a big echo/reverb tail, and there is a transition featuring ambience/texture that foreshadows the rage that the man feels. It sounds like horror movie strings and builds tension as we see the man unraveling.

3.11.30 M31 Fury - 00:55:08 - 00:58:06 (Duet 5)

This cue is a persistent two-note timpani pattern that goes on for a very long time. It is visceral and embodies the man's jealous fury as we see him destroying things in his room. Eventually the trombones enter, and it gives the viewer the feeling that something very dark is about to happen. The high harmonics that are harmonizing with the trombones are slightly late and shimmer above them, adding to the tension. In this sequence we see the man throwing a burning tree, a pope, a giraffe, and other things out of a window. At 57:30 the trombones come back but they are being processed through a high pass EQ and a massive room reverb that creates textures and pads, obscuring the starts and ends of each note. In the original film the music is very similar, it features Catalan drums doing an even more repetitive and simple musical gesture than my own version.

3.11.31 M32 Snowy castle - 00:58:09 - 00:59:45 (Synthesis Quartet)

This music feels almost like a funeral dirge or procession, but still somehow feels like the hero is on his journey. It functions to resolve the tension that was built up in the previous scene. At this point the film pivots to a completely unrelated plotline, focusing on a snowy castle in Paris which is the location of horrific crimes. As we see the castle and the crimes are described, the synthesis quartet cue that previously paired with the mudslide and the shooting of the boy returns but in full form. The glimpses of this cue were a foreshadowing of the film's dark conclusion.

3.11.32 M33 Duke of blangis - 00:59:48 - 01:02:25 (Quintet 3)

The penultimate scene shows a man emerging from the snowy castle looking like Jesus, looking around at the sky and his surroundings. Quintet 3 works in this moment as it provides a mysterious and unnerving sonic accompaniment to the disturbing scene. The sound pans from left to right in a way that is disorienting and the emotional center of the scene is hard to place. Toward the end it feels like some resolution might come, as if the composition is leading us to an answer, but instead it fades and moves onto the final cue.

3.11.33 M34 Horror – 01:02:27 – 01:02:40 (Master Session)

This final cue shows a crucifix with scalps on it, and is accompanied by pleasant, up-tempo music. In the original film there is similarly happy and joyful music that accompanies this scene, which is clearly Buñuel's way of making a statement about Christianity and the church's history of violence. The juxtaposition of this image with the respective music is unnerving.

3.12 Concluding remarks

The Augmented Reality Orchestra is an effective expressive and creative tool for film scoring and composition. It colors individual sounds in a unique, original, and interesting way, and expands upon the limitations of traditional orchestration, revealing a greater degree of flexibility and range for the instruments and ensemble. From a creative perspective, it is inspiring to find new sounds and hear new combinations of these sounds blend and interact. The ARO adds to the dream-like quality of this music, and supports the theory that original, unique sounds are disorienting to a certain extent, which helps the viewer suspend disbelief and engage more deeply with the film. Similarly, it is exciting to feel the emotional response that comes from watching a film with this palette as the musical centerpiece. One general observation about the difference between the ARO arrangements and traditional orchestral arrangements is the size difference. The ARO has a tendency away from tutti textures and toward smaller ensemble textures, which nevertheless sound full and tutti-like at times. With the ability to use effects to expand the width, depth and dimension of each sound, fewer instruments are necessary to fill the sonic landscape. There is still some capacity for tutti orchestration in the ARO, because the implementation of effects exists on a spectrum: on the one side exist sounds that are so affected that they are unrecognizable from their origin, and on the other side are sounds that feature such slight sonic embellishments that they sound essentially the same as their organic acoustic source. In the domain of film scoring specifically, I found that transitions between pieces of music, and entrances and exits had more creative options than a traditional orchestra offers. Among the many possibilities I found the primary techniques included sweeping in and out wide bands of frequencies with EQ to create emotional and dynamic shifts in the arrangement, automating reverb and/or saturation at the ends of phrases to create a musical ending or emphasize a dramatic moment, performing with a narrow band EQ on the full ensemble to express melodies, and finally using delay with high feedback parameters to create pads and textures. Many of these techniques were used on sub-busses or master buses and applied to the entire ensemble, which is a dimension of performance that expands upon the limitations of the organic acoustic orchestra. Additionally, the ability to layer effects and processing reveals a sort of infinite creative well from which to draw sonic ideas. There were times when I auditioned existing cues over scenes of the film and they fit perfectly in a narrative/emotional way, and any addition of effects seemed to take away from the already potent chemistry between sound and picture. Much of the music was pre-written and then placed, sequenced and processed, which also created a bit of a challenge. The scope of work would have been too large for this project had I undergone all of my writing experiments and then additionally scored a full film with no overlapping music, though I will note that since this writing and score took place, I have scored several films custom to picture using the ARO techniques, integrating with dialogue and sound design. The ARO in this context of custom scoring offered great utility, especially in its diverse ability to bring sounds in and out using different types of processing, resulting in a fluid and musical interaction with the other dimensions of film sound. In the case of this project, the limitation of only having time to implement primarily existing compositions into the score did result in moments of frustration and dissatisfaction as the result of not being able to find the perfect melodic/harmonic foundation for certain scenes. With the exception of this one challenge, the process was otherwise intuitive and creatively fruitful, and led to future scoring work that integrated a more custom writing process.

These new dimensions of writing and arranging make the creative process more inspiring and engaging for me personally. Writing with the ARO took away the limitations of traditional orchestration practice, yet with an expanded pallette and infinite sonic possibility, the principles and goals of orchestration still served as a foundation for the creative direction. In the next chapter I will analyze the specific differences between the ARO and traditional orchestration practices including dynamics, articulation, inter-instrumental balance, timbre, and texture, and how these elements have been disrupted from a performance and sonic position.

Chapter 4
Orchestral Effect Technique

4.1 Introduction

In this chapter I will review the theories and techniques that have developed through my composition process. This project has focused on composition and reinforces the idea that when a composer is writing for an instrument and effects, the nature and function of the effects can impact the process of composition, and vice versa. If a string player were to play a slur from one note to the next, the way a player would execute that would be different based on, for instance, the delay time and number of repeats on a delay effect – the composer would write in space for the extra repeats so that it did not clash with new phrases being played. The composer might write a slur connecting two different pitches with sixteenth-note values, and have the repeats created from the delay effect be very close together, creating a tremolo effect, or it might be a slur that connects two whole-notes, with spaced out repeats to create a slow washing decay. The articulation, the dynamic, the room ambience, the written notes and the parameters on the effects all inform each other to achieve the stylistic goal of the composition.

Identifying these dimensions and analyzing how they interact with each other has been key to developing strategies for writing effectively in this context. Thinking about the frequency range of the whole composition, and how added effects change the bands of frequency that each instrument fills is important. Similarly, this project explores concepts of depth and movement across multiple dimensions within the arrangement. The concept of foreground, middle ground and background is important and informs how we process each sound. Understanding live performance and capturing a live musician (with effects, or with the eventual intention of adding effects) is relevant, as the end goal of these compositions is to be captured by a microphone as played by a human in an acoustic space, and then processed through effects. Central to my thesis has been understanding existing orchestration practices and standards and modifying them to fit this new sound palette. In traditional, acoustic Western art composition, a composer would sit down to write an orchestral work thinking about the sonic, performative, and expressive limits of each instrument in a standard ensemble. This remains fundamental to my approach, but with the added consideration of how the effects can change the sound and functionality of each of those instruments, and how the ensemble as a whole can interact through the effects.

My project therefore resides in the liminal space between two fundamentally different approaches to contemporary orchestration: the notation-based approach to scoring, which has been the standard medium of classical composers, and the DAW-based approach. The latter approach is typically favored by those with a sound-engineering and production-oriented background, and is thus the domain of popular musics and, increasingly, film music composition

Classical composers[25] tend to write for the concert hall and use orchestration as a strategy and technique to address issues of balance and playability in relation to expressive intent – sometimes positively impacting expression, sometimes forcing compromise, but always centrally important to the expressive result. This group is looking for new sounds as opposed to preexisting sounds that have been standardized through sample sets. Film composers writing for real players would to some extent also be part of this group.

Production-focused composers tend to write for commercial projects like advertising, film and TV music, and video games. Such an approach may also be used in popular music, musical theatre, and other genres where the output is a recorded artefact rather than a live performance. For this group the DAW is the central operating platform, and the composer is more likely writing for a sample library, the output of which is not only a mockup but also a finished product. Concerns of balance and playability are therefore irrelevant, the only metric for success being the sonic output in relation to the commercial function.

My project bridges these two worlds, bringing the DAW (in the form of effects) into the concert hall, and the orchestral score into the DAW, since my composition process requires processing of

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[25] In contemporary musical practice the distinction between "classical composer" and "film music composer" is not necessarily clear as these categories often encompass the individuals. Contemporary composers often adapt their style and workflow processes for different environments, which is not necessarily a new occurrence as classical composers have long been commissioned to write film scores. In addition, contemporary composers write music for ads, TV, animation, podcasts, mixed media, etc. to make a livable wage. Additionally with advances in digital workflow technology contemporary composers also engineer, mix and master their own music, roles that in the past were sub-contracted out to experts in each field.

scores with effects, which may take place during live performance, during production, or during post-production. The DAW-to-concert-hall approach also overrides issues of balance and to some degree playability, as my Augmented Reality Orchestration Theory notes.

I will go through the various techniques and theories in this chapter and relate them back to my compositions.

4.2 Overview of Augmented Reality Orchestra Theory principles

The goal of this project is to develop composition and arrangement techniques for film composers in the context of the Augmented Reality Orchestra. Upon analysis of my compositions and techniques I have identified four conceptual categories in which the ARO expands upon the existing limitations of the acoustic orchestra: timbre, movement, dimension, and balance. In the following section I will define these categories, and then will use them as a framework for analyzing the impact of each individual effect on orchestration and film scoring practices.

4.2.1 Timbre expansion

The first element is the implementation of effects to change the timbral nature of individual orchestral instruments, and then pairing those augmented sounds to create a different timbre collectively. These changes can be utilized to enhance the expression of the instruments and narrative structure of compositions. Additionally, in the context of orchestration, with the ability to change the timbral essence of any instrument, it removes the limitations that otherwise predetermine the instrument's role in the arrangement, so in the context of ARO techniques, any instrument can function in any orchestration role.

The implementation of effects can be conceptualized on a continuum with, on one side, light or barely noticeable effect levels such as transparent reverb used to emulate a real-world space, and in the middle of the spectrum noticeable effects that modulate the timbre while still allowing the original timbre to be heard, such as delay, and on the opposite side, effects that result in a disruption of the recognizable characteristics of the instrument or ensemble, resulting in a pure effects-based timbre where the original source material is not discernable. This continuum applies to ensembles being processed through sub and master busses as well, on one side the ensemble is almost indiscernibly augmented, and on the other, the ensemble is so processed that it has become an entirely unrecognizable and new sound. Additionally, with the application of automation, these effect levels can shift and be performed in musical and strategic ways to serve various narrative and scoring functions.

4.2.2 Movement expansion

Automation can be considered "second order performance", whether enacted live by the instrumentalists or by a producer in post-production. This information needs to be coded onto the score if the piece is to have a life outside of the DAW. While expression and timbre are typically governed by "first order performance", namely the sounds the performer elicits from their instruments, the "second order performance" functions in much the same way as the first order to modulate dynamics, tone color, expression and articulation in response to the performer's interpretation of the work. In addition to modulating the instrument's inherent dynamics, articulation, tone color and range to achieve instrumental expression, the instruments are effectively enhanced with a range of additional timbral operators that can be manipulated in conjunction with the more traditional acoustic parameters to enhance expression and narrative structure.

The implementation of effects with automation (second order performance) adds movement to the individual instruments and the ensemble that can be applied in many forms. Some examples of these forms are automated modulation, filter sweeping, dynamics, mix parameter on reverbs, delays, or saturation, and panning (in the context of a recording), to name a few. Movement in this context is the perception of change in a sonic landscape occurring in a dynamic way. This could be achieved in a variety of ways, but most importantly is this idea that the sound is not static. In this project I seek out movement that feels human and is performed rather than creating music that sounds like predictable, robotic patterns of automation. All these effects create an additional dimension of movement across a sonic landscape that is unavailable to a conventional live ensemble and in traditional orchestration practice.

4.2.3 Dimension expansion

The addition of reverbs, delays and some forms of modulation can create embellished and added perception of dimension in an ensemble. Large reverbs can make things sound incredibly far away, augmenting our perception of depth. Filters can make things sound underwater, spatial effects and panning (again in the context of a recording) can manipulate the perception of the width, making things sound further out to the left or right. The other evolution of these concepts is the implementation of automation into the performance of adding dimension to a soundscape. For example, performing the mix parameter of a reverb allows the composer to dynamically move things forward and backward in the sonic landscape. One could also change the character of the reverbs over the course of a piece, so that sounds can exist in a variety of emulations of different physical spaces. On the other end of the spectrum, the composer could choose to obliterate a sound into a wash of texture by increasing the mix parameter to 100 percent, then could bring back its clarity by returning to the dry signal. Traditional orchestration aims to create a background, middle ground, and foreground through timbre. ARO techniques document that concept and explore multiple additional dimensions to the composition process by way of effects.

4.2.4 Balance

Balance in DAW-based production is qualitatively and quantitatively different to balance in an acoustic orchestral context. ARO theory arises out of the differing conceptualization of the notion of balance, reconciling the schism between electronic and acoustic solutions to the problem of balance, with a resultant shift in orchestral practice as the live orchestra adopts electronic balance instead of the acoustic balance that has informed orchestral texture for centuries. The concept of balance in this project has been central and has revolved around trying to solve problems of imbalance. When certain effects are implemented, they have the potential to overpower the balance of the ensemble, or others can obscure the landscape and make everything indistinct. As these problems arise, if they cannot be resolved by lowering the mix parameter, the solution was often found in additional filtering, EQ changes, automating volume, panning, or effects. All of these tools help achieve balance by creating specific places in the sonic landscape for each sound to live, whether it is a place on the frequency, width, depth, or volume spectrum.

Another strategy is to design tones using multiple instruments with three dimensionality in mind, using the effects to achieve balance across those dimensions. For instance, starting with a lower, warmer, softer tone like a marimba and potentially applying a lot of reverb to push it further back in the mix, then doubling that part with an instrument that has more attack and presence in the mid-range, and applying a moderate amount of reverb, and finally adding a third dry unison part played by an instrument that has significant attack and presence and has a timbre that cuts through the middle and background. Acoustic orchestration procedures are designed to achieve this same aim of balance, layering and multidimensionality. The effects function to embellish this result by making instruments' timbres more versatile by way of offering tools to shape and transform their tones and presence. Additionally, the implementation of effects adds the possibility of auditioning changing parameters in the context of the existing balance within an ensemble to try different approaches and techniques to achieve the desired outcome. For example, there are multiple effects that can push a sound further back into the ambient soundscape like reverb, delay and granular processing, each of which have a number of parameters that alter the character of the timbre and where it sits in the mix, so rather than having two variables to manipulate, dynamics and instrumentation, like in traditional orchestration, the ARO can offer a wider array of solutions to the same problem. The added fourth dimension of performing modulating effect parameters glues together the existing three-dimensions used in traditional orchestration.

4.3 Overview of sub-bus and master bus application principles

Implementing effects on groups of instruments, or an entire ensemble has proven to be a central tool in the process of writing and arranging with the Augmented Reality Orchestra. Conceptually I think about the application of an effect on a single instrument as a brick in the timbral wall. When effects are applied to groups of instruments on a sub-bus, the effect is more fundamental to the character and essence of the work, or the scene being scored as entire sections of the timbral wall take shape together. When an effect is placed on the master bus it suggests that the effect is pervasive in implementation and importance and has the potential to mark out crucial narrative moments. For instance, there are points in my score when the entire ensemble and musical texture dissolve quickly, which represent a serious disruption of the narrative status quo.

On several occasions I send the signal of a recorded performance to a sub bus and process the signal, then print it and mix it in with the original. In *Multiplicity for Solo Cello,* I explore this concept at depth, and start with a single performance processed through multiple sub-busses to create an entire landscape of sound. Controlling the extent of the application of an effect on a fader gives much needed flexibility for capturing automated performances of changing effect levels. This process is like performing the mix parameter on an effect but can offer a different mechanism if the mix parameter on a specific effect is controlled by a knob, sometimes a fader on an auxiliary bus gives the performer more control and precision. In some cases, these parameters, both mix percentage and the fader on an auxiliary bus, can be routed to physical hardware, which makes the performance easier to control.

When applying effects to the master bus, there are several compelling techniques that result in expressive ways to shape the narrative of a piece of music. One such technique is to use pitch shift as you would in the process of manipulating a tape machine, slowing down the speed of the sound along with the pitch at the same time, which I experiment with in Quintet 2. When slowed to a complete stop, it has a recognizable sound effect quality that is a piece of our musical cultural fabric. When slightly slowed down or sped up, a similarly recognizable sonic character occurs, and colors the timbre of the ensemble in different ways.

Another technique in the realm of master bus modification is to implement a slow panning effect on the entire mix in combination with some ambient reverb, creating the effect of feeling like the mix is slowly turning on a carousel around the listener in headphones. In addition to this if you add EQ swells into the mix it creates an elliptical shift in position. I explored this approach in Quintet 3 with satisfactory results.

Finally, automating effects in and out on the master bus can change the atmosphere of an entire piece for a moment by applying effects to all the instruments at once. These effects can mirror pivotal moments in the film or serve onomatopoetic functions as effects color the narrative and story. The type of effect can change based on the film scoring problem that needs to be solved, but the ability to modify the entire ensemble offers a final layer of manipulation and emotional control over the audience’s perception of the story.

4.4 Principles of ARO theory in the context of each individual effect

In the following section I analyze each effect and how they interact with Augmented Reality Orchestration practices, specifically with the four central principles of ARO: timbre, movement, dimension, and balance. I discuss these ideas in the context of traditional orchestration practices and theory, outlining the ways that the effects expand upon the limitations of the craft. I also focus the discussion on the composition of film music specifically.

4.4.1 Reverb

Reverb is the effect created when a sound reflects within an acoustic space and reverberates. In the realm of timbre, reverb is capable of coloring the timbre of the instrument to make it sound different in several ways, creating interesting decays. When applied to multiple instruments in an ensemble it can create textures, and the tonal color of those textures can be controlled and refined. Reverb can pair well with other effects like saturation and serves as a tool to soften and smooth out the abrasive character of the effect. Similarly, I often implement a strategy of placing an EQ on either side of a reverb effect to control which specific frequencies I want to process through the effect, and how I want to shape them on the other side. Automating reverb to create movement is one of the most common ways that I implement this effect and seems to be a central element of the ARO toolkit. Increasing the mix parameter and decay time at strategic times like at the ends of sections or musical phrases often produces a musical decay that can be refined to fit the moment. Another strategy is to increase the mix parameter while the sound is being voiced to color the timbre, and then automating it down at the ends if the airy decay does not suit the composition. Dimension is a central way that reverb adds to the limitations of traditional orchestration practice. Typically, all the instruments of the orchestra are performed and captured in the same acoustic space, so dynamics are the primary vehicle for individual instruments or sections to come to the foreground or fade into the background. Reverb adds the perception of near and far, allowing the composer to place things on that alternate axis, and move them over the course of the piece. The ability to control this parameter is relevant to the conversation about balance as well because the near/far presence of different voices in the ensemble can be adjusted using reverb to contribute to the overall balance of the piece.

In the context of traditional orchestration, reverb adds many possibilities that were otherwise unavailable to traditional orchestrators. For instance, using the effect to expand the decay of instruments that are not otherwise physically capable of perpetual sustain, like a snare drum, means that any instrument can become a texture or pad, or be used to harmonize in a section sustaining long notes. This reality vastly expands the variety of timbral choices in the realm of orchestration. Additionally, as noted previously, the ability to control the near to far dimension broadens the scope of how the ensemble achieves balance. As Peter Doyle muses in *Echo and Reverb: Fabricating Space in Popular Music Recording, 1900 – 1960* (2005):

> Echo and reverberation made it seem as though the music was coming from a somewhere – from inside an enclosed architectural or natural space or "out of" a specific geographic location – and this "somewhere" was often semiotically highly volatile. On reflection it became clear that with the addition of echo and reverb, "place" and "space" had become part of the larger musical equation, a new component in the musical totality. To understand how and why echo and reverb "did something" to the music then, it would be necessary to investigate these sonically represented spaces.
>
> (Doyle, 2005)

In the context of film scoring, reverb can be used to help support many of the artistic goals of the craft. Using reverb, a composer can place the ensemble in the same acoustic space as it is being portrayed in a film, potentially supporting the inclination toward suspension of disbelief. Examples of the effect in its most extreme form can create otherworldly washing textures or thunderous percussive sounds that can serve as the sonic foundation to a textural underscore.

4.4.2 Delay

Delay is the duplication and repetition of a sound. Delay has the potential to impact the timbre of a sound, or our perception of a sound if the repeats are close enough to the fundamental sample. For instance, slap back delays, or delays that emulate tape echo change the way a sound is perceived. Some delays have modulation parameters and warble from tape that create slight pitch modifications and ambience to the timbre. The primary character of delay is in the rhythmic repeats and echoes that come after the initial sound. In several instances in this collection of compositions I increased the feedback parameter at the ends of phrases or at the end of a composition to create long washing textures from a selection of the final few notes in a piece, feeding back on itself. This is an example of the delay effect creating new timbres and sounds from original sources, which can then be colored, modified, and rhythmically altered further with additional parameters on the delay effect, or additional layers of effect processing. Another technique that I developed in the domain of timbre is to apply delay to high percussive instruments with sharp attacks and lots of overtones like crotales or celesta, with the intention of blurring the line between subdivisions, creating textural drones. In Duet 12 I add a performance dynamic by automating the delays in and out to selectively decide when the sound becomes a pad or drone versus a rhythmic figure, supporting the movement component of the theory. The implications of this technique are that almost any initial tone can become a texture by using delays. Additionally in the realm of movement I often use granular processing or reverb to achieve a specific tonal or textural effect, and then process it through a delay to add a rhythmic component to the otherwise washy tone. This also works in reverse, starting with a rhythmic delay and adding reverb or granular processing to open it up or wash it out at strategic times. The general rule that I have established is that placing the delay at the end of the effect chain results in a more focused rhythmic figure or pulse and placing it earlier in the chain results in a more rhythmically ambiguous tone. The ability to bring rhythms in and out of a cue by automating the delay parameter supports the ARO's goal of expanded control over dimensionality of an ensemble or soundscape. Additionally, these tools can be applied in the realm of film scoring to add movement or energy to a scene that features a cue with the right emotional tone but which lacks the proper momentum. From a creative perspective, I use delay on melodies with short phrases so that the echo finishes the phrase. This can be useful as a writing tool as well, monitoring a tone through the delay effect and experimenting with different melodies through a variety of settings, all of which uniquely inspire different performative choices, leading to new creative avenues.

As an effect that is fundamentally rhythmic, delay can function to support grooves and percussion arrangements. One approach is to think about short arpeggios as being the building blocks of a drum groove, playing a simple pattern then using delay to repeat it with an eighth or sixteenth-note pulse, emulating a high-hat part. Once that part is established and looping, a second layer of delay processing can create echoes that emphasize different subdivisions of the measure to be designed to function as a bass drum or snare would, until finally sequencing all the parts into an interpretation of a drum set groove. This is something that I experiment with in Quintet 6. Another approach to this is to play a simple percussion part and then add a delay effect and print the result, then go back to the initial dry signal and change the parameters on the delay effect and print that alternate result. This process is repeated until a rhythmic fabric is created with interesting polyrhythms, and because they are all based on the same initial performance, the interlocking parts should line up. Sometimes I repeat this process with a handful of different initial rhythms and weave together an arrangement of the parts. Duet 10 was one of the compositions where I explored this technique. Also, the real chamber ensemble is an example of this, featuring several live recordings of percussion parts being processed through various delay effects and subdivisions creating a new polyrhythmic feel and timbral color to the arrangement.

Delay is one of the most versatile and inspiring effects and was certainly one of the most regularly used in this project. It supports the expansion of every category in ARO theory, building on the foundations of traditional orchestration. As a writing tool and versatile sonic enhancer it functions to expand the horizons of film music composition.

4.4.3 Saturation

Saturation is a mixture of compression and harmonic distortion created when a signal overloads the capacity of an analog piece of gear, creating additional harmonic frequencies that in their simplest form add warmth to a tone, and at their extremes sound aggressive and jarring. In the context of timbre, this effect functions in several different ways, the simplest of which is adding bite or attack to sounds to make them more pronounced, present, or energetic. In the ARO I use saturation to make gentle woodwinds sound like aggressive violins, for instance. I also utilize saturation to allow delicate sounds like pizzicato string lines to sit atop the mix of a large ensemble playing pianoforte dynamics, an impossible task for a traditional orchestra. Often, I increase the gain and the mix parameter at the ends of musical phrases to add dynamic energy to the melody. In the ARO I found that saturation is a useful tool for controlling the presence of an instrument in an arrangement. If a certain instrument in the ensemble was inaudible within the group, especially amidst the presence of effects like reverb and chorus which can be sonically expansive and take up space, I use saturation and specifically refine the mix and drive parameters until the instrument sits appropriately. This ability to control presence on a knob or fader proves to offer a solution to a traditional orchestration problem that previously could only be solved with dynamics and doubling instruments. Similarly, saturation can be added to groups of instruments on busses and serve the same purpose. Reverb serves the opposite function by making instruments sound further away and less present, so from an orchestration standpoint I conceptually thought about the dimension of near and far being controlled by a relationship between these two effects, both capable of shifting the presence of an instrument along the continuum. Sequencing the effects in different ways has an impact as well, as the specific order of effects changes the character of the sound significantly. If a sound is processed through saturation first, the waveform has distinct peaks emphasized by the harmonic generation of the effect which are then processed by the reverb, and those peaks created from the saturation are what the reverb hears and grabs and emphasizes. If a sound is processed through reverb first and then the wash of reverberated sound is processed through saturation, the saturation will apply more subtly to a more uniform and balanced waveform, manifesting itself with less distinct peaks and the potential to color the general timbre of the sound more than amplifying and distorting its distinct expressive characteristics. Saturation at its extremes can make instruments sound otherworldly and strange, it can function as a practical tool for presence and balance, and it can color the timbral character of a sound.

4.4.4 Chorus

Chorus is an effect that is meant to sound like multiple musicians playing the same thing at the same time, essentially doubling the signal of the initial performance but slightly shifting the pitch and timing, creating a thickness and warmth to the resulting sound. From a timbral standpoint, on one end of the continuum chorus adds a little bit of body, warmth, movement, and presence to a sound, and on the extreme end it can make a sound warbly, detuned or like a vibrato or tremolo effect. Independent of changing any parameters on the effect in real time, chorus creates a sense of movement as the pitch and timing are shifting around the original sound, but when parameters are performed through automation this effect is enhanced, especially by modifying the vibrato speed parameter, but also through the intensity control. As an orchestration tool, chorus achieves a softening effect in the same way that reverb and delay do, but typically with more timbral color, rounding out the harsh frequencies of a sound, and generally warming up the timbre. This effect is a timbral coloration device, and fundamentally changes the nature of sounds. In duet 4 I process the tenor trombone through a steadily pulsing chorus modulation, bringing movement to the long notes and adding dimension to the timbre. I performed the parameters of the effect, turning up the intensity slowly throughout the melodic phrases from 20 percent to 100 percent, and followed that increase with a similar increase in depth and rate from 30 percent to 70 percent. The resulting sense of movement and evolution throughout the piece adds dimension and energy to the composition. Another prominent example is the solo oboe composition in which the chorus effect enhances the vocal characteristics of the instrument, making it sound like a human singing. This technique can be explored with other instruments. One of the central differences between the sonic landscape of the ARO and a traditional orchestra is the unique way in which the effects change the timbral character of the instruments, and chorus has potential to expand these horizons both on individual instruments and applied to sections or entire ensembles by way of sub-bus or master bus.

4.4.5 Tremolo

Tremolo is an effect that makes an instrument sound like its trembling by making drastic shifts in volume. A tremolo arm on a guitar creates a similar effect by bending the strings and creating shifts in the pitch. The sound is like vibrato as we are used to hearing on stringed instruments, but that effect is created by slight pitch modulations as well. For this project I focus on the first example, tremolo that essentially turns a volume signal off and on at different rates to create a shaking sensation. In the domain of movement, tremolo offers several techniques to enhance the expressive capabilities of an instrument or ensemble. Automating the intensity of the effect or the speed as melodic phrases or pads are evolving creates a crescendo and increases the energy of the passage. In Quartet 1 I add a tremolo effect to a trumpet and set the depth parameter to 100%, resulting in a timbre that resembles a synth arpeggiator. I use the tremolo effect to create a pulsing rhythmic foundation in several pieces as well, including my solo horn composition. I found that the placement of the effect significantly impacted its functionality, for instance placing a reverb before the effect created a crisp tremolo rhythm essentially chopping the textural result of the reverb, whereas placing the reverb after the tremolo created a more rhythmically vague and ethereal pulsing sound. Thinking about the ways that tremolo expands the horizons of traditional orchestration, I think it is noteworthy that it opens the possibility of all instruments having the potential for vibrato, like the strings do. With the added dimension of automation, the nuances and dynamics that string players put into their performance can be emulated as well.

This is another example of how traditional orchestration sets roles for the various instruments based on their physical nature and limitations and the ARO expands their potential.

4.4.6 Phaser

A phaser effect essentially creates peaks and valleys in the frequency spectrum and moves them over time, creating a washing movement sensation. I chose not to use the phaser effect very much in this project, but I did choose to emulate the function of the effect by performing these swells with an EQ effect. The ability to choose and alter the shape of the swells, and physically perform them to the compositions proved to be a central tool. In terms of timbre, the phaser adds a distinct character to the initial tone of an instrument resembling digital laser sound effects. When applied in a subtle way, the effect can add a sense of movement and variation to an instrument's timbre. I use this in the solo composition for tubular bells and the way that the frequency changes created additional depth and movement to the overtones resulted in a distinct and stylish aesthetic. I also apply it to the solo bass clarinet composition, keeping the mix parameter set to 13% so that the effect does not overpower the instrument, and still it makes the composition sound otherworldly and futuristic. Perhaps phaser is a tool that thrives in the domain of science fiction film music. In the way that phaser is typically used, I do not think that I reveal any breakthrough techniques that expand the horizon of traditional orchestration practices, but when it is manually performed on an EQ effect, there are several ways that it can support the expressive goals of an ensemble and film scoring. I will elaborate more on this in section 4.5.1 below.

4.4.7 Pitch Shift

Pitch shift is an effect that changes the pitch of an instrument by a selected musical interval. Typically, this results in a shortened duration for the sample as the audio is sped up to achieve the increased pitch interval. There are also pitch shifters that work in the frequency domain, rather than the time domain. The timbre of the pitch typically stays unaffected within a certain interval range from the original sample and then as it strays too far it begins to sound distorted and unrecognizable. The timbral effect can be desirable in some musical contexts, and different types of pitch shifters have ranges larger than an octave within which the pitch can shift and still sound like its original sound source. In my solo marimba composition, I performed the marimba part an octave lower than I intended it to be voiced and then pitch shifted it up an octave, creating a synthesizer style lead tone timbre with gritty overtones and subtle portamento movement between pitches. This example explores the ways in which pitch shift can be used as a tonal coloration tool. In the realm of movement, I perform pitch shift in the middle of compositions to create dramatic effects at transitions and in climactic moments. I often use pitch shift in conjunction with reverb to build textural soundscapes, either pitching a sound up or down an octave and then applying a large room reverb. The resulting sound fills out the frequency spectrum, enhancing the control over how much sonic space the pad fills.

In considering the impact on traditional orchestration, this technique is significant. Often orchestrators will write harmonized parts for sections to fill out the textural background of a composition, and this combination of reverb and pitch shift can produce the same result with fewer players and parts. Additionally, multiple players could play a single tonic note and then, for instance, pitch shift to different intervals, building harmonic chordal parts. When paired with a loop pedal a single performer could create the ambience of an entire section using the pitch shift effect. In a live situation, latency is a required consideration as well.

The other significant expansion of traditional orchestration practice is the expanded range of each instrument when considered through pitch shifting. Many orchestration choices are made based on the range limitations of each individual instrument, but with the added processing of pitch shift, limitations in range are dissolved, and choices can be made based on stylistic preferences rather than out of necessity.

In my score for this project, I use Quintet 2 which features a harp arpeggio with flute melodies and every 30 seconds or so the entire cue is pitch shifted down an octave, creating an unnerving and dramatic effect. This is an example of how the effect can be used to make massive shifts in the narrative flow or signify transition or variation in the film.

4.4.8 Granular Processing

Granular processing is the process of slicing a piece of audio into tiny fragments and then looping them, creating a mist of sound from an original sound source. I use this effect on a spectrum, on one end it adds a slight shimmering effect and subtle harmonic embellishments, and on the other it creates a wash of sparkly texture. The rate of the looping is variable, as is the size of the splice, and performing both parameters creates an opportunity for movement and added dimension in a composition. There is also a feedback component that can be automated to create strategic washes of sound or entire soundscapes if the parameter is increased far enough. I use this strategy in my solo timpani composition. In the realm of dimension, granular processing, when automated, can function to control the near and far depth of a sound but with a different timbral color as the washing is created by little splices of sonic information rather than acoustic reflections. I use the mix, splice, size and repeat time parameters to make sounds change from clear and dry to textural over the course of various compositions in this project. The implications for enhancement to traditional orchestration practice are similar to reverb and pitch shifting from the previous section in the sense that textural soundscapes can be created with fewer instruments, and their tonal character and color can be performed as parameters over the course of a performance. Additionally, the ability to perform the granular effects parameters creating rhythmic, pitch and timbre variations opens many possibilities. Regarding film scoring, this effect has the potential to be a central tool for any composer as its resulting sounds and textures often resemble subtle orchestral underscore arrangements that accompany film but with added dimension and sonic complexity.

4.4.9 Wah

The wah effect creates an EQ sweep across the frequency spectrum. This effect, like the phaser, was not used a lot, but is essentially the same as the manual EQ filter sweeps that I used as one of my primary techniques. Typically executing fast sweeps across the spectral range, the wah effect creates a distinct and recognizable change in timbre to any instrument. When implemented at any speed parameter, the resulting movement adds energy, character and added depth to a performance. I use it in my solo bass trombone composition, which is a slow and melodic piece. The effect creates a pulse that feels imprecise and comes in and out like waves crashing, but also has a digital, sort of laser-like color to it, perhaps more suitable to modern electronic music or funk compositions. Another application of the effect is in my solo tuba composition in which the wah's sixteenth-note pulse adds energy, driving the composition forward. The mix parameter is at 50% so the initial attack of the dry tuba is audible and punchy, while the decay evolves into a different timbral color and rhythm, adding dimension to the sound. In the same way that the tremolo opens up every instrument to the possibility of performing an effect similar to vibrato, wah can add energy and varied rhythmic pulses to any instrument.

4.5 Principles of ARO theory in the context of general sound controls

The following are less effects and more sound shaping controls that help achieve balance in an ensemble. In their extremes they can be used as effects, and some of the effects we discussed in the previous section are simply shifting the parameters of these controls, but nonetheless it is worth discussing each and their role and function in the ARO.

4.5.1 EQ

EQ is simply the ability to control the frequency spectrum. As a tool, EQ can serve every individual instrument track in a multitude of ways. In the realm of timbre, I often create a sound using effect chains, and then carve out unwanted frequencies whether they were, for instance, muddy low end, or harsh harmonics that are feeding back. I create an extremely narrow band and increase the gain before slowly sweeping it across the spectrum while auditioning a sound to see if I can identify any specific frequencies that are harsh or unpleasant. Once I find them, I pull the peak down and significantly lower the gain of those specific places in the spectrum. These techniques allow the effects to be implemented in often extreme ways, and then offer me a tool for cleaning up the aspects of them that had become unruly.

As noted earlier, creating bell curve or narrow band peaks and valleys in the frequency spectrum, and then performing sweeps across them at different speeds and in strategic moments has been one of the most common techniques in this project. This is also known as a resonant filter. The movement and life that these sweeps create within the arrangements adds to the expressive quality of the pieces. Narrow frequency sweeps can pinpoint and sequence individual notes, creating a tool for writing melodies, sometimes sounding like a whistling tea kettle, like in M22. Wide band frequency sweeps result in dramatic emotional response, for instance pulling out all the low frequencies in a sound at once, and then swelling them back in while synced to picture, like in the Meta effects quartet, created significant emotional reactions. In duet 4 I explore both strategies, first creating a droning pad and then slowly performing a moving wide bell curve EQ across the spectrum, then duplicating the initial sound source and performing melodic variations with a narrow band EQ on top of the first layer.

EQ has the potential to be effective before and after each effect, dictating what information is going into the effect and what is coming out. Similarly, I use EQ on sub-busses and master busses in almost every composition to achieve balance and carve out unnecessary harmonics, frequencies and overtones created by multiple instruments blending in the ensemble. Additionally, I sometimes increase the gain in some spectral locations to enhance or emphasize those parts of the ensemble. This single tool pushes through many of the existing limitations of traditional orchestration, as choices are often made based on the essence of each sound and the way that the different sounds blend together, and yet with EQ, the undesirable aspects of these sounds can be carved out and refined.

4.5.2 Panning

Panning is the process of placing things on the left/right spectrum in a stereo listening environment. In a traditional orchestra, the sections are positioned on stage strategically so that the resulting ensemble will achieve balance. In DAW-based music production, each instrument can be placed anywhere from 0 to 100 on either the left or right side. This tool can help balance an ensemble and change our perception of the relative volumes of the different instruments. As an effect, panning can be automated or performed so that sounds move across the left/right spectrum throughout a piece, or at strategic times, which is something that would be a comical challenge to achieve in a live orchestra setting. Slow panning can create movement in a composition, and fast panning can create chaos and energy. In film scoring, panning can be used to create a connection with the visuals that are seen on screen. Onomatopoetic sounds mirroring a visual that comes from the left side of the screen can be panned to the left side to further enhance suspension of disbelief and connection between score and film.

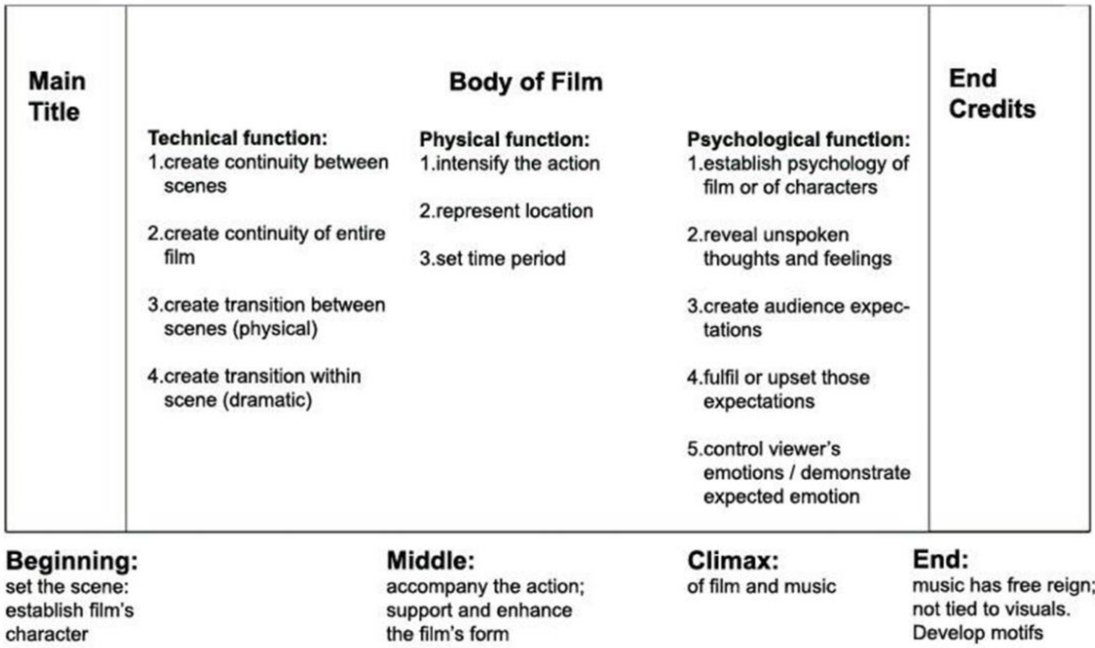
4.5.3 Volume

In traditional orchestration, as we have noted before, the main variables are dynamics and instrumentation. Each instrument has a dynamic range, and a performer is instructed to play specific dynamics at specific times. With automated volume capabilities, the timbre of the instrument does not have to change with the volume. For instance, the timbre of a cello playing quietly is quite different from the sound of a cello playing aggressively and loudly. Therefore, the dynamic predetermines the timbral character and color of the instrument, but the ARO explores how volume can be controlled through external processing, so the timbral character of the instrument can be chosen based on stylistic preferences rather than out of necessity for balance. In a live performance context, a performer whose instrument is being amplified by a microphone could use a foot-controlled volume pedal to implement this effect.

When applied to changes in sub-busses and on the master bus, volume control can create new ways of controlling the implementation of effects. For instance, in duet 14 I print the bass clarinet through saturation and reverb both dry and with the effects, and then automate the volume of the processed version in at strategic moments creating a subtle and gradual change in the sonic landscape. This technique is effective at following the developing narrative of a film scene, gradually increasing the eeriness and suspense, for instance.

4.6 Implications for film scoring

Film scoring fulfills several functions, including physical scoring (action, movement, geographical location), technical scoring (scene transitions etc.) and psychological scoring (characterization etc.). There are various discussions of the functions of film music in the literature, but I will use a summary created by Christopher Jeffery that offers a visual model for understanding the categories and types of functions. This model references and incorporates the discussions of Gorbman (1987), Prendergast (1992), Davis (2010) and Copland (2021) on the topic of film music’s functions.



(Jeffery, 2017 p.56)

I use the architecture of this list of functions to evaluate ways in which the ARO provides an opportunity to add to the creative and sonic possibilities of music in the context of accompanying a film.

4.6.1 Technical functions

I interpret this category to represent techniques and methods for making sequences of scenes and an entire film more cohesive by way of thoughtful transitions and overarching themes and sounds.

4.6.2 Create continuity between scenes

Sub-bus and master bus applications can create continuity between scenes and the entire film. Additionally, unique soundscapes can be representative of key locations and timeframes within a story, and their recurrence can weave together the meaning between scenes adding to the story arc. Purposeful effects such as reverb or delay tails, or EQ sweeps can help transitions feel more natural and cinematic as scenes are transitioning. Specific sounds, textures or processing associated with recurring characters can weave scenes together in an effective way. Furthermore, unique sounds or textures that are unusual or startling can help a scene pivot to a new feeling or emotion, setting up the next moment in the film. With the expanded palette of sonic sounds and gestures, there are additional opportunities to audition musical transitions that serve the storytelling as sequences of scenes progress.

4.6.3 Create continuity of entire film

Granular processing offers the opportunity to repurpose a previously used cue later in the film, but processed into textural granules, essentially creating the equivalent of an impressionist painting version of the original cue. This technique is an instance of variation, which builds continuity without being repetitive. Another example of variation is using alternate instrumentation with variable processing on a recurring cue. Another way to create continuity across an entire film is to apply processing to the sub-bus and/or the master bus. This has the potential to color the entirety of the soundscape in a uniform way across the entire film, this is the same conceptual approach as the color tints in various scenes in the film *Traffic (2000)*– there is symbolism and consistency with the way that the entirety of the visual is tinted, and it contributes to a feeling of continuity across the entire film. One other instance of continuity is in creating signature sounds for characters or places and having them recur throughout the film. This is a basic principle of film scoring with recuring musical themes, but the same can apply and be effective in the domain of unique sound.

4.6.4 Create transition between scenes (physical)

Having control over the decay of sounds, whether through expansive techniques like reverb, delay feedback loops, granular explosions into a mist of sound, or abrupt stops by way of EQ, volume automation, pitch shifting, etc. opens a new realm of creative possibilities as to how a transition can occur.

Additionally, having the quality and timbre of sounds remaining relatively static throughout a cue, but then automating timbral changes by way of effects at the transition can offer new approaches to the changing scene. In M5 Alarm I process the final moments of the cues through extreme feedback, granular synthesis and a massive textural room reverb to control the decay of the ending and help the cue finish in a musical way, coordinated to the picture.

4.6.5 Create transition within scene (dramatic)

Pitch shift placed on a single instrument, or a bus offers a technique for implementing a dramatic transition between scenes by shifting the entire mix down to a stop, or up into key from silence like a record player being turned on. In M18 Blind Man I add a large room reverb and a space echo to the final pizzicato hit of the double bass in the previous cue and then pulled down the high midrange frequencies between 1kHz and 5kHz about 6-8db, making the sound feel distant and hollow. This might have otherwise been executed with a volume fade, but instead I changed the timbre of the sound to cue the viewer that a transition was occurring. Similarly, in M15 Chaise Lounge I found that the entrance was too abrupt, so I added an EQ effect and performed a filter sweep to help the dynamics of the crescendo feel more animated. Initially the cue has most of the low end carved out, but when we see the woman on the poster come to life the low end emerges supporting her movement and the transition into the next scene. This kind of specific scoring adds precision and character to the gestures that support transitions from scene to scene. Another example is M11 Lava Flow in which we see a mud slide that flashes on-screen seemingly randomly, and later we similarly see the image of a toilet that momentarily appears. For these moments I followed the timing of the cuts and implemented fragments of the Synthesis Quartet, which has low sludgy-sounding sonic characteristics with the intention of supporting the transition in an onomatopoetic way.

4.6.6 Physical functions

This category represents the ways in which the score connects the viewer to the time, place and physical action occurring in a film.

4.6.7 Intensify the action

Additional depth, dimension and movement can make things seem bigger and more extreme. Saturation creates more aggressive and violent sounding timbres and can therefore influence the intensity of an ensemble/composition. EQ creates opportunities to intensify action, as the composer can automate increases in frequencies at strategic times that crescendo either the high end or low end of the sound, resulting in a rush of energy and excitement. Panning can create movement that mirrors the actions of a character or event on screen, intensifying the action. The effects offer new opportunities to turn orchestral sounds into new sonic phenomena that can mirror the images or moments in a film by way of onomatopoetic visual accompaniment. One example of this is in Quintet 4 as it is paired with M13, Imperial Rome in which we see buildings exploding and I orchestrate massive reverb clouds to accompany the visual of the plumes of smoke resulting from the explosions. Another example is the use of Quartet 1 in M23, where the man slaps the mother and the EQ and distortion are turned on in that moment, coloring the gesture in a distinct way.

4.6.8 Represent location

Certainly, in the realm of sci-fi and fantasy, or surrealistic fictional worlds this augmented orchestra could help evoke a space away from the organic natural world. Considering location within the physical space of the image, panning is another way to think about location, as sounds and musical gestures could literally be located to the right or left and move across the screen with characters or artifacts in a film. From my own surrealist score the location is less a physical one and more a conceptual one, a surrealist location that transcends norms of time, space and logic. As the L'Age d'Or concept included the feeling of mirroring a dream state, the physical location can be that of the dream mind, and can purposefully break rules and explore new sonic ground. In M21 Party from my score we find ourselves at a fancy party, and the music is elegant and supports that location appropriately, but Bruñel periodically injects images of trashy, vulgar, terrible people to contrast the high society scene, and in those moments I used effects processing be it EQ sweeps, feedback loops, or extreme saturation to interrupt the essence of the elegant music and draw attention to the contrast.

4.6.9 Set time period

Applying these effects to instruments could create a futuristic sound. Using creative application of EQ filters, subtle tape saturation and chorus can make sounds appear to be recorded in a previous era, emulating microphones run through tape machines with limited frequencies.

4.6.10 Psychological function

This category addresses the ways in which a score functions to create a psychology of the film and/or characters, reveal unspoken thoughts and feelings, create and fulfill audience expectations and influence the emotion of the viewer generally.

4.6.11 Establish psychology of film or of characters

When effects like chorus are added to instruments or buses with extreme settings they can represent disorientation, uneasiness, or tension with the dissonance of the resulting timbre. Tremolo can emulate the sensation of trembling, and phaser can create dizziness. All these effects have the potential to change the way the viewer feels as they experience the film. An example of using the ARO to reveal the nature of the film is in M14 Surrealist Prison Stroll in which a man is kicking a violin down the street as he walks. I feature a string cue here with heavily processed saturation, creating a gritty and dissonant timbre that functions as a sonic representation of the absurdity of this moment in the film. One more example in this vein is M13 Imperial Rome in which we see buildings randomly blowing up, accompanied by a card reading, “The diverse and picturesque aspects of the great city!”. To highlight the absurdity of this contrast I copied a fragment of a previous cue and processed it through heavy reverb to pair with the dust spewing out of the destroyed buildings. This use of effects to mirror the visuals in an onomatopoetic way is an example of the functionality of the ARO in this domain. One more example of mirroring the psychological state of the characters is in M8 Bandits in which we see the bandits wandering across the landscape and as they appear to become weary, and their situation seems to be especially dire the cue becomes heavily processed with effects. The unusual sounds of the ARO pair nicely with a feeling of disorientation.

4.6.12 Reveal unspoken thoughts and feelings

A character’s inner dialogue could certainly be represented as intoxicated or delusional with the implementation of effects on their motif. Similarly, it could be contrasted with other characters’ motifs being represented with no effects. One could also work on a spectrum, having a character’s motif begin dry with no effects and gradually become more and more processed through effects as the story impacts their perspective and mindset. The more subtly this could happen the more effective it would be.

4.6.13 Create audience expectations

With the ability to create a sonic texture out of any individual instrument, ambient soundscapes can become representative of different cinematic places, characters or actions, and once these are established, their emergence later in the film can signal the audience that a recurrence is imminent. Similarly, unique sounds can be associated with elements of the film and recur throughout a film, building the viewers expectations. In M14 Surrealist Prison Stroll a man is being dragged around the city by prison guards, and the woodwind quintet is repeating an anxious, persistent and repetitive figure that gives the impression that this moment is filled with chaos and moving toward some kind of disaster. Some of this feeling of chaos is the result of the woodwinds being processed through delay effects along with the metal percussive hits.

4.6.14 Fulfill or upset those expectations

In the cue that I noted in the previous section, M14, that persistent, anxious woodwind cue points toward a feeling of chaos and tension, and instead of leading to a crescendo, or a peak point of tension, the man glances at a poster and falls into a romantic dream state. At this point M15, Chaise Lounge overlaps in a wash with the M14 tension cue, and the audience is swept into a diametrically opposite mood and energy. The previous cue built an expectation that was then upset by this musical shift, and the texturization of the cues, as well as a subtle sweep in the EQ filter added to the musicality of the transition. As noted previously, the ARO can be particularly useful during scene transitions. These can often be moments of revelation where an expectation is fulfilled or upset, and the ability to use the ARO's expanded toolkit to maximize expressive potential in these moments supports the notion that it is an effective scoring tool.

4.6.15 Control viewer's emotions/demonstrate expected emotion

With more control over the ensemble and the timbres, the expressive capability of the instruments and group is expanded and consequently so is the ability to control emotion. More generally, these tools inspire different approaches and consequently outcomes to the creative process, and with additional inspirations comes further exploration into new sonic and compositional territory. New qualities of musical texture create new emotional responses, and the ARO offers a vast array of options to explore. As a rule, any way in which the ARO can make music more emotionally evocative is a way that it could control the viewer's emotions or demonstrate expected emotion. The ability for string players to perform vibrato is a nuance that can enhance the expressive qualities of the instrument, and with tremolo, which is a different but similar sounding effect, adding the possibility of that articulation to any orchestral instrument, an argument can be made that tremolo offers new avenues to creating emotional music. Similarly, the ability to pitch shift instruments expands the limitations of range for instruments that traditional orchestrators must abide by, and with this expanded set of possibilities comes the potential for more emotionally expressive results. In Duet 14 I explore the idea of bringing in effects in a subtle and gradual way so that the listener does not realize they are present right away. Manipulating perception in this way is an interesting approach to subconsciously influencing the experience of the viewer. Similarly, in Duet 15 this happens in a textural domain, easing in subtle changes to the underscore soundscape, having it evolve over time, and moving the processing in and out, creating different variations of the drone that all support this same function.

4.7 Implications for game music

Performing the parameters of an effect over the course of a composition relates to dynamic music used in video games, which essentially has parameters like pitch, tempo, etc. that can be variable so that a piece of music can repeat and stay fresh. Music has the ability to influence our perception of a character, as Luan Ferreira Araújo explores in *Resonant Icons: The Role of Music in Shaping Video Game Characters*:

> The characters are normally images, still or moving, presented through the computer screen and captured by our eyes; while music is, essentially, soundwaves captured by our ears. However, a song can emphasize certain features of a character depending on many factors, such as its tempo or the instruments used, evoking certain physical characteristics of this participant of the narrative, which would normally be captured by our eyes.
>
> (Araujo, 2024, p. 13)

With an expanded musical pallet of the ARO, there are more approaches and possibilities for enhancing and clarifying the perception of a character at any given moment. Additionally, different versions of the same musical composition can be presented when the character of the game is in different situations. *Game Sound* elaborates on this:

> The example I used was from *Super Mario Bros.*, in which the music's tempo increases when the timer in the game begins to run out. Koji Kondo (2007), the composer of the *Super Mario* series, has described four components of dynamic music:
>
> 1.The ability to create music that changes with each play through;
>
> 2.The ability to create a multicolored production by transforming themes in the same composition;
>
> 3.The ability to add new surprises and increase gameplay enjoyment; and
>
> 4. The ability to add musical elements as gameplay features.
>
> (Collins, 2008, p. 14)

This is one way in which the research gathered in this project could potentially be utilized by parallel fields, to be incorporated into or to inform arrangement decisions in dynamic game music. For example, a single composition could be processed through a myriad of different effects to change its essence on repeated playthrough, or performing effect parameters could happen at different rates or in different ways to make each repetition unique.

4.8 Concluding remarks

Orchestration choices have traditionally been made based on the acoustic and mechanical limitations of the instrument in the context of the problem that needs to be solved. Because these limitations are gone, or much reduced, in the ARO context, there are more choices, and those choices can be made by way of different motivations. For instance, the orchestrator can choose a timbre based purely on a desired instrumental sound and not worry about its other qualities that might conflict with the function or role that it plays in the arrangement. Within the context of this sound selection, the possibilities are expanded significantly because the effects can change the essence of a sound, which can be manipulated and modified in several directions by the effects, so now for each individual sound there is an entire palette of sonic variations that its timbre can become, and that is just within the realm of individual instruments. As ensembles are created by combining groups of digitally processed instruments the timbral possibilities exponentially expand. After composing the pieces for this project and then sitting down to score *L'Âge d'Or*, I found myself starting with a choice about a specific sound and how I could augment its timbre. Then as I approached the next phase of adding a second and third instrument, I remained in the domain of sound, looking to design a sonic aesthetic, and using the digital effects to manipulate the functionality of each sound in the context of the arrangement to fulfill the strategic and functional principles of acoustic orchestration, i.e.: achieving back, middle and foreground, achieving balance across the ensemble, building expressive dynamics into the composition, creating and developing a rhythmic motif, etc. A snare can be textural, or melodic or harmonic, and a flute can be aggressive and percussive, for instance.

Writing parts for the ARO generally abides by the rules of idiomatic writing, but with some exceptions. Idiomatic writing has several components, including writing for correct range, and exploiting the timbral color of these ranges. It also covers playability, in the sense of knowing what type of writing works well or is possible or impossible for specific instruments. These elements remain relevant even in the ARO context, as the player produces the sound pre-effect. Sometimes the sounds that the instrument creates in the ARO are ones that would never otherwise be made because they are for instance at times too quiet to be audible, or sound too ugly on their own, but after processing they are usable. With the use of the pitch shift effect, any sound can be transposed up or down, both extending the flexibility of the instruments in terms of the playability of parts and expanding the possible range. For example, an instrument might play the highest note in its range, which is then pitch shifted up an additional octave, or play the lowest note in its range, which is then pitch shifted down. With further exploration on the topic, performance techniques could develop based on ways to perform that pre-effect signal that would maximize the expressive impact of the post-effect sound. This study does not include a detailed assessment of performance practice of each instrument, but this is an area for potential future research.

Due to the exponential sonic possibilities introduced by ARO processes, it is not possible to exhaustively categorize all the possible timbral modulations, but the framework of ARO theory presents a scaffold for approaching and managing these possibilities in a methodical and constructive manner.

Conclusion

Introduction

I will begin by answering my research sub-questions and use this as a basis for addressing the primary research question. I will then situate the completed study and its implications in the context of past and future research.

Research sub-questions

1. What are the expressive, aesthetic, and ideological implications of processing orchestral music in the 21st century through digital effects, and what technical and conceptual techniques lend themselves to achieving this processing?

Regarding expressive and aesthetic implications, digital effects expand the horizons of expression and aesthetic quality in orchestral music through movement, multidimensionality and endless timbral variety. The orchestra through digital effects has the potential to blossom and expand into new ways of thinking about orchestral music, arranging and the potentially radically innovative aesthetics and style of that ensemble. There are potential real-world implications of this development. In my study I develop concepts from the classical world and use them in the context of writing for film music, but if these techniques became standard in the concert hall, they could potentially revive the orchestra's image for a new generation.

2. What challenges are presented when monitoring effected instruments in a performance setting, and what solutions are there?

Some technical limitations and strategies were identified in the domain of engineering including mic placements, monitoring and feedback concerns. Typically, the arrangement of the monitors and the microphones take careful thought in a live performance setting of this kind. Directional mics that are placed as close as possible while also capturing the ideal acoustic sound of the instrument is the ideal engineering approach. Additionally, it is important to closely monitor the gain-staging which includes the volume level of the preamp that is determining how loudly the mic is picking up the instrument as well as the gain level being implemented by the effect. Controlling and limiting the final output gain stage of the signal proved to be especially important when signals were being processed through compressors or distortion/saturation effects which naturally make the sounds more aggressive and louder. Additional strategies were developed including how to sequence multiple effects and applying effects to sub or master busses.

3. What theoretical foundation can be developed for the application of effects on orchestral instruments in a film composition context?

I developed ARO as a practical framework for making sense of the extensive possibilities in the domain of combining the orchestra and effects. The methodological process of exploring with each instrument individually, and then in increasing numbers aimed to establish a research foundation on which others can build. The project identifies the four central ways that digital effects change the way we approach orchestration and compositions. Then it goes through each of the effects and describes specific applications, techniques, and style choices for implementing processing with the outcome of these four categories in mind. Secondly, it offers a glimpse into the process of experimenting with these effects, and implementing them into a film score, mapping out the thought process and logic behind the choices with the goal of both fitting these compositions into a film score in a way that is tasteful and functions to enhance the film and narrative, and exploring how the Augmented Reality Orchestration Theory enhances the ensemble in those four main categories. My creative experimentations with ARO functioned as an attempt to make sense of the extensive possibilities in the domain of combining the orchestra and effects, and to serve as a starting point on which others can build.

4. How do the electronic effects change the impact and nature of the tones created from these instruments?

The orchestral instruments’ tones can be manipulated in a number of ways. The attack, decay, sustain and release of the sounds can be modified to impact the nature of the sound. Reverb and delay can create a three-dimensional sonic plane, making sounds seem closer or further away to different extents. Saturation and granular effects can make sounds seem otherworldly or texturize them. Pitch shifters and EQs can modify the pitch of any sound and remove or add gain to the frequency spectrum at any point. Effects like tremolo, flanger, chorus and phaser can change the timbral quality of a sound, making it sound thicker, underwater, warbly, or pulsing. These effects have the capability of changing the essence of the sounds themselves and can add depth and clarity to the whole sonic picture of an ensemble.

5. Could the Augmented Reality Orchestra become a live performance tool for film composers?

Further research is necessary to establish a better foundation for engineering and effectively monitoring the Augmented Reality Orchestra in a live performance context. During my limited experimentations recording, monitoring, and capturing live instruments being processed in real time, I did notice that hearing the effects as a performer improvised or performed written parts influenced their style, imagination, note selection, rhythm, and other aspects of the performance. In some cases, the performer's resultant sound was so obscured by effects that the inspiration was diminished, but in most cases the performers would get new ideas and explore new creative avenues in response to their instrument being monitored through effects. If a film composer uses players' instincts and style in an improvisational context to produce/develop the music, then the ARO techniques are useful. This would likely happen in smaller group writing sessions to develop the parts, as hiring an orchestra is expensive and taking time for exploring improvisation would be impractical. It could also function as a tool to inspire a player to lean into a performance with more passion or be inspired to adapt their artistic approach to a performance. Yet it will likely be more practical in most contexts to record an orchestra as an ensemble dry and apply the effects in post-production. The complexities are lessened with a smaller ensemble, and capturing small groups' live performance through monitored effects might be an interesting approach and sound. This study discusses orchestration and composition, and highlights the idea that if the effects are added in the writing stage, the writing changes to accommodate the effects. Then, in the performance/recording stage, the effects can be monitored or not, but the parts are written to be processed in that specific way, influencing the dynamics, articulations and style of the live performance based on the information in the score.

6. What are the expressive and tonal limitations of traditional orchestration practices, and how can effects expand upon those limitations?

As discussed earlier, the central goal of the Augmented Reality Orchestra theory is to identify limitations in the orchestra and expand upon them. Reverbs, delays, and granular synthesis can transform any sound into one with infinite decay, and quiet sounds like flutes or pizzicato strings can become louder than roaring trombones using saturation. Sounds can change and evolve across the course of a performance in an infinite variety of ways, instruments can wander around in a three-dimensional sonic space, and balance can be achieved through more tools than just dynamics and instrumentation. Sounds can be embellished versions of themselves or be changed so drastically that they are not recognizable, and where the sound ends up is a unique manifestation of the effect-performers' personal style. These are a handful of examples of ways in which the scope and potential of the traditional orchestra is expanded.

Primary research question

What technical and conceptual techniques can assist in the development of the expressive palette and narrative possibilities of 21st-century orchestral film music processed through digital effects?

In this study I identified the expressive and technical goals of film music, and the limitations of the traditional orchestra. I then experimented with the application of digital effects to push through these limitations with a focus on serving the function of effectively scoring a film. This led me to an exploration of ways to approach the collective sound of a digitally processed ensemble, and a search for techniques that inspired new ways of writing and arranging. The expanded set of tools that the ARO presents enhanced my creative, aesthetic, and spatial possibilities which bolstered my capabilities in the domain of writing expressive, compelling music for film. The combination of the legacy of the traditional orchestra, which is woven into the fabric of listeners expectations of Western film music and the more contemporary sound of digital effects tied historical methodologies to new practices and established a way to approach implementing these sounds into scenes. All the ways that film music contributes to the expressive impact of a film were expanded and enhanced by way of the ARO. With the enhanced capabilities of creating more multi-dimensional soundscapes, and having additional control over the sounds themselves, I found myself less limited from a logistical or technological perspective, and consequently more open to be creative and imaginative. There is a problem-solving component resulting from EQ, compression, pitch shifting, and reverb that is as important to the processes of a film composer as is the expanded timbral possibilities of each instrument. Next, I will review the centerpiece of my research, which is the four ARO principles.

Timbre expansion is first, and it includes extensive experimentation in the domain of sound and sonic aesthetics. I review ways in which each effect can influence timbre and essentially make any acoustic instrument transform into almost any other sound. Effects applied in subtle ways still sound like the original instrument but with slight enhancement, while effects applied in extreme ways can make an instrument unrecognizable. The existence of this spectrum on which a creative composer can choose their path according to their style is an example of the infinite timbral variety that the implementation of these effects offers.

In the domain of movement, I discuss automation or second-order performance as a way that sounds change and evolve over the course of a piece. Multiple layers of effects can be processed by a single instrument, all of which could be morphing and changing throughout the piece, all collectively influencing the resultant sound. Again, the sequencing and interaction between multiple effects, all of which are influencing the final sound, is another spectrum of infinite variety that offers new creative choices that can be made. Effects can be applied to the entire ensemble, or to selections of instruments, which adds another layer of possibility in terms of how the effects shape the composition. Dimension refers to the introduction of the left/right and near/far special continua using panning and reverb/EQ. Balance discusses the way that these tools offer new avenues and approaches to achieving balance in an ensemble despite the vast scope of what the ensemble could potentially sound like. Balance focuses on problem solving, and using these tools to repair specific issues of balance that might arise as a result of the effects.

With more control over the individual sounds, and the soundscape itself, film composers can use the ARO as a tool for implementing the richly emotional and evocative sounds of the orchestra in ways that are exciting and sonically unique. This enhances the expressive capability of the ensemble and supports the film in a more effective way.

Implications of the study

This study offers a theoretical first step in the field of orchestration in the context of orchestral instruments being processed through digital effects. This project has functioned to document my specific creative process and establish a collection of techniques and theoretical concepts to support artistic direction and the development of the Augmented Reality Orchestra as an effective tool for writing a film score. This project has demonstrated that there was a problem that needs to be solved, while some genres use effects frequently this is by no means commonplace in orchestral music. I have explored and documented a collection of concepts and musical techniques that have the potential to assist composers' film scoring practices. Others can adopt this terminology and adapt as required to suit their own styles, film scores, or expressive requirements.

Relationship to the field

As far as I have explored, this is the first study on digital effect processing on acoustic orchestral instruments with a specific focus on how it influences orchestration and film composition. As noted in my literature review, there are numerous shows and films that are beginning to implement digital effects with orchestral instruments in their scores, many of which are writing with this same palette and facing similar stylistic and aesthetic choices that I came across during my exploration. Thus, there is a need to explore the field systematically rather than piecemeal, hence the value of this study to this burgeoning creative field. As traditional theatrical release models for films have transitioned to streaming platforms there are more stories to tell, and there is more opportunity to use music in new and inventive ways. This opportunity for new approaches to sound and scoring motivates my work to analyze the different ways that we can use and think about digital effects as they process orchestral instruments.

Limitations of the study

This study does not extensively explore live performance that is processed and monitored, and only offers an initial exploration of the complexity of engineering an ensemble in that context. Many of the examples require a DAW to execute the techniques, and though a live performance of each of these compositions would be possible, it would certainly be logistically challenging. I tried to select instruments that are most used in orchestral ensembles and use MIDI sounds and effects that sound the most authentic, but there are personal choices being made at every step of the process that inevitably link this study to a specific writing experience with a focus on developing a selection of general principles and techniques.

Suggestions for further research

Further exploring the application of these principles in a live performance context would be a relevant next step in the research. Additional experiments with different composers writing and journaling with the same palette could add additional insight, techniques, and conceptual approaches to the body of knowledge on the topic. It is hard to unravel the relationship between my unique writing experience and the conceptual and technical data gathered, so consequently I imagine that a different writing style and experience would inspire new and different ways of thinking about it. I suggest a study that explores and analyzes the ways that digital effects have been used in film scoring, and how the techniques used align or contrast with the Augmented Reality Orchestra theory principles.

Concluding remarks

This study has encouraged me to expand my horizons as a composer and orchestrator, and after writing 44 short form, and 14 long form compositions with this palette I feel I have a grasp for the ways in which the ARO toolkit supports a freer and more expansive creative process. The introduction of several new dimensions within which we can place and explore the infinite variations of orchestral sounds supports a more immersive and compelling sonic landscape and experience, and with the added movement of automation, the sounds can transform in a dynamic and musical way to support their film scoring function. One of the central themes in this study is the identification of expressive possibilities that the traditional orchestra cannot access, leading to a creative brainstorm exploring ways that digital effects can push through these dead ends, with the goal of supporting artistic vision and encouraging creativity in the context of scoring films. I hope that composers continue to write for the Augmented Reality Orchestra, and that the insights and techniques gathered here encourage authentic expression and can support the artist's vision.

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Appendix A
Individual instruments with applied effects

For an audio reference of this research, all recorded samples are available at the following YouTube link: https://youtu.be/Ymr_XHsPdCE, which is 12 hours long. Each instrument plays through each articulation while processed with an effect, then starts the articulation list again with the next effect, and so on. For example, sample one is the Piccolo, and the timecode breakdown for the division of effects is as follows:

1. Dry - 00:00
2. Chorus - 02:41
3. Delay - 05:25
4. Granular - 08:12
5. Panning - 11:18
6. Phaser - 14:00
7. Pitch Down - 16:47
8. Pitch Up - 19:31
9. Reverb - 22:18
10. Saturation - 25:25
11. Tremolo - 28:10
12. Wah - 30:52

Below is a list of the timecodes that associate with each instrument in the research set, each of which is roughly thirty minutes long.

1.Piccolo 00:00

2. Flute - 34:09

3. Alto - 68:30

4. Bass Flute - 103:07

5. Oboe - 137:38

6. Cor Anglais - 171:46

7. Clarinet - 206:03

8. Bass Clarinet - 240:34

9. Contrabass Clarinet - 273:58

10. Bassoon - 307:06

11. Contrabassoon - 340:47

12. Horn - 371:57

13. Trumpet - 405:53

14. Tenor Trombone - 439:50

15. Bass Trombone - 473:38

16. Tuba - 507:26

17. Timpani - 541:40

18. Crotales - 546:38

19. Glockenspiel - 551:49

20. Tubular Bells - 557:17

21. Xylophone - 562:50

22. Marimba - 567:58

23. Vibraphone - 573:07

24. Celeste - 577:47

25. Piano - 582:21

26. Harp - 586:57

27. Violin - 591:29

28. Viola - 625:23

29. Cello - 659:20

30. Double Bass - 693:19

Appendix B
Overview of effects

In the following section I will list the different types of effects and give a short explanation as to what they sound like and how they are created. The list will cover the most commonly used effects, which are also the ones that were used in my research.

Reverb: “A Sound processing device that simulates natural acoustic reverberation by mechanical or electronic means" (Grove Music Online, 2024).

In the realm of timbre, reverb certainly has the potential to color the timbre of the instrument and make it sound different in several ways creating interesting decays. When applied to multiple instruments in an ensemble it can create textures, and the tonal color of those textures can be controlled and refined. Typically, you can control decay time, mix percentage, and pre-delay, which is the amount of time between when you hear the original signal source and when the reverb effect begins. It is also common for reverb effects to have controllable parameters that modify certain frequency ranges so that you can shape the nature of the timbre most commonly to add or remove brightness. There are several different types of reverbs as well in both the digital and analogue realm. Mechanical analogue reverbs include spring reverb, which uses an interaction with an actual spring to create reverberance, and plate reverb, which sends the audio signal through a large thin sheet of metal and captures the vibrations created by the sheet. There are physical space reverbs that are either created by capturing sound in a physical space, or by digitally modelling a physical space, which is called a convolution reverb. Additionally, there are algorithmic reverb that use mathematical algorithms to create reverb.

Delay: “An electronic device which projects overlapping signals – i.e., a sound played directly, that same sound delayed by a small number of milliseconds, and that sound again some several milliseconds later; the delay can range to as much as several seconds, and the reproduced signal may be layered upon itself numerous times by means of a feedback circuit” (Gilbert & Kernfeld, 2003).

Delay has the potential to impact the timbre of a sound, or our perception of a sound if the repeats are close enough to the fundamental sample, for instance slap back delays, or delays that emulate tape echo change the way a sound is perceived. Delay effects usually have mix parameter controls, echo time, which is how much time separates the repeats, feedback, which is the length or number of repeats, and some frequency modification like low and high cut parameters. Some offer the ability to tempo sync, or tap tempo, and then to change the groove and feel as well.

Saturation: "Saturation is a combination of two distinct but related effects – soft knee compression, and harmonic generation. Saturation occurs when a signal's input can no longer be matched by the output in a linear fashion; it can be used as a creative and sonically pleasing effect during audio production" (Sage Audio, 2024).

In the context of timbre, this effect functions in several different ways, the simplest of which is adding bite or attack to sounds to make them more pronounced, present, or energetic. Usually, the main parameters on saturation effects are drive and level. Often there are preset tonal options, and the ability to apply EQ modifications to change the timbral character. They have a mix parameter as well.

Chorus: "An electronic treatment that transforms the sound of a single instrument or voice so that it approximates to the sound of many instruments or voices playing in unison" (Grove Music Online, 2003a).

This is achieved by doubling the signal of the initial performance but slightly shifting the pitch and timing, creating a thickness and warmth to the resulting sound. From a timbral standpoint, on one end of the spectrum chorus adds a little bit of body, warmth, movement and presence to a sound, and on the extreme end it can sound warbly, detuned and like a vibrato or tremolo effect. Chorus usually has a rate parameter which sets the frequency of the LFO which is modulating the signal, a depth parameter which determines how deep the sweep of the sound will be, and delay which is also like intensity, it determines how much of the delayed copy is mixed with the original sound source. Some chorus pedals have EQ shaping tools and feedback parameters as well.

Tremolo: “The tremolo effect is reminiscent of the sound common to the classic guitar amps of the 1950’s and 1960’s. While its sound is somewhat like the flange’s watery tone, the tremolo produces an even more pronounced underwater effect” (Brewster, 2003).

Tremolo is an effect that makes an instrument sound like it is trembling by making drastic shifts in volume. A tremolo arm on a guitar creates a similar effect by bending the strings and creating shifts in the pitch. The sound is like vibrato as we are used to hearing on stringed instruments, but that effect is created by slight pitch modulations as well. For this project I focus on the first example, tremolo that essentially turns a volume signal off and on at different rates to create a shaking sensation, or the sound of a voice talking through a fan. Tremolo effects typically have a depth or intensity parameter, which changes the amplitude of the LFO, or low frequency oscillator, which is an oscillator lower than 20Hz that creates a pulsing, rhythmic modulation of a sound parameter. Tremolo also has a rate or speed parameter, which controls the frequency of the LFO, changing the speed of the wobble.

Phaser: “An electronic device that transforms the timbre of an instrument or a voice by superimposing on the original sound a copy of it, the phase patterns of which are altered. It is closely akin to a flanger and can produce a similar effect” (Grove Music Online, 2003b).

A phaser effect essentially creates peaks and valleys in the frequency spectrum and moves them over time, creating a washing movement sensation. I chose not to use phaser very much in this project, but I did choose to emulate the function of the effect by performing these swells with an EQ effect. Phaser typically has a speed or rate function, controlling the frequency of the LFO and changing the modulation speed. They usually have a width parameter controlling the range of frequencies that the sweeping phase-shifting will pass through. Feedback or resonance is another common parameter, controlling the amount of phase shifted signal that gets processed again through the same circuit.

Pitch shift: Pitch shift is an effect that changes the pitch of an instrument by a selected musical interval. Typically, this results in a shortened duration for the sample as the audio is sped up to achieve the increased pitch interval. The timbre of the pitch usually stays unaffected within a certain interval range from the original sample and then as it strays too far begins to get distorted and unrecognizable. The timbral effect can be desirable in some musical contexts, and different types of pitch shifters have ranges larger than an octave within which the pitch can shift and still sound like its original sound source. Pitch shift effects always have a pitch option, giving you the ability to change pitch by semitones, or sometimes in cents. There is sometimes a formant option, which allows for the timbral characteristics of a pitch shifted sound without needing to change pitch. There is a mix parameter too, typically.

Granular processing: Granular processing is the process of slicing a piece of audio into tiny fragments and then looping them, creating a mist of sound from an original sound source. I used this effect on a spectrum, on one end it added a slight shimmering effect and subtle harmonic embellishments, and on the other it creates a wash of sparkly texture in an instant. The rate of the looping is variable, as is the size of the splice, and performing both parameters creates an opportunity for movement and added dimension in a composition. There is also a feedback component that can be automated to create washes of sound or entire soundscapes if the parameter is increased far enough. Granular effects usually have a mix parameter, a pitch parameter, allowing you to change the pitch of the spliced repeats. They typically have a splice parameter, which allows you to determine how small the fragments of sound will be, and a delay parameter, which determines the timing of how the repeats will present themselves. Finally, there is a feedback/recycle parameter to create textural manifestations of the sound.

Wah: "An onomatopoeic term derived from the sound created the regular boost and cut of treble frequencies. It is applied to devices which produce this effect, notably the Harmon mute for the trumpet and trombone, and to a signal processor unit generally operated by means of a foot pedal" (Grove Music Online, 2002).

The wah effect creates an EQ sweep across the frequency spectrum. This effect, like the phaser, was not used a lot in this project, but is essentially the same as the manual EQ filter sweeps that I used as one of my primary techniques. The wah effect creates a distinct and recognizable change in timbre to any instrument by performing fast sweeps across the spectral range. When implemented at any speed parameter, the resulting movement adds energy, character and added depth to a performance. Wah pedals usually have two positions, on and off, but digital plugin versions of the effect have equalization shaping options and mix parameter as well.

Equalization (EQ): “An electronic device that enables a sound to be shaped by amplifying or removing one or more areas of its total sound spectrum” (Davies, 2001).

EQ is simply the ability to control the frequency spectrum. As a tool, EQ could serve every individual instrument track in a multitude of ways. In the realm of timbre, I often create a sound using effect chains and then carve out unwanted frequencies whether they are muddy low end, or harsh harmonics that are feeding back. EQ parameters usually include the ability to shape the Q, which determines whether the selected frequency bump will be, on one side of the spectrum bell-shaped, and on the other, narrow like a pin. The other two parameters that you can control with an EQ effect are gain and frequency.

Panning: Panning is the process of placing sounds on the left/right spectrum in a stereo listening environment. In a traditional orchestra, the sections are strategically positioned on stage so that the resulting ensemble will achieve balance. In music production each instrument can be placed anywhere from 0 to 100 on either the left or right side. This tool can help balance an ensemble and change our perception of the relative volume of the different instruments. As an effect, panning can be automated or performed so that sounds move across the left/right spectrum throughout a piece, or at strategic times, which is something that would be a comical challenge to achieve in a live orchestra setting. Slow panning can create movement in a composition, and fast panning can create chaos and energy. Panning effects like auto-pan can control the width of the movement, the rate of the movement, and the offset between the left and right side.

This is an introductory review of these effects. Later this thesis will explore the multiple phases of experimentation and composition, all of which center around the discussion of the implementation of these effects. More information on their use and function, especially in the realm of orchestration will be explored throughout this project. I will now move on to the methodology portion of this study.

Appendix C
Effects and parameters used in film score cues

The following reference table that provides which effects and settings were used on the orchestral instruments in the film score. This reference aims to reveal the combinations of effects that produced the sounds for a listener/analyst but also provides all the information that a performer needs to recreate the sounds featured in the score.

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
M1: Title Screen						
Bass Flute	Reverb	Mix: 100%	EQ	Narrow Q: -18 db at 750Hz		
		Pre-Delay: 20 ms		Narrow Q: -12 db at 2k		
		Decay: 19.69 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
M2: Scorpions						
Master Bus	Granular Synthesis	Mix: 100%	Reverb	Mix: 62%	Delay	Mix: 60%
		Pitch: 0 cents		Pre-Delay: 20 ms		Echo 1: 500 ms
		Splice: 1/8th note		Decay: 4 s		Echo 2: 300 ms
		Delay: 1/8the note		Mod Rate: 2.53 Hz		FB: 50%
		Recycle/FB: 25%		Mod Depth: 38%		Bpm: 120
M3: Mountains						
Alto Flute	Reverb	Mix: 100%	Reverb 2	Mix: 61%		
		Pre-Delay: 20 ms		Pitch Shift		
		Decay: 4 s		Decay: 91%		
		Mod Rate: 2.53 Hz		Size: 50%		
		Mod Depth: 38%		Mod Rate: 15%		
				Mod Depth: 30%		
Horn						
	Reverb	Mix: 100%	Reverb 2	Mix: 61%		
		Pre-Delay: 20 ms		Pitch Shift		
		Decay: 4 s		Decay: 91%		
		Mod Rate: 2.53 Hz		Size: 50%		
		Mod Depth: 38%		Mod Rate: 15%		
				Mod Depth: 30%		
Violin	Reverb	Mix: 36.9%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Cello	Saturation	Mix: 5%				
		Drive: 60%				
		Level: 50%				
M4: Barracks						
Bass Clarinet	Saturation	Mix: 100%	Reverb	Mix: 100%		
	In: :18 Out:32 In:52 to enc	Drive: 50%	In: :18 Out:32 In:52 to enc	Pre-Delay: 20 ms		
		Level: 50%		Decay: 4 s		
				Mod Rate: 2.53 Hz		
				Mod Depth: 38%		
Contrabass Clarinet	Reverb	Mix: 61%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
M5: Alarm						
Trumpet	Granular Synthesis	Mix: 55%				
		Pitch: 1200 cents				
		Splice: 1/8th note				
		Delay: 1/8th note				
		Recycle/FB: 45%				
M6: To Arms						
Contrabass	Reverb	Mix: 100%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
M7: Hippopotamuses						
Flute	Granular Synthesis	Mix: 100%				
		Pitch: -1200 cents				
		Splice: 1000 ms				
		Delay: 1000 ms				
		Recycle/FB: 45%				
M8: Bandits Climb						
Cor Anglais	Tremolo	Depth: 40%				
		Groove: 50%				
		Feel: 50%				
		Accent: 1/8th note				
		Rate: 120bpm				
Tuba	Chorus	Intensity: 50%				
		Depth: 50%				
		Rate: 65%				
		Level: 45%				
M9: Boats						
Alto Flute	Reverb	Mix: 100%	Reverb 2	Mix: 61%		
		Pre-Delay: 20 ms		Pitch Shift		
		Decay: 4 s		Decay: 91%		
		Mod Rate: 2.53 Hz		Size: 50%		
		Mod Depth: 38%		Mod Rate: 15%		
				Mod Depth: 30%		
Horn						
	Reverb	Mix: 100%	Reverb 2	Mix: 61%		
		Pre-Delay: 20 ms		Pitch Shift		
		Decay: 4 s		Decay: 91%		
		Mod Rate: 2.53 Hz		Size: 50%		
		Mod Depth: 38%		Mod Rate: 15%		
				Mod Depth: 30%		
Violin	Reverb	Mix: 36.9%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
		Mod Depth: 38%				
Cello	Saturation	Mix: 5%				
		Drive: 60%				
		Level: 50%				
M10: Love Mud						
Violin	Saturation	Mix: 100%	Delay	Mix: 25%		
		Drive: 60%		Echo 1: 500 ms		
		Level: 50%		Echo 2: 300 ms		
				FB: 55%		
				Bpm: 120		
Cello	Saturation	Mix: 100%	Reverb	Mix: 21.4%		
		Drive: 60%		Pre-Delay: 20 ms		
		Level: 50%		Decay: 4 s		
				Mod Rate: 2.53 Hz		
				Mod Depth: 38%		
M11: Lava Flow						
Alto Flute	Filter	Drive: 7				
		LFO Rate: .25				
		Cutoff: 500 Hz				
		Resonance: 7				
		Mix: 100				
Cello	Filter	Drive: 5				
		LFO Rate: 5.5				
		Cutoff: 500 Hz				
		Resonance: 6				
		Mix: 100				
Horn	Filter	Drive: 7				
		LFO Rate: .3				
		Cutoff: 750 Hz				
		Resonance: 0				
		Mix: 100				
Contrabass	Filter	Drive: 6				
		LFO Rate: .25				
		Cutoff: 300 Hz				
		Resonance: 7				
		Mix: 100				
Master Bus	Filter	Drive: 9				
		LFO Rate: .5				
		Cutoff: 20kHz				
		Resonance: 5				
		Mix: 100				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
M12: Detained						
Flute	Granular Synthesis	Mix: 20%	Reverb	Mix: 33%		
		Pitch: 1200 cents		Pre-Delay: 20 ms		
		Splice: 1000 ms		Decay: 4 s		
		Delay: 1000 ms		Mod Rate: 2.53 Hz		
		Recycle/FB: 45%		Mod Depth: 38%		
Horn	Delay	Mix: 65%				
		Echo 1: 500 ms				
		Echo 2: 300 ms				
		FB: 55%				
		Bpm: 120				
M13: Imperial Rome						
Bass Flute	Reverb	Mix: 28%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Oboe	Reverb	Mix: 74%				
		Pitch Shift: 1200 cents				
		Decay: 91%				
		Size: 50%				
		Mod Rate: 59%				
		Mod Depth: 30%				
Trumpet	Delay	Mix: 65%				
		Echo 1: 500 ms				
		Echo 2: 300 ms				
		FB: 55%				
		Bpm: 120				
Tuba	Saturation	Mix: 45%				
		Drive: 60%				
		Level: 50%				
Glockenspeil	Granular Synthesis	Mix: 50%				
		Pitch: 0 cents				
		Splice: 1/8th note				
		Delay: 1/8the note				
		Recycle/FB: 25%				
M14: Surrealist Prison Stroll						
Tubular Bells	Saturation	Mix: 100%				
		Drive: 60%				
		Level: 50%				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
Master Bus	Delay	Mix: 65%				
		Echo 1: 1/4 note				
		Echo 2: 1/4 note				
		FB: 55%				
		Bpm: 92				
M15 Chaise Lounge						
Alto Flute	Delay	Mix: 65%	Reverb	Mix: 65%		
		Echo 1: 1/4 note		Pre Delay: 20 ms		
		Echo 2: 1/4 note		Decay: 91%		
		FB: 55%		Size: 50%		
		Bpm: 92		Mod Rate: 2.53 Hz		
				Mod Depth: 38%		
Violin	Granular Synthesis	Mix: 65%				
		Pitch: -1200 cents				
		Splice: 1/8th note				
		Delay: 1/8the note				
		Recycle/FB: 25%				
Violin 2	Chorus	Modulation Mode: 1	Reverb	Mix: 47%		
				Width: 100%		
				Delay: 300 ms		
				Feedbacak: 50%		
Tenor Trombone	Granular Synthesis	Mix: 100%	Saturation	Mix: 15%		
		Pitch: -1200 cents		Drive: 65%		
		Splice: 400 ms		Level: 50%		
		Delay: 300 ms				
		Recycle/FB: 75%				
M16: Cow in Bed	Chorus	Intensity: 35%	Reverb	Mix: 40%		
Xylophone		Depth: 0%		Delay: 16.53 s		
		Rate: 0%		Mod Rate: 2.53		
		Level: 45%		Mod Depth: 38%		
Harp	Delay	Mix: 50%				
		Echo 1: 500 ms				
		Echo 2: 300 ms				
		FB: 55%				
		Bpm: 120				
M17: Longing						
Contrabass	Saturation	Mix: 100%				
		Drive: 60%				
		Level: 50%				
Celeste	Granular Synthesis	Mix: 20%				
		Pitch: 0 cents				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
		Splice: 1/16th note				
		Delay: 1/8the note				
		Recycle/FB: 45%				
M18: Blind Man						
Clarinet	Tremolo	Depth: 100%	Reverb	Mix: 31%		
		Groove: 50%		Pre Delay: 20 ms		
		Feel: 50%		Delay: 4 s		
		Rate: 200 bpm		Mod Rate: 2.53		
				Mod Depth: 38%		
Marimba	Saturation	Mix: 100%	Graunular Synthesis	Mix: 45%		
		Drive: 60%		Pitch: -1200 cents		
		Level: 50%		Splice: 1/2th note		
				Delay: 1/8the note		
				Recycle/FB: 75%		
M19: International Goodwill Society						
Tubular Bells	Granular Synthesis	Mix: 100%				
		Pitch: -1200 cents				
		Splice: 2000 ms				
		Delay: 1000 ms				
		Recycle/FB: 60%				
Croatles	Granular Synthesis	Mix: 100%				
		Pitch: -1200 cents				
		Splice: 2000 ms				
		Delay: 1000 ms				
		Recycle/FB: 60%				
M20: Rome Estate						
Piccolo	Pitch Shift	Pitch: -12	Reverb	Mix: 35%		
		Formant: -12		Pre-Delay: 20 ms		
		Drive: 0		Decay: 4 s		
		Mix: 70%		Mod Rate: 2.53 Hz		
				Mod Depth: 38%		
M21: Party						
Master Bus	Saturation	Mix: 50%	Tremolo	Depth: 60%	Reverb	Mix: 54%
		Drive: 60%		Groove: 50%		Pitch: 1200 cents
		Level: 50%		Feel: 50%		Feedback: 0
				Rate: 80 bpm		Diffusion: 9
M22: Boy Fire Gossip						
Bass Clarinet	Delay	Mix: 25%				
		Echo 1: 1/4 note				
		Echo 2: 1/4 dot				
		FB: 55%				
		Bpm: 132				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
Bassoon	Delay	Mix: 65%				
		Echo 1: 1/4 note				
		Echo 2: 1/2 dot				
		FB: 55%				
		Bpm: 132				
Contrabass Clarinet	Delay	Mix: 65%				
		Echo 1: 1/4 note				
		Echo 2: 1/4 dot				
		FB: 75%				
		Bpm: 132				
Vibraphone	Delay	Mix: 50%				
		Echo 1: 1/16 note				
		FB: 0%				
		Bpm: 132				
Xylophone	Reverb	Mix: 72%				
		Pre Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
M23: Courtship						
Bass Flute	Reverb	Mix: 77%				
		Pre Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Trumpet	Tremolo	Depth 100%				
		Groove: 50%				
		Feel: 50%				
		Rate: 96 Bpm				
Viola	Delay	Mix: 50%				
		Echo 1: 500 ms				
		Echo 2: 300 ms				
		FB: 50%				
		Bpm: 120				
M24: Additional Longing						
Celeste	Granular Synthesis	Mix: 50%				
		Pitch: 0 cents				
		Splice:1/8th note				
		Delay: 1/8th note				
		Recycle/FB: 20%				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
M25: Escape to the Garden						
Violin	Delay	Mix: 50%				
		Echo 1: 1/4 note				
		Echo 2: 1/4 dot				
		FB: 70%				
		Bpm: 120				
M26: In the Garden						
Bassoon	Reverb	Mix: 33%				
		Pre Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Cello	Delay	Mix: 65%				
		Echo 1: 300 ms				
		Echo 2: 300 ms				
		FB: 35%				
		Bpm: 120				
Croatles	Delay	Mix: 45%				
		Echo 1: 1/8th dot				
		Echo 2: 1/8th				
		FB: 65%				
		Bpm: 136				
M27: Caught						
Flute	Reverb	Mix: 33%				
		Pre Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Violin	Granular Synthesis	Mix: 50%	Reverb	Mix: 35%		
		Pitch: 0 cents		Pre-Delay: 20 ms		
		Splice:1/8th note		Decay: 4 s		
		Delay: 1/8th note		Mod Rate: 2.53 Hz		
		Recycle/FB: 20%		Mod Depth: 38%		
Violin	Granular Synthesis	Mix: 50%				
		Pitch: 0 cents				
		Splice:1/8th note				
		Delay: 1/8th note				
		Recycle/FB: 20%				
Cello	Saturation	Mix: 50%				
		Drive: 60%				
		Level: 50%				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
M28 Statue Toe						
Flute	Reverb	Mix: 17%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Alto Flute	Reverb	Mix: 35%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Basoon	Reverb	Mix: 17%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Horn	Reverb	Mix: 17%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Piano	Reverb	Mix: 35%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Harp	Reverb	Mix: 17%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
Violin	Reverb	Mix: 17%				
		Pre-Delay: 20 ms				
		Decay: 4 s				
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
M29:Conductor Stops						
Alto Flute	Saturation	Mix: 50%	Wah	Drive: 50%		
		Drive: 60%		Mix: 50%		
		Level: 50%		Pedal: 70%		
				Filter: 100%		

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
Tenor Trombone	Chorus	Intensity: 35%	Reverb	Mix: 35%		
		Depth: 100%		Pre-Delay: 20 ms		
		Rate: 20%		Decay: 4 s		
		Level: 45%		Mod Rate: 2.53 Hz		
				Mod Depth: 38%		
M30: Betrayal						
Oboe	Delay	Mix: 60%	Granular	Mix: 100%		
		Echo 1: 1.2 ms		Pitch: 0 cents		
		Echo 2: .5 ms		Splice: 1/8th note		
		FB: 0%		Delay: 1/8th note		
		Bpm: 120		Recycle/FB: 25%		
Trumpet	Delay	Mix: 50%	Granular	Mix: 100%		
		Echo 1: 5.2 ms		Pitch: 0 cents		
		Echo 2: 270 ms		Splice: 1/8th note		
		FB: 40%		Delay: 1/8th note		
		Bpm: 120		Recycle/FB: 25%		
M31: Fury						
Bass Trombone	Granular Synthesis	Mix: 30%				
		Pitch: 1200 cents				
		Splice: 1/8th note				
		Delay: 1/2 note				
		Recycle/FB: 25%				
Timpani	Reverb	Mix: 40%	Saturation	Mix: 50%		
		Pre-Delay: 20 ms		Drive: 60%		
		Decay: 1.7 s		Level: 50%		
		Mod Rate: 2.53 Hz				
		Mod Depth: 38%				
M32: Snowy Castle						
Alto Flute	Filter	Drive: 7				
		LFO Rate: .25				
		Cutoff: 500 Hz				
		Resonance: 7				
		Mix: 100				
Cello	Filter	Drive: 5				
		LFO Rate: 5.5				
		Cutoff: 500 Hz				
		Resonance: 6				
		Mix: 100				
Horn	Filter	Drive: 7				
		LFO Rate: .3				
		Cutoff: 750 Hz				

Cue/Instrument	Effect 1/Timecode	E1 Parameters	Effect 2/Timecode	E2 Parameters	Effect 3/Timecode	E3 Parameters
		Resonance: 0				
		Mix: 100				
Contrabass	Filter	Drive: 6				
		LFO Rate: .25				
		Cutoff: 300 Hz				
		Resonance: 7				
		Mix: 100				
Master Bus	Filter	Drive: 9				
		LFO Rate: .5				
		Cutoff: 20kHz				
		Resonance: 5				
		Mix: 100				
M33: Dukes of Blangis						
Master Bus	Granular	Mix: 15%	Panning	Feel: 50%	Reverb	Mix: 50%
		Pitch: 1200 cents		Width: 100%		Pitch shift: 1200 cent
		Splice: 1/8th note		Smoothing: Soft		FB: 0
		Delay: 1/2 note		8 bars 5 steps		Diffusion: 90%
		Recycle/FB: 75%		116 Bpm		Size: 50%
M34: Horror						
Master Bus	Saturation	Drive: 75%	Reverb	Mix: 24%		
		Tone: 65%		Pre-Delay: 20 ms		
		Mix: 70%		Decay: 1.7 s		
				Mod Rate: 2.53 Hz		
				Mod Depth: 38%		

Appendix D

Scores

L'Age d'Or

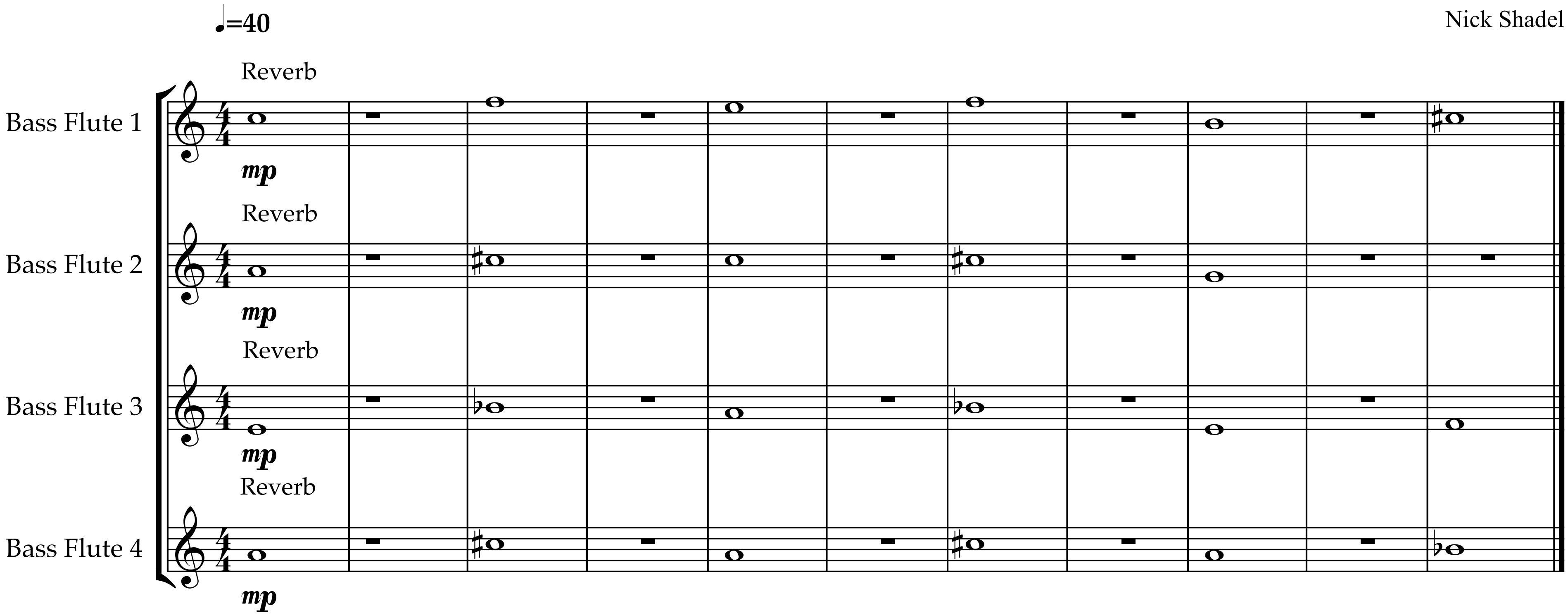
Nick Shadel

Piccolo Flute
Flute
Alto
Bass Flute
Oboe
Cor Anglais
Clarinet
Bass Clarinet
Contrabass Clarinet
Bassoon
French Horn
Trumpet
Tenor Trombone
Bass Trombone
Tuba
Timpani
Crotales
Glockenspiel
Tubular Bells
Xylophone
Marimba
Vibraphone
Celeste
Piano
Harp
Violin
Viola
Cello
Double Bass

Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

M1 Title Screen [Solo 4]

Nick Shadel



M2 Scorpions [Quintet 1]

Master Bus Processing: Granular, Delay, Reverb

Nick Shadel


6
Picc.
Hn.
Cel.
Pno.
Vln. 1


tr
10
Picc.
Hn.
mf
Cel.
mf
Pno.
mf
mf
Vln. 1
mf


14
Picc.
Hn.
Cel.
Pno.
Vln. 1


18
Picc.
Hn.
Cel.
Pno.
Vln. 1


21
Picc.
Hn.
Cel.
Pno.
Vln. 1


24
7
Picc.
Hn.
Cel.
Pno.
Vln. 1


28
Picc.
Hn.
Cel.
Pno.
Vln. 1
mf
mf
mf
mf
mf
mf


32
Picc.
Hn.
Cel.
Pno.
Vln. 1


36
Picc.
Hn.
Cel.
Pno.
Vln. 1


tr
40
Picc.
Hn.
Cel.
Pno.
Vln. 1


43
tr
Picc.
Hn.
Cel.
Pno.
Vln. 1


47
(tr)
Picc.
Hn.
Cel.
Pno.
Vln. 1

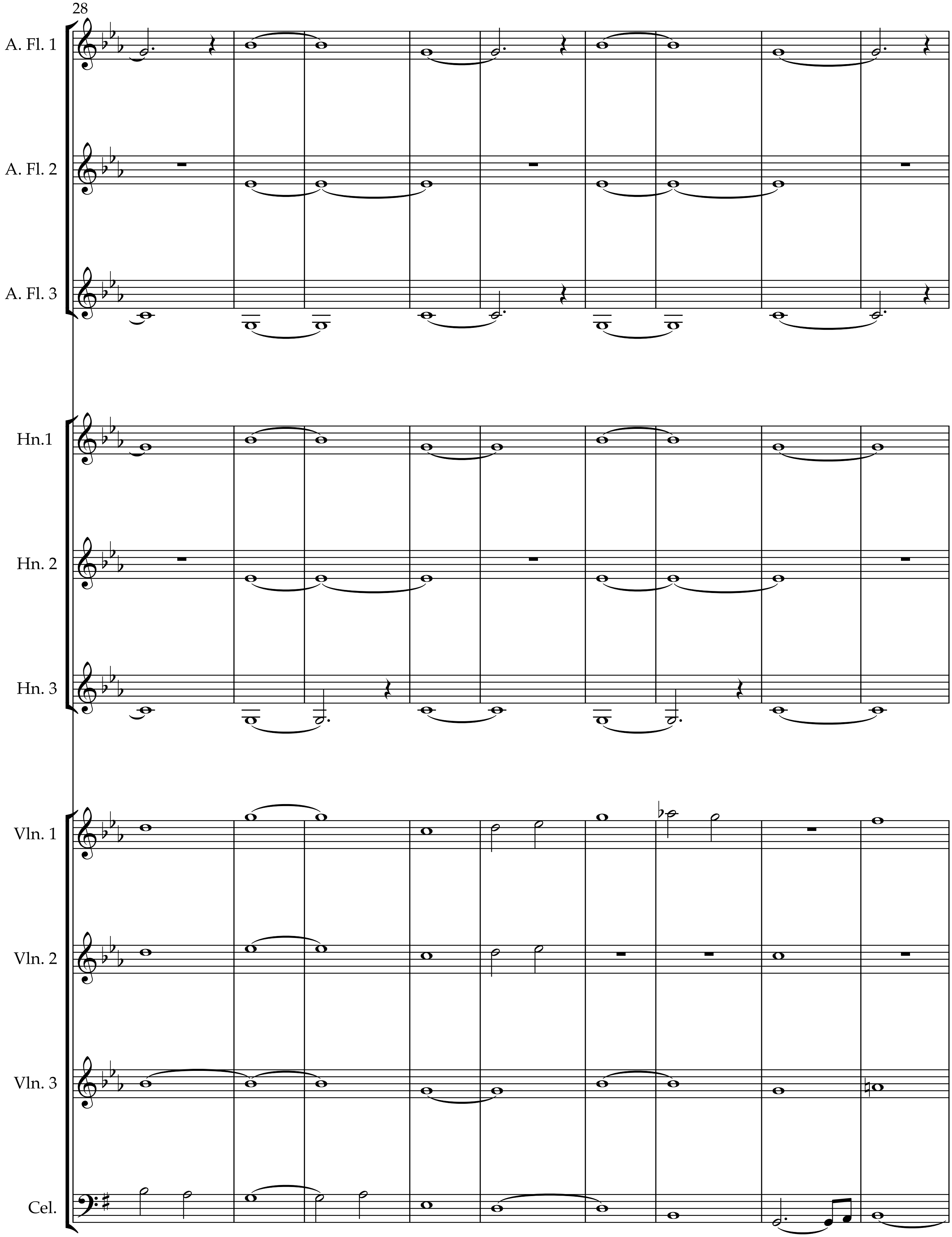

214
(tr)
49
Picc.
Hn.
Cel.
Pno.
Vln. 1

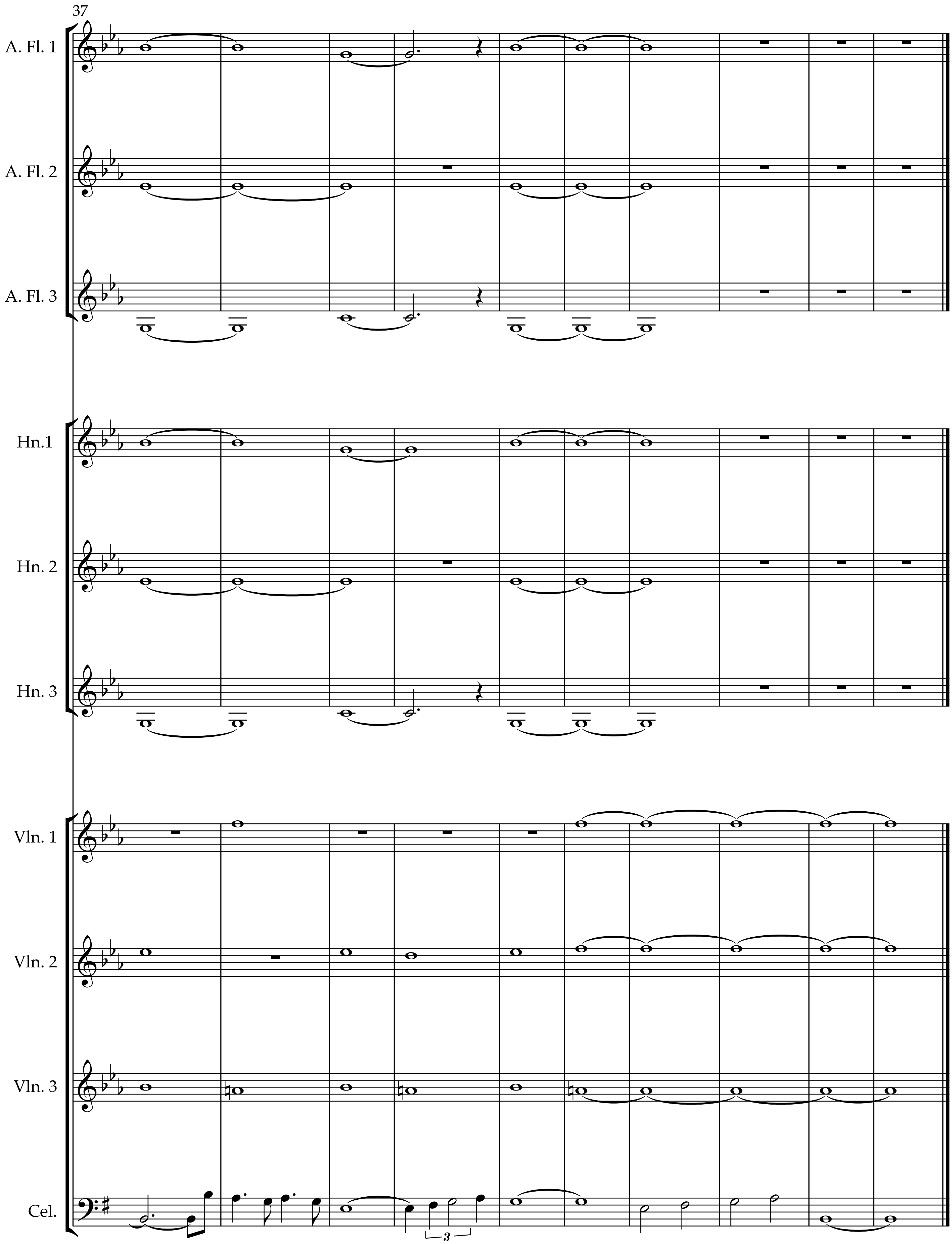
M3 Mountains [Quartet 3]

Nick Shadel


10
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.

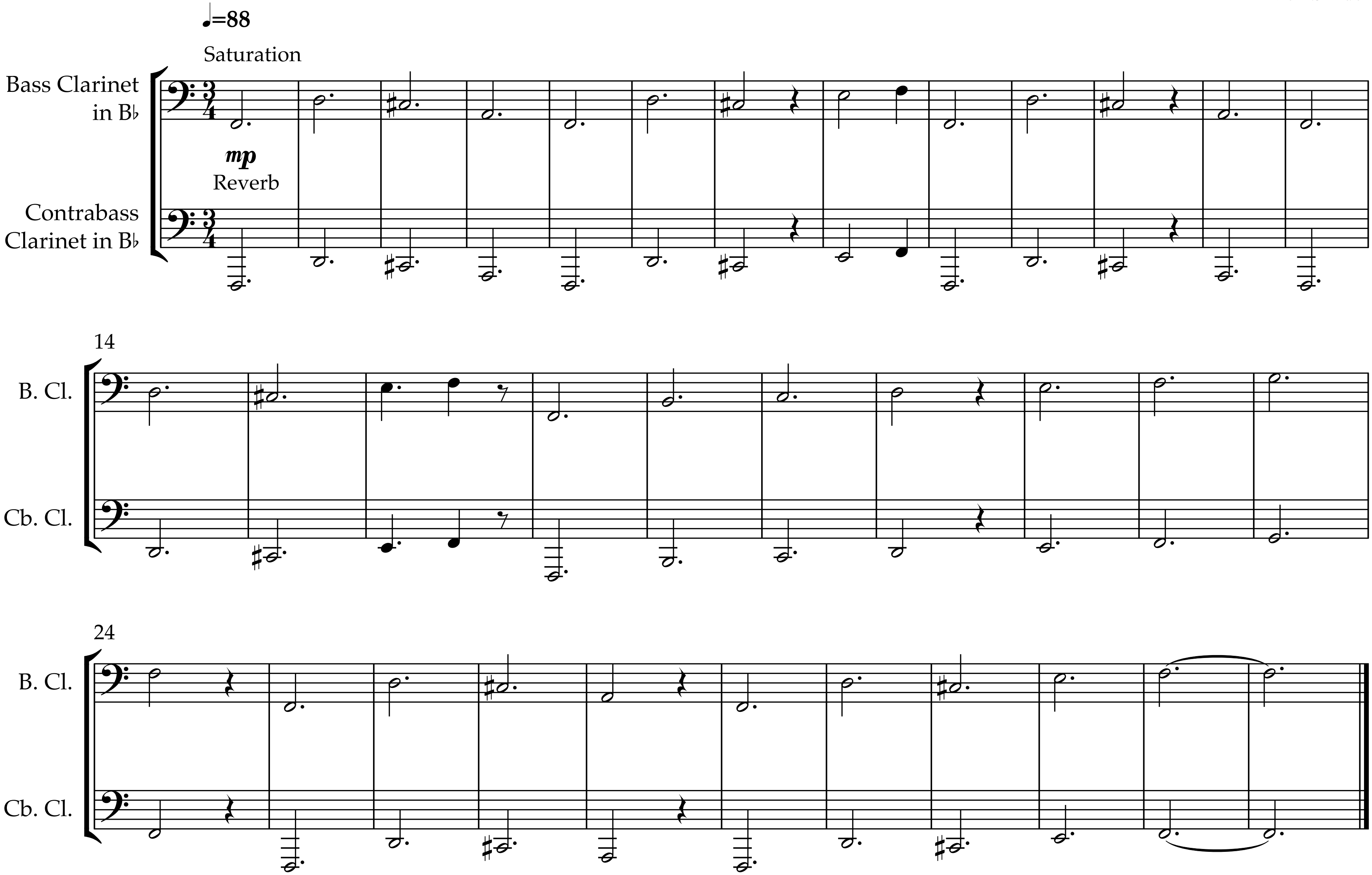

18
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.
3


28
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.


37
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.
3

M4 Barracks [Duet 14]

Nick Shadel



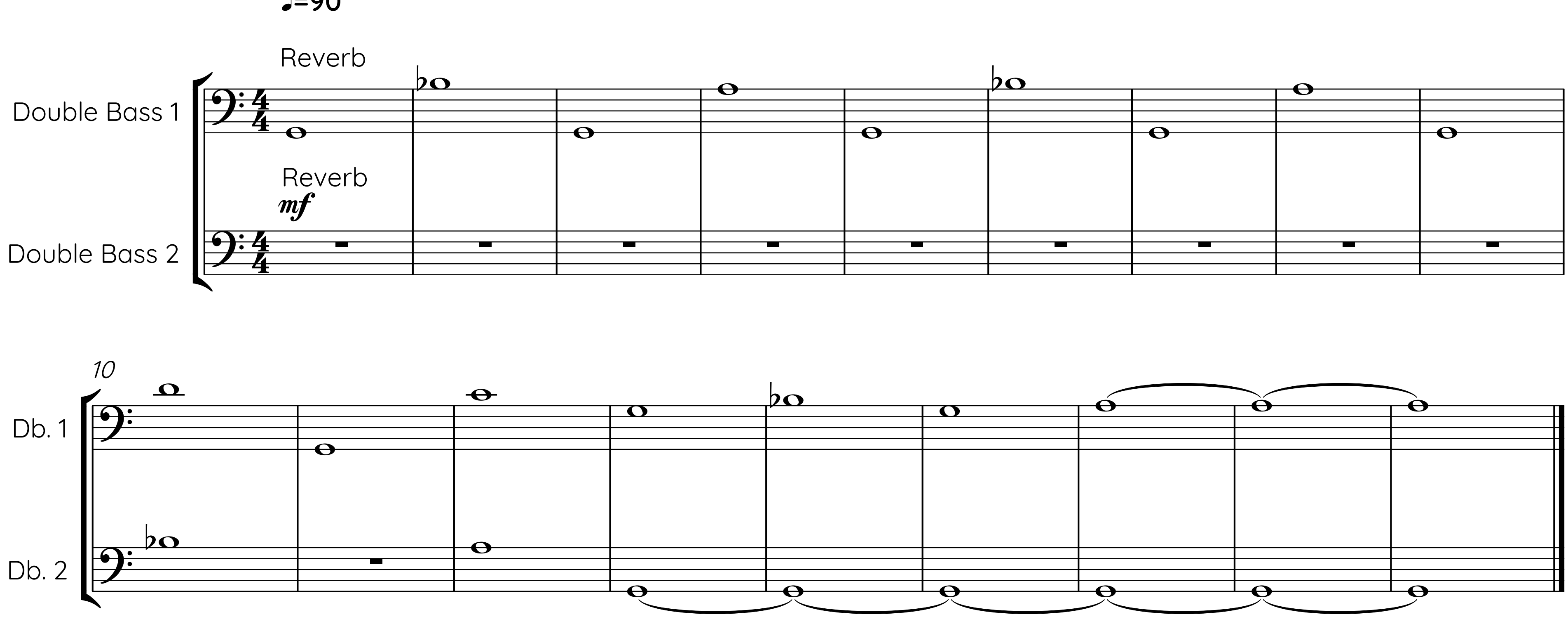
M5 Alarm [Solo 12]

Nick Shadel


14
Tpt. 1
Tpt. 2

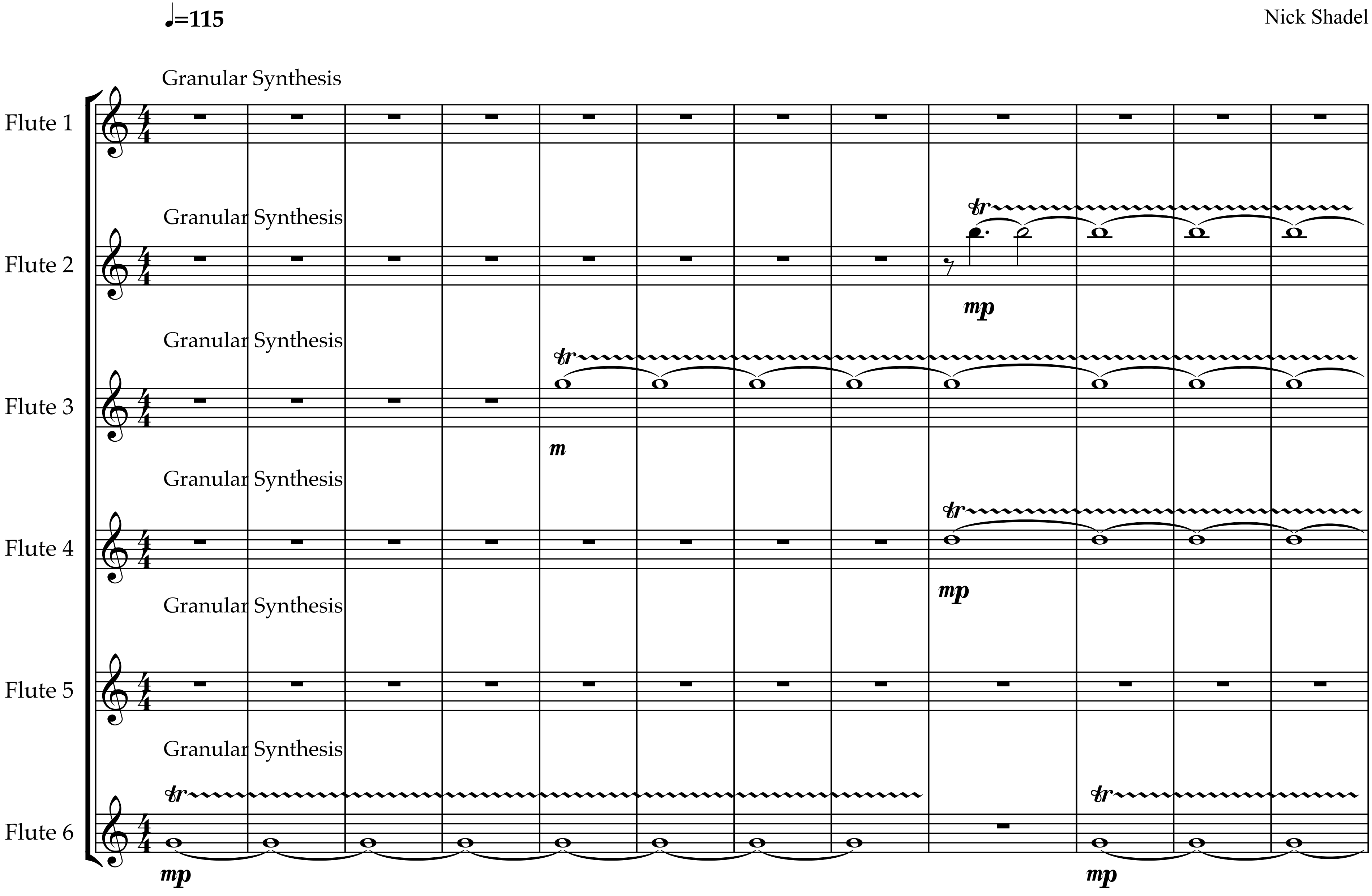
M6 To Arms [Solo 29]

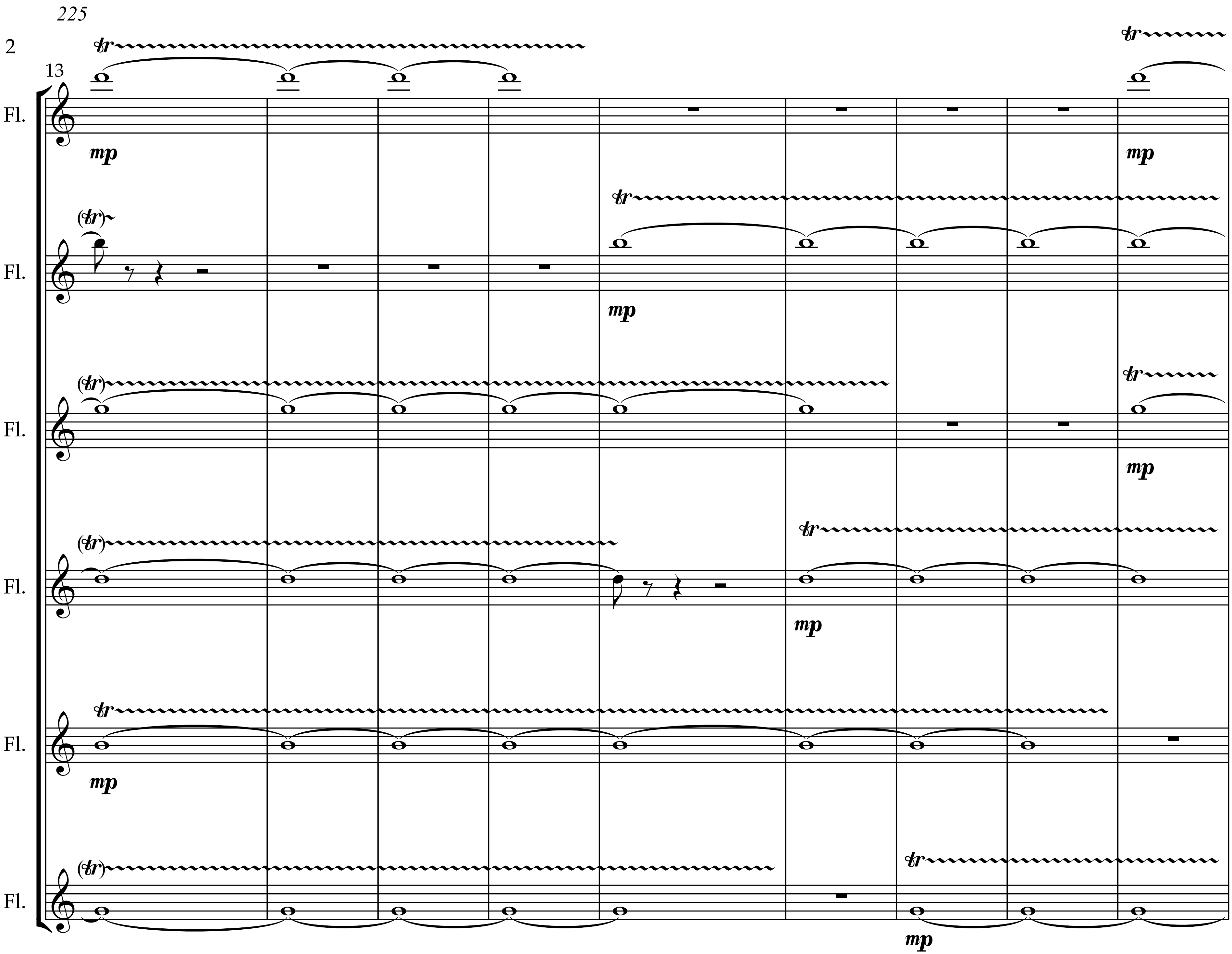
Nick Shadel

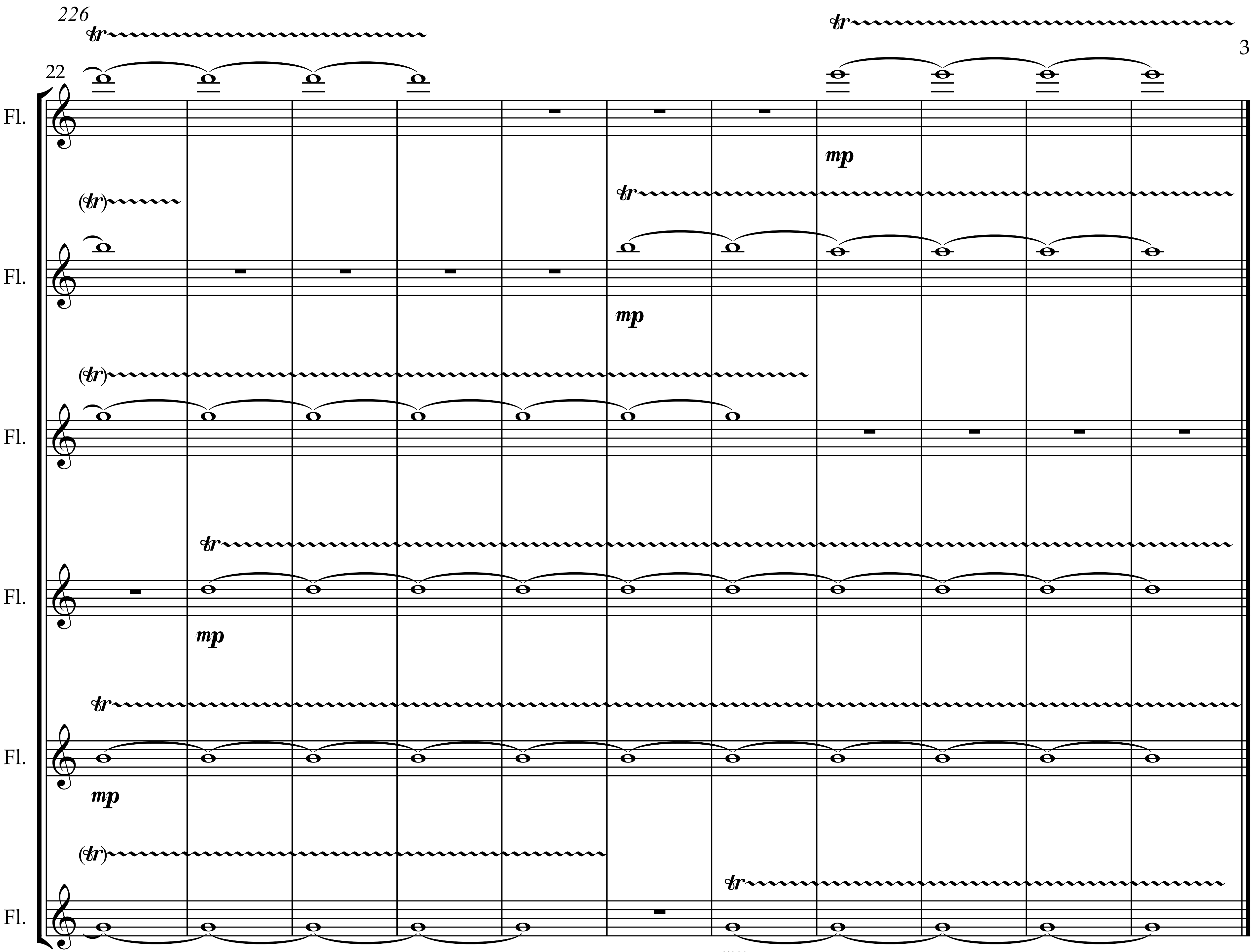


M7 Hippopotamuses [Solo 2]

Nick Shadel

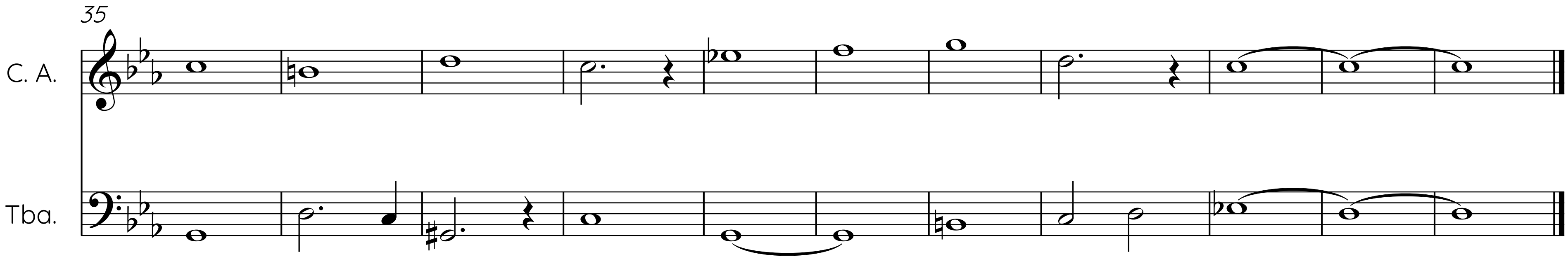



225
13
Fl.
Fl.
Fl.
Fl.
Fl.
Fl.
tr
(tr)
mp


226
22
Fl.
Fl.
Fl.
Fl.
Fl.
Fl.
mp
mp
mp
mp
mp

M8 Bandits Camp [Duet 13]

Nick Shadel

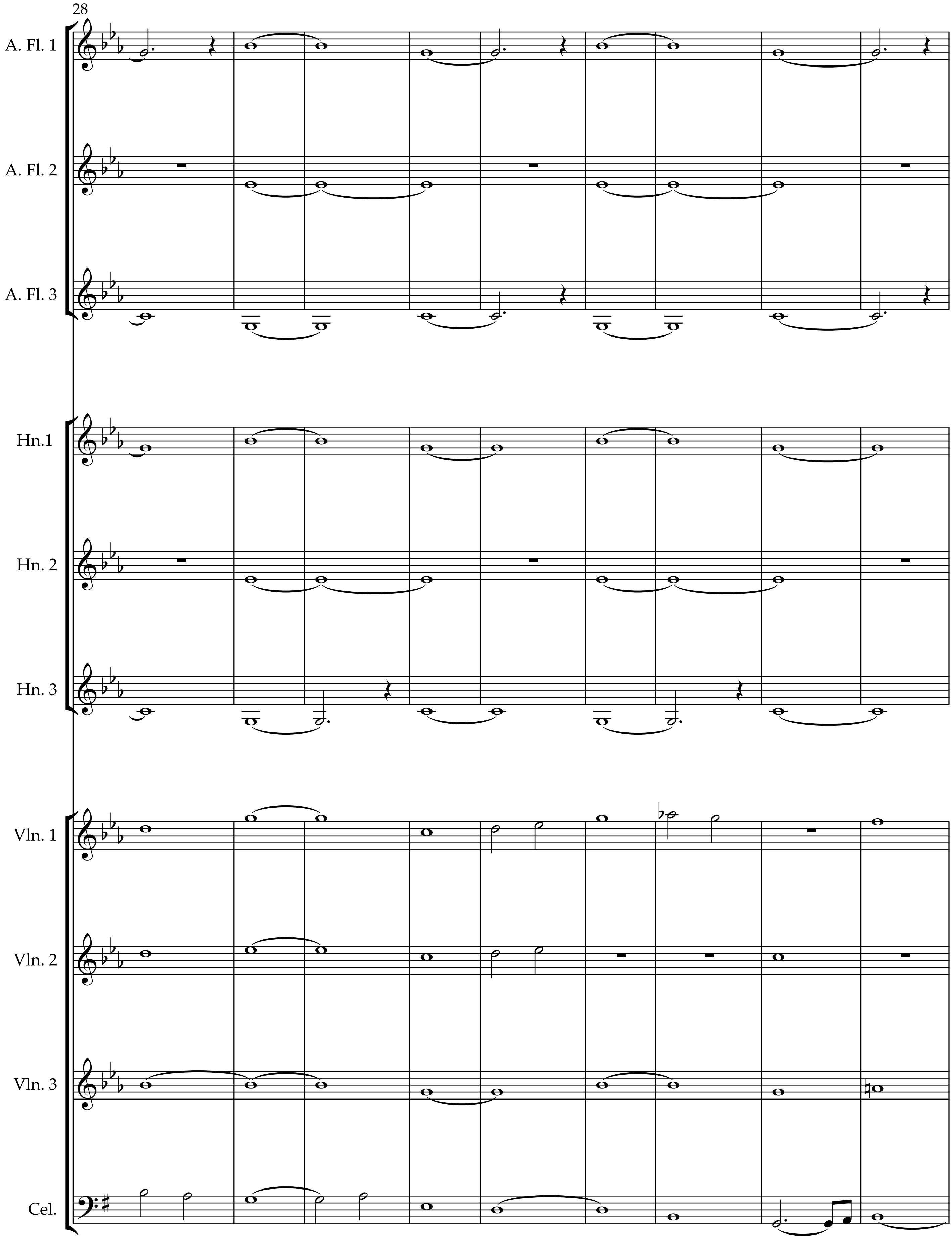

35
C. A.
Tba.

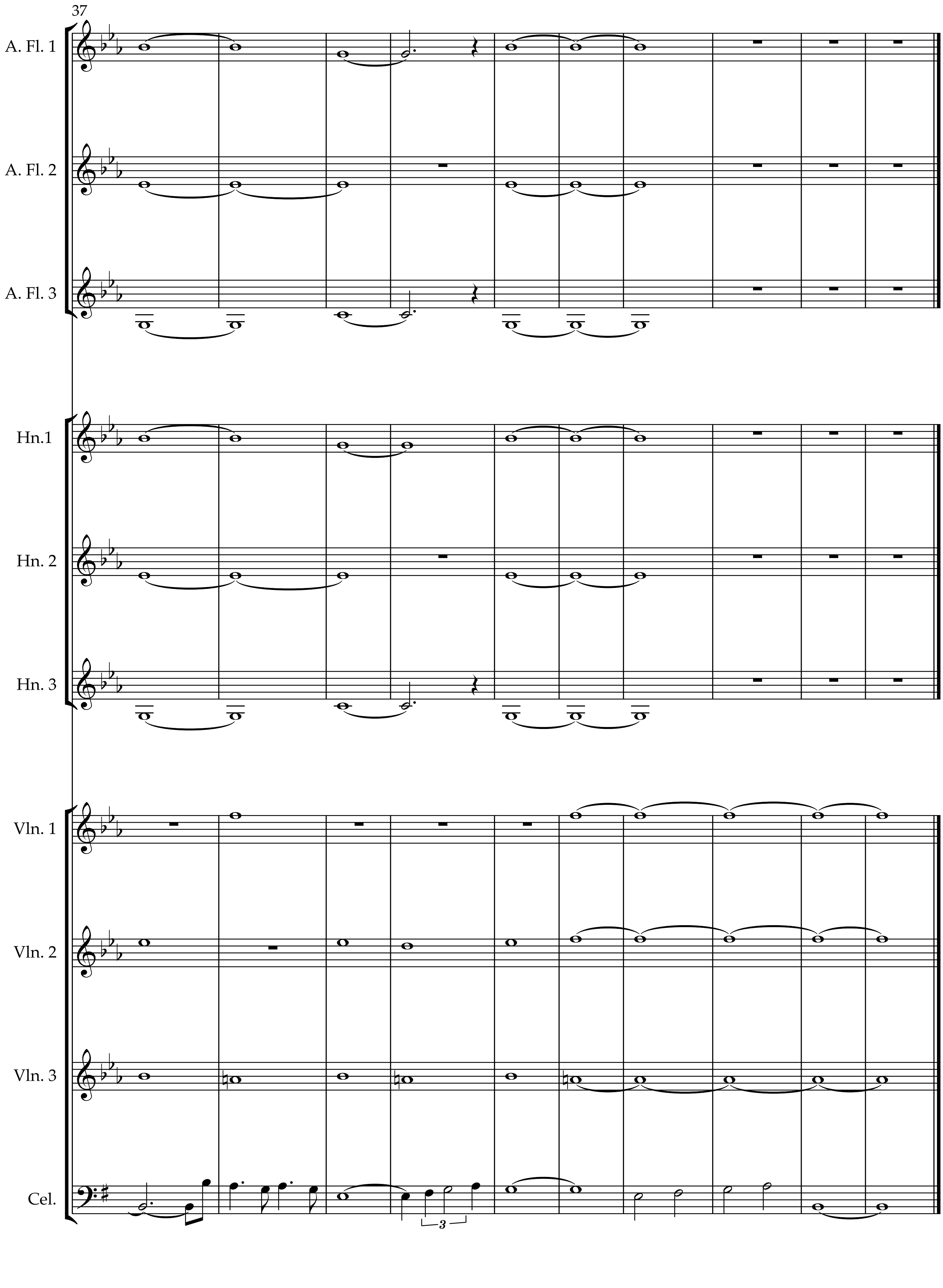
M9 Boats [Quartet 3]

Nick Shadel


10
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.


18
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.
3


28
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.


37
A. Fl. 1
A. Fl. 2
A. Fl. 3
Hn.1
Hn. 2
Hn. 3
Vln. 1
Vln. 2
Vln. 3
Cel.
3

M10 Love Mud [Duet 3]

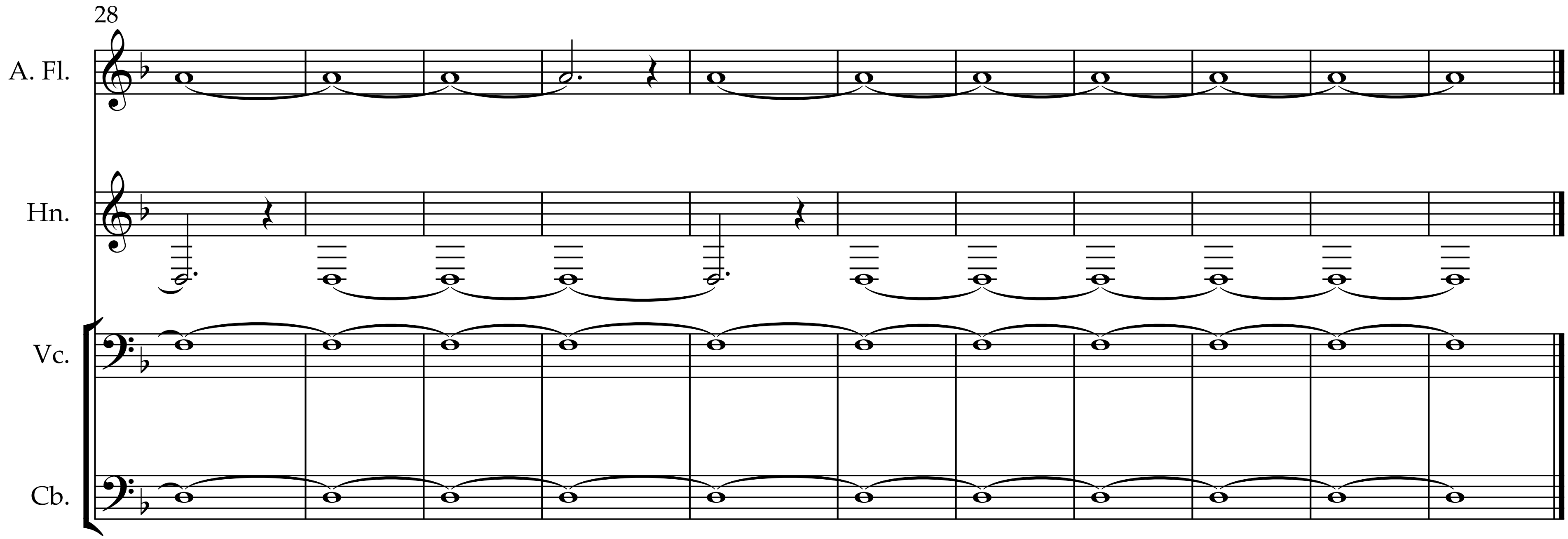
Nick Shadel


25
Vln.
Ce.
33
Vln.
Ce.
38
Vln.
Ce.

M11 Lava Flow [Synthesis Quartet]

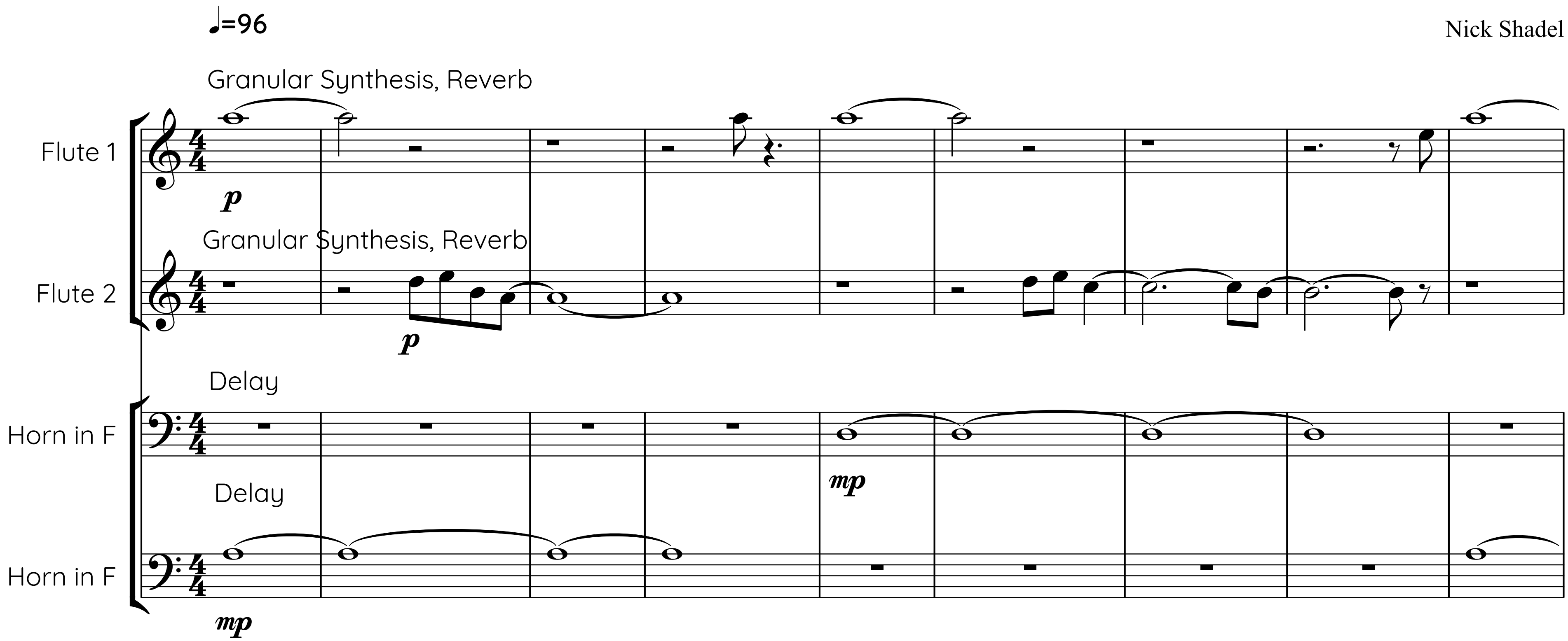
Nick Shadel


10
A. Fl.
Hn.
Vc.
mp
Cb.
19
A. Fl.
Hn.
Vc.
Cb.


28
A. Fl.
Hn.
Vc.
Cb.

M12 Detained - [Duet 1]

Nick Shadel




10
Fl. 1
Fl. 2
Hn.
Hn.
21
Fl. 1
Fl. 2
Hn.
Hn.


31
Fl. 1
Fl. 2
Hn.
Hn.
40
Fl. 1
Fl. 2
Hn.
Hn.

M13 Imperial Rome [Quintet 4]

Nick Shadel


6
B. Fl.
Ob.
Tpt.
Tba.
Glck.


11
B. Fl.
Ob.
Tpt.
Tba.
Glck.
3


16
B. Fl.
Ob.
Tpt.
Tba.
Glck.


21
B. Fl.
Ob.
Tpt.
Tba.
Glck.


26
B. Fl.
Ob.
Tpt.
Tba.
Glck.


32
B. Fl.
Ob.
Tpt.
Tba.
Glck.


37
B. Fl.
Ob.
Tpt.
Tba.
Glck.


43
B. Fl.
Ob.
Tpt.
Tba.
Glck.


49
B. Fl.
Ob.
Tpt.
Tba.
Glck.

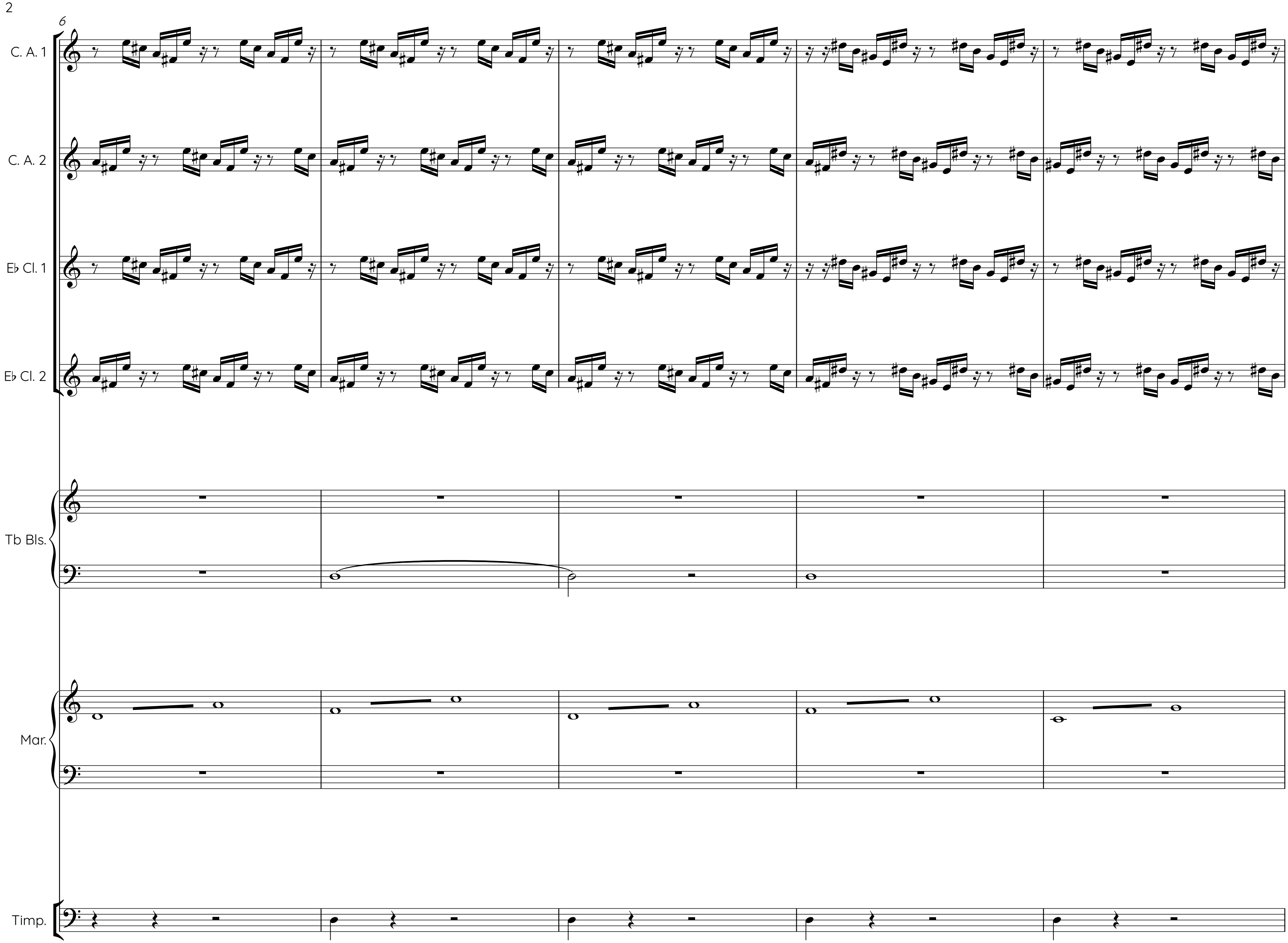

55
B. Fl.
Ob.
Tpt.
Tba.
Glck.

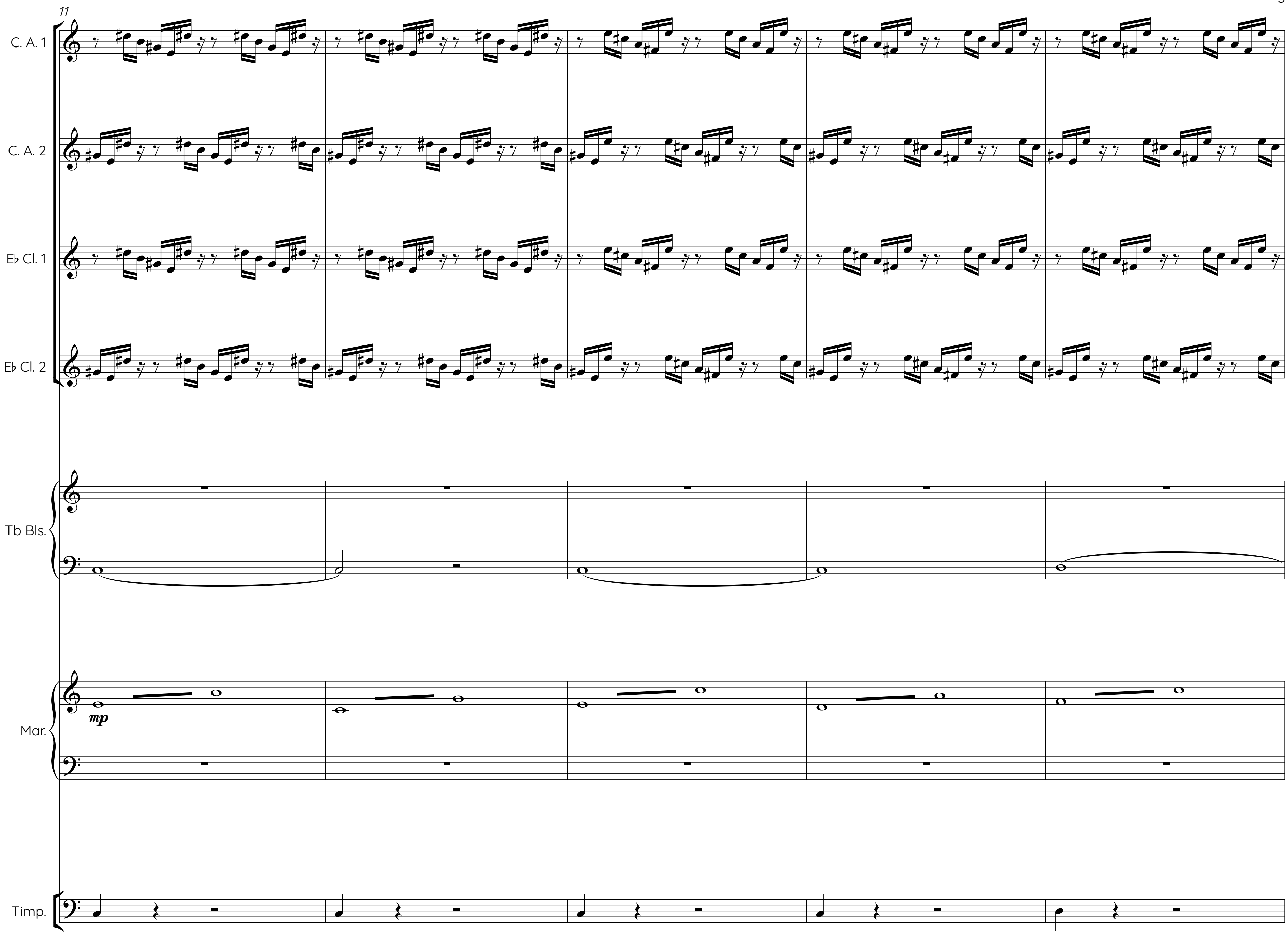

60
B. Fl.
Ob.
Tpt.
Tba.
Glck.

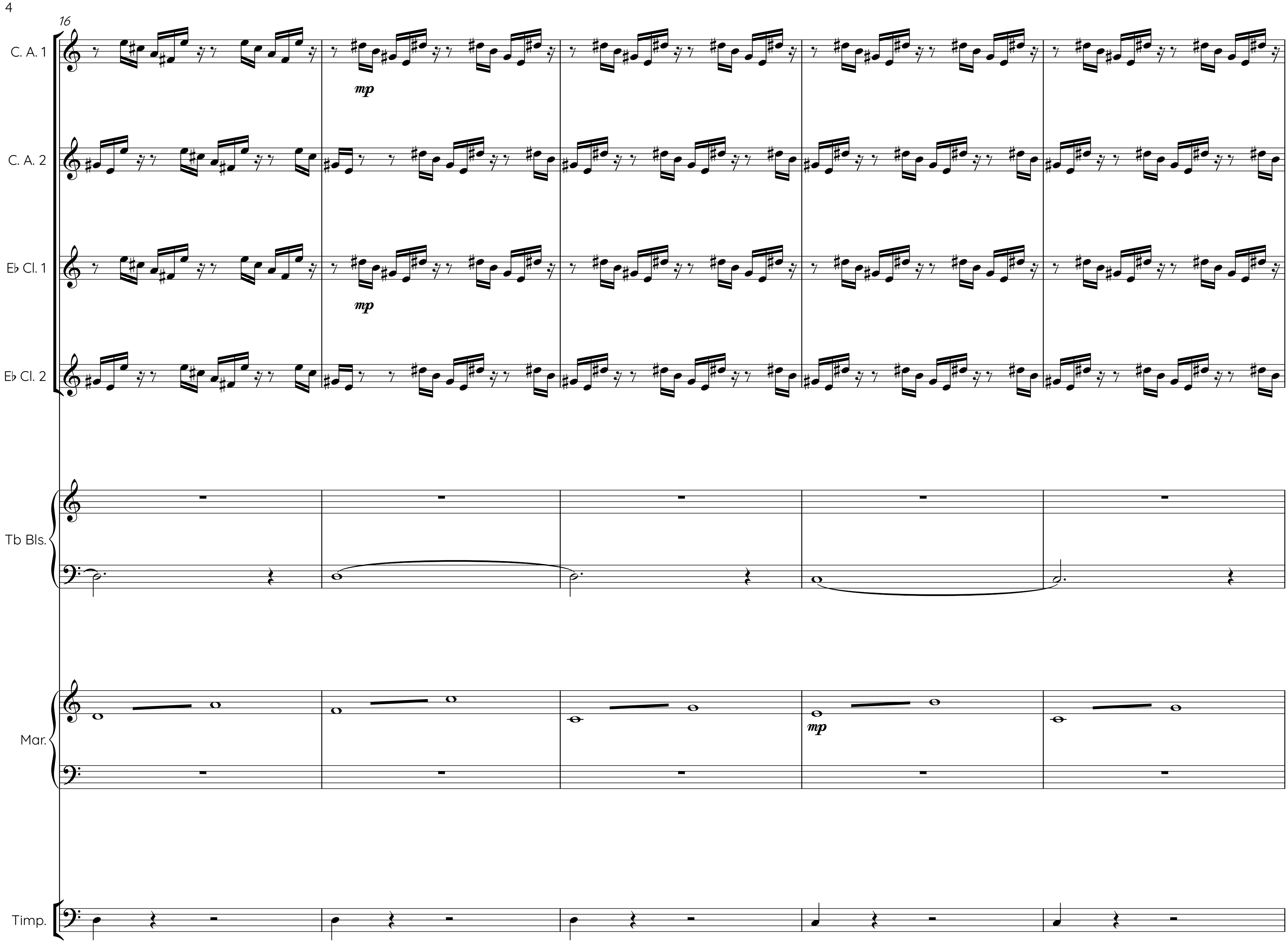
M14 Surrealist Prison Stroll [Quintet 5]

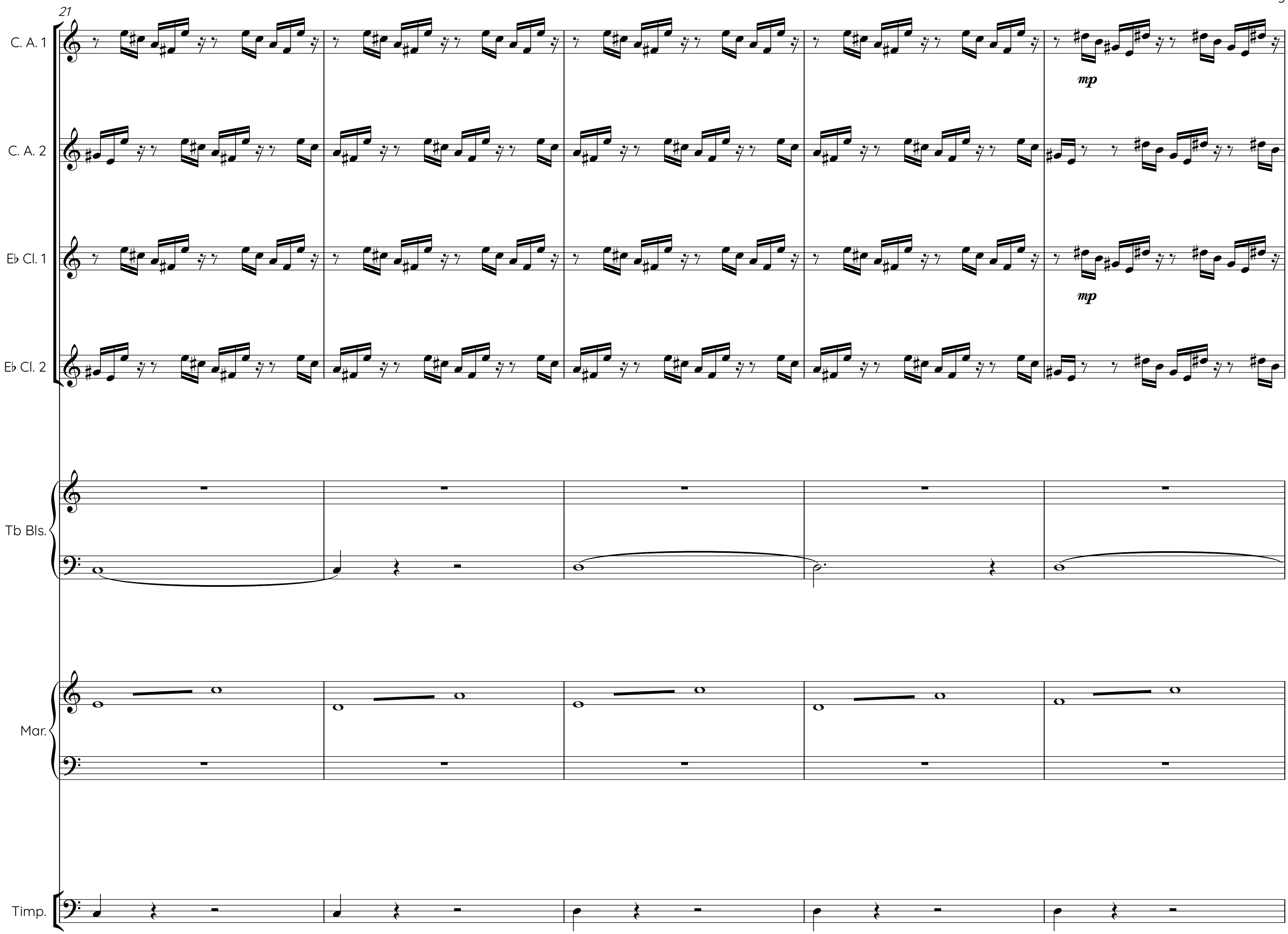
Master Bus Delay Effect

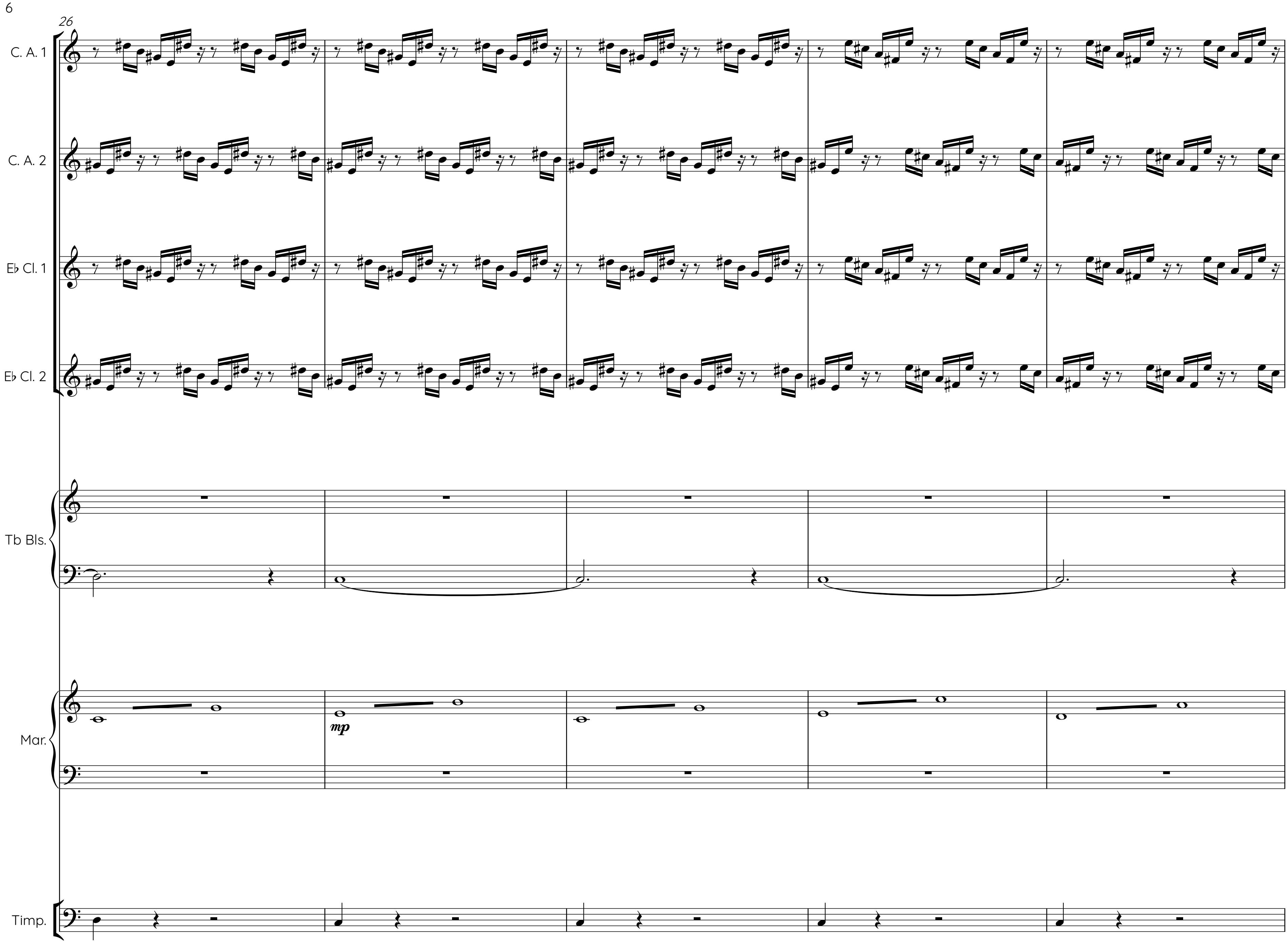
Nick Shadel

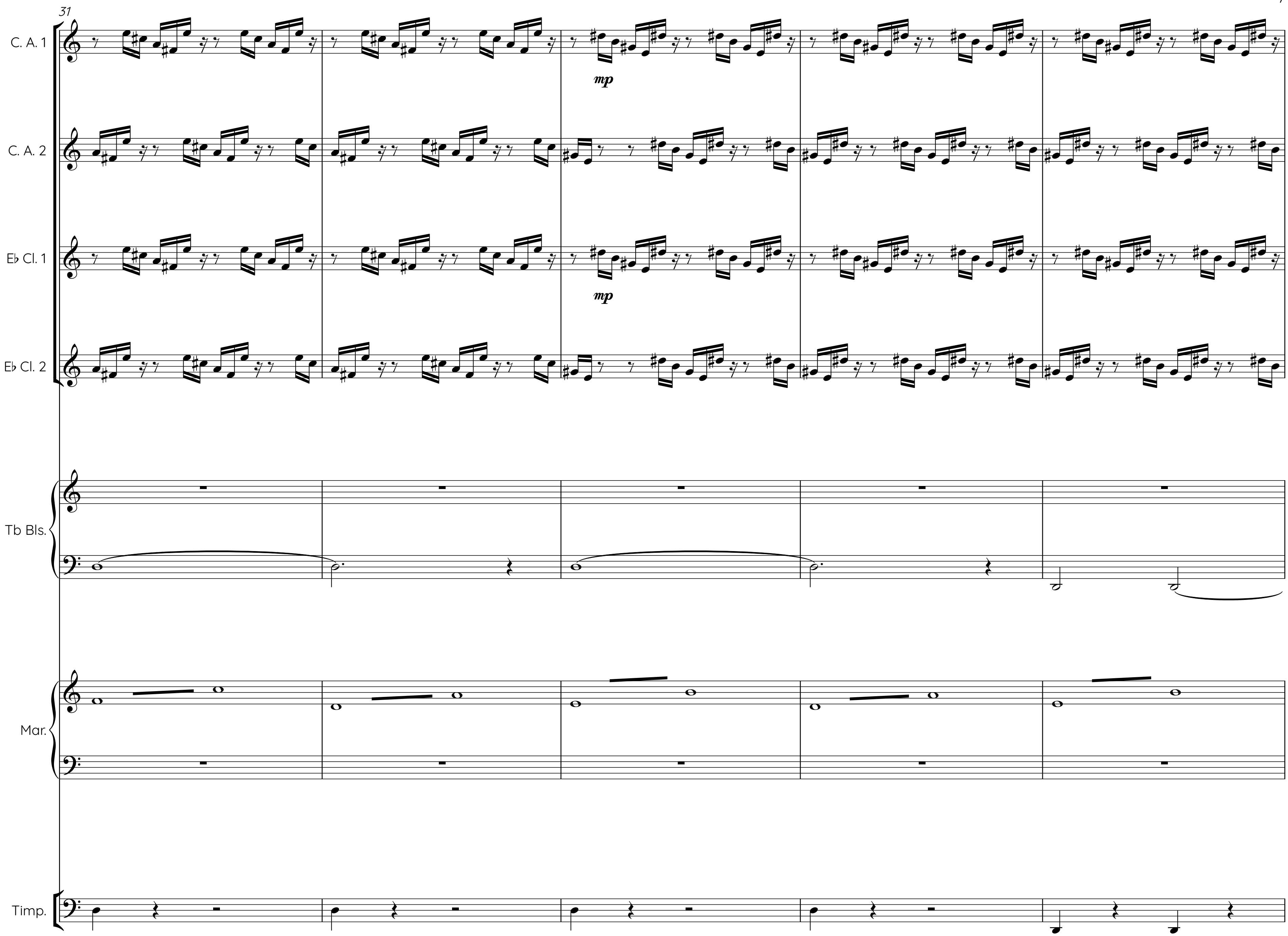

6
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
Timp.


11
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
mp
Timp.


16
C. A. 1
mp
C. A. 2
E♭ Cl. 1
mp
E♭ Cl. 2
Tb Bls.
Mar.
mp
Timp.


21
C. A. 1
mp
C. A. 2
E♭ Cl. 1
mp
E♭ Cl. 2
Tb Bls.
Mar.
Timp.


26
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
mp
Timp.

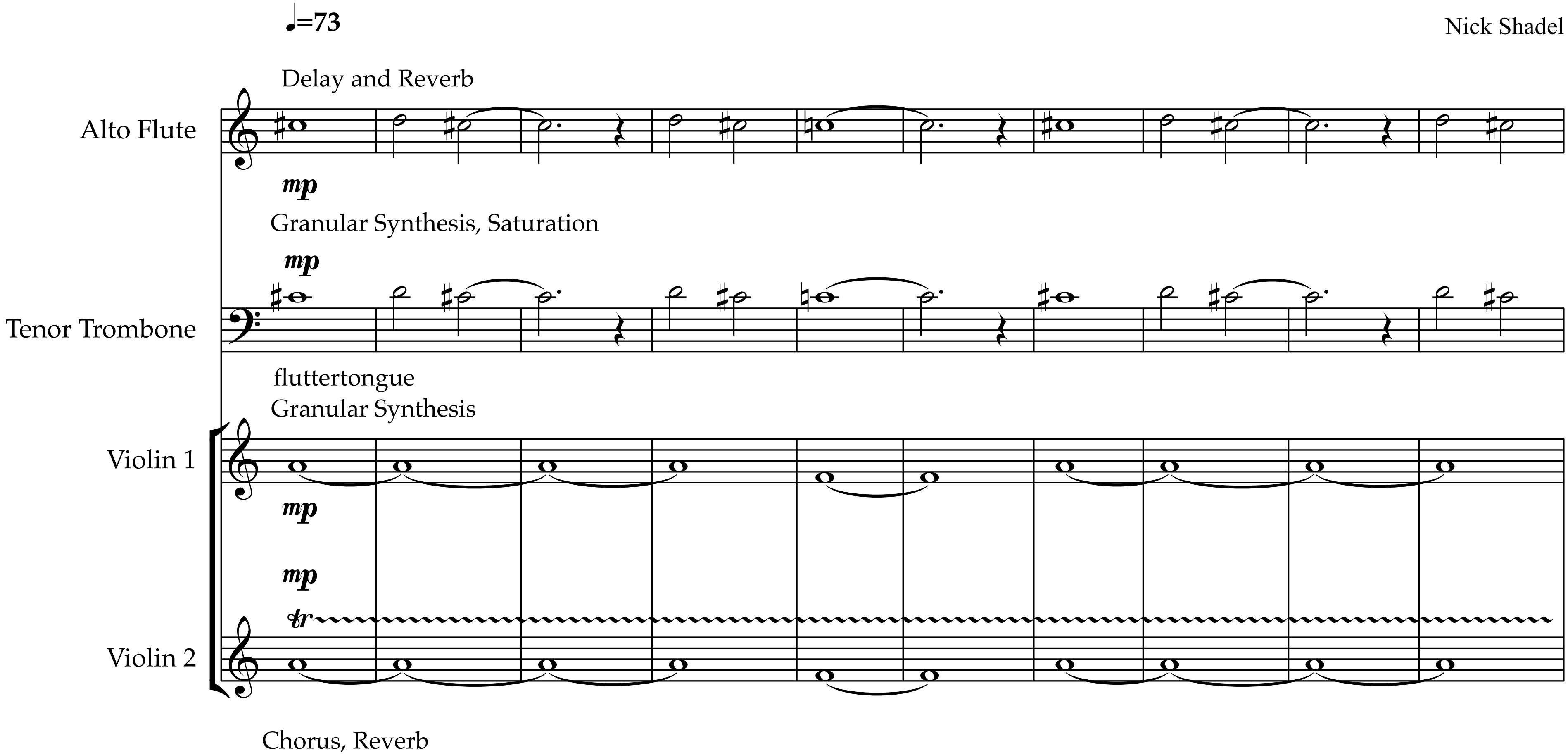

31
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
Timp.
mp
mp

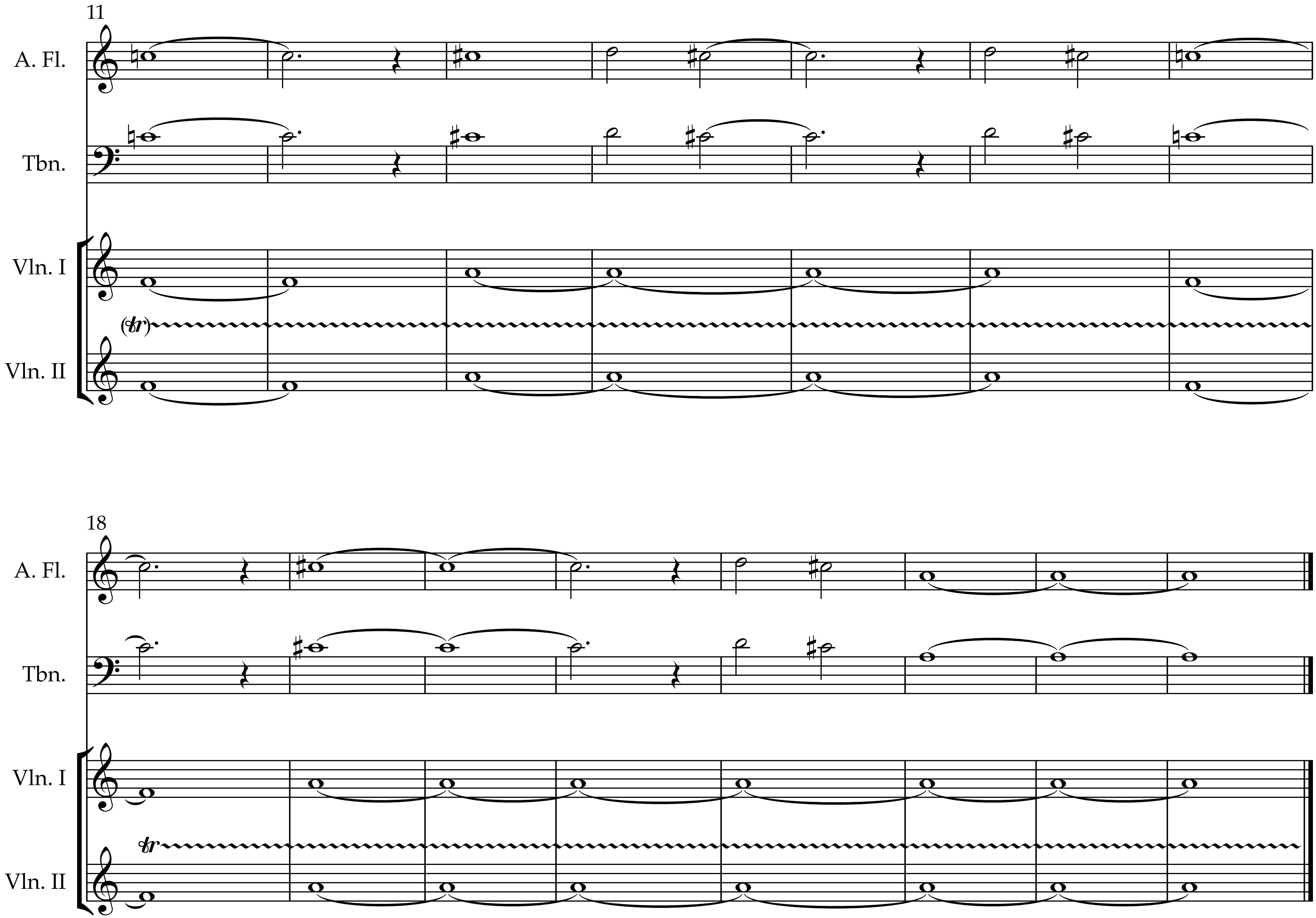

36
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
Timp.


40
C. A. 1
C. A. 2
E♭ Cl. 1
E♭ Cl. 2
Tb Bls.
Mar.
Timp.

M15 Chaise Lounge [Meta Effects Quartet]

Nick Shadel




11
A. Fl.
Tbn.
Vln. I
(tr)
Vln. II
18
A. Fl.
Tbn.
Vln. I
tr
Vln. II

M16 Cow in Bed [Duet 8]

Nick Shadel


266
8
Xylo.
Hp.
G♮
G♯


16
Xylo.
Hp.
D♯
D♮


24
Xylo.
Hp.
G♮


31
Xylo.
Hp.

M17 Longing [Duet 2]

Nick Shadel


18
Cel.
Db.
27
Cel.
Db.
35
Cel.
Db.

M18 Blind Man [Duet 7]

Nick Shadel


17
Cl.
Mar.
25
Cl.
Mar.

M19 International Goodwill Society [Duet 11]

Nick Shadel


18
Crot.
Tub.
22
Crot.
Tub.

M20 Rome Estate [Duet 10]

Nick Shadel


14
Picc.
Vib.
18
Picc.
Vib.

M21 Party [Quintet 2]

Master Bus Saturation, Tremolo, Reverb

Nick Shadel


9
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.
13
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.


17
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.
21
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.


25
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.
29
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.


33
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.
37
Fl.
Tbn.
Cro.
Hp.
Hp.
Vla.

M22 Boy Fire Gossip [Quintet 6]

Nick Shadel


8
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


15
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


22
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


29
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


36
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


43
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


50
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


57
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


64
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


71
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


78
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.


84
B. Cl.
Cb. Cl.
Bsn.
Xyl.
Vib.

M23 Courtship [Quartet 1]

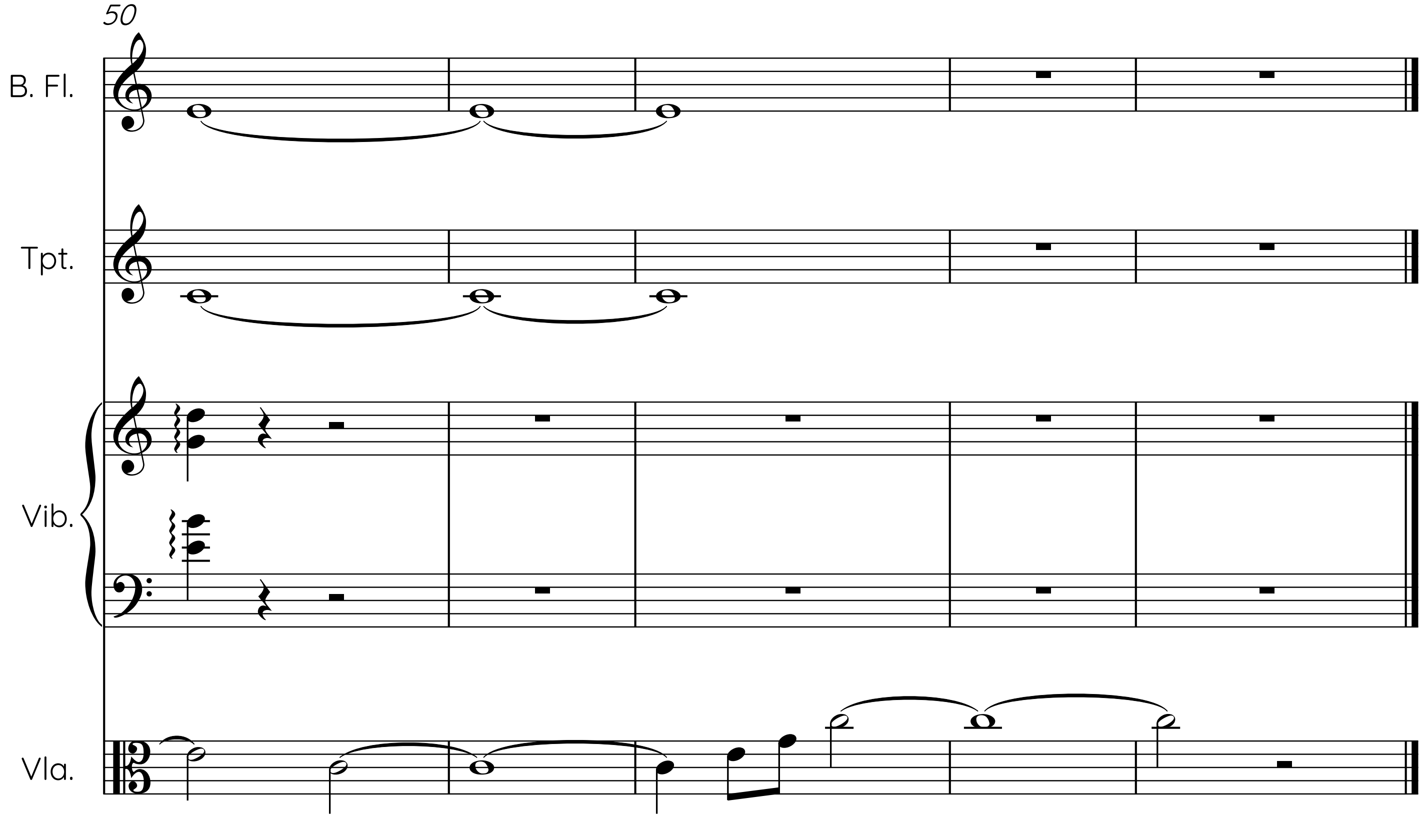
Nick Shadel


10
B. Fl.
Tpt.
Vib.
Vla.
15
B. Fl.
Tpt.
Vib.
Vla.


21
B. Fl.
Tpt.
Vib.
Vla.
26
B. Fl.
Tpt.
Vib.
Vla.


31
B. Fl.
Tpt.
Vib.
Vla.
36
B. Fl.
Tpt.
Vib.
Vla.


41
B. Fl.
Tpt.
Vib.
Vla.
46
B. Fl.
Tpt.
Vib.
Vla.


50
B. Fl.
Tpt.
Vib.
Vla.

M24 Additional Longing [Solo 23]

Nick Shadel


6
Cel.
3
Cel.
12
Cel.
3
Cel.

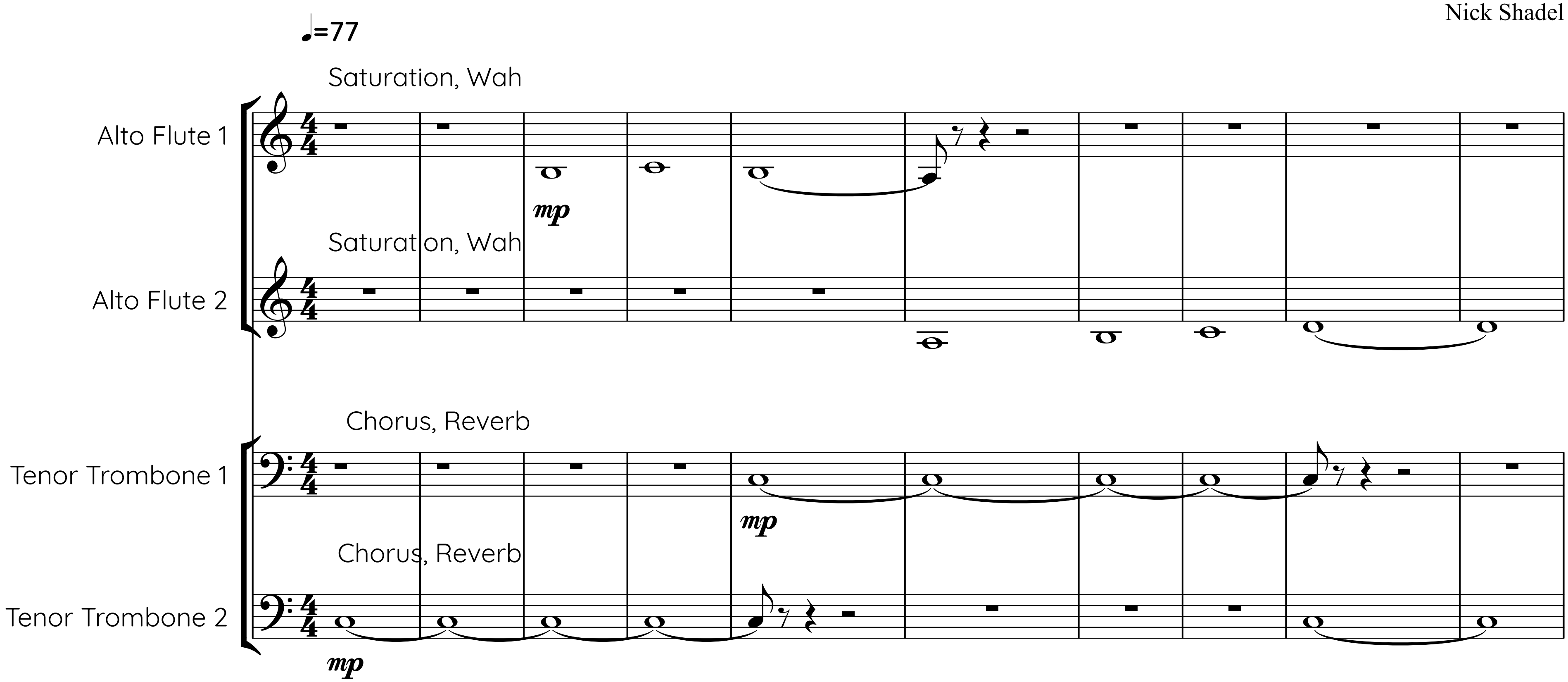
304

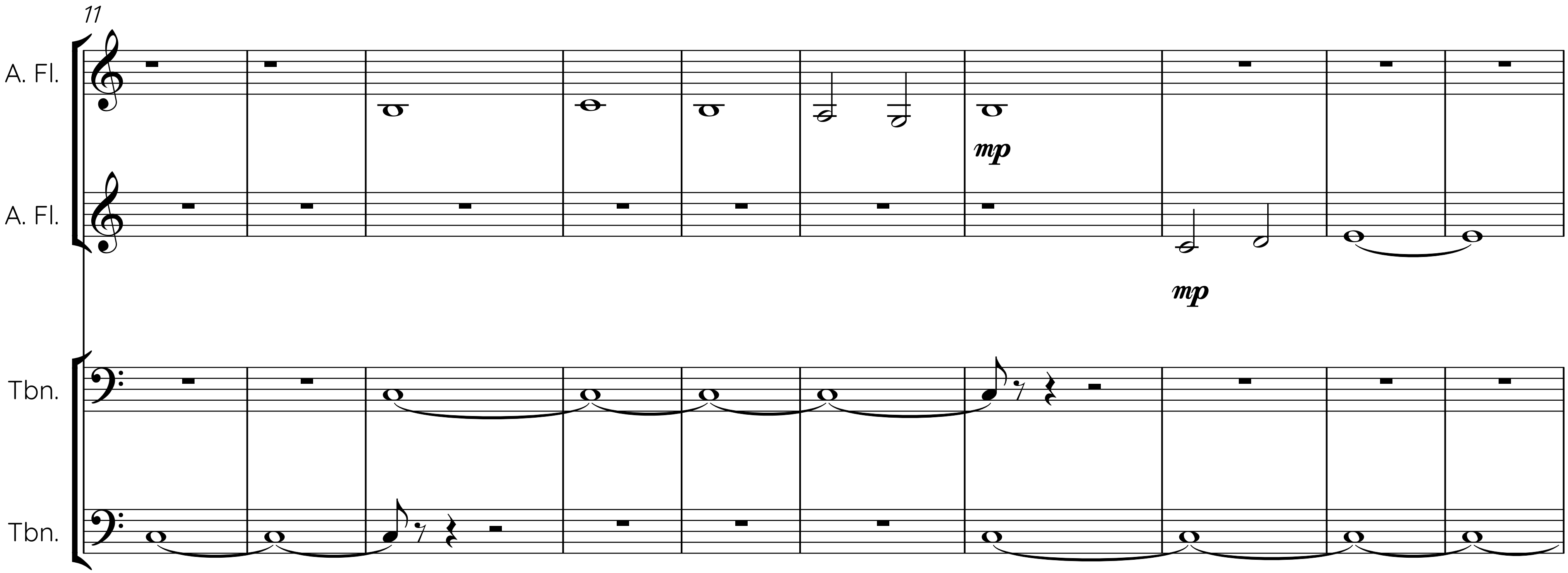
M25 Escape to the Garden [Solo 27]

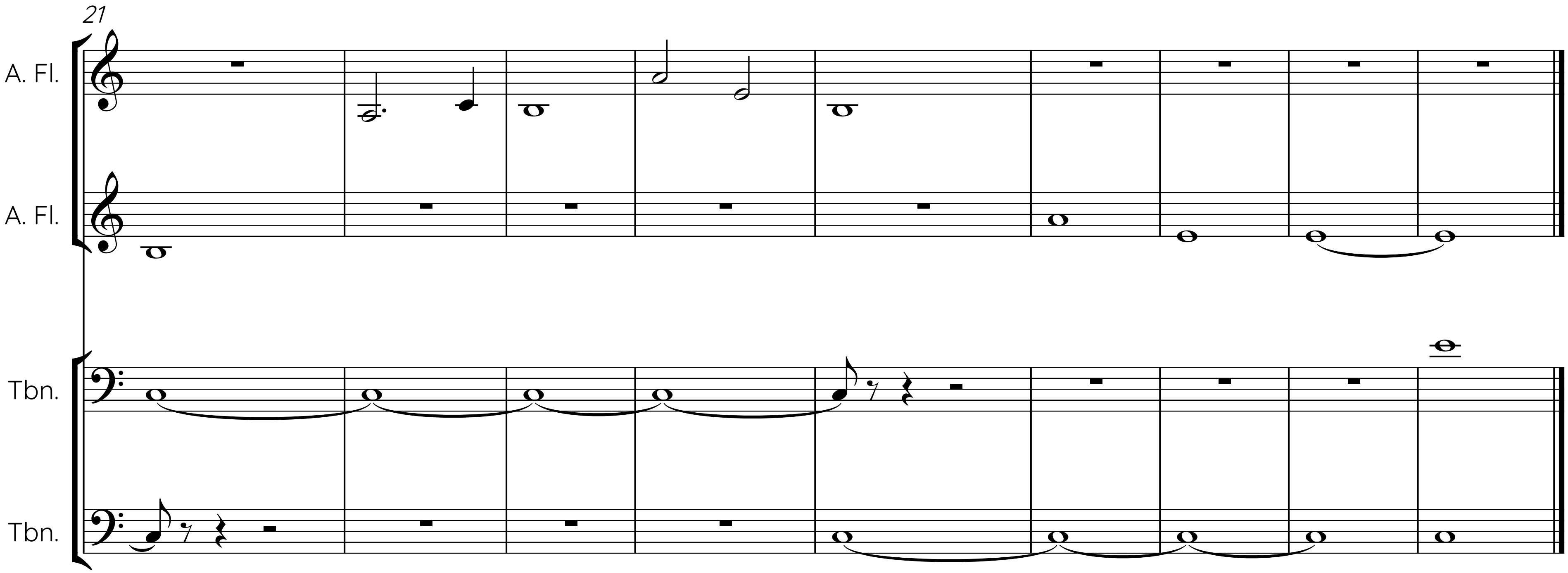
Nick Shadel

M29 Conductor Stops [Duet 4]

Nick Shadel




11
A. Fl.
mp
A. Fl.
mp
Tbn.
Tbn.


21
A. Fl.
A. Fl.
Tbn.
Tbn.

M26 In the Garden
M27 Caught
M28 Statue Toe

Nick Shadel

Movement 1: 136 bpm 4/4
Bassoon with Reverb
Cello with Delay
Crotales with Delay

Movement 2: 80 bpm 4/4
Flute with Reverb
French Horn
Tenor Trombone
Crotales
Harp
Violin with Granular Synthesis and Reverb
Violin with Granular Synthesis
Cello with Saturation

Movement 3: 132 bpm 3/4
Alto Flute with Reverb
French Horn
Violin with Saturation
Cello with Saturation and Reverb

Movement 4:85 bpm 4/4
Flute with Reverb
Alto Flute with Reverb
Bassoon with Reverb
French Horn with Reverb
French Horn
Piano with Reverb
Harp with Reverb
Violin with Reverb
Cello
Double Bass

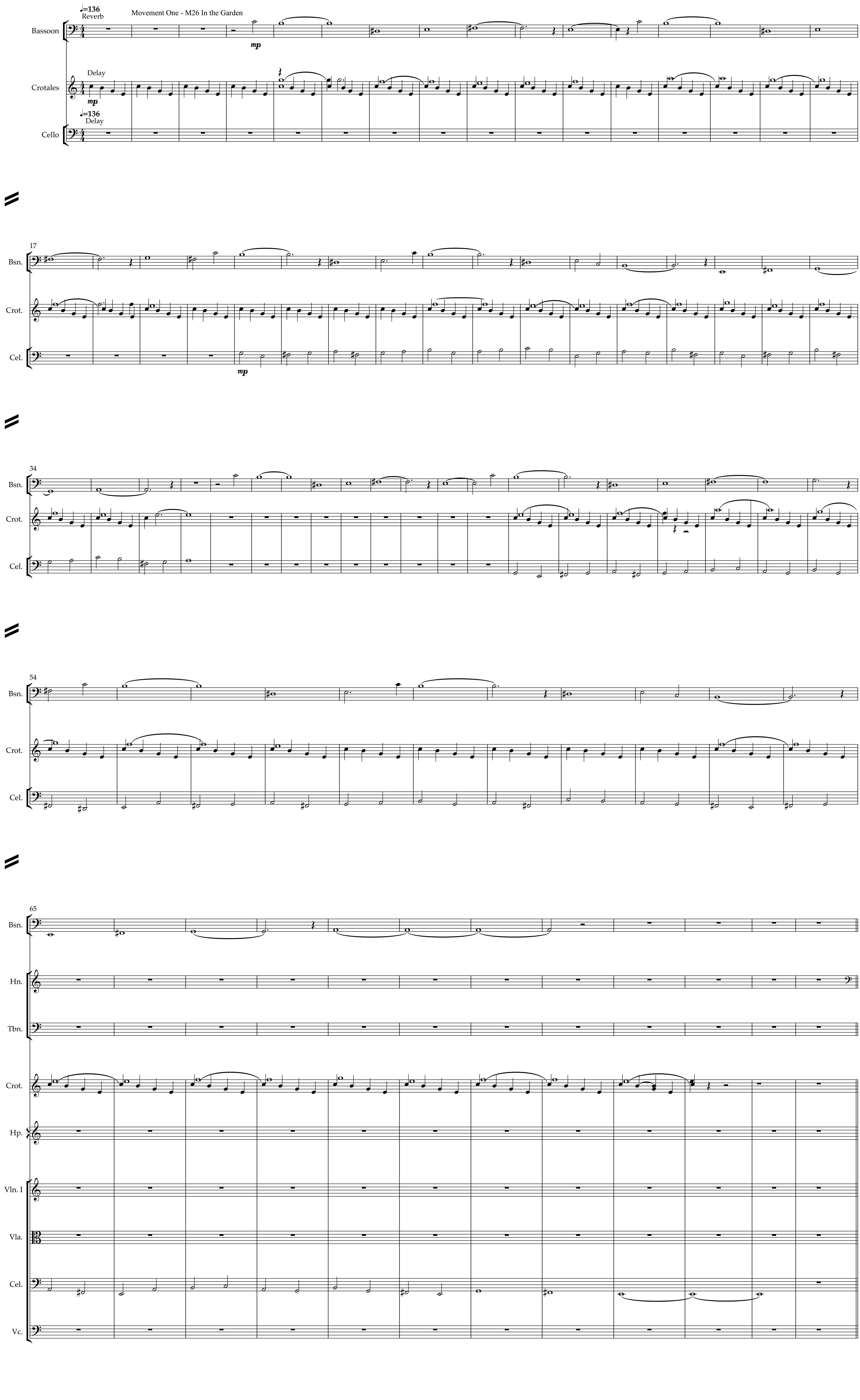
Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

November 23, 2022

M26 In the Garden, M27 Caught, M28 Statue Toe [Midi Chamber Ensemble]

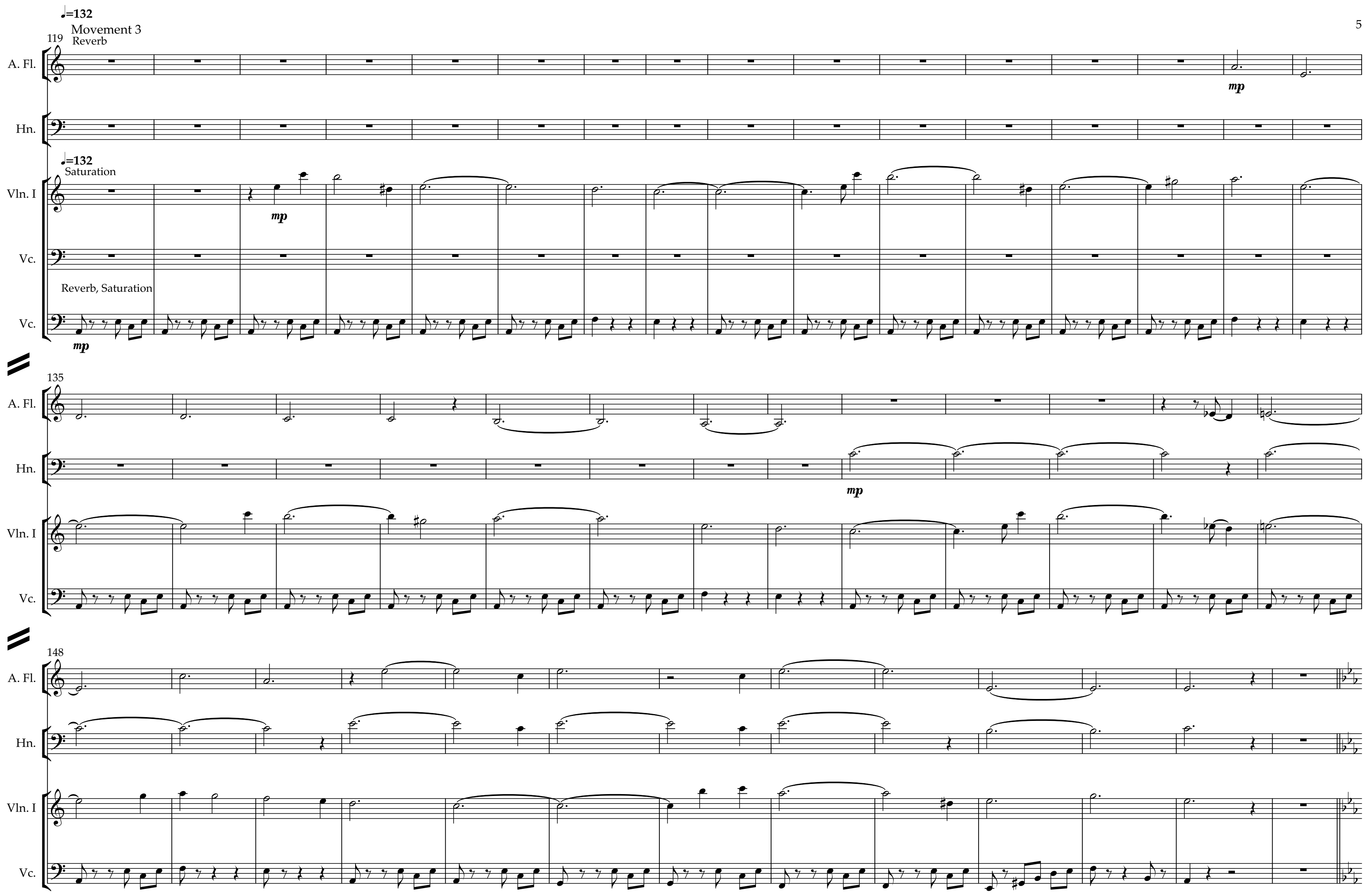
Note: Each movement ends with a reversed soundscape of a fragment of the movement just played, conductor will cue transitions to the next movement.

Nick Shadel




♩=80
Movement 2 M27 Caught
3
77
Reverb
Fl.
Hn.
Tbn.
Crot.
Hp.
Hp.
♩=80
Granular Synthesis, Reverb
Vln. I
Granular Synthesis
Vla.
Saturation
Cel.
Vc.
mp
84
91
m


4
98
Fl.
Hn.
Tbn.
Crot.
Hp.
Hp.
Vln. I
Vla.
Vc.
105
Fl.
Hn.
Tbn.
Crot.
Hp.
Hp.
Vln. I
Vla.
Vc.
111
Fl.
Hn.
Hn.
Tbn.
Crot.
Hp.
Hp.
Vln. I
Vla.
Vc.
Vc.

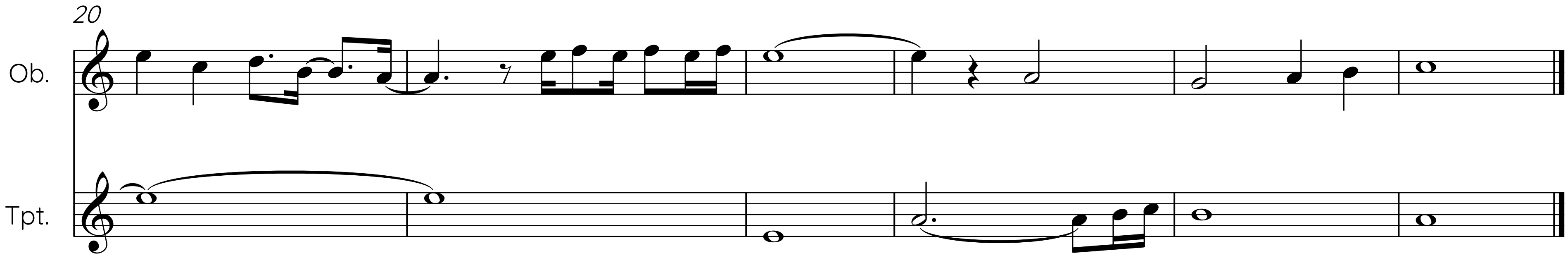

5
♩=132
119
Movement 3
Reverb
A. Fl.
Hn.
♩=132
Saturation
Vln. I
Vc.
Reverb, Saturation
Vc.
mp
135
148


6
♩=85
Movement 4 M28 Statue Toe
161
Reverb
Fl.
A. Fl.
Bsn.
Hn.
Hn.
Pno.
Hp.
Hp.
Vln. I
Cb.
mp
168


175
Fl.
A. Fl.
Bsn.
Hn.
Hn.
Hp.
Pno.
Hp.
Hp.
Vln. I
Cb.

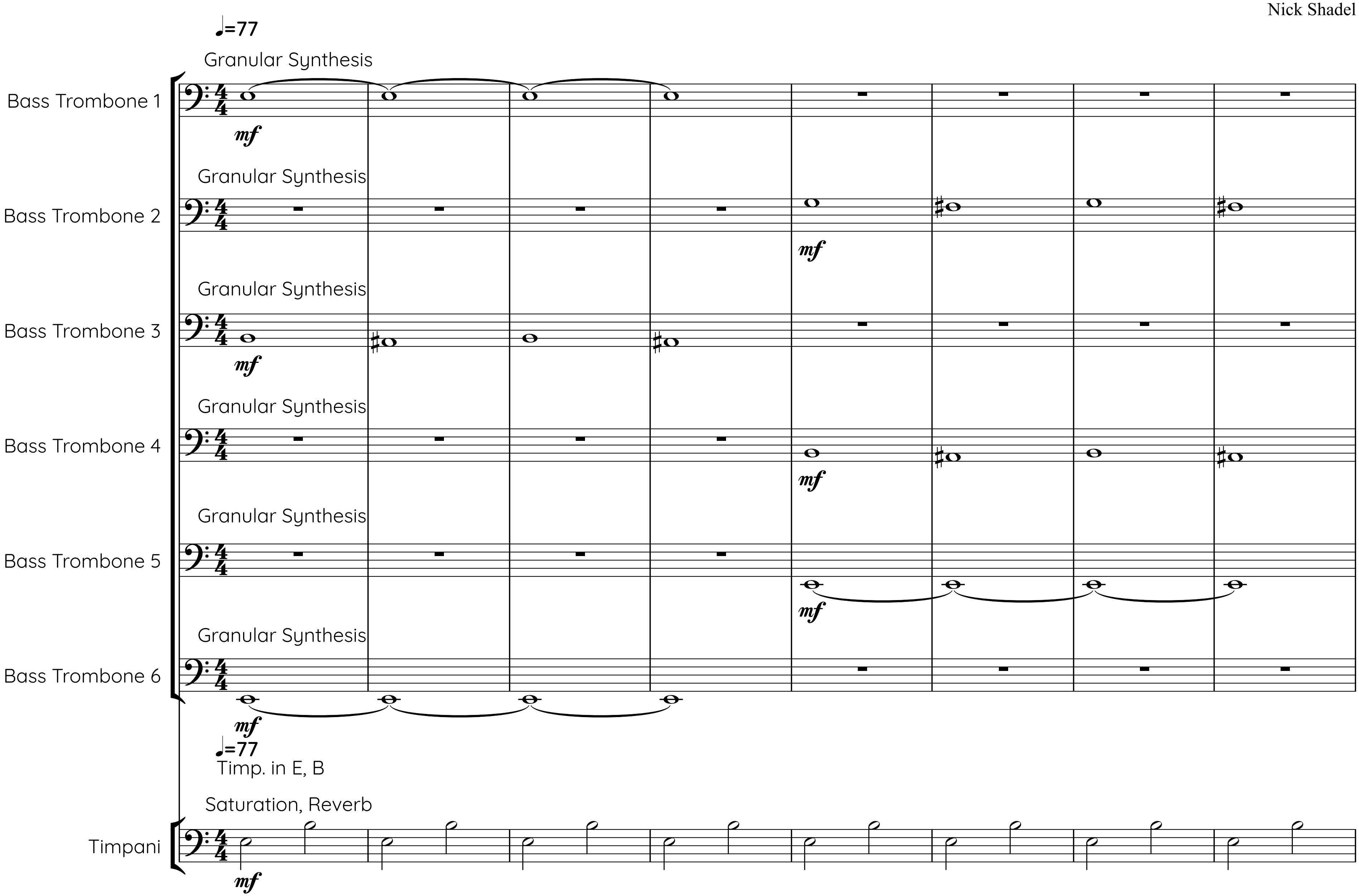
M30 Betrayal [Duet 6]

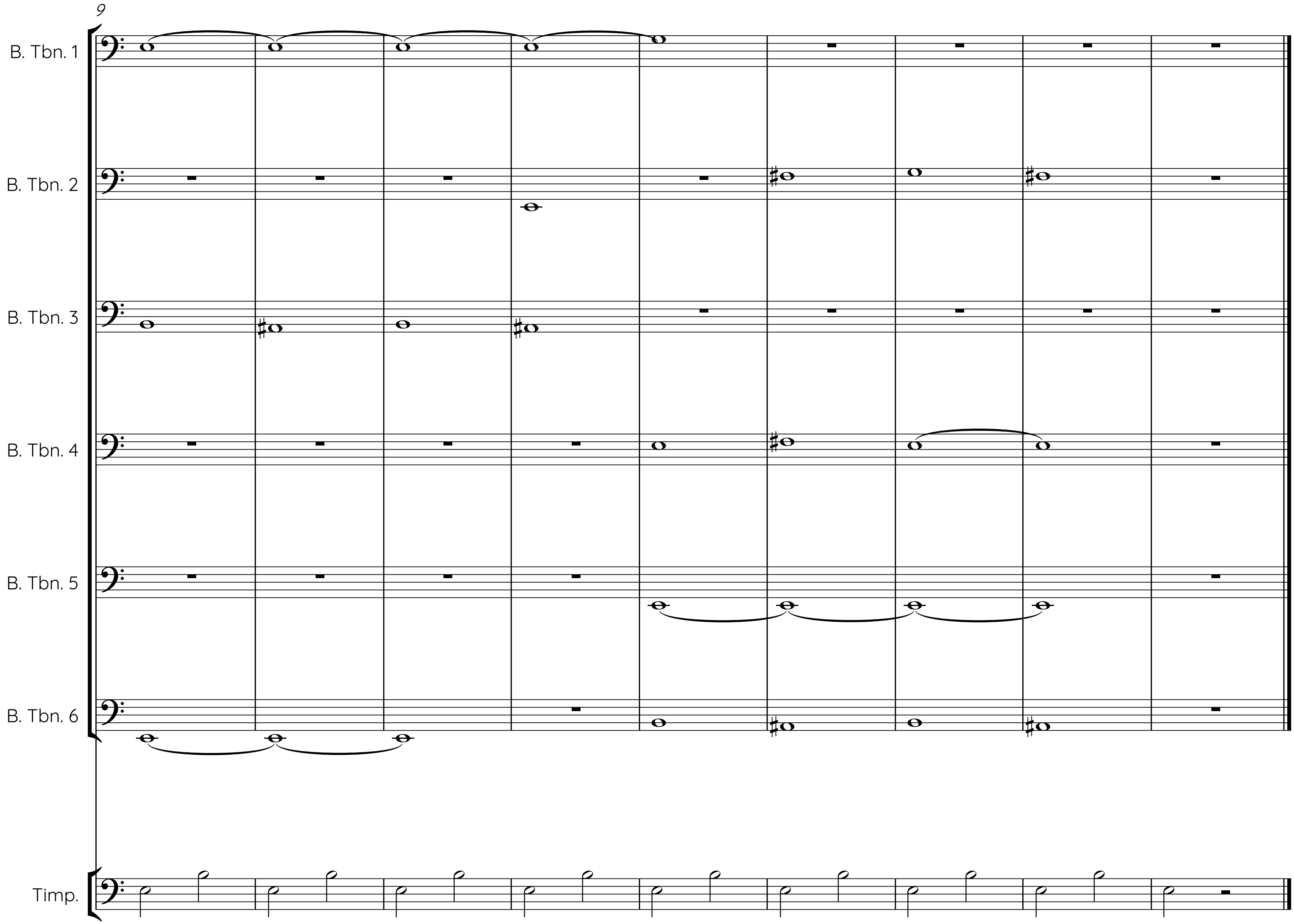
Nick Shadel


20
Ob.
Tpt.

M31 Fury [Duet 5]

Nick Shadel

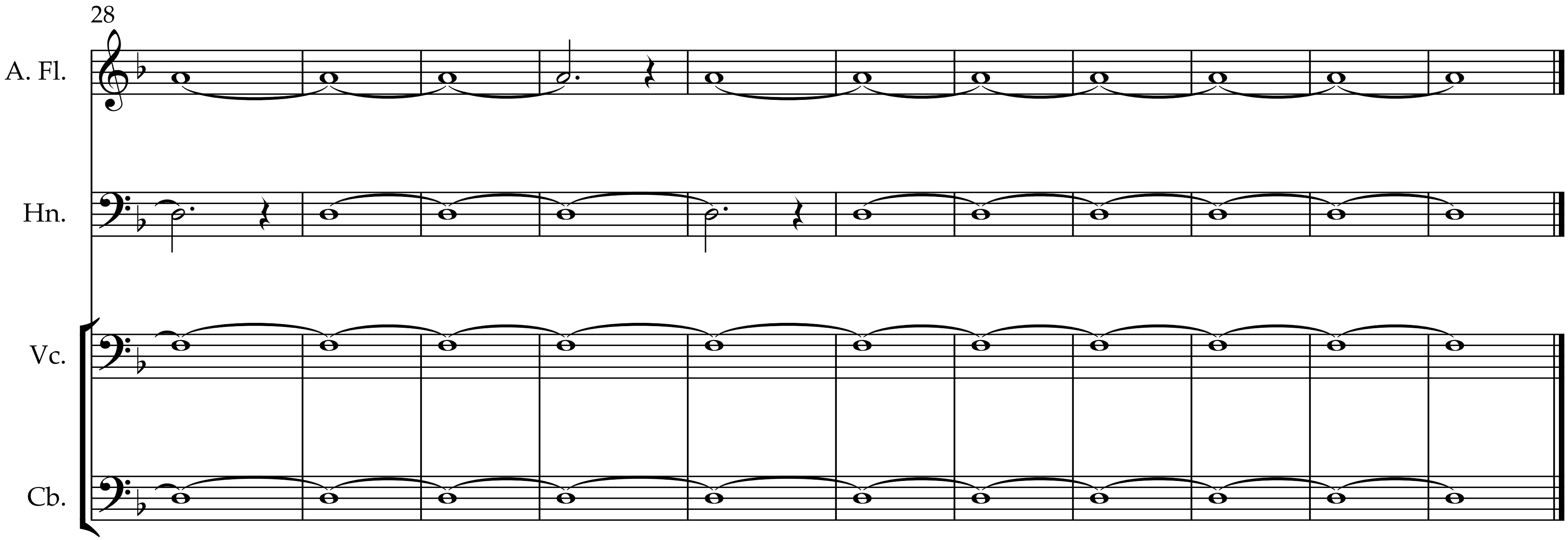



9
B. Tbn. 1
B. Tbn. 2
B. Tbn. 3
B. Tbn. 4
B. Tbn. 5
B. Tbn. 6
Timp.

M32 Snowy Castle [Synthesis Quartet]

Nick Shadel


10
A. Fl.
Hn.
Vc.
mp
Cb.
19
A. Fl.
Hn.
Vc.
Cb.


28
A. Fl.
Hn.
Vc.
Cb.

M34 Horror

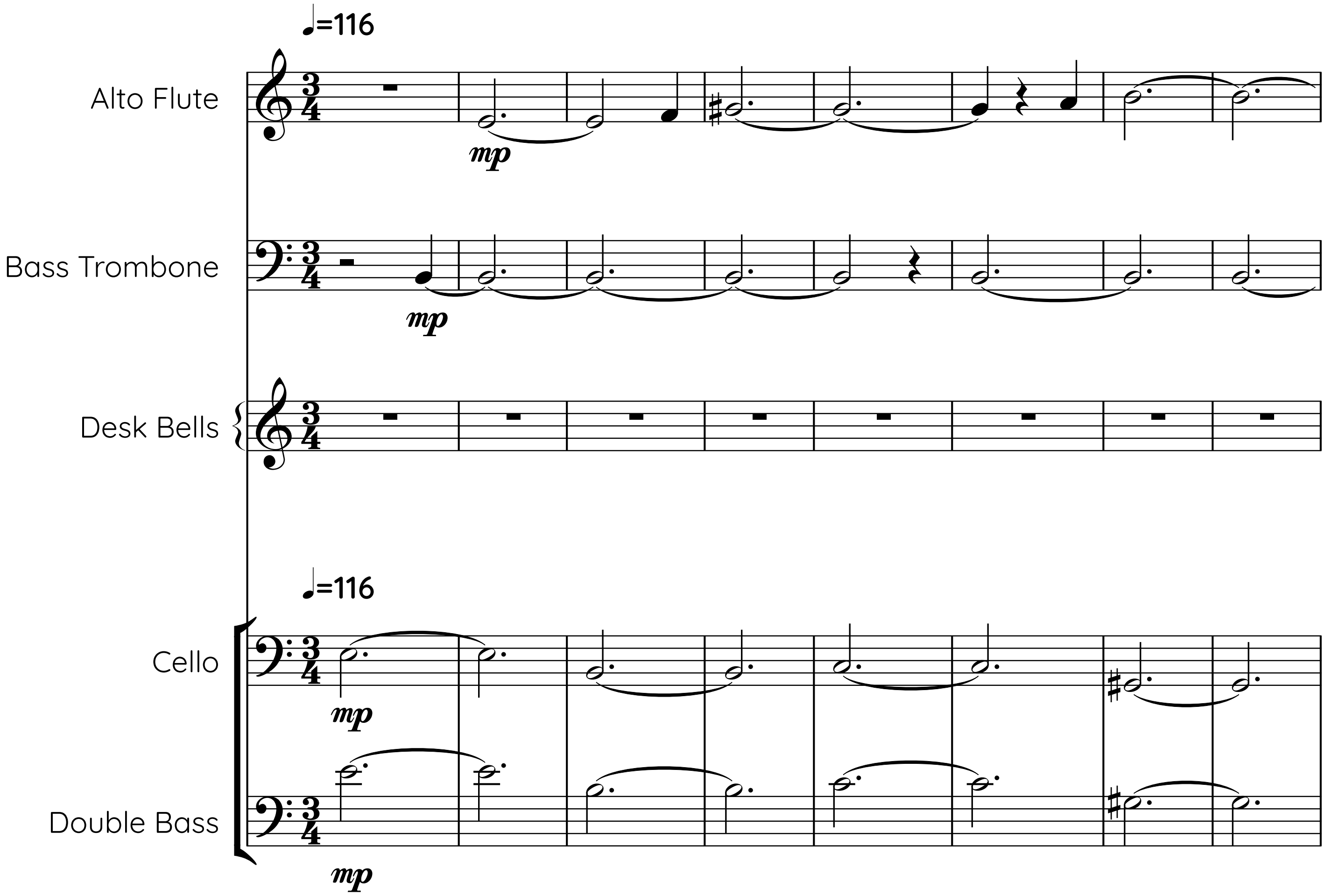
Master Bus Saturation, Reverb

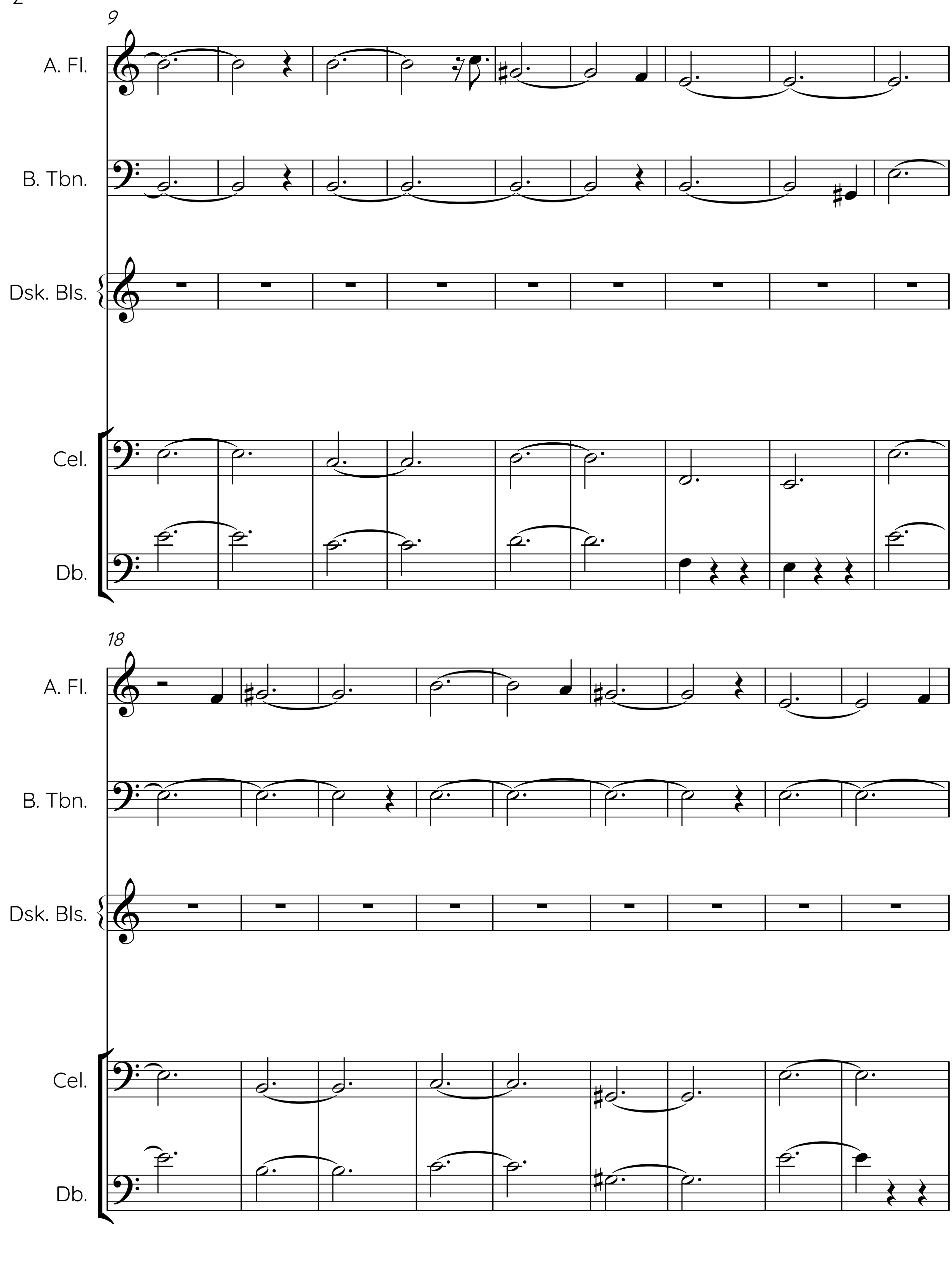
Nick Shadel

M33 Duke of Blangis [Quintet 3]

Master Bus Reverb, Auto-Pan, Granular Synthesis

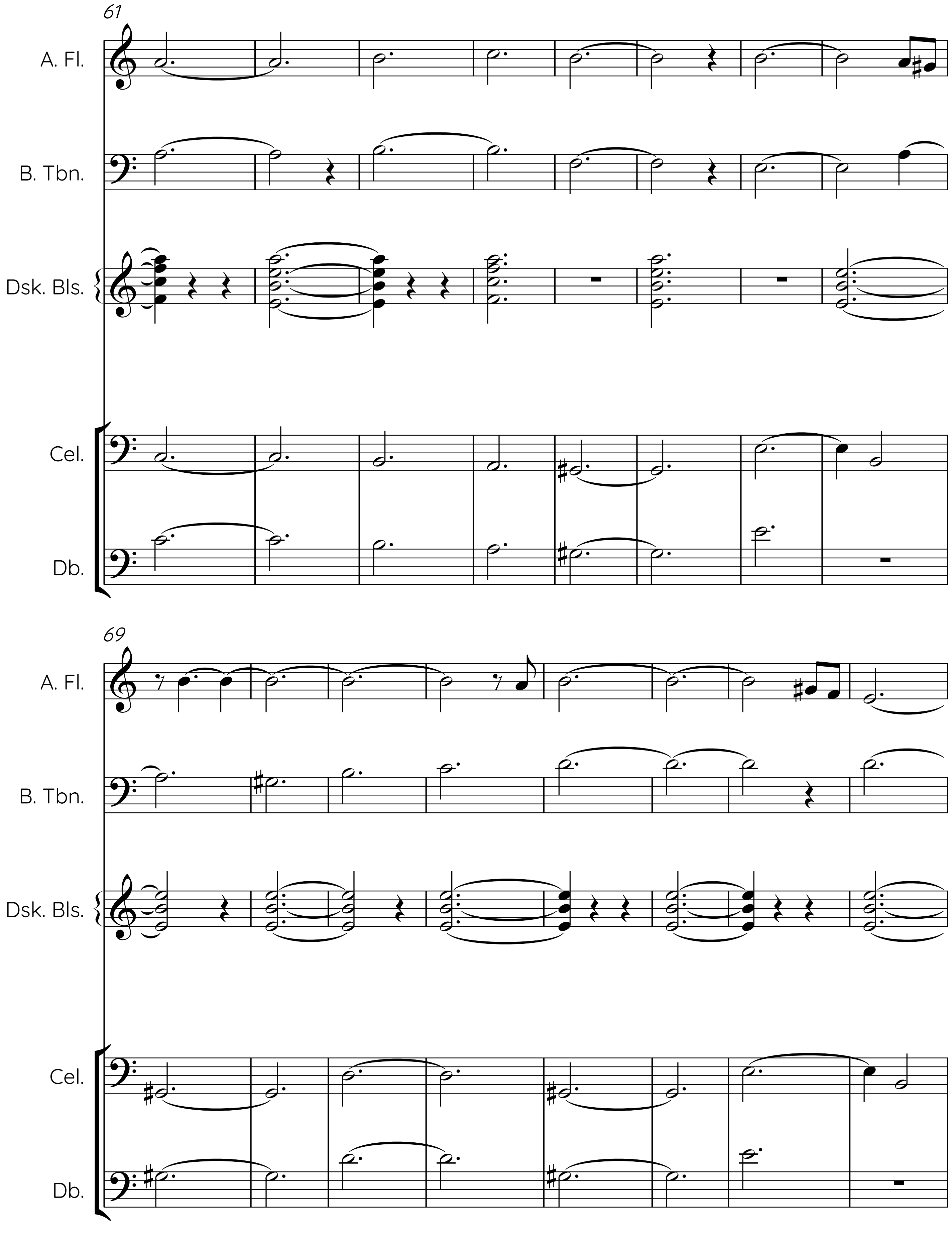
Nick Shadel



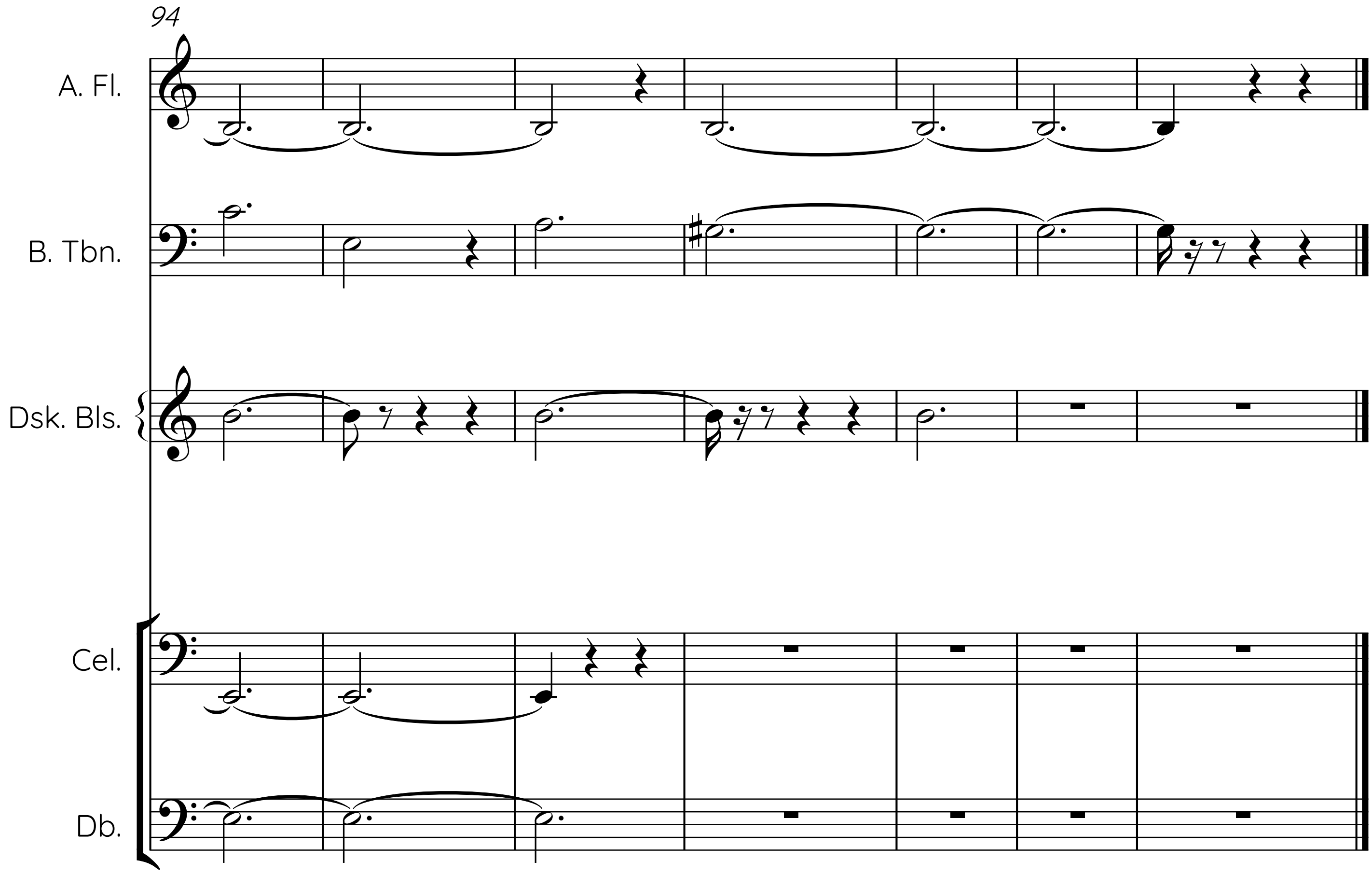

9
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.
18
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.


27
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.
36
A. Fl.
B. Tbn.
Dsk. Bls.
mp
Cel.
Db.


45
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.
53
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.


61
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.
69
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.


77
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.
85
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.


94
A. Fl.
B. Tbn.
Dsk. Bls.
Cel.
Db.

Solo Compositions

Nick Shadel

Flute
Oboe
Cor Anglais
Clarinet
Bass Clarinet
Contrabass Clarinet
Bassoon
Horn
Tenor Trombone
Bass Trombone
Tuba
Timpani
Crotales
Glockenspiel
Tubular Bells
Xylophone
Marimba
Vibraphone
Piano
Harp
Violin
Cello

Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

1. Piccolo

Nick Shadel

3. Alto Flute

Nick Shadel

5. Oboe

Nick Shadel

6. Cor Anglais

Nick Shadel

7. Clarinet

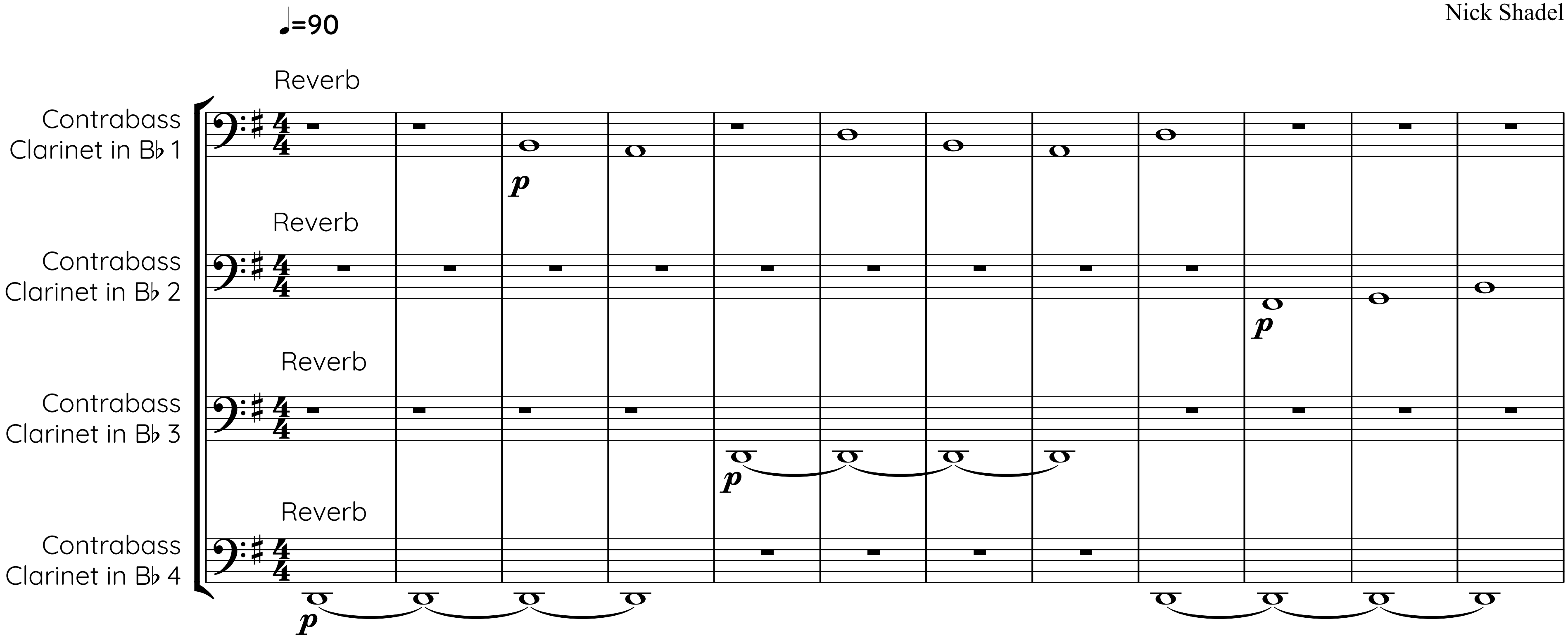
Nick Shadel

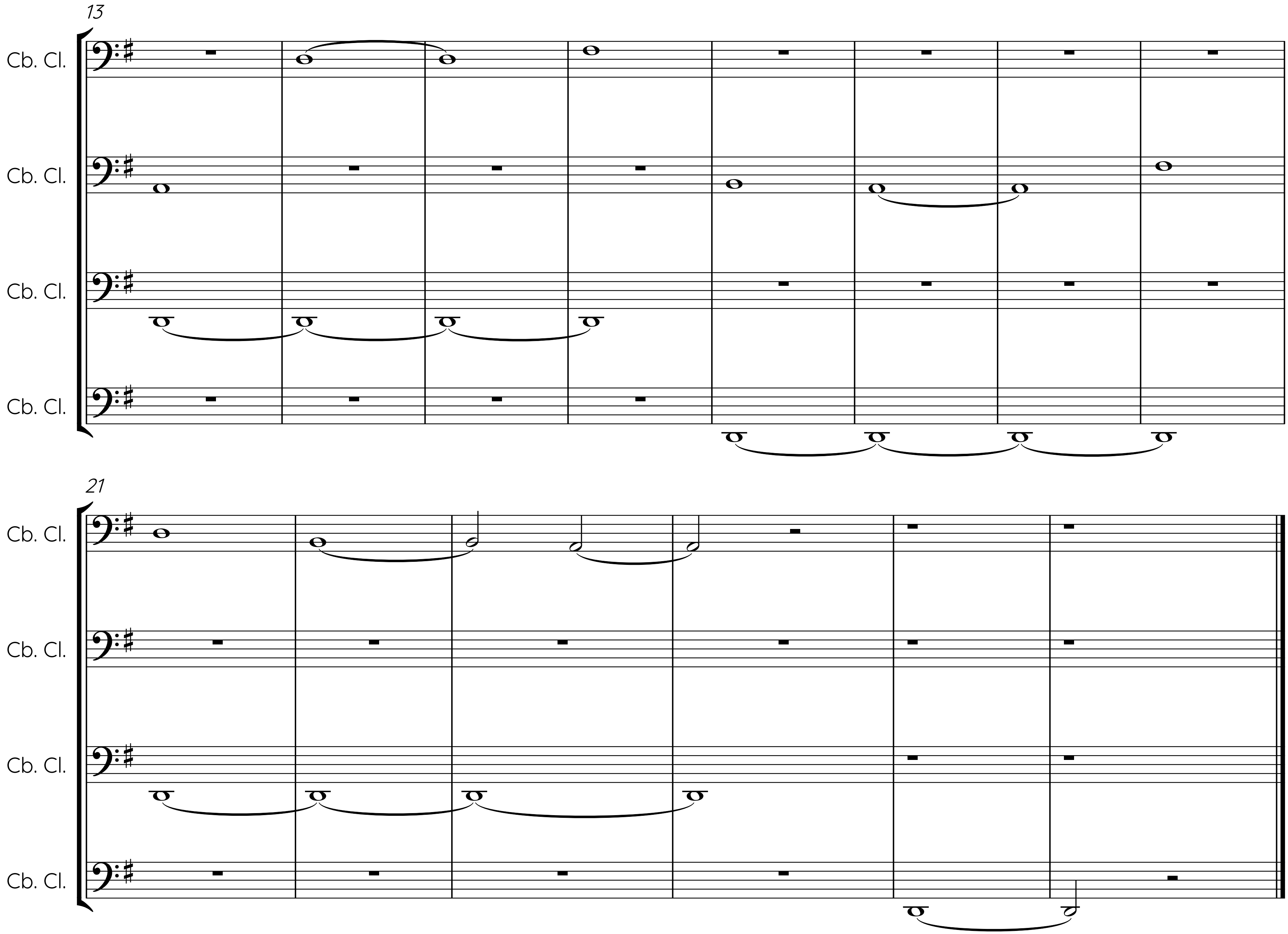
8. Bass Clarinet

Nick Shadel

9. Contrabass Clarinet

Nick Shadel




13
Cb. Cl.
Cb. Cl.
Cb. Cl.
Cb. Cl.
21
Cb. Cl.
Cb. Cl.
Cb. Cl.
Cb. Cl.

10. Bassoon

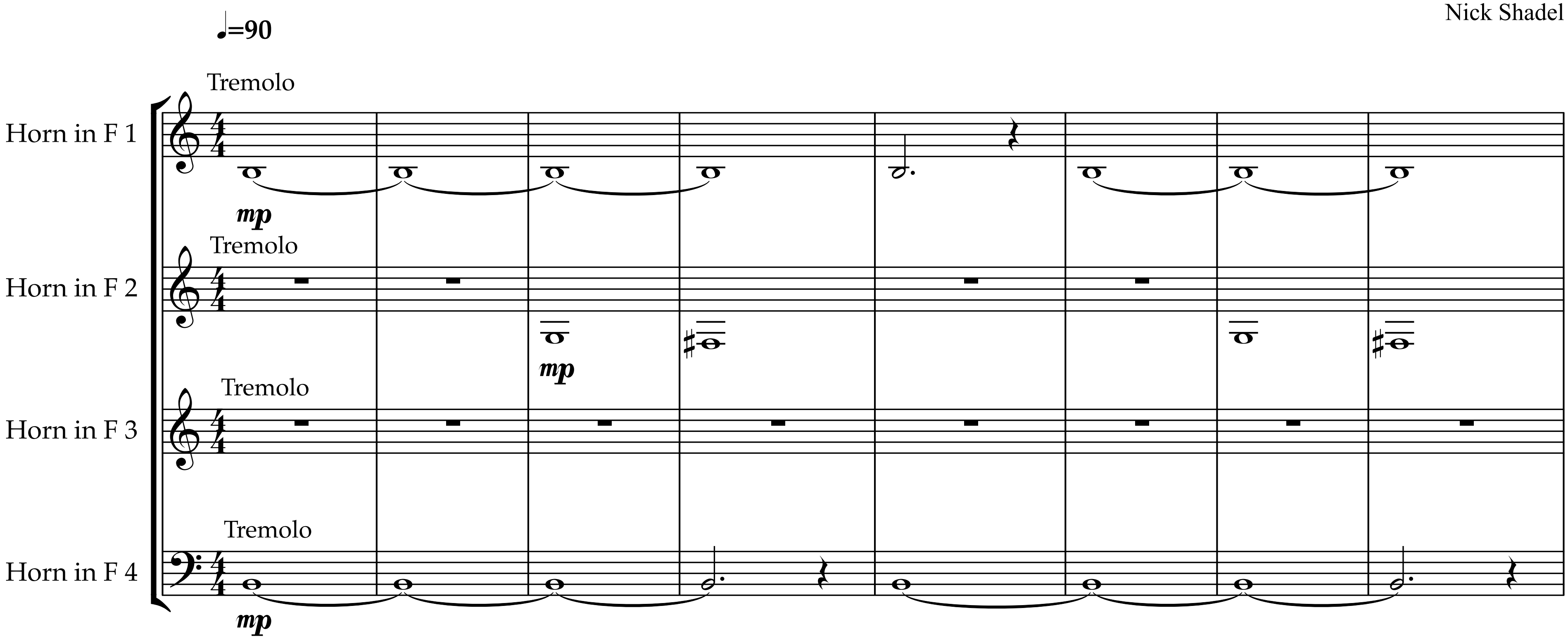
Nick Shadel

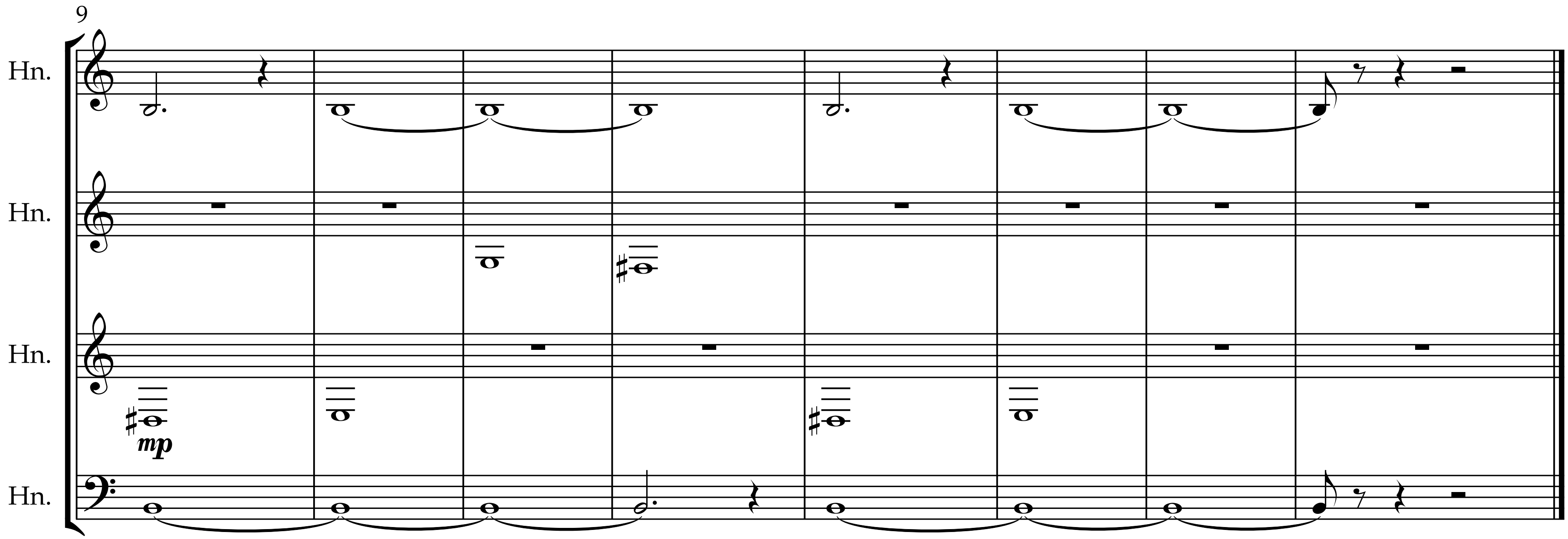

12
Bsn. 1
Bsn. 2
17
Bsn. 1
Bsn. 2

11. Horn

Horn Quartet

Nick Shadel




9
Hn.
Hn.
Hn.
mp
Hn.

13. Tenor Trombone

Nick Shadel

14. Bass Trombone

Nick Shadel

15. Tuba

Nick Shadel

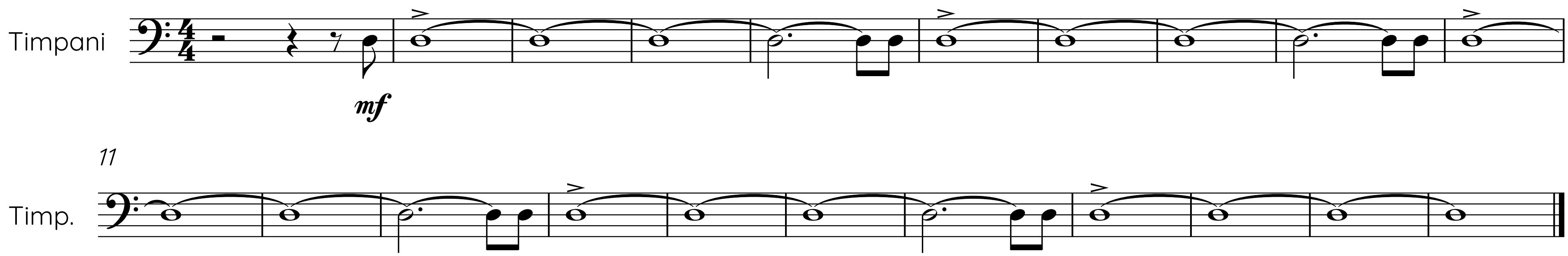
16. Timpani

♩=112

Delay

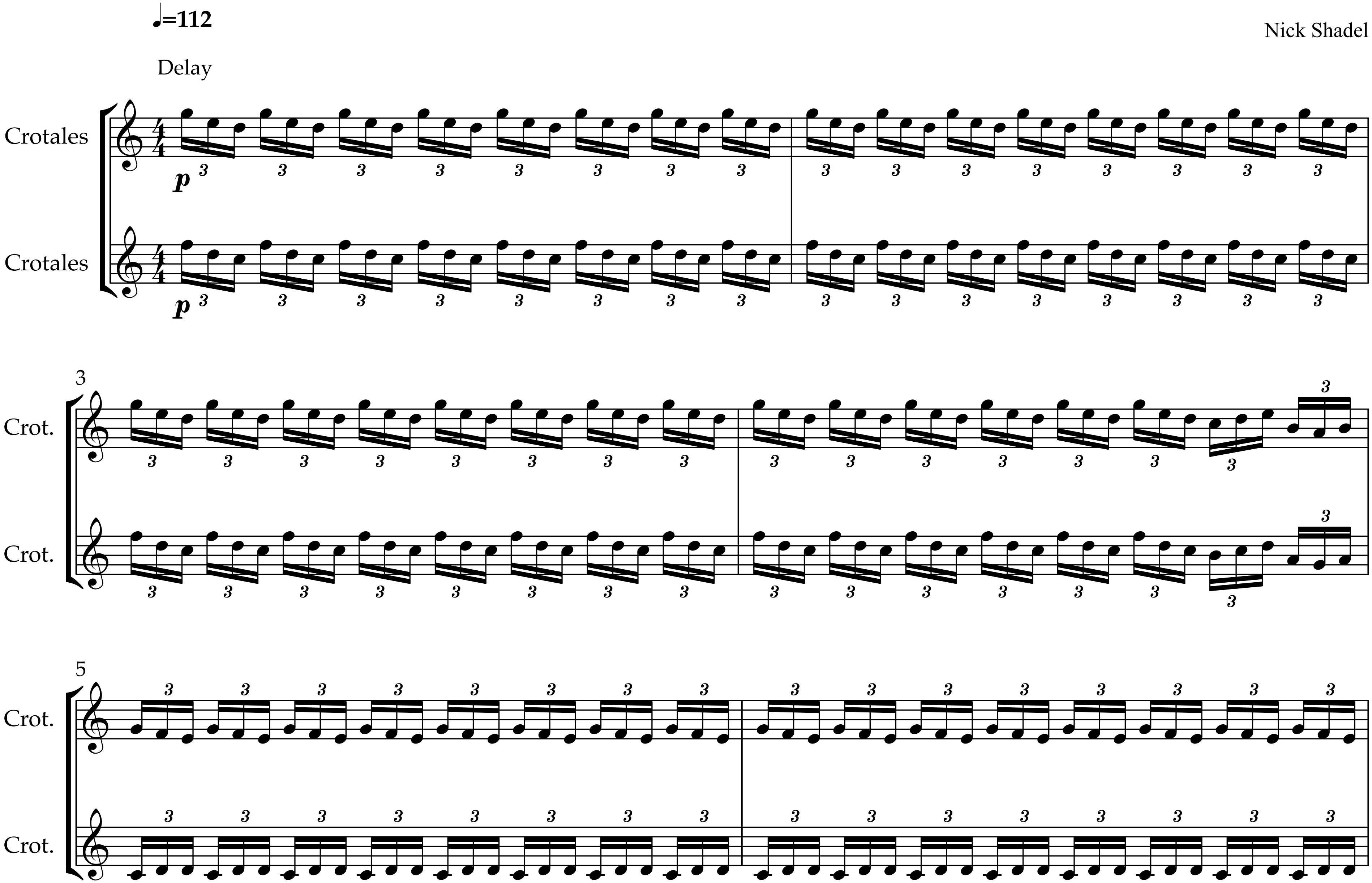
Timp. in D

Nick Shadel



17. Crotales

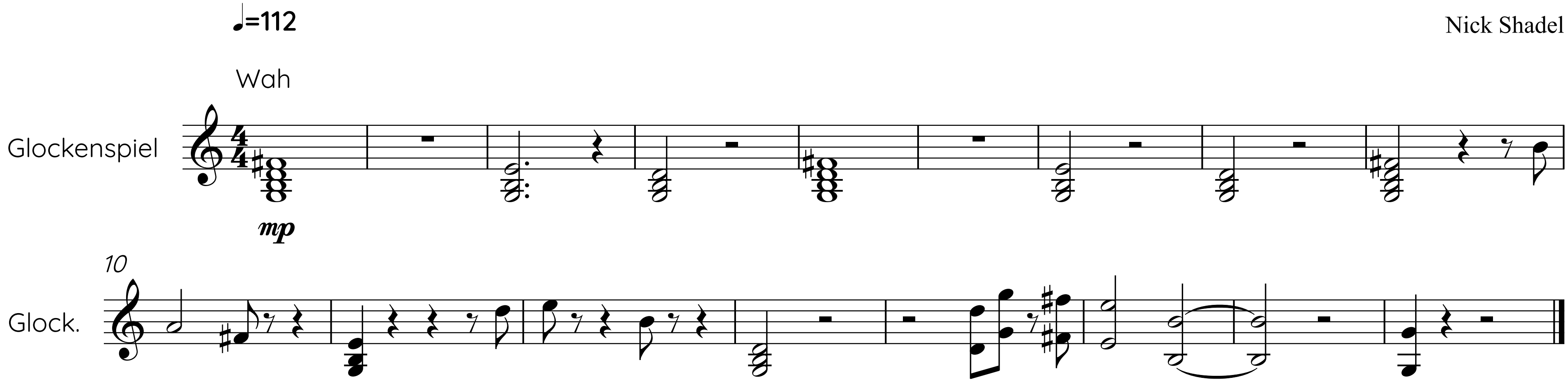
Nick Shadel




7
Crot.
Crot.
9
Crot.
Crot.
11
Crot.
Crot.

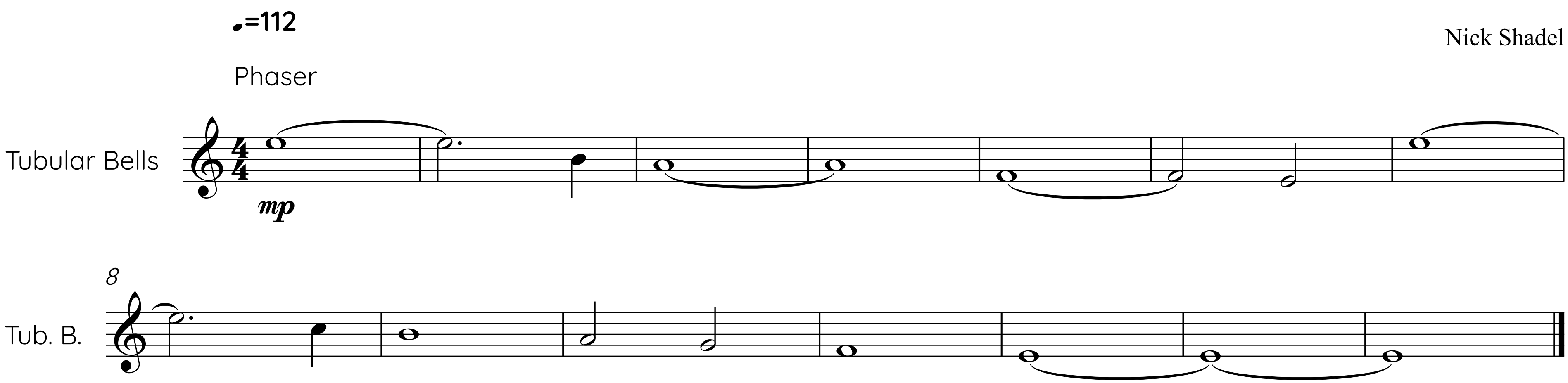
18. Glockenspeil

Nick Shadel



19. Tubular Bells

Nick Shadel



20. Xylophone

♩=96

Nick Shadel

Tremolo

21. Marimba

Nick Shadel

22. Vibraphone

♩=96

Nick Shadel

Reverb
Motor on

24. Piano

Nick Shadel

25. Harp

Nick Shadel

♩=96

Delay

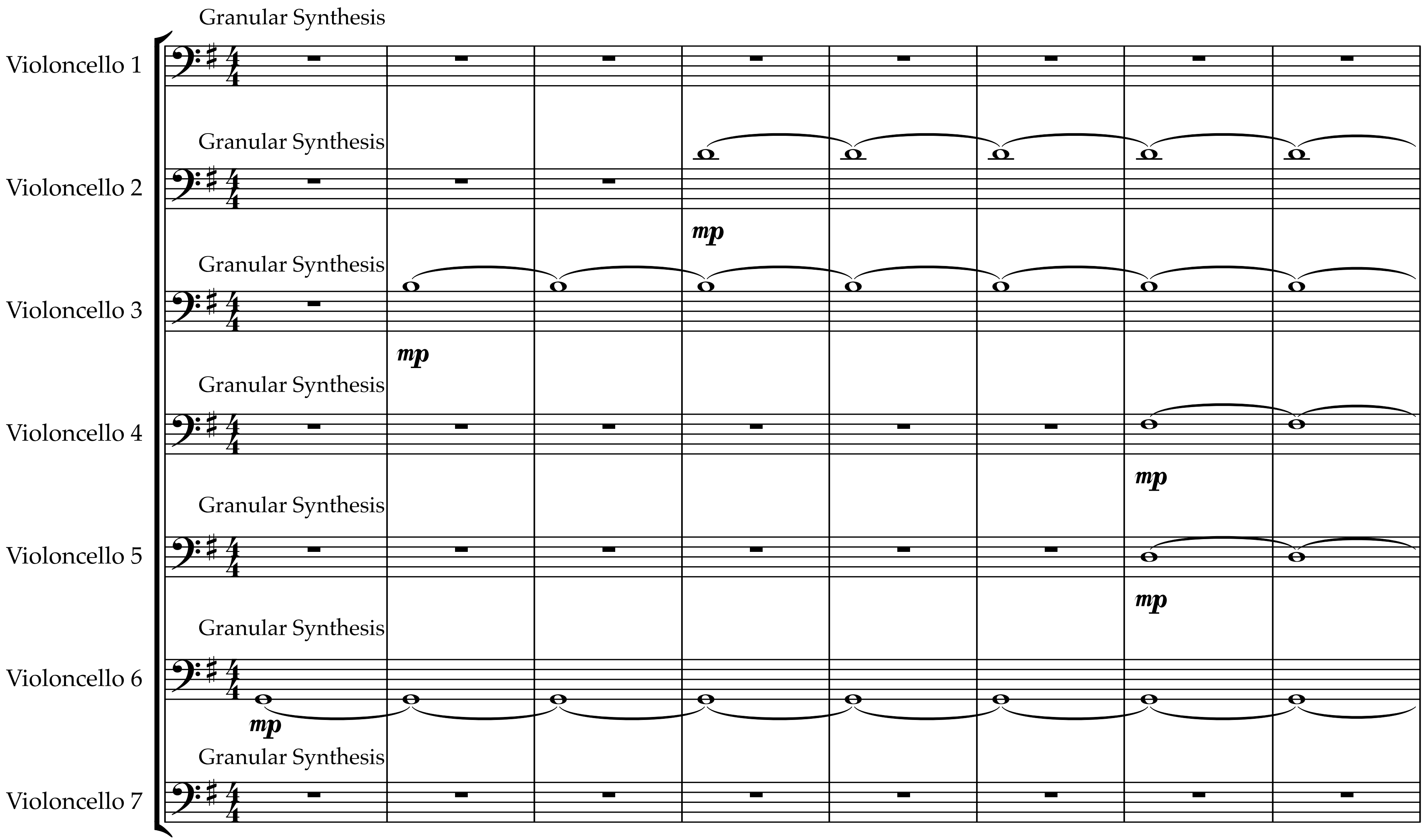
26. Violin

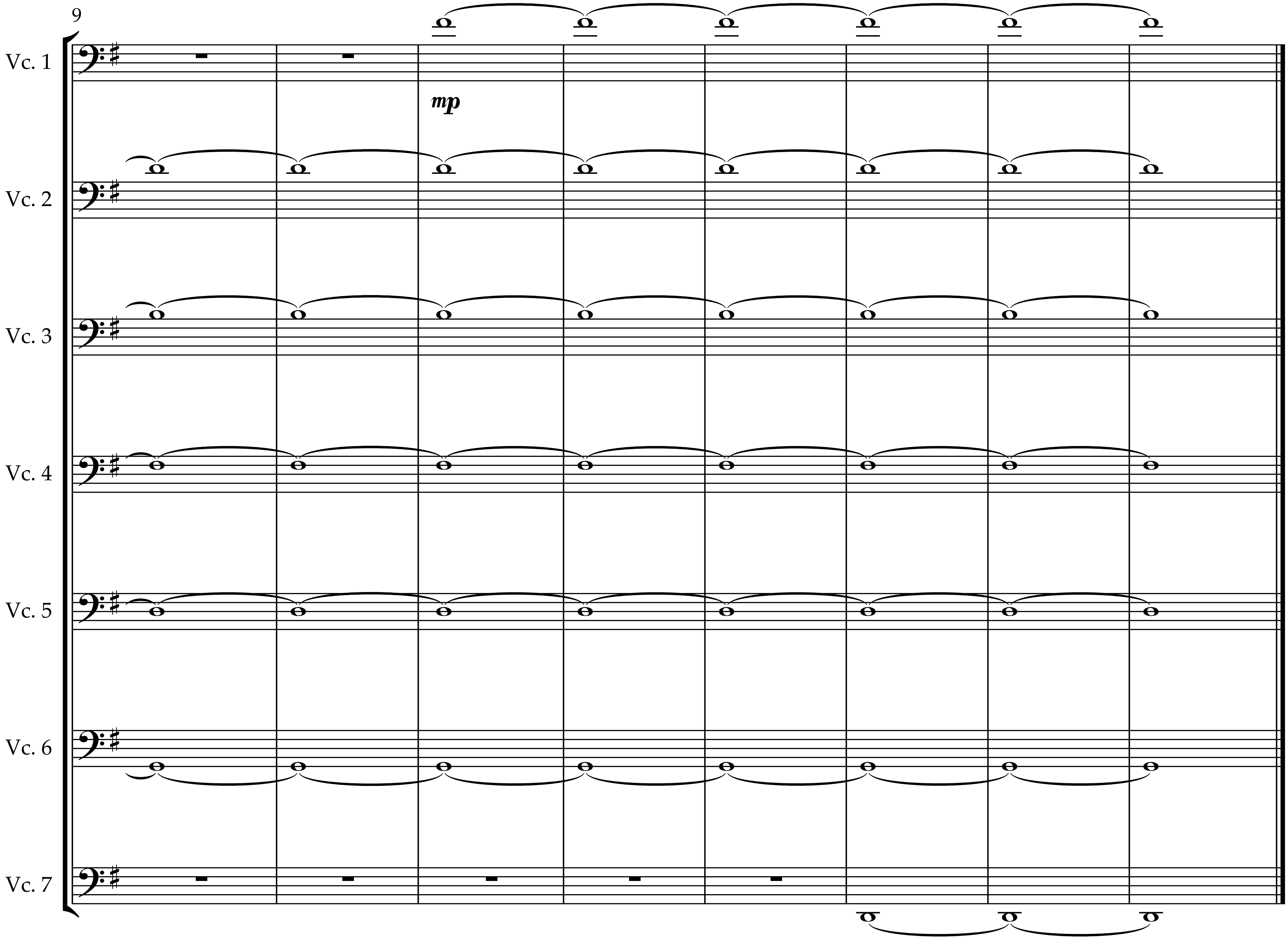
Nick Shadel

28. Cello

120 bpm

Nick Shadel




9
Vc. 1
mp
Vc. 2
Vc. 3
Vc. 4
Vc. 5
Vc. 6
Vc. 7

Duet Compositions

Nick Shadel

Duet 9 - Piano and Viola
Duet 12 - Bassoon and Crotales
Duet 15 - Glockenspiel and Bass Flute

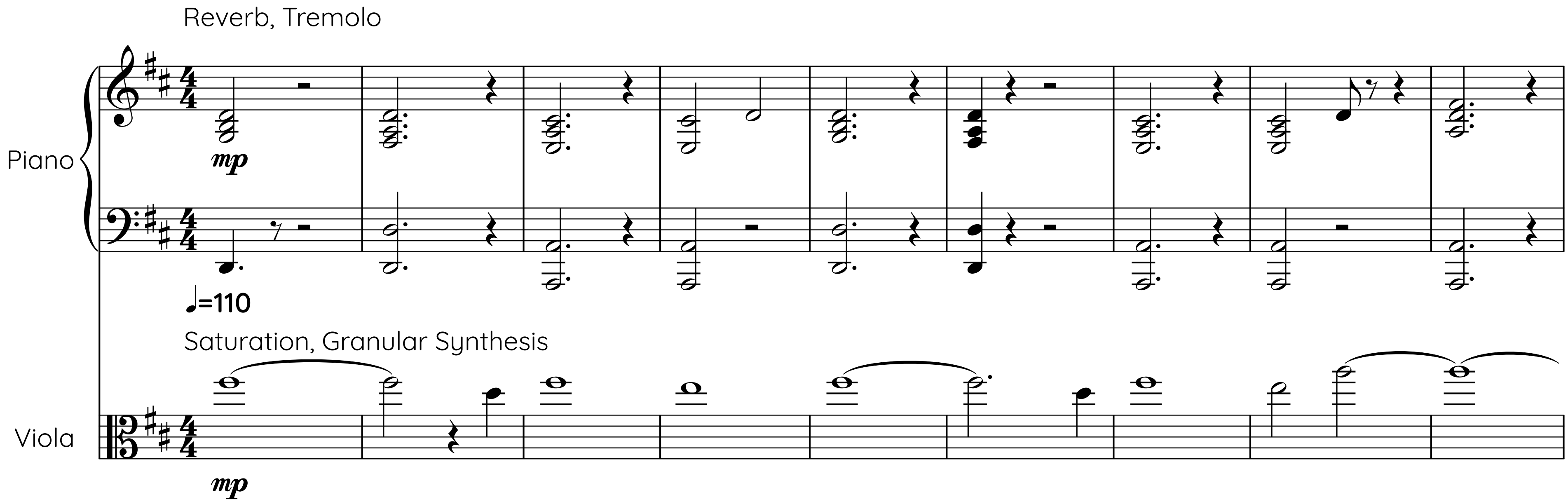
Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

Duet 9

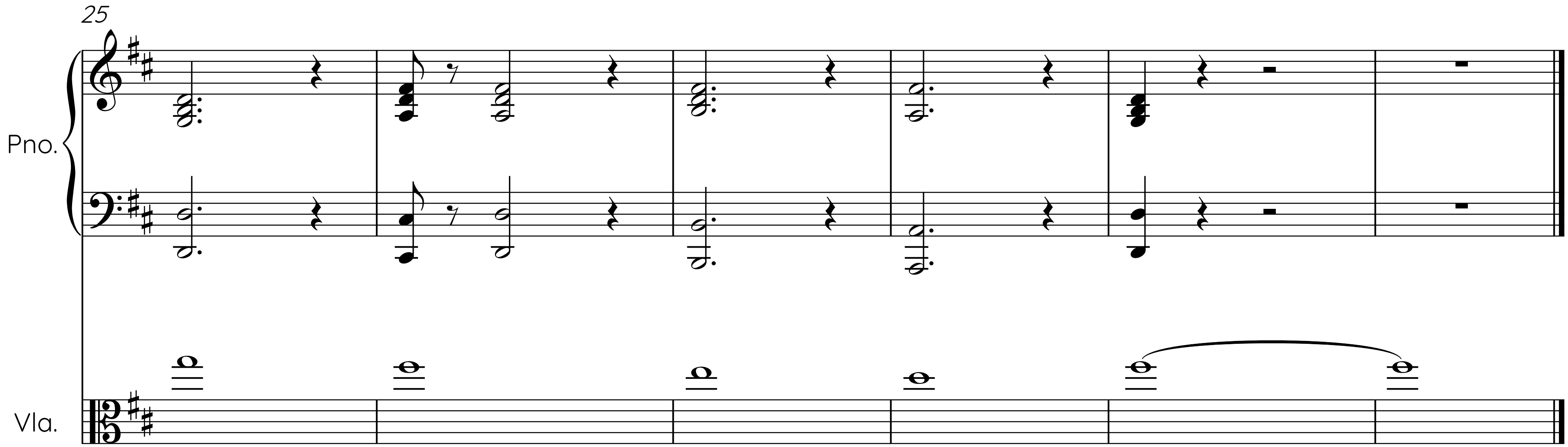
Piano and Viola

♩=110

Nick Shadel



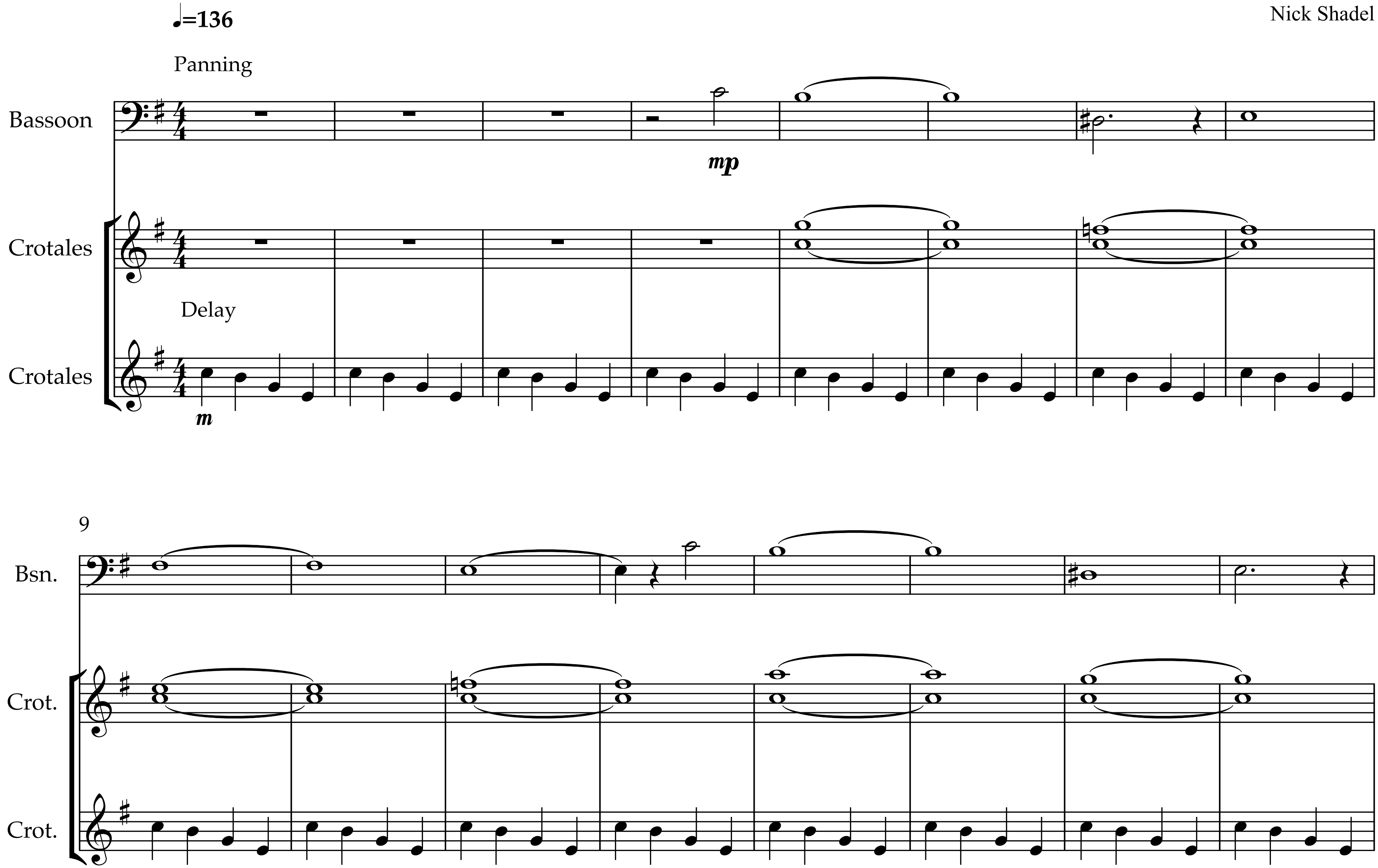

10
Pno.
Vla.
20
Pno.
Vla.

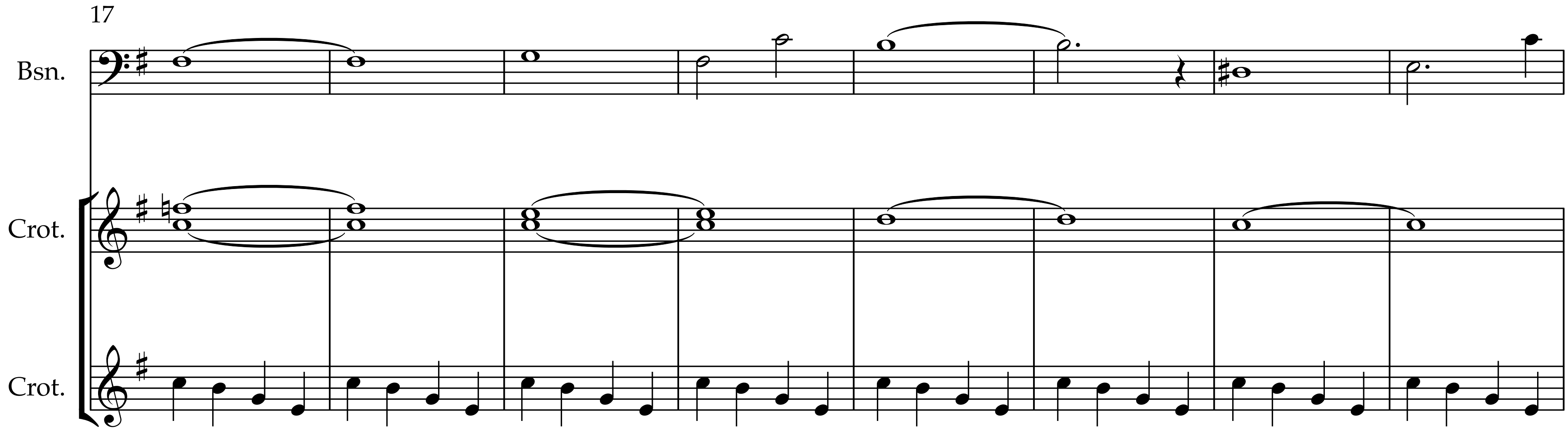

25
Pno.
Vla.

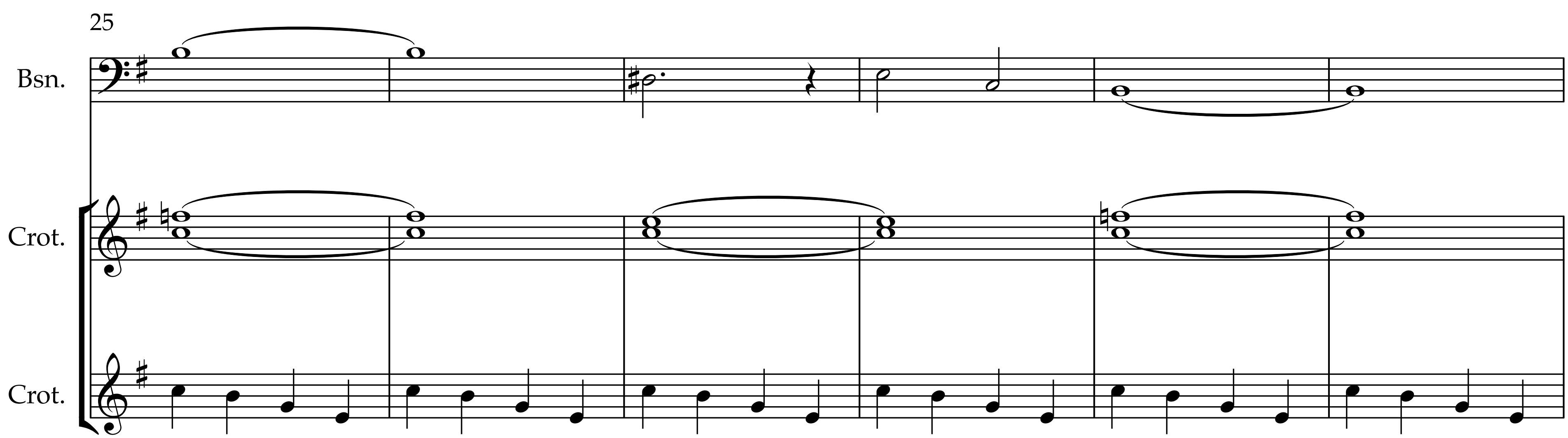
Duet 12

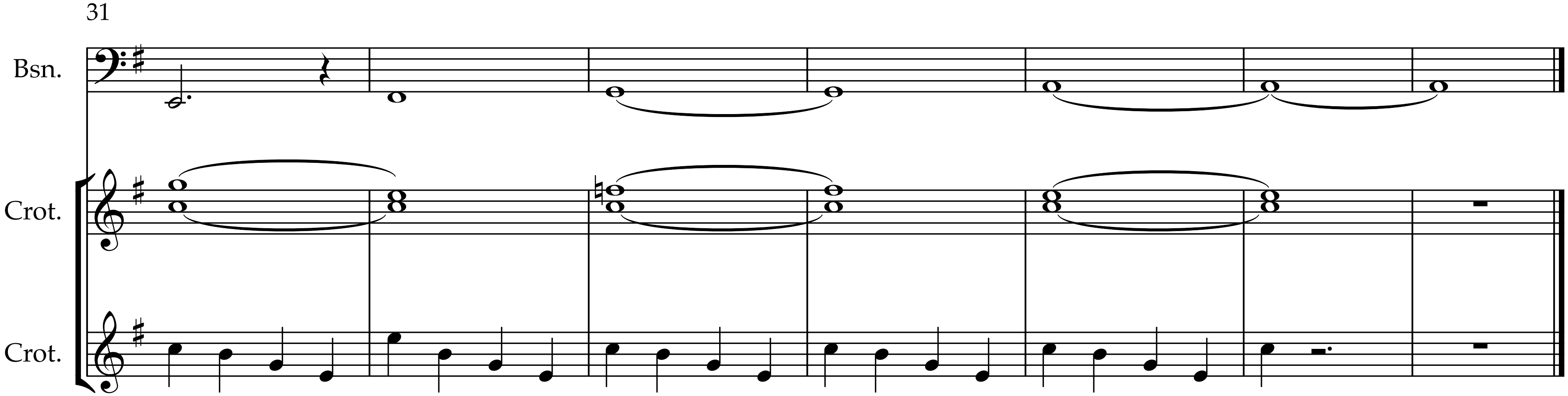
Bassoon and Crotales

Nick Shadel




17
Bsn.
Crot.
Crot.


25
Bsn.
Crot.
Crot.


31
Bsn.
Crot.
Crot.

Duet 15

Glockenspiel and Bass Flute

Nick Shadel


13
Glock.
B. Fl.
19
Glock.
B. Fl.
24
Glock.
B. Fl.

Quartets

Nick Shadel

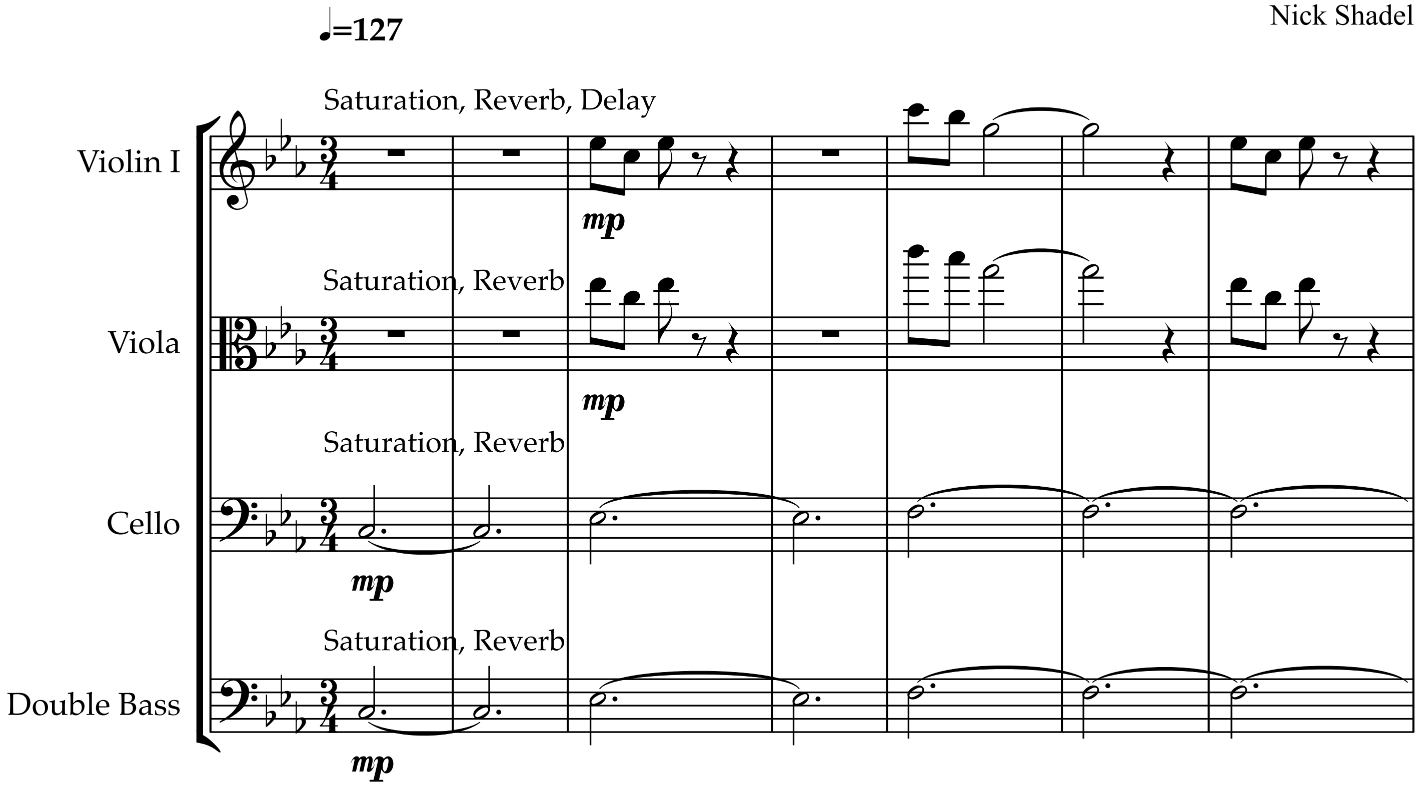
Quartet 2 - Violin, Viola, Cello and Double Bass

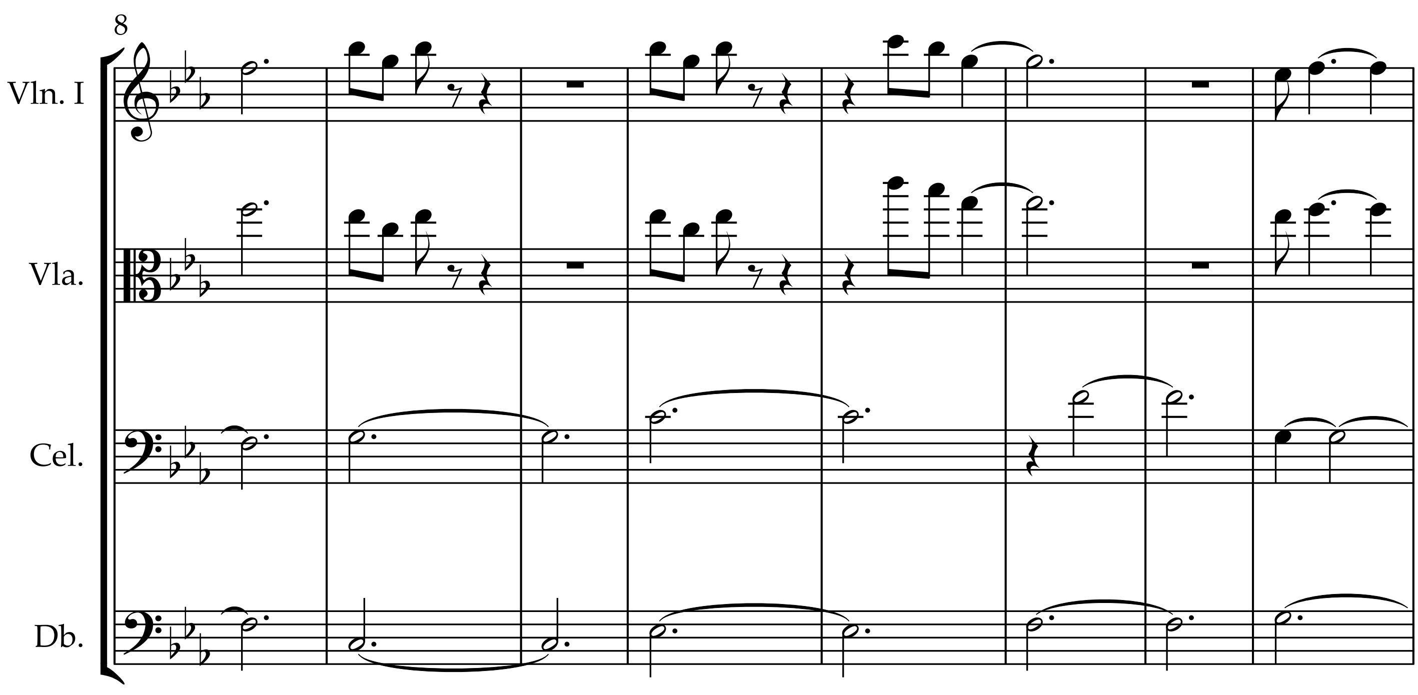
Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

Quartet 2

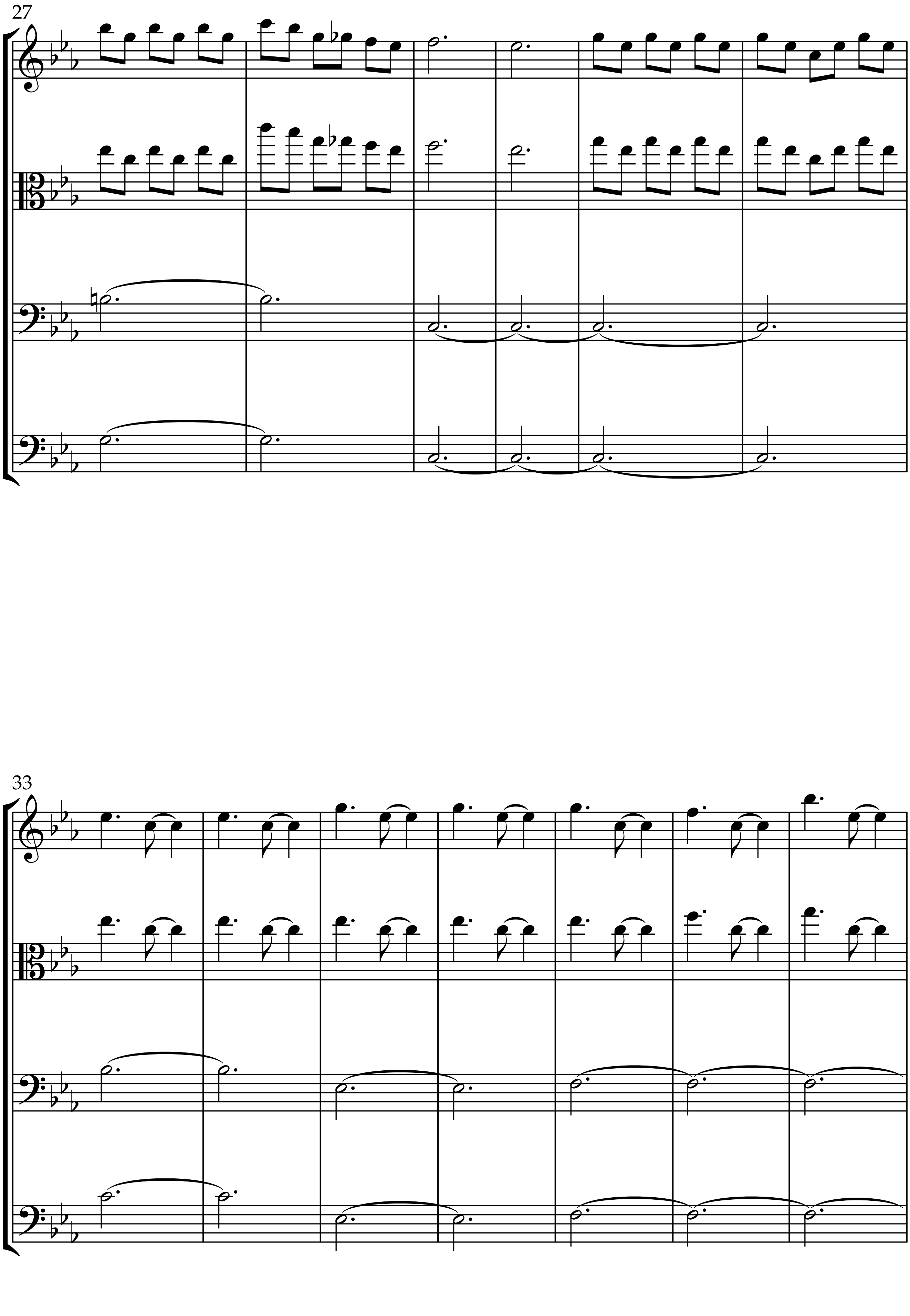
Violin, Viola, Cello and Double Bass

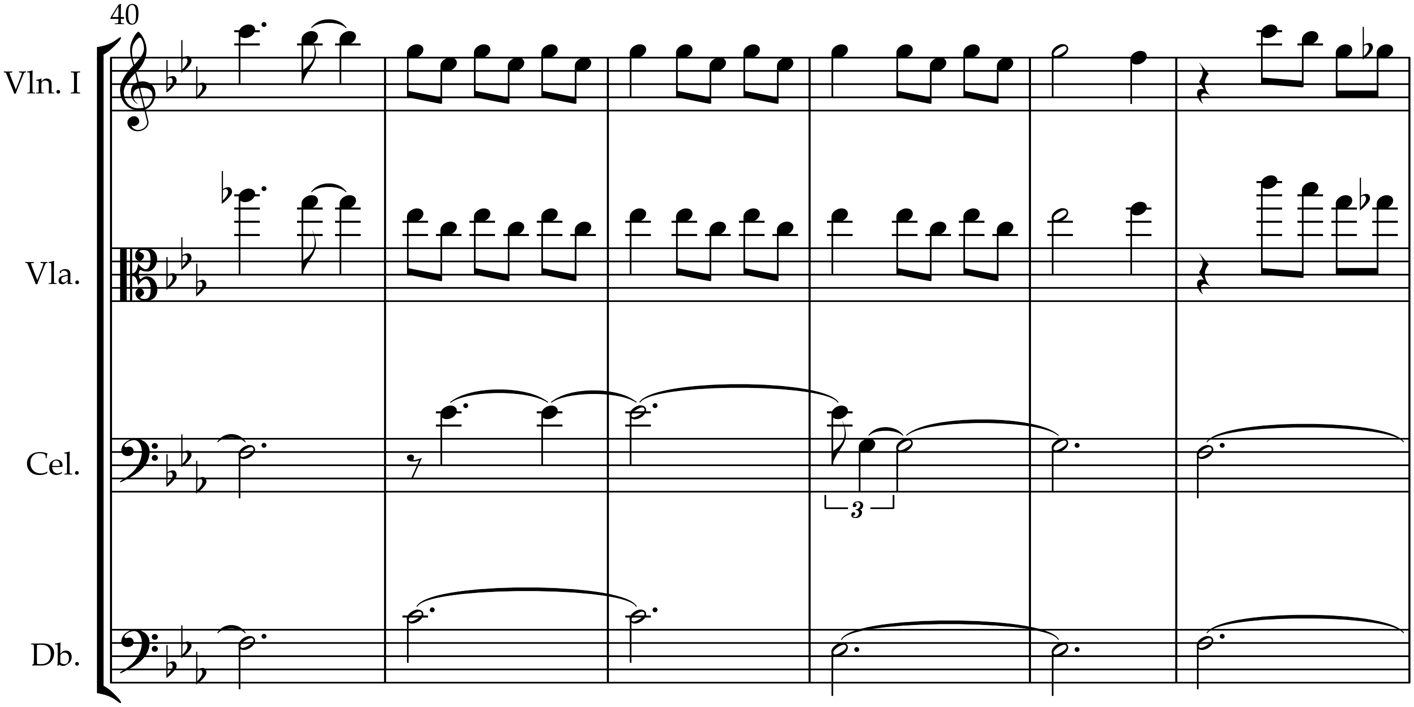
Nick Shadel

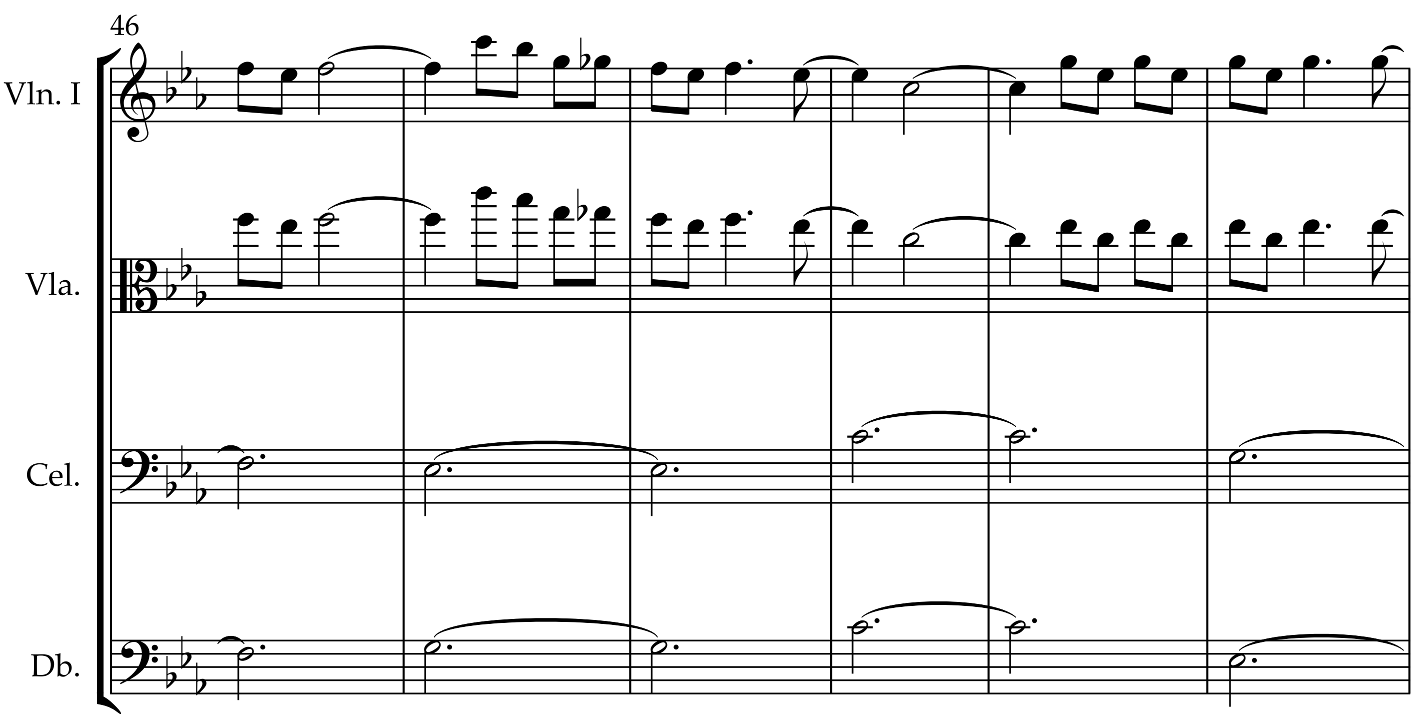


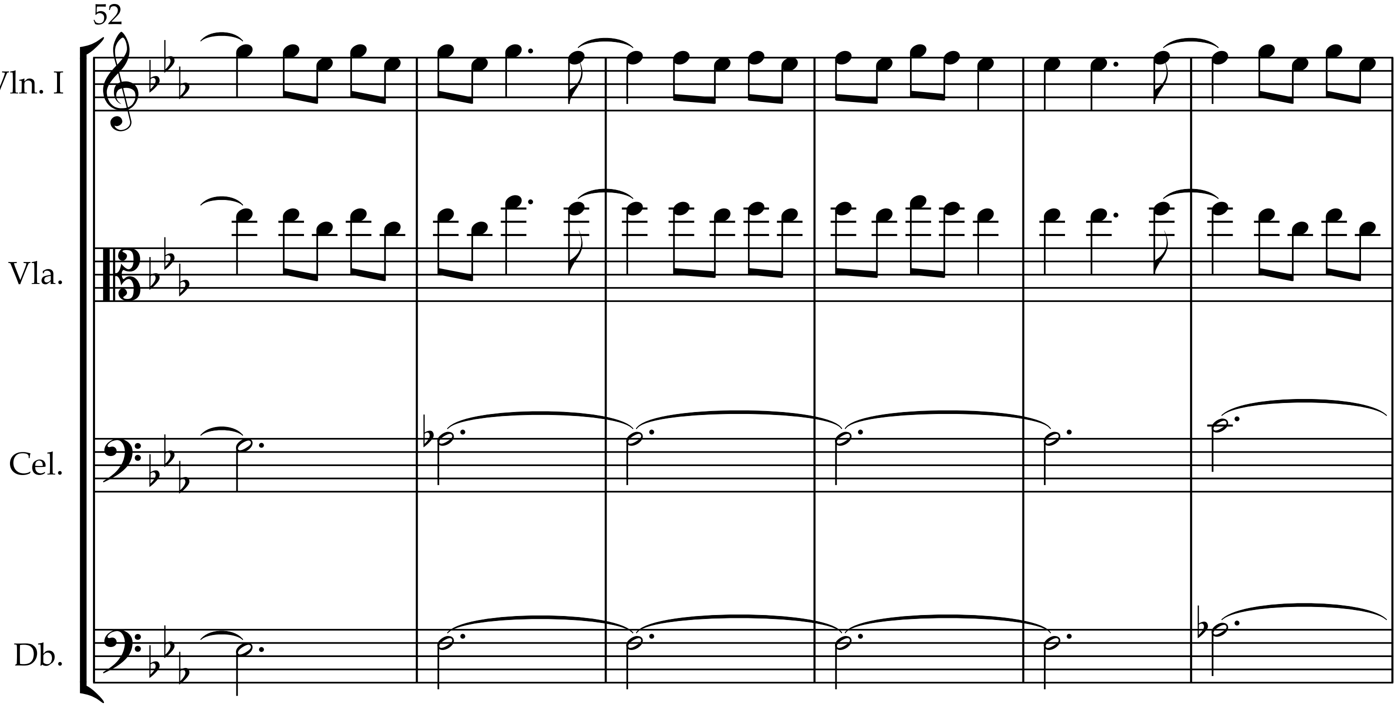


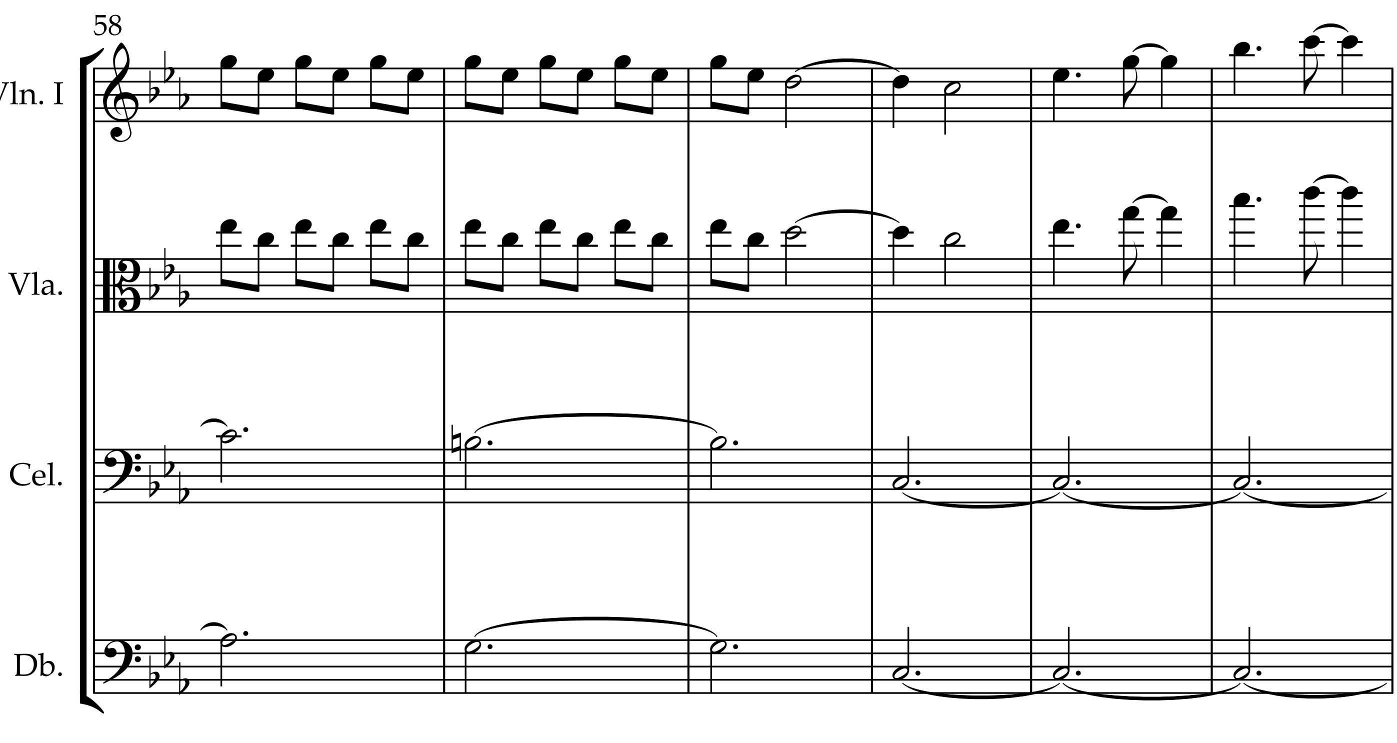

16
Vln. I
Vla.
Cel.
Db.
22
Vln. I
Vla.
Cel.
Db.


27
Vln. I
Vla.
Cel.
Db.
33
Vln. I
Vla.
Cel.
Db.


40
Vln. I
Vla.
Cel.
3
Db.


46
Vln. I
Vla.
Cel.
Db.


52
Vln. I
Vla.
Cel.
Db.

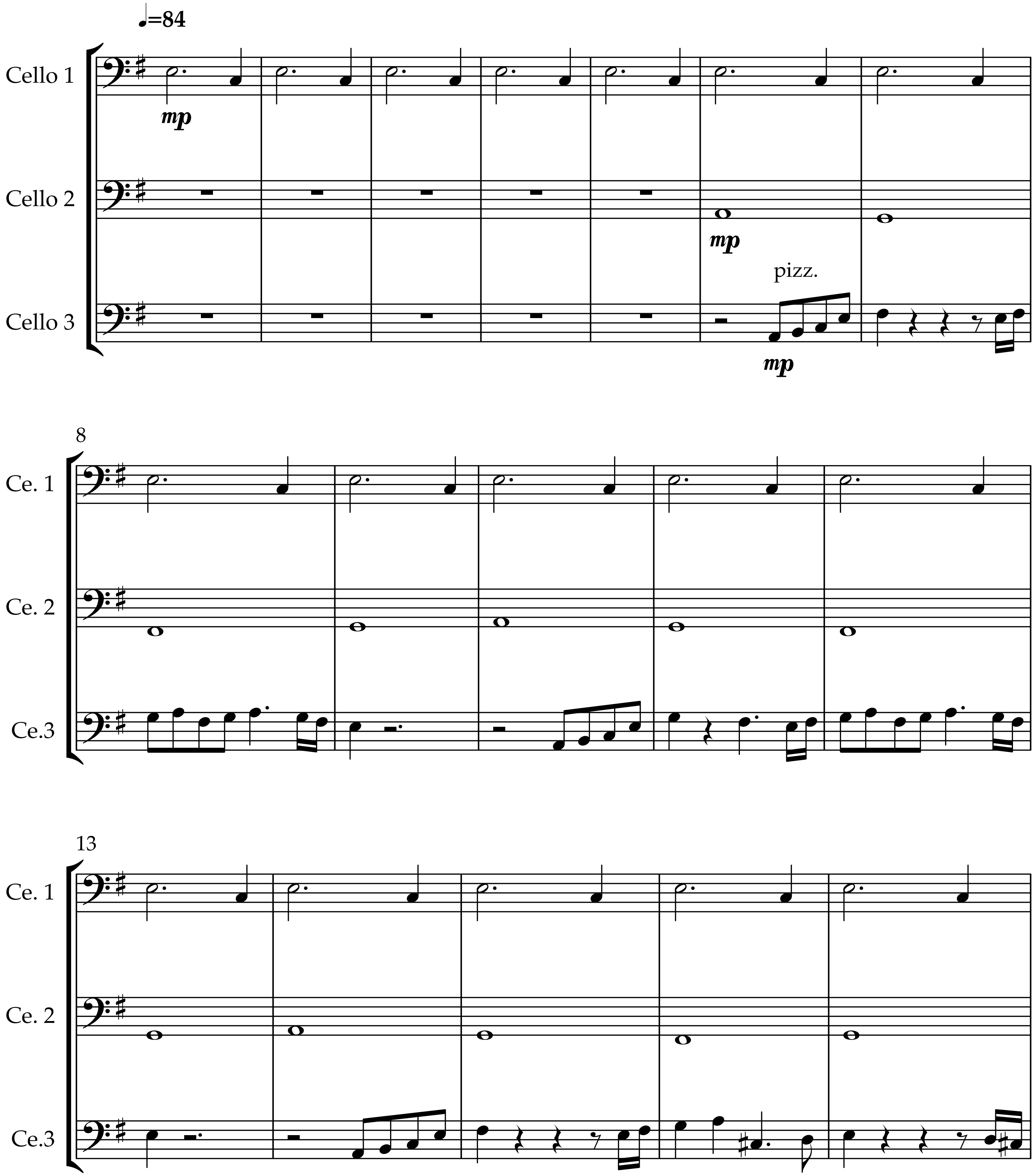

58
Vln. I
Vla.
Cel.
Db.


64
Vln. I
Vla.
Cel.
Db.

Multiplicity for Solo Cello

Three Cellos with Saturation, Reverb, Tremolo, Granular Synthesis, Delay, Chorus

Nick Shadel




18
Ce. 1
Ce. 2
Ce.3
22
Ce. 1
Ce. 2
Ce.3

Real Instrument Chamber Orchestra

Nick Shadel

Flute with EQ, Saturation, Delay and Reverb
French Horn with Granular Synthesis and Saturation
French Horn with Granular Synthesis, Saturation and Reverb
8 Percussion
Piano with Reverb
Violin with Delay
Cello with Delay and Reverb
Cello with Delay and Reverb
Contrabass

**Percussion List:*

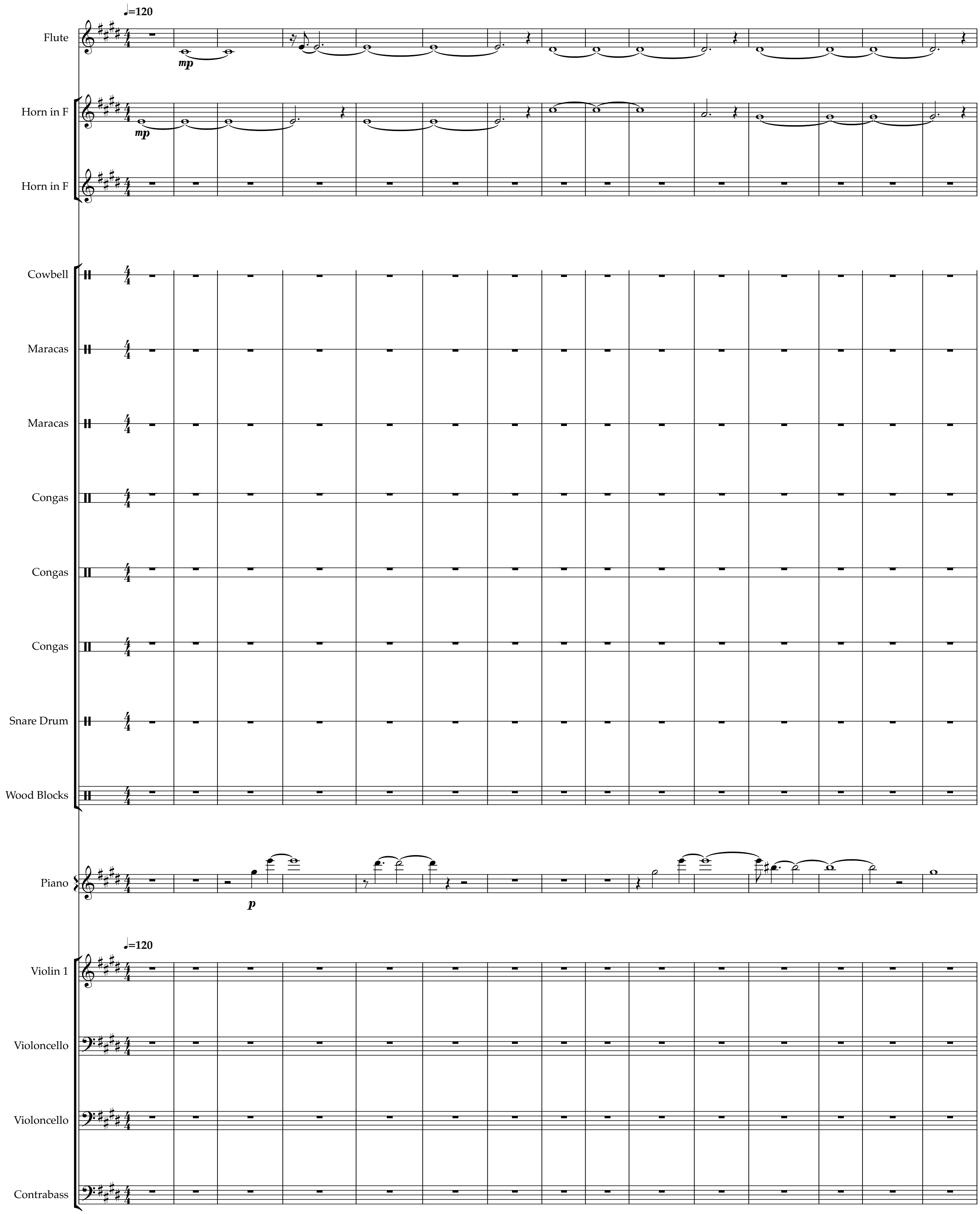
Percussion 1: Cow Bell
Percussion 2: Maraca
Percussion 3: Maraca
Percussion 4: Conga
Percussion 5: Conga
Percussion 6:Conga
Percussion 7: Snare Drum
Percussion 8: Wood Block

Score in C
All instruments are notated at concert pitch
Octave-transposing instruments are notated according to their conventional written ranges

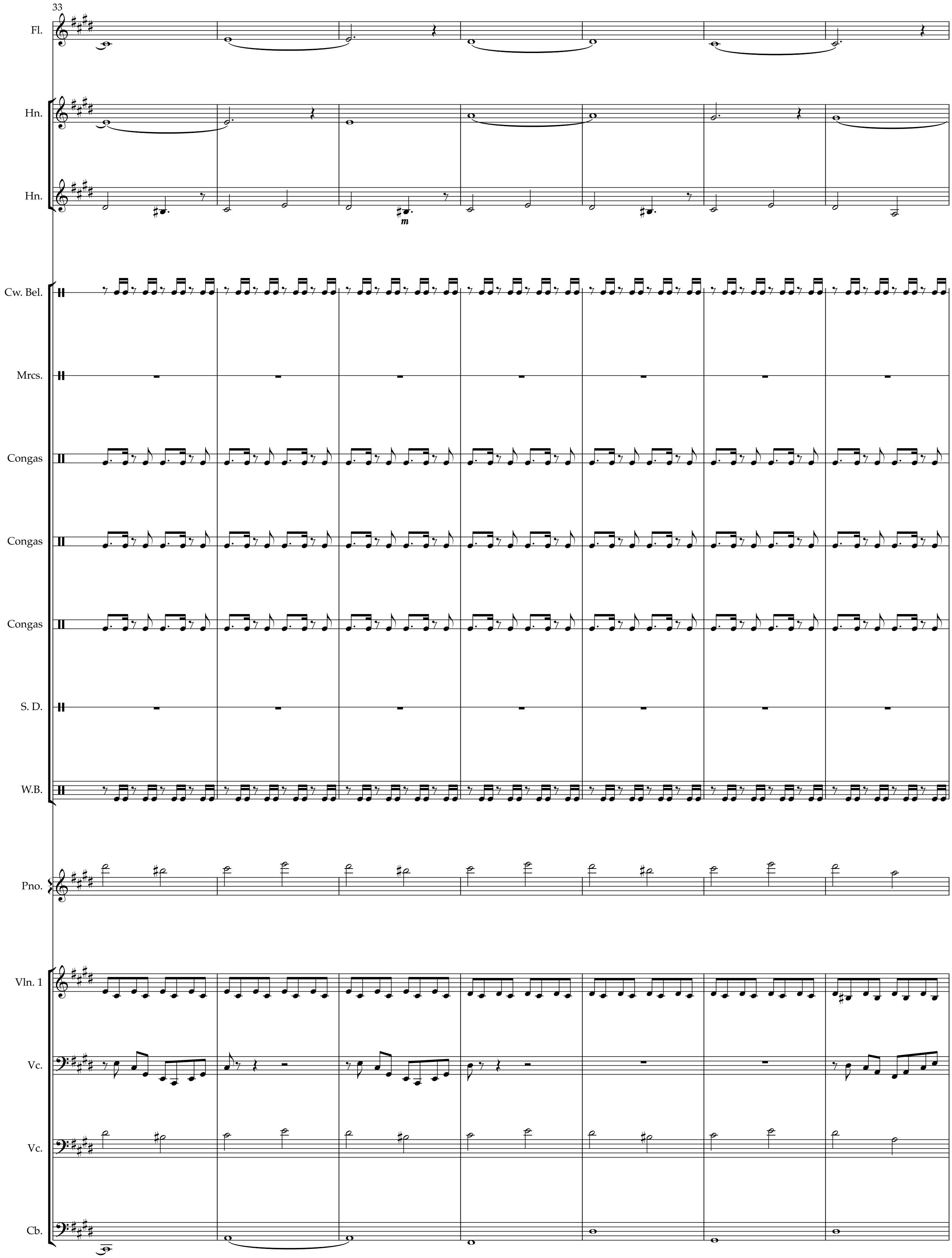
December 12, 2022

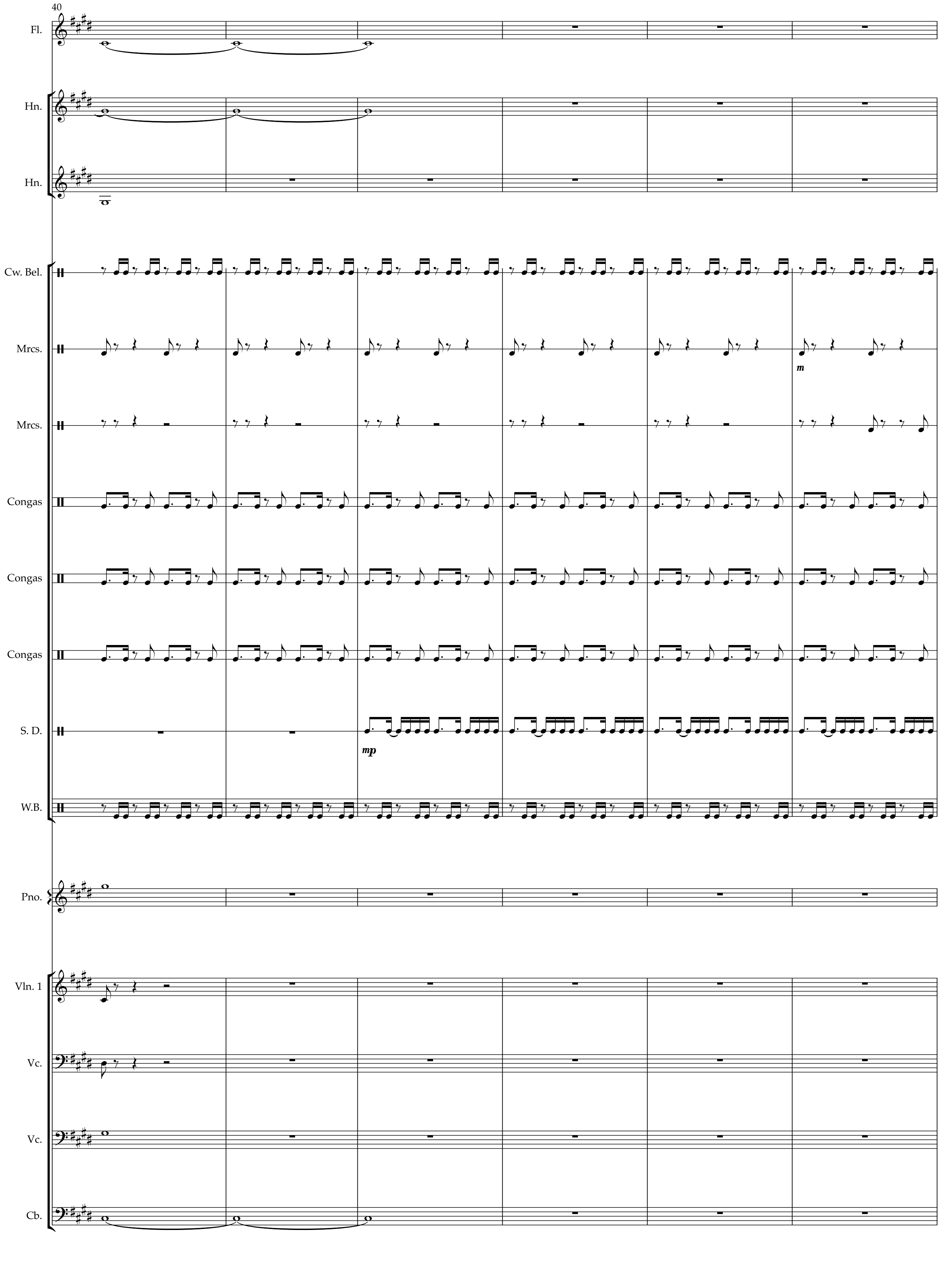
Real Instrument Chamber Orchestra

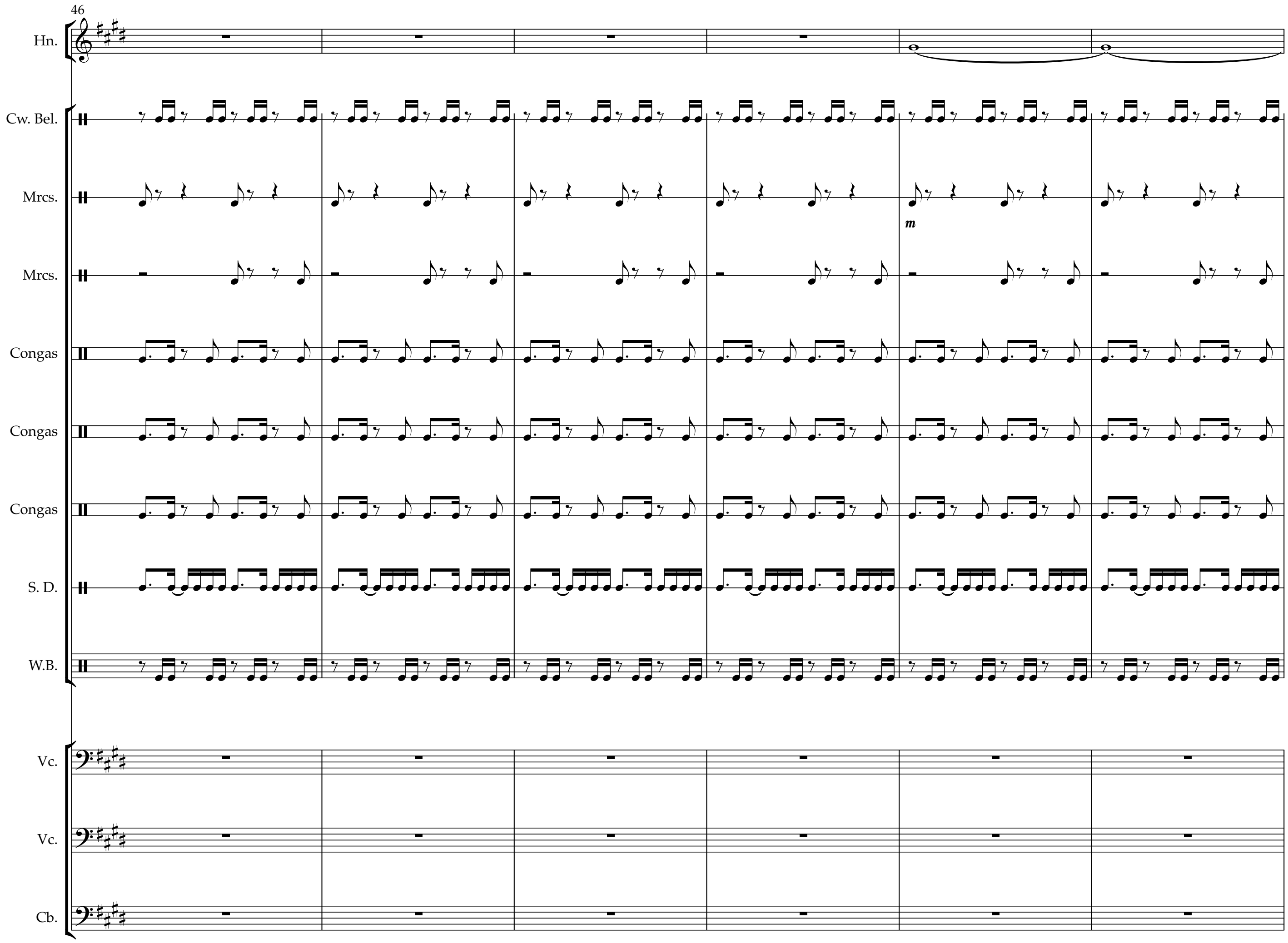
Nick Shadel



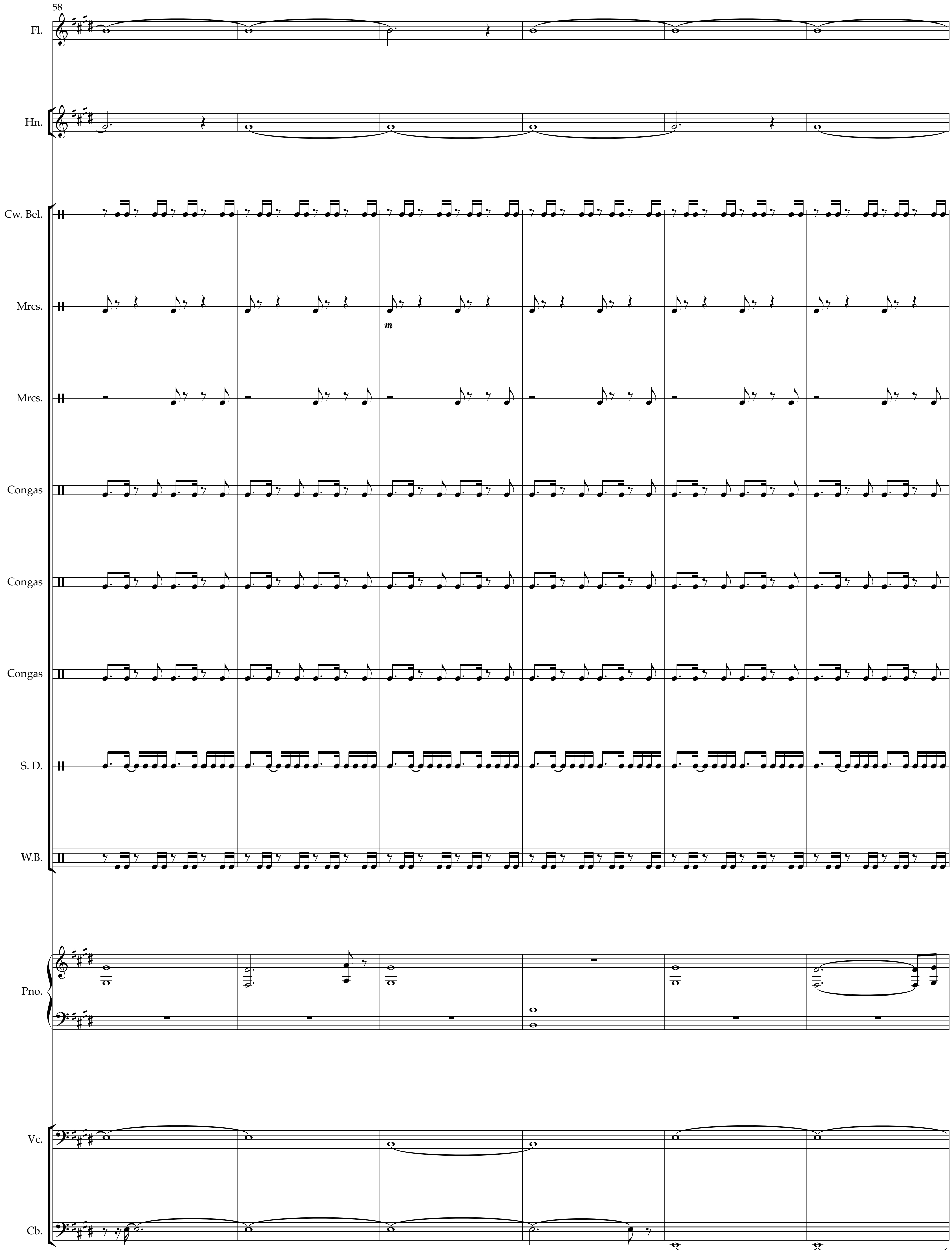

16
Fl.
Hn.
Pno.
Vln. 1
Vc.
Cb.
mp
p
25
Hn.
Hn.
Cw. Bel.
Congas
Congas
Congas
W.B.
Pno.
Vln. 1
Vc.
Vc.
Cb.

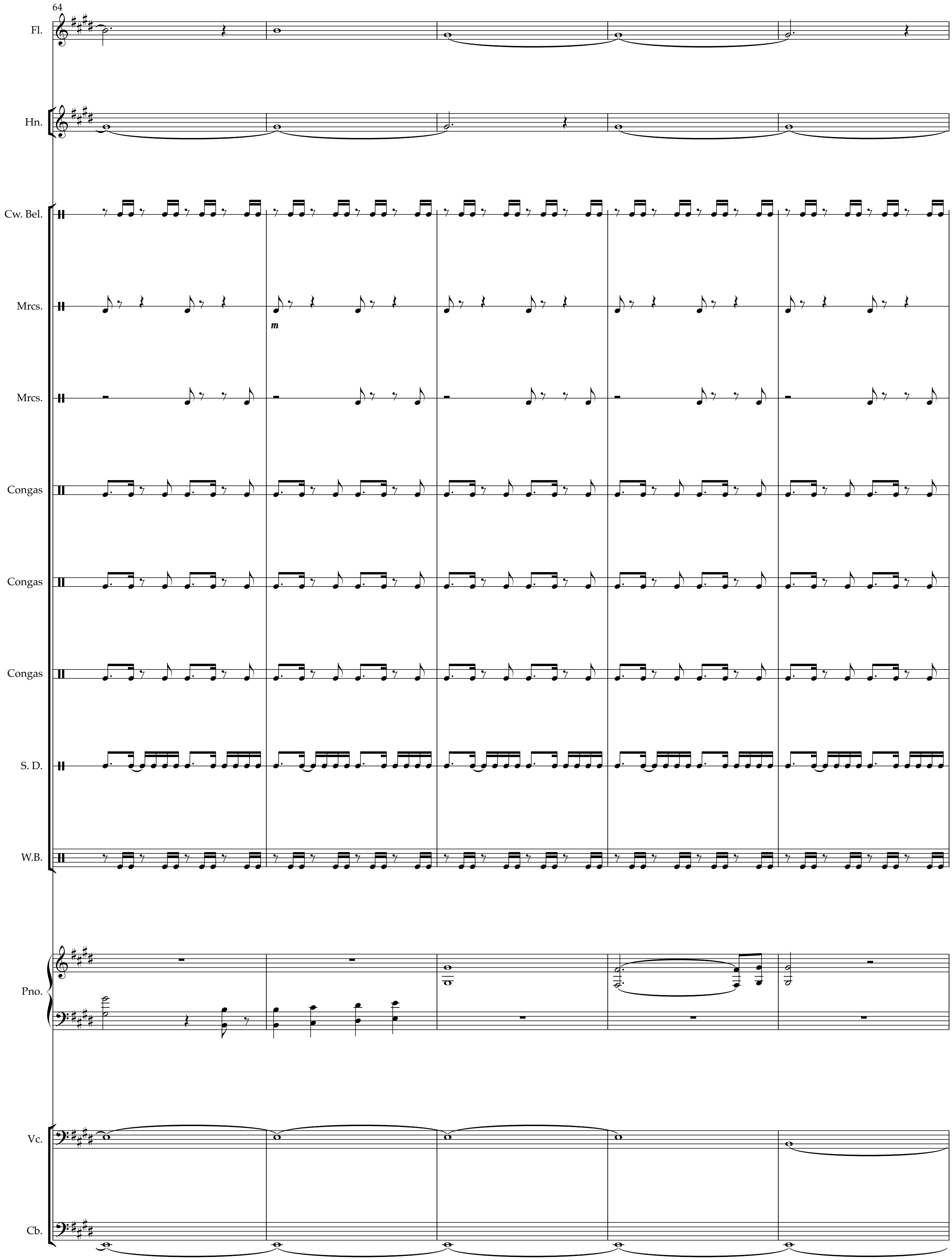

33
Fl.
Hn.
Hn.
m
Cw. Bel.
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
Pno.
Vln. 1
Vc.
Vc.
Cb.

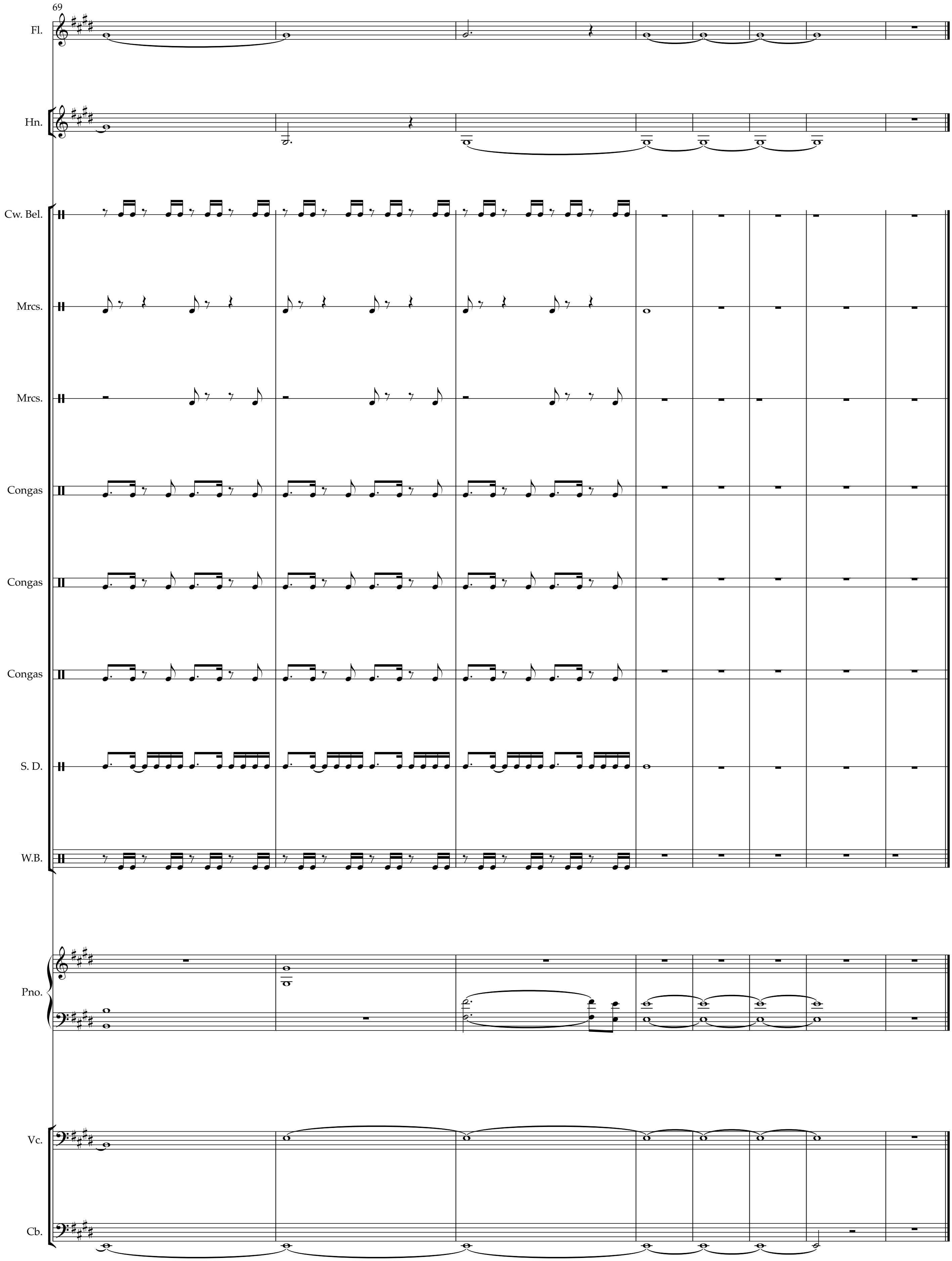

40
Fl.
Hn.
Hn.
Cw. Bel.
Mrcs.
m
Mrcs.
Congas
Congas
Congas
S. D.
mp
W.B.
Pno.
Vln. 1
Vc.
Vc.
Cb.


46
Hn.
Cw. Bel.
Mrcs.
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
m
Vc.
Vc.
Cb.


52
Fl.
Hn.
Cw. Bel.
Mrcs.
m
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
Pno.
Vc.
Vc.
Cb.


58
Fl.
Hn.
Cw. Bel.
Mrcs.
m
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
Pno.
Vc.
Cb.


64
Fl.
Hn.
Cw. Bel.
Mrcs.
m
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
Pno.
Vc.
Cb.


69
Fl.
Hn.
Cw. Bel.
Mrcs.
Mrcs.
Congas
Congas
Congas
S. D.
W.B.
Pno.
Vc.
Cb.