

ACADEMY OF PERFORMING ARTS IN PRAGUE
MUSIC AND DANCE FACULTY

MASTER'S THESIS

**MANUFACTURING EXPECTATION AND PREDICTIVENESS IN
ORCHESTRAL MUSIC OF THE PAST EIGHTY YEARS WITH
RESPECT TO MY OWN COMPOSITIONAL PRACTICE**

Prague, 2022

Michael Andrew Burt

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Art of Music

Composition

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D e c l a r a t i o n

I declare that I have prepared my Master's Thesis independently on the following topic:

Manufacturing Expectation and Predictiveness in Orchestral Music of the Past Eighty Years with Respect to My Own Compositional Practice

under the expert guidance of my thesis advisor and with the use of the cited literature and sources.

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Abstract

This thesis concerns the examination of compositional practices used in service of predictiveness within musical form and presentation as it pertains to orchestral music of the past eighty years. This document seeks to bridge the gap between the musical languages of contemporary compositions and classical formal structures. By highlighting the compositional techniques that some composers use to convey their concept, or “perceptual lens,” the music may be understood. These techniques will be derived through purely musical means, as opposed to strict reliance and reference to programmatic explanation, to create a key (as in a map) or guiding principles. The compositional techniques will be grouped into three categories: the consistency of melody and time, the consistency of process and timbre, and the consistency of macro-structure, which prepare the basis for predictiveness in music. Musical expectation is clearly defined and parsed out into hierarchies of cognition, allowing for contextual analysis of the pieces. This understanding of music cognition (expectation) coupled with an understanding of compositional technique (prediction) creates the end result for the listener/analyst/musician/composer of analytical conclusion.

This thesis will focus primarily on the aspects created through these specific compositional techniques of Messiaen’s ***Turangalila Symphony*** (1946-48), Silvestrov’s ***6th Symphony*** (1994-95), Penderecki’s ***De Natura Sonoris No.1*** (1966), and my own work; ***Subversion on Archimedes’ Constant for Symphonic Orchestra*** (2022).

Keywords: expectation, music cognition, predictiveness, form-building, consistency, musical parameters, compositional technique

Abstraktní

Tato práce se zabývá zkoumáním kompozičních postupů používaných za účelem predikce v hudební formě a prezentaci v orchestrální hudbě za posledních osmdesáti let. Tento dokument se snaží překlenout propast mezi hudebními jazyky současných skladeb a klasickými formálními strukturami. Zdůrazněním kompozičních technik, které někteří skladatelé používají k vyjádření svého konceptu neboli „vnímací čočky“, lze hudbě porozumět. Tyto techniky budou odvozeny čistě hudebními prostředky, na rozdíl od striktního spoléhání se a odvolávání se na programové vysvětlení, aby se vytvořil klíč (jako v mapě) nebo řídicí principy. Kompoziční techniky budou rozděleny do tří kategorií: konzistence melodie a času, konzistence procesu a tónu a konzistence makrostruktury, které připravují základ pro predikci v hudbě. Hudební očekávání je jasně definováno a rozloženo do hierarchií poznání, což umožňuje kontextovou analýzu skladeb. Toto porozumění hudebnímu poznání (očekávání) spolu s porozuměním kompoziční technice (predikci) vytváří konečný výsledek pro posluchače/analytika/hudebníka/skladatele analytického závěru.

Tato práce se zaměří především na aspekty vytvořené prostřednictvím těchto specifických kompozičních technik Messieanovy **symfonie Turangalila** (1946-48), Silvestrovovy **6. symfonie** (1994-95), Pendereckého **De Natura Sonoris č. 1** (1966) a mé vlastní tvorby; **Subversion on Archimedes' Constant for Symphonic Orchestra** (2022).

Klíčová slova: očekávání, hudební poznávání, predikce, formování, konzistence, hudební parametry, kompoziční technika

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1. Introduction

It is the hope of this thesis to generate an understanding with composers that classical thinking and classical models of structure in form building can be applicable to all parameters of music making. For instance, a sonata form could be present in the dynamics parameter of a piece or a theme and variations within timbral instead of melodic and phrasal structure. As to the bloated-ness and forwardness of this communication, it is up to the composer with the structures or within multiple layers of cognition and therefore not easily accessible to the general listener or rather to highlight them as an emphasis in order to bridge the gap between classical modes of expectation and more contemporary ways of thinking. This is of course only one way to think about structure: modern thinking requires modern models of form-building and creation. Classical structures and ways of doing things are only a jumping point from which to think about tectonics of music with stochastic forms of generation or mathematical models or anything new that can come into the purview of composition.

Each of the selected pieces chosen highlights a certain tenet of this hypothesis-philosophy, whether it's Messiaen's **Turangalila Symphony** which highlights motivic and rhythmic expectation (nicely explained by the generative theory of tonal music, "GTTM", (specifically defined below) coined by Lerdaahl and Jackendoff in 1983), Penderecki's **De Natura Sonoris No. 1** which highlights timbral and frequency-based expectation, and finally Silvestrov's **Symphony No. 6** which highlights structural, tectonic based expectation. My piece, **Subversion on Archimedes' Constant**, is an attempt at a combination of all of these parameters working in synchronicity, with some of these working more effectively than others in practice.

1.1 A Note on Opposition

While many composers choose to delve into the world of macro form-building and structure, it is also very common, especially in the contemporary mode of thought, not to concern oneself with the larger forms and tectonics of a piece. This thesis and its hypotheses therein are not the only approaches. Again, this thesis is meant

as a supplemental suggestion, a guide and tool into a larger form of musical composition. This thesis does not pertain to generative forms of music-making; it does not pertain to minuscule microstructures of precise mathematical expositions. Rather it is intended for the assuming creator that is interested in developing theories of how to generate large-scale communication and predictive mechanisms within their formal structures of music. It has been well documented that many composers instead decide to alienate and isolate their process as much as possible in order to pursue the idea of a pure process or pure sound reaction, regardless of whether their intent or the mechanisms happening within a form are apparent and easily communicable. For some composers, the sound is not the result. Rather they engage in conceptual art or utilize deterministic methods of music generation that have higher importance than the result. While utilizing some of the generative processes found in this model of generation, this thesis is generally not of this philosophy; the sounding result that creates the expectation, predictive methods, and subversion is paramount.

1.2 On the Subject of Expectation

To better facilitate the main point of this thesis, some wide breadth must be given to the fraught definitions of "expectation." Generally, "expectation is a theoretical construct whose meaning and definition is open to debate"¹, and this is the prevailing mood between philosophers, aestheticians, psychologists, and general science. The minutiae that can be agreed upon are very broad and simple, accounting for complete variability between personal cognition and perceptions, theories of what expectation's role in nature is supposed to be, and the larger contexts of random chance and anticipation. For simplicity's sake, I will be referring to the delineations of expectation as laid out by David Huron in his text, "Sweet Anticipation: Music and the Psychology of Expectation," Daniel Levitin in "This Is Your Brain On Music," and Siu-Lan Tan, Peter Pfordresher and Rom Harré in "Psychology of Music: From Sound to Significance." These books provide a comprehensive look into the models of experimentation and varying hypotheses,

¹ Huron, David Brian. Sweet Anticipation: Music and the Psychology of Expectation. Pg. 42. Cambridge, Mass: MIT Press, 2006.

with relation to expectation and predictiveness in different situations/contexts, that have been explored over the past century of cognitive science. The relevant portions that will directly pertain to the methodology of analysis (explained in detail below) are as follows:

- The ITPRA Theory of Expectation²: This theory separates the mind's response to stimuli into five distinct stages: "Imagination, Tension, Prediction, Reaction, and Appraisal, which encompasses the entire range of reaction; from pre-outcome to post-outcome". Composers must be aware of each of these stages in order to fully appreciate the complexity of their creative decisions: to be consciously aware of the options and possible outcomes of different modes of structure, tectonic movement, and detail emphasis.
- Gradation Hierarchy of Expectation³: The gradation of musical expectation can be precisely defined from schematic (cultural expectations) to dynamic (manufactured familiarity), followed by veridical expectation (repetition), and finally conscious expectation (awareness of musical theory/structure).
- Narmour's Implication-Realization model⁴: comparing juxtaposed stimuli and then predicting a future outcome based on that comparison.
- Lerdahl and Jackendoff's Generative Theory of Tonal Music (GTTM)⁵: While this is used as an additive to Schenkerian Analysis (in that they both seek to reduce music into a more basic shape), this theory proposes a four-tiered hierarchy system to music cognition.
- Schenkerian Analysis: Released to the world in 1935, this model of analysis has become the benchmark of contemporary analysis throughout the 20th and 21st centuries. Basing this theory in the reduction of structure to reveal

² Huron, David Brian. *Sweet Anticipation: Music and the Psychology of Expectation*. Pgs. 15-18. Cambridge, Mass: MIT Press, 2006.

³ Huron, David Brian. *Sweet Anticipation: Music and the Psychology of Expectation*. Pgs. 224-238. Cambridge, Mass: MIT Press, 2006.

⁴ Tan, Siu-Lan, Peter Pfordresher, and Rom Harré. *Psychology of Music: From Sound to Significance*. Pg. 112. Hove, East Sussex [England]; New York, NY: Psychology Press, 2010.

⁵ Tan, Siu-Lan, Peter Pfordresher, and Rom Harré. *Psychology of Music: From Sound to Significance*. Pg. 112. Hove, East Sussex [England]; New York, NY: Psychology Press, 2010.

the deep core within, and thereby easily compare wildly different compositions, is an inviting prospect in a post-tonal landscape.

What these models give are different systems of thought to the ideals of tension, stimulus, and reflection. This is the core of expectation, and by recontextualizing these to work on all parameters of music cognition, a new synthesis of understanding can occur, especially with more contemporary mediums of creation.

Much of the work and research already done on expectation revolves around the prediction of tonal elements within music. As carefully laid out by Mark Schmuckler⁶, deep dives into harmonic, melodic, and ultimately instinct-driven frequency-based expectation provide useful examples to delineate certain patterns in specific focus groups. Bear in mind that the main relevance of these experiments to this thesis lies solely in their conclusions that different cultures breed different emphases of auditory cognition, and that generally, humans have the capacity to be taught to expect a stimulus if that stimulus is presented in a cohesive, communicable manner. I also postulate that many of these tonal-expectation models are also applicable to parameters other than Western musical forms and phrase structure.

For instance, another driving force behind this thesis is Narmour's implication-realization model, which looks past the hierarchies of GTTM and instead looks into the minute share of basic melodic structures. Narmour was concerned about determining what listeners' expectations would generate if played a certain melodic phrase or by establishing a certain structure of a piece and therefore creating a new synthesis of cognition, also known as dynamic or veridical expectation. While he was mostly concerned with tonal music, I will seek to reuse this model into a more general context so that it is applicable to parameters other than melodic/tonal thinking. Instead of playing two notes next to each other and asking for a guess as

⁶ Mark A. Schmuckler, "Expectation in Music: Investigation of Melodic and Harmonic Processes," *Music Perception* 7, no. 2 (December 1, 1989): pg. 128, <https://doi.org/10.2307/40285454>.

to what the third is likely to be, (with and without the context of key/tonic), using this philosophy/strategy with dynamics, timbral juxtapositions, temporal proportions, and spectral morphology can influence a resulting analysis into accepting multiple layers of communicative cognition.

1.3 Teleology vs. Evolution vs. Tension

And finally, if what precedes a moment is what generates expectation then the result or the cadence is what finally allows us to reflect on the stimuli being presented and therefore determine whether this expectation was valid, subverted or ignored altogether. To give a simple example, within the C major and minor scales, the note G is given more importance than the note C because the tonic is only established through that intervallic relationship. This approach can be at odds with the idea of teleological scholarship, whereby the stimulus and its power is not derived from what precedes but rather by the goal that is achieved by the end of reflection. Put plainly, do the ends justify the means. Teleology in evolution is the idea that natural selection was ultimately a goal-oriented form of change; that nature set a specific goal that had to be achieved by allowing species to manipulate their own genetics until they finally achieved the evolutionary goal that would allow them to survive. Many evolutionary scientists are hesitant to describe natural selection as a goal-oriented process but would rather lean towards the random nature of change in this regard. The tension of the desired result of survival is apparent in both scenarios, but one suggests an underlying propulsion towards a certain result, as opposed to a natural tendency that exists by its own rulebook. And after the tension of a finished result is let go, there is an immediate shift to the anxiety of uncertainty as the form is given the freedom to go to any place, begin any new process. So on top of looking at pre-stimuli tension, it is also important to focus on post-stimulus uncertainty because generative expectation is when you take that uncertainty and effectively communicate the next form in that void of expectation. This interplay between tension before and uncertainty after is the basis for teaching and creating predictions and ultimately going against that learned expectation and creating subversion.

Musically speaking, these scenarios are presented from the perspective of the composer, the musician who performs the piece and finally the analyst who receives the final stimuli. Because of the elusive nature of cognition and musical understanding, there are many layers of differing stimuli which commingle to result in a final reflection-analysis. The intention of the composer may be interpreted or misinterpreted by the musician who then could either be heard, and thereby understood, correctly or incorrectly by the analyst. The ultimate goal of this thesis is rather to give the first link of this chain, the composer, access to optional tools on which to understand how what they decide to do in generating material could translate into, down the line. Whether or not the composer ultimately decides to focus their efforts of generative expectation on their intimate understanding of the piece rather than those who come after is a case-by-case, personal choice. This speaks to the unique nature of performance, personal understanding and cognition; these guidelines are not to be understood as end-all be-all final expressions of how a piece will be interpreted but rather be utilized in service of a propositioned result.

1.4 Glossary of Terms

In order to convey a consistent level of understanding, a glossary of terms is provided below in order to keep track of the definitions of certain common words used in music, cognition theory, and in general:

Music: Dictated/Intended sound (& amplitude) over time

Physics/Acoustics

- Spectra: the whole gamut of sound, organized by frequency/hertz (hz) and kilohertz(khz), Humans hear roughly 20hz-20khz
- Noise: Random, non-periodic
- Pitch: Identifiable, contextual, periodic, listened to

Cognition/Feeling

- Rhythm: When sound occurs, and how quickly/often
- Fundamental/Tonic: The main tone/basis of a musical structure
- Melody: A single voice/phrase made up of discrete pitches (linear/horizontal)
- Polyphony: Many melodies occurring together
- Harmony: The result of polyphony (vertical)
- Timbre: the color of sound, warmth, sharpness
- Harmonic Magnetism: a constant return to a median tone that serves as a basic standard or familiar return in a piece that has little to no structural tonality.
- Teleology: The concept that stimuli are defined by the purpose they serve and the goal they strive toward rather than the reason they exist
- Ripple Variation: As a ripple in water, a focal point then expands outwards, becoming less and less related to its starting point

Levels of Expectation

- Schematic: Gained through culture and up-bringing, can be limited to familial or community
- Dynamic: Designed from long form familiarity, activates long-term memory
- Veridical: Learned through repetition, activates the short-term memory
- Conscious: Active analysis and prediction of on-going stimuli, with expectations codified from experience, practice, and personal synthesis

1.5 A Note on Schematic Aesthetics

As mentioned previously the base level of expectation is the radical level or cultural expectations that is learnt through time since birth from the specific communities that we inhabit. This is the structure on which all the rest of the layers of expectation are built; you don't know what you don't know, and those instincts come from repetition and from the layers of knowledge that you have gained through osmosis. Because of this every culture has its own pitch schemes; expectations of pitch sequence in which different expectations of phrase, tonality and form closure can occur. Because of these large differences in expectation on the very basic level there cannot be an expectation that what works for one group works for all. The pieces that are used in this thesis are of the Western tradition but the techniques that I seek to explore and to dissect are universally translatable between different schematic cultures. Historically much of the conversation around expectation has revolved around tonal systems of analysis, but now building into more generalized, less pitch-oriented, and spectra-based modes of form building can allow us to explore these interrelationships. Not just on a basic Western tradition but perhaps on a global scale. This thesis is served to give tools and ways in which to view form-building a piece from the perspectives of sound dramaturgy and tectonics. It is not meant to be a goal nor is it meant to be the final goalposts of a piece. It does not say that if you structure music in this way, then its effect will always be exactly the same in every case; following the mechanisms of expectation rather than any aesthetic value that they may hold. The goal is to push analysis further away from a tonal-based system into a broader tectonic-based form building system. It will still be applicable in a tonal realm but will then also be applicable to different global systems of tonality and also structures that deal with anything beyond 19th century thinking.

These analytical approaches are also applicable to the conversation of pure sound versus collaborative art, specifically composers intending to recreate the sounds of nature versus artificially manufacturing soundscapes and timbre. When speaking of the most basic of sound knowledge and context the majority share, there are those sounds that surround them on a day-to-day basis: the sounds of urban

environments, natural environments, voices and the like. Obviously, if something closely resembles a familiar sound there will be an expectation that it will follow the same rules, structure and guidelines that are associated with whatever sound is being resembled. There will be a heightened level of generative predictiveness with these sorts of sounds then with things that are more artificial or non-organic. So as a general rule of thumb, the more familiar a sound is, the more expectation, tension, and prediction is associated with it. Schematic expectations will vary based on the environment that the composer, listener, and performing musician is used to, whether that would be urban, rural, minute silence or overwhelming activity.

One of the tenets of exploring how people establish schematic expectations is that we learn to recognize and give importance to a speech. It has long been theorized⁷ that the musical rhythm of speech influences how cultures have developed and created their own forms of musical thought, it also influences how different cultures view different musical ideas and thoughts: what may seem pleasurable to one group (because it sounds familiar) may sound strange, foreign and even unsettling to another. This instinctual reaction to the stimuli is the core of how nature functions and ultimately survives. When civilization is allowed to thrive and care for things more than basic survival, different types of expectation can emerge, including artistic. So suffice to say, the efficacy of generating expectation is dependent on many factors, many of which are beyond the control of the composer. This thesis shall only deal with that which can be manipulated consistently and fluently, with minimal variation in the outcomes of broad analysis.

Also worth mentioning is the level of engagement of an audience at any given moment may change depending on context and situation. What is ultimately satisfying or coherent to a listener can change from being in the comfort of one's home or in an atmosphere of a new music concert hall. Inviting listeners to engage with a complex piece of music when they are literally not in the mood would generate less expectation or less effectiveness than something simpler and cliched,

⁷ Huron, David Brian. *Sweet Anticipation: Music and the Psychology of Expectation*. Pg. 188. Cambridge, Mass: MIT Press, 2006.

in that specific moment. So rather than focusing on the reaction of a potential audience and an analysis of educational cognition, the tools in this thesis assume a level of engagement that requires active listening, active engagement and a willingness to pursue something different or new. The intent of the creator/composer may well be not to create large-scale forms or have an interest in building expectation but rather focusing on purely process-based extrapolation or looking for something tactile, synthetic, emotive. Again, these are aesthetic values of music which do not pertain to the tools and processes being explored in this thesis.

1.6 Basic Methodology

The basic methodology for analysis comes in a multi-pronged approach. On a very basic level there are three questions that are broadly explored through a system of parameters. These questions are as follows:

1. Is a "tonality" established in the form? Whether this is harmonic, melodic, rhythmic, spectral, frequency-based or structural "tonic", there is a definite return back to some median. This can be easily reflected in a return or cadenza of some sort (also the many layers to the idea of a cadential closure), as well as exploring the strength of the uncertainty that happens after a potential closure the moment when anything in a piece could invariably happen. Another term that can be used is harmonic magnetism.
2. How is the macro form established? This requires an exploration of the general formal elements within the piece, as well as analyzing frequency maps and spectrographs to follow down the path of frequency-based expectation; looking at macrostructures of temporal sound itself. Instead of focusing on individual schemas of tonal systems, of fundamentals and of leading tones and classical style of analysis, this thesis deals with tectonic structures such as active versus passive textures (shifting parameters versus static), consistent direction of melodic movement, dynamic shape, consistency of repetition and variation, and clarity of tone as opposed to excited noise.

3. After exploring how the tonality is established, other parameters of expectation can be explored and developed. Parameters such as rhythm, melody, temporal, timbral/spectral/frequency can help dictate the multiple layers of expectative and predictive building going on within a formal structure. Exploring techniques that, without a context and in a given moment can be considered generative elements of expectation.

With these parameters and questions explored for each piece a more coherent hypothesis and a conclusion can be surmised on the effectiveness of communication of expectation. How these selected pieces can create predictive natures within new recognizable structures (and therefore narrative), how the fall of functional harmony leads precipitously to syntax building, and how that new syntax is codified, strengthened and ultimately how effectively it's presented.

2. Consistency of Melody and Repetition - *Turangalila Symphony (1946), By Olivier Messiaen*

Like many of the pieces of the era, Messiaen's *Turangalila Symphony* effectively uses established motifs, tonalism, and rhythmic consistency to create feelings of tension, expectation, and surprise. For analysis purposes, this paper will not be dealing with the entire 40-minute masterwork but mainly with specific sections throughout, culminating in a focus on the final movement of the piece.

The symphony is dominated by the rhythmic structures of Indian music. These rhythms are closely linked with their motivic associates: rarely do you have one without the other. Over the course of an hour, these rhythms and these melodies are clearly defined by repetition and through slight variation. As they are introduced, more and more ideas are juxtaposed with already established norms and begin to creep into the purview until finally, in the final movement of the piece, it all jumps together in a collage of memory, variability and contrast. Mainly, this portion of the thesis shall be dedicated to showcasing the effectiveness of introducing material and through the course of recapitulation, repetition, and contrast by juxtaposition to generate a predictive structure. Along with Messiaen's effusive love of symmetry, the many melodic phrases, motifs and themes are scattered fairly evenly throughout the structure.

2.1 Melodic Form-Building

As with many motivic compositions of the time, *Turangalila* emphasizes and reintroduces established content and consistent intervallic structures in order to solidify association and familiarity to the material. Subtle introductions give way to complex expositions, and in a return to recapitulation, these materials are given the emotive power of nostalgia, narrative purpose, and clarity of form through clear definition and statement.

Dealing with the Generative Theory of Tonal Music (GTTM) and exploring how it is applicable on micro and macro forms, gives a basis to understanding tonal

expectation. Simply, the GTTM “seeks to ‘strip away’ all the nonessential notes to uncover the very core of a musical piece.” It “identifies four components of music that are hierarchically structured, and identifies a system of ‘rules’ that listeners intuitively apply in order to understand the piece. Even though listening itself is a dynamic activity, their theory is concerned only with the ‘final state’ of the listener’s understanding.”⁸

So as discussed above, this theory is predicated on the ending result, and therefore the Reflection proponent of expectation cognition. This theory is relevant to Messiaen’s symphony in that the piece employs traditional harmonic phrases, with clear, pitch-based cadences that dictate the ending of active information-gathering and the start of reflective evaluation. What the GTTM offers, in terms of expectation, is a codified tool in which to evaluate, based on a system of filtered hierarchies, the resultant efficacy of a given motif, phrase, and sound event. In the way, it touches upon the importance (beginning in tonal music) with understanding the interplay of micro and macro structures, how they influence one another, and ultimately how they may be manipulated in order to produce a consistent result.

2.2 Temporal Introduction of Material

Looking at when exactly these melodic phrases and repetitions occur and how often they occur throughout the piece gives a glimpse of how effective repetition expectation is to becoming familiar with and understanding the synthesis of ***Turangalila’s*** musical presentation. Messiaen described 4 cyclic themes that were the strongest and most structural to ***Turangalila***; this thesis describes two of which are the most identifiable and ultimately, predictive.

One of the strongest and most recognizable themes shown throughout the piece is the “Statue Theme”, which consists of simple eighth notes and is usually played by

⁸ Tan, Siu-Lan, Peter Pfordresher, and Rom Harré. *Psychology of Music: From Sound to Significance*. Pg. 112. Hove, East Sussex [England]; New York, NY: Psychology Press, 2010.

brass. It is soloist in nature as it is usually isolated within the overall orchestration, opting for clarity over complexity.



Figure 1. "Statue Theme", Appears in the 1st, 4th, 5th, 7th, & 8th Movements

While it does not appear in the final movement, it nonetheless acts as a first taste of familiarity within the piece. Respectively, it appears at a fairly constant temporal interval, especially after the fourth and fifth movements where it is utilized and transformed into a chaotic and frenetic accompaniment to other melodic phrases, one of the first moments of stark juxtapositions that happens within the structure.

The second of the most recognizable themes is the "Love Theme". Being a lot more complicated than its predecessor and due to its complete length of around 20 seconds on average, it is often found to be quoted and not in its complete entirety. Where it does appear in its entirety is where it makes up the bulk of the harmonic structure, going from the 2nd movement onward.



Figure 2. "Love Theme," Appears in the 2nd, 4th, 6th, 8th, & 10th Movement

The Love Theme is a sort of foil and companion to the Statue Theme in that it appears on the movements that the other does not, while also often being a clear melodic phrase and statement, separate and clear from the accompanying

orchestration. In general, it also follows the same pattern of temporal consistency coming about in a consistent time frame. And given that it is repeated so often in the final movement, it is often one of the most recognizable and famous parts of this Symphony.

At a bare minimum, both of these phrases are clearly heard in the same context and in the same key at least five times throughout the Symphony, not including repetitions within the same movement. When accounting for the many variations and quick quotations that these melodies undergo, it is clear to understand that this is one of the simplest forms of teaching expectation or having a recognizable motive that arrives in the same spectra in the same instruments, in the same time frame, and in the same context.

2.3 Juxtaposition

After nearly an hour's worth of methodical, careful exploration and exposition of his themes, the culmination of his form is found in the final movement. The explosion of contrast, fast-paced energy and clear quotations/references to previous material makes this movement stand out above the rest as the clearest example of setup and payoff, in a predictive sense. Pre-established material is played in its entirety, in the same key and orchestration it was introduced, before quickly shifting to the next texture and motif. The syntactical expectation is present for the phrases themselves, but the order and magnitude of these motifs is unpredictable, creating an interesting balance of familiarity and fresh presentation.

Summary

Turangalila derives its tonality from its use of classical form and structure, while beginning to delve into more contemporary forms of harmonic, timbral, and formal construction. Reintroducing material that becomes known and recognizable allows for more opportunity to either fully complete a melodic phrase from beginning to end and solidify comfort in the structure or to have moments of deliberate subversion of those predictions.

3. Consistency of Process -

De Natura Sonoris No. 1 (1966), By Penderecki

Penderecki in *De Natura Sonoris No. 1* showcases the type of generative expectation which comes from consistent change. While there are some structural elements that repeat throughout, acting as a sort of anchor, the majority of the piece isn't self-referential; rather it continues to progress in change until finally at the end we are left with a completely different sound world from where we begin. While it is difficult to predict what happens from moment to moment from a harmonic perspective, the structure communicates effectively that it will continue to consistently change, which then becomes its own form of generative form-building. The changes are deliberate, transitory, and follow a communicable logic that allows for a complete analytical conclusion.

3.1 Frequency-Based Form-Building

Unlike Messiaen, Penderecki relies on context through spectral familiarity or rather continued reference to similar ranges of the frequency band. The overall structure of this piece is very deliberate, moving from soundscape to soundscape, through feathering, dovetailing, and a connected movement from the utmost highest band of the spectra to the lowest. It then expands into the full spectrum of sound-noise through full orchestration and complete use of the frequency range.

The fall of functional harmony inevitably leads to musical language-syntax building; without the basis of traditional theory and harmonic form, the composer uses other means to guide musical phrasing and create a musical narrative-language.

Separate parameters are invoked in order to satisfactorily and effectively generate sound-time, while historical precedent dictates instinct, first reactions, and general predictions. In this context, analysis has had to change priority as historical context was available or new performances. While it is true that most musical practice was non-historical up until the early 1800s (as in performances of music older than a few years were very rare and not at all the perfunctory norm) , the landscape of musical efficacy and common musical presentation has shifted to much more

referential material. New processes and new explorations of sound are available, but at a much slower progressive rate than in the past. In response, analysis has had to search through new parameters in order to present and find colloquialisms, form, and understanding of complex, radical musical exposition. One such parameter is frequency.

Simply put, frequency as an analytical lens comes as tonal systems decay and mutate into more general forms of timbre and texture. In the *De Natura*, these parameters are used to create reference and familiarity with contemporary musical structures, such as spectral polyphony and non-linear sound events. Silence plays as much a role in the diegesis of the syntax as the notes and tone shapes themselves and helps shape the space in which these events occur.

Referring to both the spectrographs of the first two minutes of the piece (Figure ?) and its entirety (Appendix iv.), one can see the delineations of strict structure belying the piece. The highest pinpricks of spectra give way slowly to the entire gamut of frequency, these sharp attacks serving to activate the sonic space and provide ample attention to the minute changes in accompanying spectral clouds. For the beginning process of music, the orchestration of timbres allows for little to no clashing between harmonics; clear demarcations that foreshadow the sheer white noise of later sections. By allowing time between fresh ideas, and by allowing the natural decay of space to influence the timing of separated events, the structure makes itself consciously communicative. While notes, tones, and exact textures aren't revisited the same way twice, the expectation of silence in between the harshness offers a respite to the overwhelmed portions of the spectra, and a reset of analysis for the created phrases.

3.2 Temporal Proportions

One of the strongest layers of expectation found within the *De Natura* is that of temporal spacing. As clearly shown below in a listening score, the beginning two minutes arranges itself into sections of 6 seconds long each. This is quite logical as the piece and the score itself are not written with standard time signature notation

but rather with time-based notation (dictated lengths of time). Most new sections are clearly denoted by a strong attack, a staccato note that is shared between similar instrument timbres in a certain spectral space. In the few moments where the six-second intervals are elongated or shortened, it is a deliberate, notated rubato and accelerando that acts as temporal subversion.

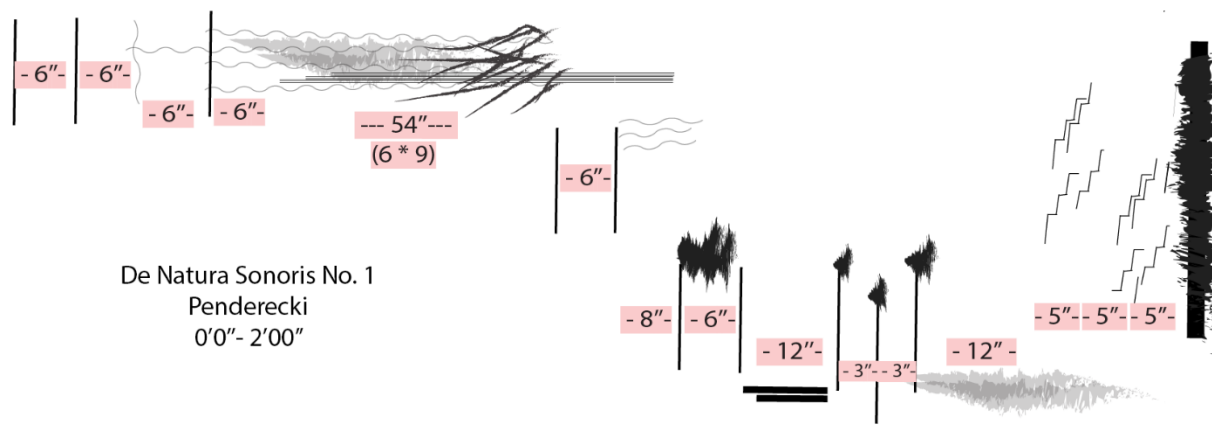


Figure 3. Listening Guide to the First Two Minutes of *De Natura Sonoris No. 1*

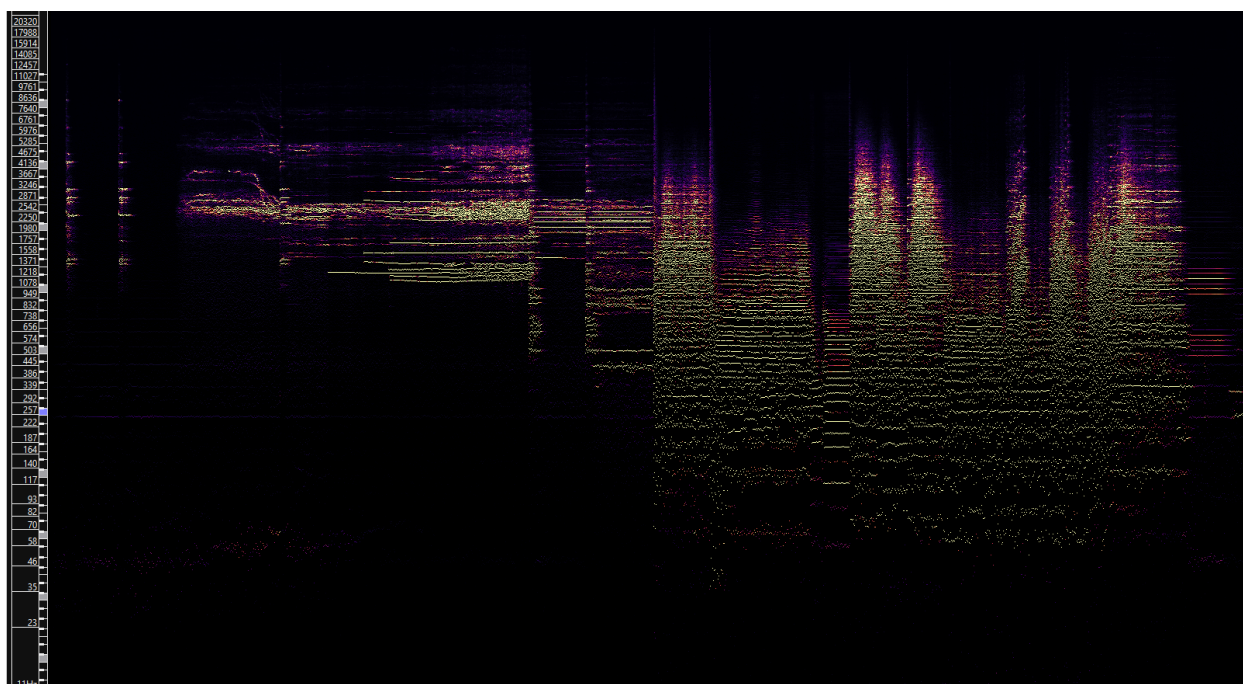


Figure 4. First Two Minutes of *De Natura Sonoris No. 1*, Peak Frequency Spectrograph

This pattern of delineating sections in equal measure continues for the entire piece but it is at its strongest in the first minutes. As with all the selected pieces in this thesis, the strongest expected elements are introduced fairly early in their respective processes. This allows the maximum amount of time with the material and, logically, allows for more repetitions, more time for reflection on what was heard before, and more opportunities for the overall form to be communicated. In the *De Natura*, the even stronger pull of rhythmic consistency shines forth as a clear basis of tonality and a focal point for the structure. It is almost as if it is operating at an incredibly slow tempo and the temporal contract that is written is not so much an easily identifiable set of rhythms, but rather spaces in silence and time which would become familiar at the end. The structure is therefore codified by repeated use or subverted through elongation or diminution.

3.3 Orchestrated Polyphony

When dealing with a spectralist's idea of polyphony, re-evaluating the definition of polyphony as melodies interacting and instead of taking moments of parameters of their own context and allowing them to speak for themselves. A polyphony of timbres is what sets the stage for generative cohesion, supported by the organicism of reverberation decay and non-linear treatments of melody-timbre. Specific moments in time are executed, repeated, and allowed to gestate atop each other, creating a network of disparate tone shapes that combine through their proximity, rather than any deliberate accompaniment. For example, by activating a wide swath of frequency through the use of the tam-tam, anything can emerge from this cloud and act as a harmonic continuation. By orchestrating the spectra in this specific way, what would be considered harmony and intervallic contrapuntion in tonal thinking is reimagined as frequency mapping and spectral polyphony.

Summary

By expertly avoiding clashes between harmonics when first introducing the musical syntax of the piece, Penderecki offers clarity into his unique world of tone, timbre, and texture. Careful attention to the timing and length of sound events allows for

long-form expectation and surprise, while operating outside of the explicative model of tonality.

4. Consistency of Macro-Structure -

Symphony No. 6 (1994/95), By Valentin Silvestrov

Silvestrov's ***Symphony No. 6*** is a behemoth masterwork; utilizing an hour long macrostructure, while presenting itself as a masterclass in consistency and relishing in the process. This piece utilizes harmonic magnetism or an exploration of a median tone, with a consistency of timbre being juxtaposed with completely different shapes, treatments, and emphasis.

4.1 Harmonic Magnetism

While this symphony exhibits characteristics inherent to tonal forms of harmony, it nonetheless exists and operates in contemporary, 20th-century thinking. While voice-leading plays an important role in the shifting harmonies that dominate throughout, they are always set atop a drone-like constant, played in the lower spectra. This true tonality gains and loses priority as the orchestration above it either dominates the perceivable threshold or recedes into an ever-present median tone. Specifically, it takes over a minute for the drone base to change, and even then it is only by a small increment of a half step up. It fluctuates back and forth through the bottom-most range of perceivable spectra, always activating the space by its movement of air and small shifts in pitch. When this drone dissipates, as it does when the main melody is played in its entirety, that sonic bedrock suddenly shifts; a surprising contrast at first which then effectively shapes the overall form structure for the remainder of the symphony. The deliberate time given to solidify specific tone colors through constant drone brings the hierarchy of change and staticism to the fore, and effectively generates expectation. Unlike a key in tonal thinking, this drone texture recedes into the subconscious, becoming as unnoticeable as possible to serve as a comparative median through which to understand the rest of the parameters and machinations of the piece.

4.2 The Permeability of Non-Active Analysis

This section will deal with what happens when the piece moves slowly enough that active engagement in analysis of the piece is unlikely. This pseudo-meditation state is a large topic of discussion with many composers where the attainability, the credibility, and the allure of achieving a relaxed state rather than a constant active engagement with the material at hand.

What also becomes glaringly apparent in the Symphony is the machination of time, and how effortless a structure can engage with its content on a subconscious generative level. Short term memory accounts for about 3-12 seconds⁹ of conscious data reception, with anything after either being ignored or relegated to long-term cognition, which doesn't begin to solidify until exposed to the same conclusive stimuli again and again. When new stimuli take longer than this period to occur, it becomes more and more difficult to actively manage higher cognitive listening skills, resulting in temporary loss of active analysis or "zoning out". What makes the Symphony effective at this level, is the level of care taken to set up consistent spectral qualities, dynamic thresholds, and referential process within the first few moments of the composition. Silvestrov establishes temporal consistency, with alternating periods of active movement (average 2-5 seconds) with periods of static decay (average 4-7 seconds), easily allowing for the phrases to slip from dynamic repetitions into veridical cognition.

Summary

Silvestrov uses the orchestra to its fullest extent, allowing for the overall timbre, slowness of tempo and deliberate moments of surprise and overwhelming sound to at first to convey the piece's intentions, and then extrapolate conventions that he sets forth in real time. It focuses upon a simple, single theme which it breaks down to its core elements, manipulating it at the deepest dimensions of cognition and process. Keeping within the same harmonic and structural framework for so long allows for real-time creation of musical syntax and prediction.

⁹ Huron, David Brian. *Sweet Anticipation: Music and the Psychology of Expectation*. Pg. 228. Cambridge, Mass: MIT Press, 2006.

5. Consistent Coalescence/Bringing It All Together - *Subversion on Archimedes' Constant* (2022), By Michael Andrew Burt

When analyzing *Subversion by Archimedes' Constant*, one must understand the basics of mathematical structure and proportion. The ineffable Pi (3.1415926..etc.), sometimes romantically known as Archimedes' constant, is a number with a never-ending generative process of decimals that helps us to define circular structures in our world. In this sense, it functions very narratively; ever-shifting, ever-changing, and constantly improving upon its previous iteration. Musically, this generates endless fascinating structures, proportions, and parameters with which to derive musical style. For example, pi has its influence on the harmony, melody, rhythmical structure, proportional structure of the overall form, and even in some aspects of the spectral treatment of the music. While the piece is not purely stochastic, purely chaotic, or truly generative, the influence of a mathematical structure on a human, emotive prediction and reaction response allows for a different type of expectation. An expectation that is not necessarily instinctual but rather proportional, a process also seen in the *De Natura Sonoris*.

While mathematical structures have existed in music from its very beginnings (as seen in tuning structures, the way instruments are played, and in the Pythagorean models of harmonic overtones), "math music" or numerical determinism has reemerged within the last 80 years as a response to the instinctual, emotional romantic forms of the 19th and 20th centuries. Deterministic models of music dominate many periods and genres throughout music history, such as isorhythmic motets, contrapuntal chant, and methods of music distribution and codification before notational systems. Better technology used in computer programming, and more firepower in terms of generating mathematical proofs, has allowed all walks of creative and scientific exploration into the interconnectedness between sonic, visual, physical and predictive mediums/schools of thought.

Being that this piece is presented as a proof of concept, it has its structural flaws and its communicative flaws which degrades its ultimate goal of presenting a mathematical proof as a musical concept and thereby translating math logic and expectation into emotional cognition into more of a transitory model of haphazard moments and specific sound events/timbres. But the ultimate use of this piece especially in the context of this thesis is to present another conversation about what is and what isn't effective when trying to generate expectation within a new universe of music.

	I ₀	I ₁₀	I ₁	I ₂	I ₆	I ₁₁	I ₃	I ₅	I ₄	I ₈	I ₉	I ₇	
P ₀	3	1	4	5	9	2	6	8	7	e	0	t	R ₀
P ₂	5	3	6	7	e	4	8	t	9	1	2	0	R ₂
P ₁₁	2	0	3	4	8	1	5	7	6	t	e	9	R ₁₁
P ₁₀	1	e	2	3	7	0	4	6	5	9	t	8	R ₁₀
P ₆	9	7	t	e	3	8	0	2	1	5	6	4	R ₆
P ₁	4	2	5	6	t	3	7	9	8	0	1	e	R ₁
P ₉	0	t	1	2	6	e	3	5	4	8	9	7	R ₉
P ₇	t	8	e	0	4	9	1	3	2	6	7	5	R ₇
P ₈	e	9	0	1	5	t	2	4	3	7	8	6	R ₈
P ₄	7	5	8	9	1	6	t	0	e	3	4	2	R ₄
P ₃	6	4	7	8	0	5	9	e	t	2	3	1	R ₃
P ₅	8	6	9	t	2	7	e	1	0	4	5	3	R ₅
	R ₁₀	R ₁₀	R ₁	R ₂	R ₆	R ₁₁	R ₃	R ₅	R ₄	R ₈	R ₉	R ₇	

	I ₀	I ₁₀	I ₁	I ₂	I ₆	I ₁₁	I ₃	I ₅	I ₄	I ₈	I ₉	I ₇	
P ₀	E♭	D♭	E	F	A	D	G♭	A♭	G	B	C	B♭	R ₀
P ₂	F	E♭	G♭	G	B	E	A♭	B♭	A	D♭	D	C	R ₂
P ₁₁	D	C	E♭	E	A♭	D♭	F	G	G♭	B♭	B	A	R ₁₁
P ₁₀	D♭	B	D	E♭	G	C	E	G♭	F	A	B♭	A♭	R ₁₀
P ₆	A	G	B♭	B	E♭	A♭	C	D	D♭	F	G♭	E	R ₆
P ₁	E	D	F	G♭	B♭	E♭	G	A	A♭	C	D♭	B	R ₁
P ₉	C	B♭	D♭	D	G♭	B	E♭	F	E	A♭	A	G	R ₉
P ₇	B♭	A♭	B	C	E	A	D♭	E♭	D	G♭	G	F	R ₇
P ₈	B	A	C	D♭	F	B♭	D	E	E♭	G	A♭	G♭	R ₈
P ₄	G	F	A♭	A	D♭	G♭	B♭	C	B	E♭	E	D	R ₄
P ₃	G♭	E	G	A♭	C	F	A	B	B♭	D	E♭	D♭	R ₃
P ₅	A♭	G♭	A	B♭	D	G	B	D♭	C	E	F	E♭	R ₅
	R ₁₀	R ₁₀	R ₁	R ₂	R ₆	R ₁₁	R ₃	R ₅	R ₄	R ₈	R ₉	R ₇	

Figure 5. Generative 12-Tone Matrix Based on Pi (3.14) in both Number and Letter Notation

Throughout the piece, 3.14 (e.g. the first three digits of pi) takes precedence in the terms of the rhythms and structure proportions of the piece, the first 50 digits of Pi are translated into 12-tone structure and control what happens harmonically and melodically. Care was given to the overall macro form in terms of trying to have proportional time-based material of 3 to 1 to 4. However, this process constitutes only a small part of the overall structure as this 3.14 is mostly purposed to serve as a limiting device, a focus point in which to explore (in a smaller scale) a mathematical constant. Having a consistent set of rules is generally what gives Western traditional music its expective power, and so by creating a similar kind of rules by which this piece would be governed, there are certain limitations on what could follow what and also how the piece would unfold microstructurally. The experiments of generating expectation syntax are found in the macro systems of

repetition, spectra-based form-building and the juxtaposition between opposing positions or opposing parameters.

5.1 Compare and Contrast

As mentioned before in the section about expectation and how it's generated through form and parameters, it is important to remember that what precedes a closure of events is what creates expectation. Put in another way, closure is the absence of expectation and intention. A prediction has been made and either has been fulfilled or has been subverted, Activating the appraisal response in our tiered system of expectation. This appraisal tells us whether or not the presentation of **Subversion** or fulfillment of expectation is effective or communicable. With this in mind, the basic macro-structures that govern the effect of prediction (and consequent subversion) are tales of strict juxtaposition.

The original premise of the piece was built on the idea of listening to an established piece of music behind a closed door with occasional moments when the door was fully open and you would get the full spectrum of sound. The thought was that adding this extra narrative layer of spectral context on top of a fairly simple baseline could help communicate the extra levels of cognition and soundscape that could exist within a musical syntax. Not only would the piece function as an exposition of expectation in form and content but also the manipulation of the actual space in which you perceive that structure would have a macrostructure of its own. Ultimately, the broad idea and message of this piece is to bridge languages of musical syntax; from a more Romantic era and historical context that has morphed over the last 100 years, to contemporary treatment of exposition. It became a pseudo-theme and variations form, with each variation moving further away from the original context of the material presented. This became paired with the concept that by the time the end of the piece arrives, seemingly disparate and random parameters (dynamic shape, timbre color, snippets of melody, rhythms, and harmony) could become recognizable, familiar, and ultimately allow for the audience to gain a perspective that would normally be reserved for only the most educated of music scholars. The objective is to establish a throughline and

connection between more traditional forms of cognition and understanding with how to digest a completely new formal syntax, one that has never been fully explored or fully experienced beforehand (at least in its unique context). Put another way, the concept was to give a guiding vision of the history of music exposition, which would lead from a highly repetitive and recognizable classical form of expectation to a more difficult, more contemporary treatment of the same exact material. A theme and variations which would move through eras in music, rather than different classical styles of form and style. To that end, the variations will become more and more unrecognizable from its original presentation, much like a ripple in a drop of water becomes less defined and absolute the further from its origin. But, also like a ripple, there is a clear indication of the direction and relationship any given point has to its origin, no matter how developed. This phenomenon will be referred to in this thesis as a ripple variation.

This form of theme and variation is not novel, but what makes this piece unique is the multiple layers of deliberate expectation-cognition that set themselves at work; some blatant, and some subtle. What began as a narrative-driven exposition is transformed into a much larger, and much more metatextual form through the two diegetic functions at hand: self-sufficient, self-inhabiting sound events layered alongside the disruptive perspective of a clear-cut sound editor's juxtaposition. Explored below, these two creative voices lend their coinciding viewpoints on the material generated and produced by the rules of composition set forth before the sound material was created, and the order and length in which this material is presented. The clash between self-organized phrases of musical structure (that are then strictly defined, shaped and positioned by that secondary perspective) creates staggering juxtaposition; a whiplash of soundscapes and hopefully, multiple layers of generative and perspective form-building.

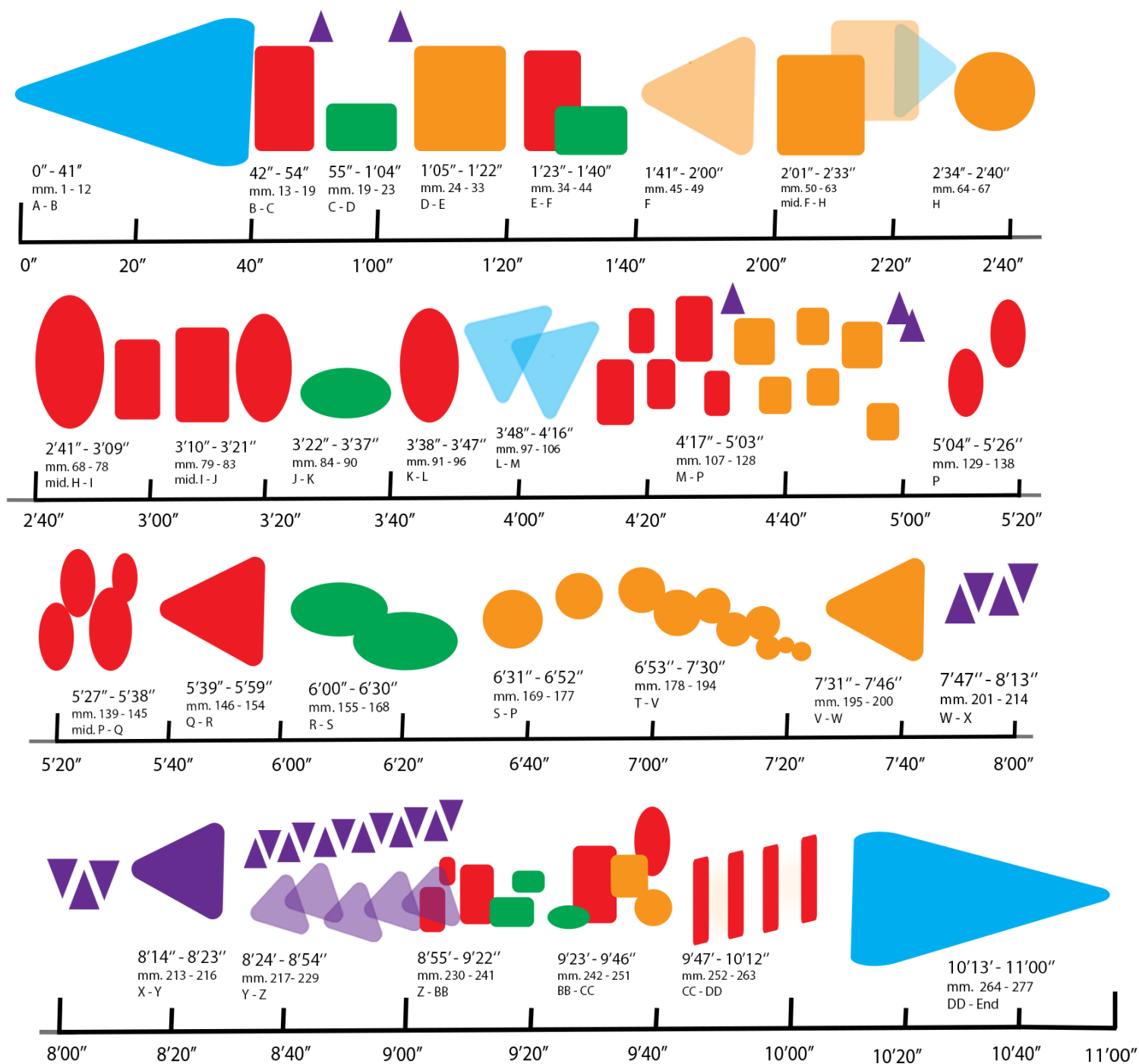


Figure 6. Subversion on Archimedes' Constant, Sectional Analysis and Listening Guide (Appendix i., pg. 49 for key)

5.1 Tectonics

5.1.1 Active vs. Passive

With this in mind, we begin by looking at the most basic of structures within the piece: active vs passive. (For the purposes of this analysis we will begin by looking at the written intention of the piece and then moving on to the auditory reality of the performance.) With the original premise of an opening and closing stage door, a structural part of this piece of more active, clear sections and more muffled, static sections was there from inception. What this eventually gave birth to was the constant and sporadic shifts of texture that define the piece. While attempting to be more akin to the *De Natura Sonoris* in its changing form, the piece instead enters the chaotic realm of soundtracks and film music. Generally, while Penderecki keeps his change consistent, fluid, and ever so decisive, *Subversion* deliberately references past material with little regard for smooth transition or subtle transformation, as well as shifting tempo and texture. This is more referential to the last movement of the *Turangalila*, where pre-established material is blatantly juxtaposed next to completely tonally, and temporally, separate sections of music.

This constitutes the first, albeit fairly simple, generated level of expectation. The piece will shift quickly from one idea to the next, and after a slow, static section will come an agitated, active section. Anytime a transition is prolonged between two sections of different affect, this presents an attempt at deliberately extending the tension before the inevitable shift to new material. The penultimate section (mm. 203-251, Sections V-CC) serves as a synthesis of these two textures, and acts as the longest transitory period: a fraught and chaotic accompaniment of phasing French horns and woodwinds to a static forefront of slow, glissandi strings. As the music reaches the end of this period, a final complete return to fast versus slow completes the overall form idea. But now instead of fast and slow sections occurring over minutes at a time, it is a frenetic back and forth of quick sixteenths and fast-crescendo chords, ending with a return to the material of the opening section, but now in reverse order.



Figure 7. Three-Note Phrases that form the base of the 2nd Section/ "Green" Material

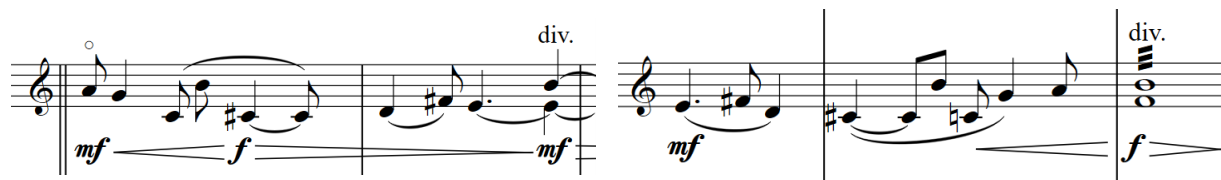


Figure 8. A melody, and its reverse, found at mm. 70 & 74, respectively

5.1.2 Reverse Texture

This ending cadenza, seen in the listening score as a final blue triangle, helps to communicate another overall idea within the form-building: pre-existing material returns in its reverse, mirrored form, creating a narrative sense of exploring the possibilities of the pronounced material and then returning to a familiar, repeated phrase. This reverse texture, easily accessible by the twelve-tone nature of the harmonic structure, helps keep the harmonic quality of the structure intact, while allowing for differing and surprising material. Through the widespread use of phrases of three notes (arranged in groupings of four, as they complete separate twelve-tone cycles) it sets up a constant rhythmic expectation with balanced, symmetrical repetition. The melodic phrasing is also similar; jumps and leaps in the melodic phrase which ends in a leading-tone-like cadential treatment.

The most curious outcome of the reverse texture is that it is not apparent at a first glance. Certain hints and clues are scattered throughout the transition phases between forward and backward treatments that try to convey and demonstrate the transformation at hand. Specifically, frequent use of muted suspended cymbal to accent weak beats, muted horn that move from closed to open to mimic the reversed decay and beginning pop of an attack, and the slow "winding-down" of held notes in the woodwinds by use of degrading rhythms suggests a change is approaching. All of these together are meant to simulate the effect of a tape machine or record player slowing to a crawl before rewinding back to its start. But from the first introduction, these new sections may merely come across as different

material entirely, only tangentially related to the previous phrases. This reversal theme does not truly come into sharp relief at the very end of the piece, where the unmistakable, and unaltered, beginning section is performed in reverse. This final process is the final fulfillment of the expectation built; with the key ideas laid out repeatedly and demonstratively, the static nature of this beginning material lends itself to easier entrapment with familiarity, as it was both the first thing heard (and thus the first impression, which constitutes the strongest reaction to a new stimulus) and with the help of key moments of rhythm, timbre, and orchestration being clearly referenced, an overall form can be communicated. To the keen listener, this second layer of communicated form is present and feasibly recognizable. By the end, thanks to the static nature and key referential moments of the beginning, this reversal layer of expectative form is referenced as a final glimpse into a wider context. The last section (DD – End, mm. 264-277) asks for further reflection and suggests in a simple way that perhaps the entire piece, as it began where it started, may also have had further processes occurring at once. This is part of the overall push to communicate the process through form-building and parameter-based expectation; static building blocks of tone, slowly stripped away to reveal the ending sting of brass stands in a perfect mirror to the beginning. By isolating tones, textures, and rhythmic moments, the reference to pre-existing content is made all the clearer.

5.1.3 Glitch Texture

Prominent throughout the piece are moments of harsh, quick attacks in the highest spectra of the orchestra. Following in the concept that this piece is going through a series of parameter manipulations, as one would see in a DAW, these moments of glitch convey a secondary context or diegesis to the narrative of the piece. It is an attempt to convey that there are two sets of processes happening at once within the piece; on the one hand, the expected processes of inner diegesis and narrative that goes from phrase to phrase (linear exposition) and also a secondary editing perspective that quickly juxtaposes ideas next to each other, manipulating the

spectra in so far that an equalizer (EQ) or a set delay would. In that fashion, relatively simple melodic phrases, cadences, transitory periods and material itself is manipulated and changed through a synthetic means of final exportation. These glitches also help to denote the end and subsequent beginning of different sections of the piece. Most prominently, this is apparent at mm. 201 (approximately 7'45", about $\frac{2}{3}$ through), where a long session of dealing only in the lowest spectra of the orchestra ends abruptly with the now third repetition of behind-the-bridge scratches from the string section. Not only does this series add as a reference to previous sections that had this texture, it also serves as a sort of frequency-based repetition. As there are no specific tones that are recognizable within this emotive secondary technique, the texture and timbre of the moment itself serves as a veridical motif. In very much the same way as the *De Natura*, these moments serve to create a temporal hierarchy that clearly separates sections and allows for a refreshed perspective and set of expectations. Each time a "glitch" sounds, it is immediately followed by new transformative material.

5.1.4 Proportions

Again, while special care was made to attempt a 3-1-4 proportional ratio among many layers of parameters the overall structure of the piece becomes very symmetrical; the beginning in the end or mirror of each other and the middle section which is dominated by a complete lack of the lower spectra. As seen in the listening guide (especially in the Appendix), the temporal manifestations of each individual phrase that is developed are fairly equal. Each section takes an average of 110 seconds to perform, with a slightly elongated second section, which helps to convey those transformations have occurred on pre-existing material and that this while be the case throughout the piece. This temporal consistency allows for a general idea of how often a newly radical

The figure displays three systems of musical notation. The first system is for Vibraphone, featuring a melodic line with a forte (f) dynamic and a 'Red.' marking. The second system is for Piano and Vibraphone, showing a piano (ff) dynamic and a 'Red.' marking, with a 'behind the bridge' label. The third system is for Strings, showing a forte (f) dynamic and a 'behind the bridge' label. The score includes various musical notations such as notes, rests, and dynamic markings.

Figure 9. Notated Glitch Texture, Piano/Vibes/Strings, as found at mm. 149

transformation will take place, and for how long a process will take to run its course.

5.2 Additional Musical Parameters

5.2.1 Parallels

Some additional themes of expectation are scattered throughout the piece, subtle and so terribly ambiguous, but when put together add another level to the conversation of expectation. Illusory textures throughout, such as the static stacking of disparate intervals, denote the beginnings of new sections of tectonics. Specifically, the beginnings of measure 45, measure 97, measure 146, and measure 195 are all preceded by a static texture which in itself is a repetition of the form established at the beginning of the piece. Whenever there is a new section that starts, it is a ripple variation on what came before; the notes and the rhythms aren't exactly the same but the temporal and orchestrational qualities are the same. The only time this idea is different is at the end of the piece where it is the exact opposite of what was in the beginning, at least temporally and texturally. Here at the final section, it is not preceded by just a static texture but a mixture of all of the ideas and melodic phrases that have come before, which of course includes that material but is also supported and accompanied by a synthesis of new material. Each section is clearly shown in the section analysis listening guide (Appendix i.), and it reflects each time a new transformational idea is introduced to the material. Following the opening statement for measures 1 to 44, The first transformation for measures 45 to 96 is an exploration of the reverse texture or simply taking the material Just presented and presenting its reverse order.

Also, a surprising thing is the actual subversion of the piece's overall structure (as in the namesake), which comes in the form of transitory material which is then developed into its own completely new section in the latter part of the piece, denoted in the listening guide as purple triangles. Thanks to the clear brightness of the color schema, the overwhelming collage of reds, blues, oranges and greens suddenly gives way to an entirely purple section. In musical terms, a small,

perfunctory theme slowly transforms and finds itself throughout the overall hierarchy before exploding into its own prominence. While the structure up until that point would suggest more complex machinations of the same material, this section does away with the majority of the harmonic, rhythmic, and phrasal systems established thus far in favor of a completely new synthesis. As depicted, the material that is embellished quickly dissipates in order for the recapitulation of the opening ideas, but only now in reverse. Thus, the form builds to this crescendo of new creation, then settles into a reversal back to the familiar. A parallel to sonata form, as well as a pseudo-hero's journey, in a story narrative sense. There and back again, cyclical and balanced.

5.2.2 Changing Playing Techniques and Phasing

There was an attempt through the piece to employ the extended technique of phasing, specifically split between French horns and the woodwinds from measures 221-251, section Y through CC. This was meant as the ending apex of a texture utilized all throughout, moving from one playing technique to the other as seen frequently in the string section from the entire piece. The static tones are never just that; they are usually performed with a variety of different bowings, tremolo, and dynamic shapes. This activates the space/spectra and serves as another layer of generative form-building based on texture/timbre. Regrettably, in practice this final phasing between horns and woodwinds is muffled, covered and unidentifiable in the orchestration, with low strings overpowering any sort of clear rhythmic structure happening in the mid-range frequencies.

As shown in the figures below, simple ideas are elongated, extrapolated and transformed into motivic phrases and ideas in their own right. Transformations are denoted by ever-changing sound textures and performance techniques. For example, in the instance above staccato changes to legato which adds trills, all the while rippling, doubling, and edging closer to the final synthesis point. This once again speaks to veridical exposition, whereby repetition is accompanied by deliberate transformations which lead predictions into the supposition that material returns, but not in the same exact texture.

The image displays musical notation for the upper woodwinds, illustrating the transformation of transitory material. The top section shows three pairs of staves (Piccolo, Flute, Oboe, Clarinet, Bassoon) with dynamic markings (mf, f, mp, p) and performance instructions (non legato, trills). The bottom section shows a full orchestral score for the upper woodwinds (Picc., Fl., Ob., Cl., Bsn.) starting at measure 218, with dynamic markings (p, f, mp, mf, subito p) and performance instructions (trills, non legato).

Figure 10. The transformation of transitory material ("Purple Triangle" Material) in the upper woodwinds, at mm. 25, 114, 123, & 207 respectively

5.2.3 Clarity vs. Noise

The section will explore how to distinguish differences in listening rather than visual understanding and how that translates to noise vs sound. The section will also make use of the spectrograph generated by this piece to clearly show how active structures can be less helpful in the reflective analysis of expectation in that it becomes homogeneous and difficult to separate from one another. So as to build veridical expectation through repetition, there needs to be clear indicators of what

should be remembered or a clear indication of what is being referenced later in the process. In musical terms, if a certain idea or motif is isolated through orchestration, silence, rhythmical juxtaposition, and/or dynamics, it becomes much more recognizable, and therefore memorable. In orchestrational thinking, doubling voices to compound the presence of a specific idea, separation and equalization of voices within the spectra, and repeating material using timbrally similar instruments help to keep clear certain phrases and sound events, while not necessarily repeating material verbatim. Throughout the first half of the piece, taking cues and inspiration from the treatment of motivic orchestration by Messiaen, the main ideas are shunted to the fore in pursuit of establishing a solid base of dynamic (repetition based) understanding in order to touch upon veridical prediction. Later, they become obfuscated by dense layering and delayed repetitions crashing against one another.

Figure 11. "Orange Circle" Material packed densely into the lower spectra, low strings, mm. 187-194

Another example of frequency form-building comes from a high piccolo attack, set up at multiple times throughout the introductory establishment section and returned to frequently (Specifically, mm. 16, 53-55, 109, 238-240). This piercing attack serves as a quantifiable grounding tone, which in the midst of new, transformation processes help orient analysis as a trail marker of pre-established tempus.

Figure 12. First High Piccolo Attack, mm. 16

At mm. 48, the lower strings and woodwinds combine with the upper brass to create this clarity with dynamic presence and timbral separation. This would later become noise through dense layering, (see Figure 8 above).

The musical score for Figure 13, titled "Full Orchestration of the 'Orange Square' Material, mm. 49-53", is a complex orchestral arrangement. It features a variety of instruments and dynamic markings. The woodwinds (Piccolo, Flute, Oboe, Clarinet, Bassoon) and brass (Horn, Trumpet, Trombone) sections are prominent, with dynamic markings ranging from *pp* to *f*. The strings (Violin I & II, Viola, Violoncello, Double Bass) provide a rich harmonic foundation, with dynamic markings from *pp* to *f*. The percussion section includes Snare, Hi-Hat, and Xylophone, with dynamic markings from *p* to *f*. The score is marked with various articulations and phrasing marks, including accents, slurs, and dynamic hairpins. The overall texture is dense and layered, creating a sense of clarity and dynamic presence.

Figure 13. Full Orchestration of the "Orange Square" Material, mm. 49-53

Rhythmic juxtaposition occurs when material behaves contrarily to the set standard of activity, such as a particularly fast phrase atop an established static base, or vice versa. At mm. 218-227, the lower strings join with the established 16th note active texture in the woodwinds, dominating through dynamics and contrapuntal rhythm, so even the slightest glissandi stand out in contrast. Put another way, this relationship represents the tension between a "totality" of white noise and the singularity of static pitch, reinforcing this concept of juxtaposition.

30

The musical score for measures 218-227 is presented in a multi-staff format. The upper woodwinds (Piccolo, Flute, Oboe, Clarinet, Bassoon) and strings (Horn, Trombone, Trumpet, Violin I, Violin II, Viola, Violoncello, Double Bass) are shown. The woodwinds feature complex rhythmic patterns, often with dynamic markings such as *p*, *f*, *mf*, and *pp*. The strings provide a static accompaniment, with some parts marked *mf* and others *pp*. A specific instruction for the Horns reads: "*do not synchronize with other Horns, gradually speed up/slow down over notated time (any amount of notes)". Another instruction for the Bassoon reads: "*gradually speed up/slow down over notated time (any amount of notes)". The score includes various musical notations such as slurs, accents, and dynamic markings.

Figure 14. Active upper woodwinds accompanied by static lower strings, mm. 218-227

5.2.4 Direction of Movement

This section focuses on the tectonics of movement within the process. Movement outward, movement inward, movement within the stereoscopic space, and overall tendencies towards a goal, or a completion of some process.

The Pi-generated tone row emphasizes leading tones or tones that occur next to each other, such as major and minor 2nds. This is compounded by the constant glissandi movements of the strings, whether they are playing through static sound tones or as in the beginning and in the ending a simple col legno attack up or down the open strings. (see Appendix vi.)

5.3 Sound Dramaturgy

Broadly, the dramaturgy is focused on duality. Tension and release, expectation and subversion, constant and quick or slow and static. At its best moments, ***Subversion*** highlights the strengths of real-time form-building explored in this thesis; multiple layers of prediction thinking, self-sustaining rules of engagement for consistency and analytical clarity, and consistent usage of specific language that it attempts to communicate effectively through both contemporary and classical music expression. And at worst, it muddies the lines between clarity and intention with personal instincts and the mechanical question of, "But does it sound like what I want, regardless of process?"

Overall, ***Subversion*** attempts to find its tonic and fundamental principle through multiple layers of communication. It combines different median points in order to give each reading of the piece a different emphasis but allowing multiple generative forms of prediction to emerge and be summarily communicated. It operates on multiple assumptions, including the relative skill of the attendant orchestra, the willingness of an audience to actively engage and pay close attention to finer details, and the confidence that the processes and text can speak for itself without the use of heavy, written supplements. With respect to the micro form, the dynamic repetition of phrases (à la Messiaen) establishes familiarity to the material, while

key moments of frequency reference (a la Penderecki) allow the macro to be communicated and reflected upon. Learning from Silvestrov, the temporal treatment of median, static textures influence the comfort and stability of expectation within the piece and help achieve a balance between familiarity and surprise. In respect to my own perspective, ***Subversion*** establishes expectations through a combination of reference to historical styles of orchestration and real-time musical syntax creation through repeated parameters, and deliberate subversion of these established structures. The tools presented therein represent effective ways for any composer to re-conceptualize their material into unique hierarchies of cognition and therefore truly aspire to a unique compositional voice.

Conclusions on Generative Expectation

As has been stated before, this thesis sought to explore how composers may create a feeling of expectation in prediction no matter the content and context within the subject. Generating expectation not solely on the premises of harmonic function, serialist consistency or repetition, but as a convolution and mixture of all parameters that can generate satisfactory form-building for both the sound result and the composer's process. Looking at the function of the spectral analysis, analyzing at the overall moments of form-building and the effectiveness to which these things come about in real time generates examples of how you can go about writing a piece of music with a strong purpose towards building expectation and cognition-based focus.

In each of these selected pieces, expectation is derived from multiple deterministic motivations of structure, intention, and emphasis. The different styles and emphases reflect the clear movement of history: each building upon the new syntax created by the other. Reaching this point in music history, a sheer wealth of historical context is built into every new piece of music with every repetition of every recording, building and building a newer and bolder schematic atmosphere with each generation. Predictiveness as a tool to manipulate and guide the structure of analysis and cognition has many generations of historical precedent, but only recently have these concepts been reimagined for the contemporary age. Parameters such as spectra, temporal machinations, texture, and noise have become the new arsenal from which to derive form, with the resulting music creating a new standard of hierarchical thinking and generation. By realizing this layers of cognition, new music art forms and concepts may be effectively explored and understood, well beyond the need for tonal structures and the comfort of simple capitulation/cadence.

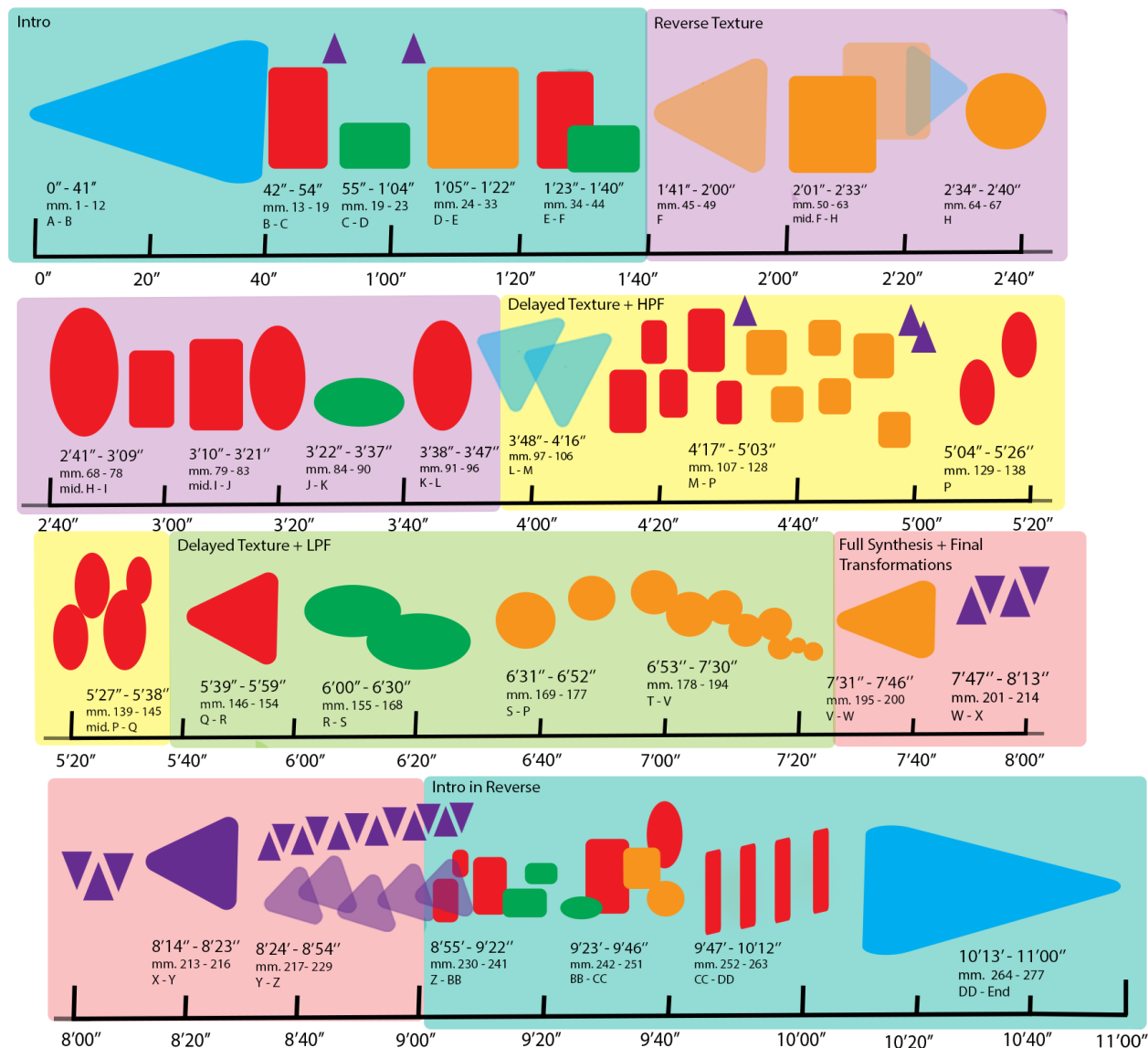
Ultimately, many of the tenets of this thesis are logical, coherent, and honest: the more you hear, the better you remember. The better you remember, the more cohesively the form is presented and understood when situations either happen

again or never return. Tension and stress are what creates efficacy, what precedes the conclusion and how it was foreshadowed is what creates possibility, and how well the story has been told determines if the last new twist of change is welcomed or obfuscated. These simple truths hold in all fields of narrative function, though what is specifically required for each varies by history, precedent, and changing definitions of common practice. Within the orchestra, a plethora of options avail themselves as to the tools in which to generate expectation. From concepts of large-form repetition, temporal consistency, and timbral recapitulation comes a branching network of interconnected parameters that build a musical syntax, in many ways unique to each composer and each piece. Understanding the historical context of a sound event is only a small fraction of the power that lies within real-time form-building. By diluting complex concepts and processes into their most basic and unambiguous form, a lens of understanding, analysis, and appreciation can emerge from even the densest manifestation of sound-time. As composers continue to push the boundaries of what music performance can be, so can the tools and methods of creation.

These perceptions have influenced my understanding of all musical structures and have allowed me to gain a deeper appreciation and understanding of newer and more complex forms of musical syntax. These tools will allow me to become more fearless in my own compositions, and to happen upon new forms of contrast and structure that spur new generative thoughts on effective communication and due practice. In the future, research may be done on the specifics of musical cognitive effectiveness on new forms of musical syntax as they are interpreted by the layman, or by instinctual provocation, by highlighting the effectiveness of communication and creating new syntactical languages through the medium of real-time form-building. From a teleological perspective, aiming to sincerely bring popular culture into contact with new forms of musical thought and demonstrably delineate new motives and processes is my personal goal in both my work and creation. To bridge the gap between the simple and the complex by use of effective tools of communication and intent.

Appendix of Scores & Spectrographs

i. Sectional Analysis and Listening Guide, Subversion



= Static texture, slow and deliberate entrances building to a large crescendo
 () is the same material in reverse, different colors denotes similar harmonic framework that coincides with the following sections

= Made up of two parts, () is the material in reverse, () is only one part at a time:

i.

ii.

(●) is the reverse.

(●) is the reverse.

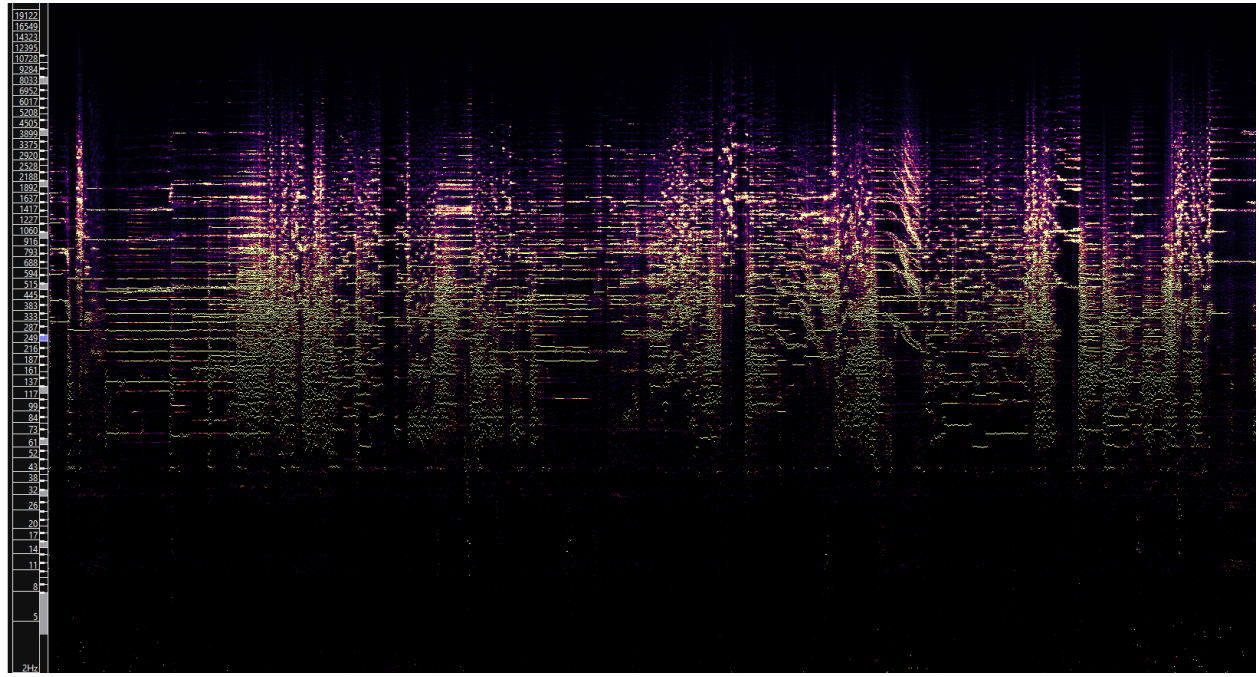


= Quick, transitory material that slowly expands throughout the piece. (▼) = reverse

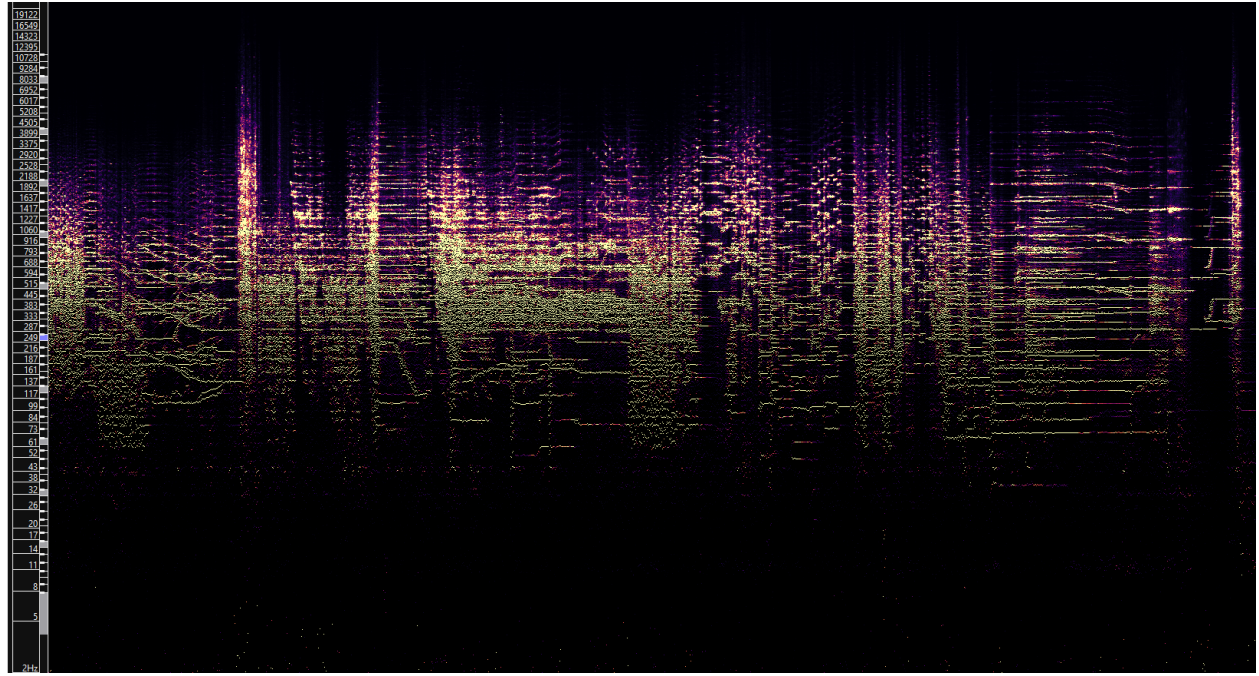


= "Faded color" denotes a sparse texture, "rotated" means similar material but not exact, and doubled/layered denotes that the material is being repeated consistently in layers and/or closely doubled in another voice at a different starting point

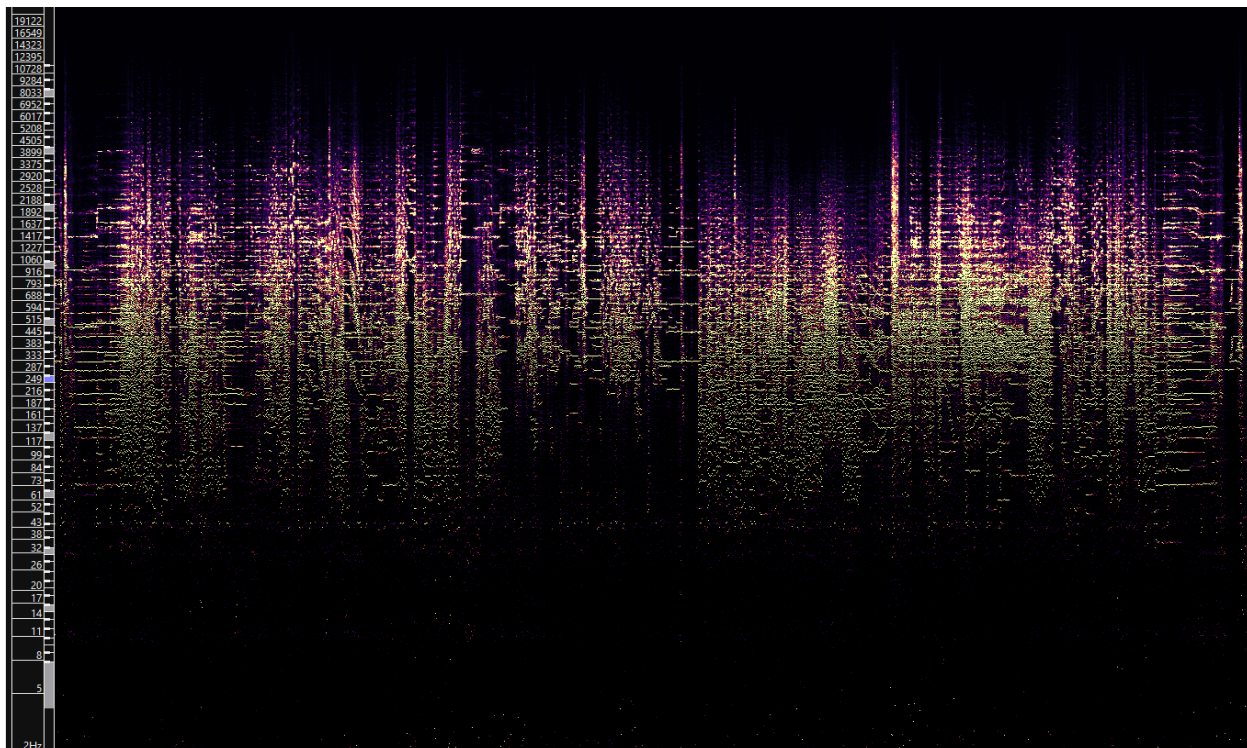
ii. Beginning of Subversion, 0'0" - 5'00", Peak Frequency Chart



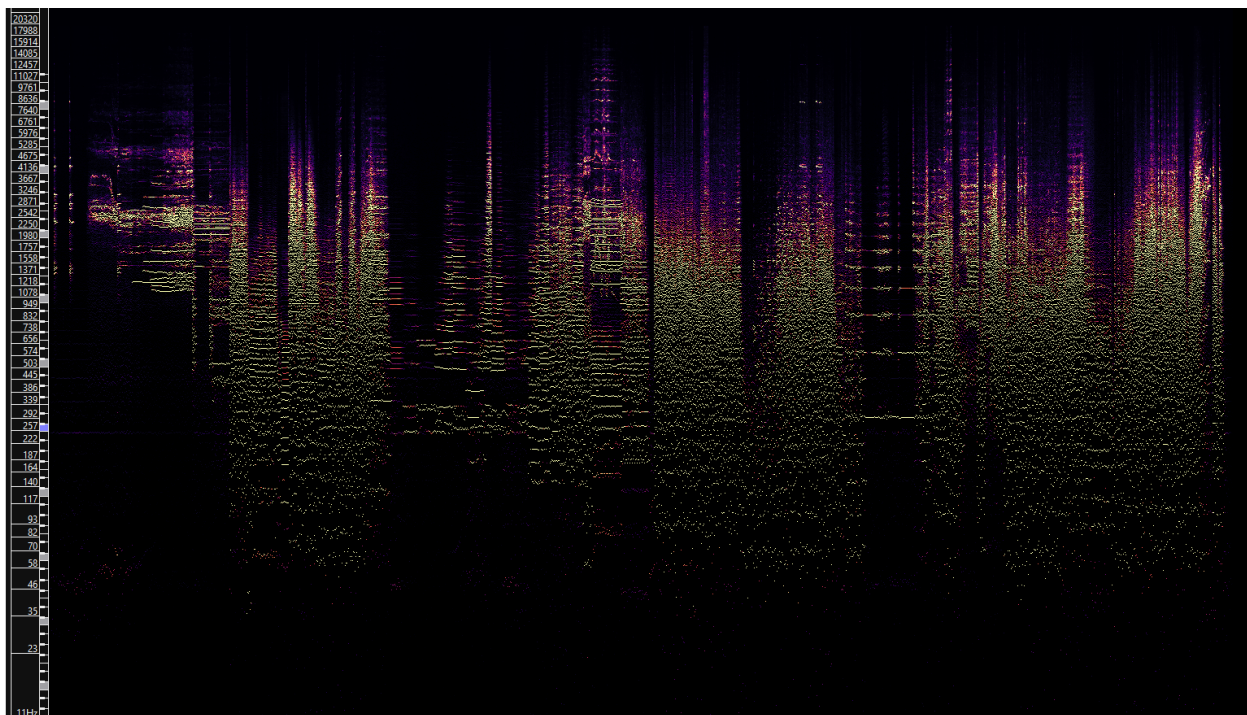
iii. Last Five Minutes of Subversion, Peak Frequency Chart



iv. Entirety of Subversion, Peak Frequencies



v. Entirety of De Natura Sonoris No. 1, Peak Frequencies



vi. Beginning and Ending of Subversion Score

Score in C

"Subversion" on Archimede's Constant
for Orchestra

Michael Andrew Burt

A
(♩ = 65)

Woodwinds:
 Piccolo: *mf* → *p*
 Flute: *mf*
 Oboe 1, 2: *pp* → *p*
 Clarinet in B♭ 1, 2: *mf* → *p*
 Bassoon 1, 2: *p* → *pp* → *mf* → *p*

Brass:
 Horn in F 1, 2, 3, 4: *f* → *pp*
 Trumpet in C 1, 2: *f* → *pp*
 Trombone 1, 2: *f* → *pp*

Percussion:
 Timpani: *mp*
 Percussion 1: Bass Drum
 Percussion 2: *p* → *mp*

Piano:
pp

Strings:
 Violins I: *f* → *ppp* → *f* → *mf* → *p* → *mp*
 Violins II: *f* → *ppp* → *f* → *p* → *mp*
 Viola: *f* → *mf* → *p* → *mp*
 Violoncello: *f* → *p* → *mp*
 Double Bass: *f* → *p* → *mp*

Performance Instructions:
 - *behind the bridge*
 - *col legno (muted) non legato*
 - *sul pont.*
 - *ord.*
 - *div. col legno tratto*
 - *pizz.*

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Spectographs Generated by Sonic Visualiser, 4.3, <https://www.sonicvisualiser.org/>.