Latent Possibilities of the Tonal System
Grammar and Historical Usage

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Preface

While music is an art, with all that that implies, music theory is a rigorously logical structure... The goal of music theory is to provide a description of materials and procedures used in musical discourse of the repertoire under study, to accurately resolve compositions into their component parts and demonstrate their internal relationships, and to provide procedures for the creation of new compositions. – Marshall Tuttle, *Harmony* (forthcoming).

What is music? How does it work? *Why* does it work?

These questions (among others) motivate the academic disciplines of music theory, musicology, music psychology, and music cognition, and they served as the impetus for my undergraduate studies in music. They remain at the heart of this culminating thesis, which attempts to de-obfuscate a particular subset of the mechanics underlying the vast corpus of tonal music.

Music is sound organized in time. The principles which underlie this organization vary from culture to culture, from epoch to epoch, and from genre to genre. The goal of this thesis is threefold:

1. To examine the grammatical principles of one particular system of musical organization (tonality).
2. To expound the logical consequences of these axiomatic principles.
3. To demonstrate the exploitation of these principles (and their logical extensions) to create music across several cultures, centuries, and genres.

No attempt is made to exhaustively answer the questions opening this preface; indeed, the numerous factors that comprise the construction, performance, and idiosyncratic experience of music are almost tautologically inexhaustible:

To strive overly for simplicity in analysis is to forget that even the simplest four-bar phrase in Mozart is made up of acoustical and psychological relationships that, if all were recounted, would stagger the mind. – Leland Smith, *Handbook of Harmonic Analysis* (San Andreas Press, 1979).

Instead, it is my hope that the following exposition will shed light on some of the inner workings of music organized by the principles of tonality and provide the reader with an enhanced perspective on the way that a given musical language can work to achieve various effects.
Acknowledgments

The germination of the ideas contained in this thesis, the inspiration to expand and expound them, and the arduous process of revising them to achieve a robust theoretical stance are all owed to the inimitable influence and guidance of my mentor Dr. Marshall Tuttle. Over the course of nearly two thousand emails, some 1,700+ Quora answers, and copious published literature of his, I have gained more insight about music from Dr. Tuttle than from any other single person or source. I thank him dearly for his undying commitment to the art of music and for his endless magnanimity.

I owe much to my two advisors in the Department of Music at New York University, Dr. Louis Karchin and Dr. Michael Beckerman. Collectively opting to devote twice as much time to my endeavor as is typically allocated to undergraduates pursuing thesis projects, my advisors provided constant support, coaching, and invaluable mentorship over the course of this project. I am especially thankful to them for the crucial feedback I received on my thesis presentation for the College of Arts and Science’s Undergraduate Research Conference on May 4, 2018, where the result of our joint labor (available to view at vishnubachani.com/music) resulted in winning the Best Presentation of the Panel award.

Additional thanks for music-theoretical contributions go to Dr. Kenneth DeLong at the University of Calgary for engaging deeply with my incessant technical questions, Nathan Pell at the Graduate Center of the City University of New York for his assiduous feedback on my Bruckner analyses, John Lawrence at the University of Chicago for replying to my serially lengthy emails with equally extended responses, and Jonathan Petty for his insights on Wagner. I also thank Christopher Stahl, Gabrielle Reid, and my father Rohit Rahi for valuable proofreading and “layperson accessibility” feedback. This project would have not come to fruition without the meaningful contributions of all the aforementioned people.

True to its original conception and purpose as a (hopefully) accessible general guide to tonality, this thesis is uncopyrighted and should be downloaded, printed, shared, pirated, torrented, circulated, and/or distributed in any other way desired. All feedback, questions, comments, etc. are welcome—I can be reached through my website: vishnubachani.com.
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Introduction

The system of musical organization commonly referred to as tonality (or, equivalently, the tonal system) has a long history and a large corpus of academic studies treating it. The set of all tonal music does not have rigorously delineated boundaries but in the realm of European art music is often considered to span the period from Pachelbel through Mahler, or from Corelli through Puccini. The assimilation of tonality by emergent genres in the twentieth century has seen its spread to a large body of pop, rock, jazz, and other musical styles, some of which will be discussed herein. This paper presents a study of the structural axioms of the tonal system and the resultant expressive possibilities that these axioms afford, using examples from diverse musical repertoires to demonstrate historical usage of these possibilities.

Definitions will be provided as necessary, and underlined words are defined in the Glossary. The Theory section is designed to build from first principles (thus be accessible to laypersons), although the Analyses section may require knowledge of diatonic harmony, Roman-numeral analysis, and other concepts covered in an undergraduate music theory sequence to understand everything fully.

It is certainly no trivial matter to characterize tonality. Being a human creation subject to revision, assimilation, syncretic adaptation, and evolution, tonality eludes an exhaustive definition, much like mathematics or science do. Nevertheless, some basic principles appear to underlie all systems of musical organization which can reasonably be called tonal. These will be expounded rigorously before developing them to explore their logical extensions.

The value of this thesis is threefold:

1. To precisely and accurately delineate tonality through an exposition of its axiomatic grammar.
2. To consider why tonality is enduring, pervasive, and robust as a musical language spanning several cultures, centuries, and genres.
3. To strive toward an understanding of how and why music works as a result of its structural underpinnings, using the tonal idiom (and its repertoire) as a case study.

The above three endeavors have been undertaken to various extents in prior studies, typically articles and monographs focusing on the theoretical foundations of tonality, tonality as practiced in the common practice period of European classical music, or tonality in a specific genre or the works of a specific composer. The novelty of this thesis lies not in the theoretical framework per se but rather in the panoptic treatment of tonality as a cross-genre and transcultural musical language and in the uniformity of the analytical method (and consequent findings) applied rigorously to music from vastly different eras and styles.
Axioms of the Tonal System

Tonality is characterized by a few axiomatic principles which then give rise to a host of logical consequences. The precise entailments of the axioms are not agreed upon by all music scholars, but for the purposes of this thesis, it is asserted that tonality is defined by the following five axioms.

In order to state the first axiom, we need the following definitions:

- **Definition**: An *octave* is the interval between one musical pitch and another with half or double its frequency.
- **Definition**: A *pitch class* is an infinite set of all octave-multiples (simply referred to as octaves) of a particular pitch.

**Axiom 1: Tonality divides the octave into twelve discrete pitches.**

The division of the octave into a discrete set of pitches is common to many systems of musical organization beyond tonality. Octave equivalence—the assumption that pitches one or more octaves apart are equivalent—was not codified arbitrarily, but a rigorous psychoacoustical justification for it is beyond the scope of this thesis.¹

Octave equivalence in the tonal system is encoded in the notational standard of using the twelve note names

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>C♯/Db</td>
<td>D</td>
<td>D♯/Eb</td>
<td>E</td>
<td>F</td>
<td>F♯/G♭</td>
<td>G</td>
<td>G♯/A♭</td>
<td>A</td>
<td>A♯/B♭</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

to refer to pitch classes rather than pitches. That is, C does not refer to a specific pitch but rather to the set \{…, C₂, C₁, C₀, C₁, C₂, C₃, …\} where C₀ represents a specific pitch. As for the specific frequencies of each pitch, A₄ (the A above the middle C on a piano) is conventionally fixed at 440 hertz (Hz) today, although this pitch varied through history.

Different tuning systems (within tonality) assign different frequencies to each pitch between any two octaves, but in this thesis, we will solely consider the tuning system known as equal temperament, in which the ratio between any two adjacent pitches is \(\frac{\sqrt[12]{2}}{2}\) (the twelfth root of two, roughly equal to 1.05946); as such, the frequency interval between any two pitches is not constant but is equal on a logarithmic scale. The interval between any two adjacent pitches is called a *half step*, and two consecutive half steps comprise a *whole step*.

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¹The overtone series, a natural phenomenon that explains how a sounding object (e.g., a vibrating string or air column) vibrates at multiple nodes of oscillation in integer ratios of the fundamental node, in part explains the primacy of the octave, as the first overtone is double the frequency of the fundamental.
The second axiom will use the following definitions:

- **Definition**: A scale is any sequence of musical notes ordered by pitch (i.e., frequency), often defined by the intervals between its pitches. For the purposes of this thesis, any scale will span a single octave.
- **Definition**: The chromatic scale is the twelve-note scale with a half step in between each pitch.
- **Definition**: A diatonic scale is a subset of the chromatic scale using five whole steps and two half steps in which the two half steps are maximally separated from each other.

**Axiom 2: Tonality chooses twenty-four diatonic scales from the chromatic scale.**

In total, there are eighty-four diatonic scales obtainable from the chromatic scale: there are seven ways to construct a sequence of five whole steps and two half steps such that the two half steps are maximally separated, and for each of those seven scale types, there are twelve instantiations of every one starting on each pitch of the chromatic scale.

However, the tonal system chooses twenty-four of these scales for general use: twelve major and twelve natural minor. The intervallic structure of these scales is

<table>
<thead>
<tr>
<th>Scale</th>
<th>Intervals (ascending)</th>
</tr>
</thead>
</table>

The natural minor scale also has two variants, the harmonic and melodic minor scales,

<table>
<thead>
<tr>
<th>Scale</th>
<th>Intervals (ascending)</th>
</tr>
</thead>
</table>

which are used to facilitate chord progressions and melodic progressions respectively; they are viewed as alterations of the natural minor scale. The justification for these alterations will be explained in the following axioms.

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The third axiom will use the following definitions:

- **Definition**: A key is an organizational system based on major and minor scales which specifies relationships between notes within the chromatic scale and chords derived from notes within the scale.
- **Definition**: A modulation is the process of changing a prevailing key.
- **Definition**: A scale degree is any element, i.e., a pitch or pitch class, of a scale.
Axiom 3: Tonal music is characterized by relationships defined by keys.

Keys build upon major and minor scales by imposing a hierarchy on the scale degrees and rationalizing the use of scalar elements (notes and combinations of them). The pitch class after which the particular scale (and key) is named (e.g., C major, A minor, etc.) is called a tonic—a source pitch class that orients the remaining scale degrees relative to it. Specifically, the pitch classes are assigned functions named as follows:

\[
\begin{align*}
\hat{1} & \text{ – tonic} \\
\hat{2} & \text{ – supertonic} \\
\hat{3} & \text{ – mediant} \\
\hat{4} & \text{ – subdominant} \\
\hat{5} & \text{ – dominant} \\
\hat{6} & \text{ – submediant} \\
\hat{7} & \text{ – leading tone} \\
\hat{b7} & \text{ – subtonic}
\end{align*}
\]

Specific syntactical rules acting upon a key’s elements (notes and their combinations) follow from these assignments of functions (and the order in which they are hierarchized), and these are propounded in the final axiom.

The fourth axiom will use the following definitions:

- **Definition:** Intervals between pitches signify the pitch difference between any two pitches named according to the number of lines and spaces between them on the musical staff. The two which will be germane for the fourth axiom are bolded in the chart below.

<table>
<thead>
<tr>
<th>Half Steps</th>
<th>Common Name</th>
<th>Alternative Names (dependent on key)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>perfect unison</td>
<td>diminished second</td>
</tr>
<tr>
<td>1</td>
<td>minor second</td>
<td>augmented unison</td>
</tr>
<tr>
<td>2</td>
<td>major second</td>
<td>diminished third</td>
</tr>
<tr>
<td>3</td>
<td><strong>minor third</strong></td>
<td>augmented second</td>
</tr>
<tr>
<td>4</td>
<td><strong>major third</strong></td>
<td>diminished fourth</td>
</tr>
<tr>
<td>5</td>
<td>perfect fourth</td>
<td>augmented third</td>
</tr>
<tr>
<td>6</td>
<td>tritone</td>
<td>augmented fourth, diminished fifth</td>
</tr>
<tr>
<td>7</td>
<td>perfect fifth</td>
<td>diminished sixth</td>
</tr>
<tr>
<td>8</td>
<td>minor sixth</td>
<td>augmented fifth</td>
</tr>
<tr>
<td>9</td>
<td>major sixth</td>
<td>diminished seventh</td>
</tr>
<tr>
<td>10</td>
<td>minor seventh</td>
<td>augmented sixth</td>
</tr>
<tr>
<td>11</td>
<td>major seventh</td>
<td>diminished octave</td>
</tr>
<tr>
<td>12</td>
<td>perfect octave</td>
<td>augmented seventh</td>
</tr>
</tbody>
</table>
• **Definition**: A **tertian** interval is an interval of a major or minor third.

• **Definition**: In the tonal system, a **chord** is a set of pitches which may be sounded simultaneously or in sequence, built in thirds (i.e., minor and major thirds) from scale degrees.

• **Definition**: A **triad** is a three-note chord in its most compact form.²

**Axiom 4**: Chords are constructed out of tertian stacks, which—together with the notes of a scale—comprise the elements of a particular key.

The three notes of any triad have specific names: the lowest note of a triad (i.e., upon which the upper two notes are stacked in thirds) is called the **root**, the next note up is called the **third**³ of the chord, and the top note is called the **fifth** of the chord. Triads are named according to the qualities of their lower and upper thirds as follows:

| upper third | minor | major | minor | major |
| lower third | minor | minor | major | major |
| **Quality** (of the triad) | diminished | minor | major | augmented |

In practice, three-note chords do not always appear with the root as the lowest-sounding pitch: often, the third is placed in the bass, resulting in what is known as the **first inversion** of a triad. When the fifth is placed lowest, the resulting chord is known as the **second inversion** of a triad.

It follows from the above chart that the qualities of the seven triads in any key are perforce determined by the intervallic structures of the key’s eponymous scale as shown below. Roman numerals conveniently encode both the root of the chord (by means of the number) and the quality of the chord (by means of its capitalization—lower-case is minor, with an additional ° symbol for diminished, and capital is major, with an additional ‡ symbol for augmented).

| Major scale: |
|---|---|---|---|---|---|---|---|
| **Root** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Quality** | major | minor | minor | major | major | minor | diminished |
| **Roman numeral** | I | ii | iii | IV | V | vi | vii° |

² Most compact form refers to the pitches of a chord being as close to each other as possible, e.g., C₁–E₁–G₁ rather than C₁–G₁–E₁.

³ The word **third** is used to denote two different but related concepts: (1) the interval between two notes, where **minor third** = three half steps and **major third** = four half steps, and (2) the middle note of a triad (or larger chord), below which (not necessarily in pitch space, but always in pitch class space) there is a **root** and above which there is a **fifth**.

---
Natural minor scale:

<table>
<thead>
<tr>
<th>Root</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>minor</td>
<td>diminished</td>
<td>major</td>
<td>minor</td>
<td>minor</td>
<td>major</td>
<td>major</td>
</tr>
<tr>
<td>Roman numeral</td>
<td>i</td>
<td>ii°</td>
<td>III</td>
<td>iv</td>
<td>v</td>
<td>VI</td>
<td>VII</td>
</tr>
</tbody>
</table>

The reason that the natural minor scale is altered has to do with the qualities of the triads of the natural minor scale and their incompatibility with the syntactical rules (propounded in the following axiom) of harmonic progression. Notice the differences in triadic qualities in the harmonic minor scale:

Harmonic minor scale:

<table>
<thead>
<tr>
<th>Root</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>minor</td>
<td>diminished</td>
<td>augmented</td>
<td>minor</td>
<td>major</td>
<td>major</td>
<td>diminished</td>
</tr>
<tr>
<td>Roman numeral</td>
<td>i</td>
<td>ii°</td>
<td>III°</td>
<td>iv</td>
<td>V</td>
<td>VI</td>
<td>vii°</td>
</tr>
</tbody>
</table>

The crucial difference is in the fifth chord, the significance of which is explained in the final axiom. The melodic minor scale, as the name implies, is used for melodic rather than harmonic purposes, and its triads’ qualities are:

Melodic minor scale (ascending; descending identical to natural minor scale):

<table>
<thead>
<tr>
<th>Root</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>#6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>minor</td>
<td>minor</td>
<td>augmented</td>
<td>major</td>
<td>major</td>
<td>diminished</td>
<td>diminished</td>
</tr>
<tr>
<td>Roman numeral</td>
<td>i</td>
<td>ii</td>
<td>III°</td>
<td>IV</td>
<td>V</td>
<td>vi°</td>
<td>vii°</td>
</tr>
</tbody>
</table>

Tonal music is governed by the usage of keys—any given section of tonal music is typically “in” a key, in the process of earmarking one, or transitioning from one key to another. Notes (prescribed by the key’s eponymous scale) and chords (prescribed by the rule of stacking-by-thirds as elucidated above) function within keys in a similar way to words functioning as basic lexical units in languages.

Axiom 5: A set of syntactical rules govern the usage of notes and chords in any key.

Some syntactical rules govern progressions between notes and chords. Deviation from these rules is certainly found in tonal music, often for expressive effect. The extended terminology, derivations, and logical development for all of the rules are contained in any undergraduate harmony textbook but are too voluminous to reproduce here, so it will suffice to simply state the rules themselves.
Cadential progressions
I–IV–V–I and substitutes:
- ii, vi, V/V, VII, N and Aug6 chords can substitute for IV
- vii° and III’ can substitute for V
- vi can substitute for the final I, rarely iii, IV or diminished seventh chords.

Circle of fifths
Any fragment of the series I–IV–vii°–iii–vi–ii–V–I can be used forwards or backwards at any
    time in major or minor.

Sequence
Any chord progression can be repeated on another scale degree.

Antecedent consequent phrasing
I ---- V, x --- I justifies any use of “x.”

Scale
Unorthodox chord progressions may be explained by the presence of scalar motion.

Pedal
Unorthodox chord progressions can be justified by held notes, called pedals, as long as the
    progression begins and ends on a chord consonant with the held note.
- A pedal in the bass is called “pedal”
- A pedal in the soprano is called an “inverted pedal”
- A pedal in an inner part is called an “internal pedal” or an “inner pedal”

Triad
I-iii–V and other harmonizations of the notes of any other triad are acceptable progressions.

Motive
Any melodic motive may be rewritten as a series of chords based on that motive.

The five above axioms serve as a common grammar for tonal music. It should be emphasized
    that such rules do not generate music, just as grammar generates language rather than poetry.
    Rather, interesting music often materializes when ambiguities in rules are exploited. The analyses
    in the remainder of this paper demonstrate exploitations of some of these ambiguities as well as
    some of the latent possibilities of the axioms, propounded formally in the following section.
Propositions Resulting from the Axioms

This section details logical extensions of the five axioms in the previous section. The propositions are not comprehensive. Definitions are provided as necessary.

**Proposition 1: A key can by identified by elements which need not include the tonic.**

This is a direct consequence of the asymmetrical layout of the notes in the major and minor scales upon which a key is based. For example, a scalar progression that merely outlines W-W-H-W-W is sufficient to identify a key as that intervallic sequence is unique.

A key can be defined in many different ways, most straightforward of which is perhaps bald assertion by the sounding of the source pitch along with its concomitant scale. Countless tonal pieces begin with assertions as such that instantly earmark the key, contextualizing the chords that ensue. Consider the opening of Bach’s Organ Duetto No. 1 in E minor, in which the opening E melodic minor scale unambiguously earmarks the key of E minor:

However, explicit assertions aside, the tonal system affords the possibility of identification of key without statement of the source pitch. Consider the hypothetical phrase:

C major is identified above without any appearance of a C. This particular characteristic does not necessarily exist in pre-tonal or post-tonal music (considering the trajectory of Western art music). In pre-tonal (e.g., modal) music, the final is defined by silence following it. In post-tonal
music, a primary tone (if there is one) can only be defined by asserting the tone itself. But in tonal music, even a half cadence is ample to define a key.

The second proposition will use the following definitions:

- **Definition**: A tonality is a de facto set of keys generated by the surface activity of keys transited in a tonal piece. Tonalities are often but not necessarily always coincident with keys in their structure. For example, a tonal piece transiting the keys of G major, B minor, and E minor (e.g., the opening sixteen bars of Beethoven’s Piano Sonata No. 27 in E minor, Op. 90) would have a tonality of E minor, whereas a piece transiting the keys of A minor, C major, Eb major, and G major (e.g., the prelude to *Tristan und Isolde*) would have a tonality of A half-diminished seventh.

**Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.

Just as the major and minor scales contain seven ordered pitches with a hierarchical order of importance, groups of keys cohere in supersets known as tonalities. While a prevailing key governs local musical action in a tonal piece, a prevailing tonality serves to guide the logic of keys transited. In other words, the axiomatic order on the scale imposed by the key nests upward to the inter-key level.

The keys available to a tonality are almost identical to the chords available to a key. Diminished and augmented chords are excluded since they cannot be the source of keys. The following chart shows the keys available to the tonality of C major:

<table>
<thead>
<tr>
<th>I</th>
<th>C major</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii</td>
<td>D minor</td>
</tr>
<tr>
<td>iii</td>
<td>E minor</td>
</tr>
<tr>
<td>IV</td>
<td>F major</td>
</tr>
<tr>
<td>V</td>
<td>G major</td>
</tr>
<tr>
<td>vi</td>
<td>A minor</td>
</tr>
</tbody>
</table>

In practice, tonalities often admit keys accessible from a key’s parallel major or minor key, so a tonality of C major/minor would admit the following keys:

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4 Credit to Marshall Tuttle for this insight.
5 Tonality is a particularly loaded term in music theory. The Wikipedia article for the term alone lists eight distinct definitions, and this thesis itself uses it multiple ways (e.g., in the title to refer to the tonal system and here in Proposition 2 to refer to a specific structure). This particular definition has precedents in the work of Marshall Tuttle and Jonathan Petty. See, for example, *Musical Structures in Wagnerian Opera* (The Edwin Mellen Press, 2000), where an analysis of the prelude to *Tristan und Isolde* on pp. 88-96 corroborates the point made here.
I    C major       i  C minor
ii   D minor       N  D♭ major/minor
iii  E minor       III E♭ major
IV   F major       iv  F minor
V    G major       v  G minor
vi   A minor       VI  A♭ major
VII  B♭ major

(It is important to note that there is a difference between III and iii, the first specifying E♭ major and the second E minor. E major would not be directly accessible to the tonality of C major/minor as a key given the G♯ (which is foreign to the keys of C major/minor) in the tonic triad.)

The manipulation of tonalities is relevant in many compositional forms and styles, especially those where inter-key relationships play a significant organizational role. Sonata form, popular in 18th- and 19th-century Europe, is concerned with the establishment of a primary key, the departure from it, and the eventual re-attainment of it. As such, a compositional problem arises in trying to wrest the original tonic: a simple modulation is not strong enough to change a tonality. In other words, modulating to keys shared by both an initial tonality and a new tonality is ambiguous because it is unclear if a tonality change has been effected or simply an intra-tonality key change. However, modulating to any key exclusive to a new tonality unambiguously effects a change of tonalities.

Notice the orbit of keys immediately accessible from a major key (circled):

\[
\begin{array}{ccc}
\text{flat side} & \text{relative/parallel} & \text{sharp side} \\
\text{ii} & \text{i} & \text{iii} \\
\text{IV} & (1) & \text{v} \\
\text{vi} & & \\
\end{array}
\]

G major is part of C’s orbit, and C major is part of G major’s orbit. Thus, a simple modulation from C to G major does not signify a change of orbits. In order to destroy C (i.e., recontextualize it as IV and affirm G as the center of a new tonality), G must be approached from its sharp side (b minor and D major) as these two keys are not accessible to C major. Hence tonalities serve to cohere tonal logic on a larger level than local keys.

**Proposition 3: The function of a note or chord is determined by context rather than by static definition.**

In the tonal system, no note or chord in isolation has function. A C major chord can function as any one of the examples in the chart below.
Say our hypothetical C major chord is followed by a D major chord, which can function as

<table>
<thead>
<tr>
<th>Function</th>
<th>in the key of…</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>C major</td>
</tr>
<tr>
<td>N</td>
<td>B major/minor</td>
</tr>
<tr>
<td>III</td>
<td>A minor</td>
</tr>
<tr>
<td>IV</td>
<td>G major</td>
</tr>
<tr>
<td>V</td>
<td>F major</td>
</tr>
<tr>
<td>VI</td>
<td>E minor</td>
</tr>
<tr>
<td>VII</td>
<td>D minor</td>
</tr>
</tbody>
</table>

Absent an unprepared modulation, this two-chord progression logically eliminates the possibility of C major being the governing key, leaving only B minor, E minor, or G major as possible keys. The progression could then be analyzed as

<table>
<thead>
<tr>
<th>Progression</th>
<th>in the key of…</th>
</tr>
</thead>
<tbody>
<tr>
<td>N–III</td>
<td>B minor</td>
</tr>
<tr>
<td>VI–VII</td>
<td>E minor</td>
</tr>
<tr>
<td>IV–V</td>
<td>G major</td>
</tr>
</tbody>
</table>

of which IV–V is the most syntactically orthodox progression. Indeed, this exact progression obtains at the very beginning of Beethoven’s *Waldstein* sonata, where the initial C major chord is perhaps perceived initially as a tonic but is wrested upon resolution to G major in a IV–V–I progression:

\[ \text{Allegro con brio.} \]
Proposition 4: The order in the syntactical progressions allows for expressive use via deviation from the expected order.

As I–IV–V–I has been codified as syntactically normative, a syntactically unexpected (or impermissible, if you prefer) progression like V–IV can be used to comment on the expected expression. An equivalent expressive commentary in English could be achieved by placing adjectives after the nouns they modify (rather than before, which is the syntactically correct positioning), as is often done (deliberately) in poetry.

Example: Verdi, _La Traviata_, Act II

Violetta: Ah no! giammai! no, mai!

\[
c: \quad V^7 \quad iv \quad V
\]

V–iv reverses the flow of time, i.e., the cadence is supposed to flow iv–V–I but here the V falls back retrogressively to iv in a shocking interruption.

By Violetta saying “Ah no! giammai!” (“No! never!”) over V–iv, a dramatic moment is created in the music where she stands against the inevitable flow of history (she eventually does agree to give up Alfredo later in the opera). The standard way of functioning is rendered expressive by deviation from it.\(^6\)

Proposition 5: Consonance and dissonance engender a basic tension–resolution dialectic.

Dissonance is a logically defined concept that requires a subsequent musical event to resolve it. Consonance is also logically defined and does not require subsequent events. Dissonance and its resolutions direct the flow of time in music.

---

\(^6\) Credit to Marshall Tuttle for this example and explication.
In the tonal system, a consonant sonority is any major or minor triad. A dissonant sonority is any chord containing an interval other than a major/minor third or perfect fifth, e.g., a diminished or augmented triad, a major-minor seventh chord, etc. Many systems of musical organization beyond tonality have means of conveying tension or resolution through harmonic, melodic, or rhythmic means. The tonal system is no different. Consider the opening of Beethoven’s First Symphony:

![Musical notation of Beethoven’s First Symphony](image)

The very first chord is dissonant (a major-minor seventh—i.e., dominant seventh—chord) because of the minor seventh between C and B♭ and the tritone between E and B♭. As such, the resolution to the next chord (a normative dominant-to-tonic resolution to F major) resolves the tension in the first chord.

**Proposition 6: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).**

Despite the use of the imprecise word “conflict,” the concept is quite straightforward and follows directly from the concept of dissonance expounded in the previous proposition. Because of the hierarchical nature of tonality (notes comprise chords which comprise keys which comprise tonalities), an expectation or tension set up on one level of the tonal hierarchy can be transferred to another one and resolved there.

Consider the recapitulation (a sonata form term denoting the reprise of a theme in the “home key” after a development of the theme in a key other than the home key) of the first movement of Gustav Mahler’s Fourth Symphony in G major, comparing it to the beginning of the movement. Two relevant pages from a score reduction by Seth Monahan are provided below.
SYMPHONY No. 4 in G MAJOR (1899)

MOVEMENT I

EXPOSITION 1

Corresponds to standard two-part exposition

(See Figs. 5.1, 5.2)

Introduction (P0): Bell world

Bedächtig Nicht eilen

Primary Theme: P1

Recht gemächlich

(Hauptzeitmaß)

IMITATIVE TENOR VOICE ADDED

Tempo I

(Hauptzeitmaß)

GUSTAV MAHLER

transcribed by Seth Monahan

G. PAC

(ELIDED)
The recapitulation proper is at m. 239, and there are some noteworthy points about it that demonstrate the proposition:

- the key (G major) returns but not the theme, i.e., the recapitulation is tonal, not melodic or motivic
- the climax on IV\(\frac{6}{4}\) preceding the recapitulation resolves to I after the recapitulation, i.e., the harmonic resolution is interrupted by the (formal) recapitulation
- the brief sleigh bell re-entrance at m. 224 foreshadows the recapitulation proper, but this can only be known in retrospect (i.e., the development could have continued)
  - not dissimilar to the “premature” recapitulation of the first movement of Beethoven’s Eroica Symphony

In this example, resolution of the sonata form’s mandatory recapitulation has shifted from an orthodox melodic/motivic recapitulation to a harmonic/tonal one. This is possible due to the nature of the tonal system’s hierarchical levels.

The propositions conclude here, not because of having achieved comprehensiveness but for more arbitrary reasons of priority and brevity. The analyses in the remainder of the thesis serve to demonstrate the historical usage of these possibilities latent in the tonal system.
Analytical Methodology

Analysis is the process of resolving an object into its component parts. As such, any analysis of a specific composition can only very rarely proceed to completion using the application of a single analytical tool. Thus, harmonic analysis, Schenkerian analysis, rhythmic analysis, formal analysis, etc. all yield results consistent with applications of specific compositional processes in a given piece. Not all methods are equally useful across the entire musical repertoire. As examples, key relationships as an analytical tool for Gregorian chant are as much out of place as are Schenkerian methods in Wagner. – Marshall Tuttle, Modal Ethos and Semiotics in Tonal Music (The Edwin Mellen Press, 2016).

To demonstrate the mechanics of tonality in the musical examples in this paper, the approach of **linear harmonic analysis** will be used. This method of analysis charts chords with respect to multiple levels of keys, i.e., accounting for keys operating on different hierarchical levels. Chords are built strictly on scale degrees, and the multiple levels of reference account for all local keys transited under any larger tonality.

<table>
<thead>
<tr>
<th>Key Signature⁸</th>
<th>Current Tonality</th>
<th>(multiple levels of reference possible)</th>
<th>Current Key</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Measure Numbers (as required)</td>
<td>Harmonic Function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Text/Comments (as required)</td>
<td></td>
</tr>
</tbody>
</table>

The following example from pp. 33-34 of Leland Smith’s *Handbook of Harmonic Analysis* demonstrates a simple linear harmonic analysis of a fragment of a Bach chorale:

---


⁸ Usually equivalent to the globally governing tonality. In cases where official sheet music does not exist (e.g., for Massive Attack’s “Psyche”, a global tonality will be posited).
A key signature/global tonality of A major is indicated by the capital A in the top left, local functions are charted in the bottom line, and keys transited (in relation to the global tonality) are marked in the middle line. The I = IV function indicates a double-function (also called a pivot) chord—in this case, the A major chord at the beginning of the second bar functions as pivot between the preceding key of A major (in which it has tonic function) and the new key of E major (in which it has subdominant function).

Linear harmonic analysis has been chosen specifically for the purpose of highlighting the hierarchical nature of the tonal system. Other analytical methods elucidate different relationships—for example, Schenkerian analysis deals with counterpoint and voice leading while neo-Riemannian theory deals with parsimonious chordal transformations. Any system accounting for multiple levels of modulations will obtain results similar to linear harmonic analysis.
Analysis – Radiohead, “Knives Out”

Radiohead is an English rock band from Abingdon, Oxfordshire, formed in 1985. The band consists of Thom Yorke (vocals, guitar, piano, keyboards), brothers Jonny Greenwood (lead guitar, keyboards, other instruments) and Colin Greenwood (bass), Ed O’Brien (guitar, backing vocals) and Philip Selway (drums, percussion).9

“Knives Out” appeared on the band’s 2001 album *Amnesiac*. Lasting four minutes and seventeen seconds, it is notorious for having taken 373 days (from March 10, 1999 to March 17, 2000) to record. Lead singer Thom Yorke said of the process:

> We just lost our nerve. It was so straight-ahead. We thought, “We've gotta put that in the bin, it's too straight.” We couldn't possibly do anything that straight until we'd gone and been completely arse about face with everything else, in order to feel good about doing something straight like that. It took 373 days to be arse-about-face enough to realise it was alright the way it was.10

Yorke has described the song as being about cannibalism. In one interview, he said,

> It's partly the idea of the businessman walking out on his wife and kids and never coming back. It's also the thousand yard stare when you look at someone close to you and you know they’re gonna die. It's like a shadow over them, or the way they look straight through you. The shine goes out of their eyes.11

In light of the above descriptions of the assiduous process behind the song’s recording and some of the implications of the lyrics, the harmonic structure of the song will be examined to demonstrate how precise exploitations of possibilities latent in the tonal system are leveraged for expressive effect.

A transcription by Warner/Chappell Music Ltd is provided below. The relevant propositions for the following analysis are:

- **Proposition 1**: A key can be identified by elements which need not include the tonic.
- **Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
- **Proposition 3**: The function of a note or chord is determined by context rather than by static definition.
- **Proposition 5**: Consonance and dissonance engender a basic tension–resolution dialectic.

---

11 Ibid.
Knives Out

Words and Music by Thomas Yorke, Jonathan Greenwood, Colin Greenwood, Edward O’Brien and Philip Selway

\[ \text{\( \frac{1}{2} = 138 \)} \]
Look into my eyes,

Look into my eyes,

bleat and frozen,

I'm not the only way you'll know I'm telling the truth.

there's no point in letting it go to waste.

back.

1.3. So

2. So
44

To Coda ♯

3. If

76
“Knives Out” was discussed briefly in a music-analytical context in Brad Osborn’s 2016 monograph *Everything in its Right Place: Analyzing Radiohead*:

Knives Out” (2001–4) starts as a more garden variety diatonic sequence—a minor mode version of the Pachelbel Canon with smooth stepwise bass. Because this sequence is so recognizable, it establishes a stronger sense of expectation…The first half features the stepwise bass motion C–B♭–A♭. When the second half begins on G, we thus expect the continuation G–F–E♭…

However, like so many surprises heard in Radiohead’s music, this one comes about through a subversion of this strong expectation. The last harmony heard in this progression does not provide the expected dyad C/E♭, but the twice chromatically inflected C♯/E♮. Chordally, this sonority could be interpreted either as a C♯ half-diminished seventh chord, or alternatively as E minor with an added raised sixth. In either case, the sonority is a profound departure from the established C Aeolian pitch center. But its real surprise stems from the break it causes in this expectation–realization chain. So strong is the sense of continuation toward a C/E♭–E♭/C voice exchange that the replacement of that final dyad with one shifted up by a semitone in each voice comes as a great shock (158–159).

The initial progression (mm. 1-11) does indeed begin with a C–B♭–A♭ sequence, but this is not quite a minor mode version of the Pachelbel Canon (i.e., a Romanesca progression) in inversion—instead, it is simply a descending progression in C minor. Pachelbel’s Canon is over a ground bass, not over a chord progression—in C minor, it would be C–G–A♭–F–C–F–G.

Osborn’s characterization of the C♯/E♮ chord at the end of the sequence as a subversion of the expectation–realization chain perhaps makes sense in the moment, but an examination of that chord’s appearances and subsequent resolutions (or lack thereof, rather) through the entire song confirm that it is not a subversion but rather the point: in the end, C♯ doesn’t resolve to anything the C would resolve to and does not function as a substitute for the C at all.

**Linear Harmonic Analysis of “Knives Out”**

![Harmonic Analysis Diagram]

The song has two basic phrases: an eleven-bar phrase that opens the song (analyzed in mm. 1-11 above) and a bridge phrase in the middle of the song (analyzed in mm. 34-44 above), both of which are repeated twice. The coda simply extends the last harmony of the first phrase. Of additional note are the unusual (sub)phrase lengths: in the first phrase, the VI harmony in the first part of the phrase lasts for three measures whereas the viiø7 harmony lasts for six measures (as if protracting the lack of resolution). The tonal plan of the form is also striking in that the bridge (typically used for transitions in popular music) is tonally *stable* (actually cadencing in D
minor) whereas the flanking phrases are not tonally closed, attempt to move from C minor to D minor.\textsuperscript{12}

The C#–E♭ chord that ends both phrases is not so much “twice chromatically inflected” (this description would only make sense if it functioned similarly to the purportedly “expected” harmony) as it is an unfulfilled dominant substitute (vii\textsuperscript{ø}) of D minor. It is often harmonized with an added B♭, e.g., in m. 11 (rendering it as vii\textsuperscript{ø7} of D), or A, e.g., in m. 33, always pointing towards D minor. The bridge (mm. 34-44) briefly realizes D minor (previously only projected by its vii chord) and works its way back through G minor followed by the vii\textsuperscript{ø7} of D minor, leading directly to a repeat of the opening phrase in C minor.

Many medieval organa start with a whole step appoggiatura.\textsuperscript{13} “Knives Out” extends that process beginning in C minor and moving to D (the C–D is a key move rather than a pitch move). Thus the key of C minor is actually an appoggiatura key to the Dorian final of D (albeit never being realized through a cadence)—the function of the C#–E♭ chord is made clear by modal logic at the end of the piece.

The four aforementioned propositions are demonstrated in action as follows:

- **Proposition 1:** A key can be identified by elements which need not include the tonic.
  - D is projected as a key by means of its vii\textsuperscript{ø}/vii\textsuperscript{ø7} chord.
- **Proposition 2:** Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
  - The tonality of D Dorian is hypothesized (over another tonality including C minor, G minor, and D minor) given the historical precedent of C–D appoggiaturas, the germane expressive significance of being “stuck” in the subtonic, and the modal logic of the key scheme.
- **Proposition 3:** The function of a note or chord is determined by context rather than by static definition.
  - Although this applies to every harmony in any tonal piece, it is especially relevant here as the C#–E♭ chord’s function is only made explicitly clear at the end.
- **Proposition 5:** Consonance and dissonance engender a basic tension–resolution dialectic.
  - Ending every phrase on a diminished (or half-diminished) seventh chord elevates the lyrical expression (also highlighted in the music video) of the song of being unable to transcend the various conflicts set up in the song, i.e., this is realized tonally by being unable to achieve the key of D despite tending toward it at the end of every phrase.

\textsuperscript{12} This phenomenon has precedents in classical music, e.g., Verdi’s “Pace mio dio” from \textit{La forza del destino}, where the rondo theme is tonally unstable while the contrasting episodes are stable. Credit to Marshall Tuttle for this insight.

\textsuperscript{13} See, for example, Léonin’s “Viderunt Omnes” from the Organum Duplum for Christmas Day. More examples can be found in \textit{Historical Anthology of Music, Volume 1: Oriental, Medieval, and Renaissance Music}, Archibald T. Davison, Willi Apel, eds., Harvard University Press, 2nd edition (1949).
Analysis – Massive Attack, “Psyche”

Massive Attack is a British trip hop band formed in 1988 in Bristol, consisting of Robert “3D” Del Naja, Grant “Daddy G” Marshall and formerly Andy “Mushroom” Vowles (“Mush”). The genre of trip hop itself was developed in Bristol in the early 1990's, fusing hip hop, electronica, and occasionally soul, funk, and jazz.

“Psyche” was first performed in September 2009 at Bestival in Isle of Wight, England. A remixed version of the track was released (prior to the release of the original) that year on an EP called Splitting the Atom, and the original saw its formal release in 2010 on the album Heligoland. The second version of the song is discussed in this analytical vignette. Lasting three minutes and twenty-four seconds, the song is unusually sparse in texture, primarily featuring solo vocals (performed by Martina Topley-Bird) and a looped guitar.

Producer Neil Davidge said the following on the recording process of Psyche:

> I played everything on Psyche, programmed it, and gave the track to Martina. She put this sketch vocal on it and everyone loved it, felt there was no point in doing more to it. I’ve got a little classical guitar I play with at home just to get ideas, and I just started playing these little licks. I’m just not a good enough guitarist to play them fluidly, so I would just lay in two parts and start looping around those and slowly and painfully build up a chord structure. I didn’t want a traditional chorus and verse and flow to this tune; I just wanted it to start and evolve into something different. – Electronic Musician Magazine, March 2010.

Indeed the song does not have a traditional chorus, verse, or flow. However, the analysis presented here will demonstrate nontrivial exploitations of tonal mechanics at play which serve to cohere the song effectively from a harmonic perspective. Neither official sheet music nor official lyrics exist for the song, so my own transcription is provided below with lyrics amalgamated from various websites, each with slightly different versions.

The relevant propositions for our analysis will be:

- **Proposition 3**: The function of a note or chord is determined by context rather than by static definition.
- **Proposition 4**: The order in the syntactical progressions allows for expressive use via deviation from the expected order.
- **Proposition 5**: Consonance and dissonance engender a basic tension–resolution dialectic.
- **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).

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14 Bestival (which derives its name from a derivative of the British music label Sunday Best Recordings) is an annual music festival held in the South of England.
Psyche
(2010 version, from Heligoland)
Massive Attack
transcr. Vishnu Bachani

Voice

Guitar, etc.

\[J = 115\]

I'm looking for you in the woods tonight, I'm looking.

Looking for you in my flashlight, I'm searching. From in the high

or down the ocean. And I pace myself in racing.

Gain the wolf. Gain the wolf.

Conjure me as a child. Slipping down a wet side.
Stretch up I can-not reach him_____ Jum- ping up they drag him from the wa- ter_____

I watch them ma- rch him in- to life______ I watch them take him from the pale______ In- to the sky for your ea- gle eye.

The sun seeds a si- ckle and a scythe______

Ri- di- cule they won't al- low.
Quench abuse and let love flower.
Rip the cage out of your chest.
Let the chaos fool the rest.
Show without showing,
What you know without knowing.
Twigs snap, I catch, no canoe only you and me.
Alone on the old sea.
Dissolving who we are.
Call out for yesterday's destiny gone. We're on a foreign shore.

It was the mark of falling.

I was the car still running. And when you call I'll be your shield for life.

And if you feel it you will fly. The sunset a begging me.

And I was set to fall in. As I was set to fall in. As I was set to fall in. As I was set to fall in. As I was set to fall in. As I was set to fall in.
Exchanging the Roman numerals in the linear harmonic analysis reveals that no perfect or imperfect cadence obtains in the piece. Conversely, the piece appears to be undergirded by pedals (held notes which rationalize the chordal action atop, beneath, or around them). The two most common kinds of pedals are tonic and dominant pedals, which, as their name implies, consist of held tonic or dominant notes. A **G dominant pedal** harmonizes mm. 1-18 and mm. 45-58 (after which G becomes a part of the chord), a **D dominant pedal** obtains from mm. 21-28 and mm. 37-44 and from m. 61 to an indeterminate location (indicated by the question mark at the end of the linear harmonic analysis, to be discussed further below). Within the pedaled sections, the pedal note often switches from a bass pedal to an inner pedal: for example, in mm. 77-78, the D pedal is a bass pedal, but in mm. 79-80, a C supplants the D in the bass while preserving the D pedal by moving it to an inner voice.

Using the Ab–D tritone in m. 3 (and elsewhere in that particular harmonic configuration), the VI–ii⁶ progression identifies C minor as the opening key, contextualizing the G pedal as a dominant pedal rather than a tonic pedal. (From the first two bars, G could be interpreted as a tonic pedal with an overlaid Neapolitan harmony, but this possibility is categorically eliminated in m. 3 as the second harmony is not V, as a harmony syntactically following a Neapolitan would be.) Notice, however, that the key would not be identifiable without the pedal—an {Ab–C–Eb}–{Ab–C–D} progression alone would be ambiguous.⁶ A similar situation obtains with the middle section, where the D dominant pedal earmarks the key of G minor. A noteworthy harmonic trope of “Psyche” is the assertion of keys purely by pedals rather than by syntactical progressions.

The end is arguably the most interesting part of the song. The passage from m. 89 to the end can be analyzed in G minor (as done in the linear harmonic analysis), Bb major (IV–vii⁶–iii), D minor, and even remotely C minor (although the beginning of the song is necessary to relate to this key). However, it refuses resolution in every one of those contexts. In D minor or G minor, there is no leading tone, and in C minor there is a raised sixth but no leading tone. Bb major has all the notes necessary for the key, but no dominant and no dominant-functioning chord.

So the final D minor harmony, which appears to achieve the stable status of a key purely by repeated assertion, can be understood in multiple contexts, most reasonably as a de facto tonic of

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⁶ The technique of using a dominant pedal with otherwise tonally ambiguous material to stabilize a key is not new. In Beethoven’s Fifth Symphony, the opening five measures are indeterminate as to key: they could be in Eb major or C minor. Only after the second fermata is C minor stated unambiguously. However, in the recapitulation of the first movement, a G pedal is added to the opening in the trumpets. This makes Eb major impossible and emphatically forces C minor. Credit to Marshall Tuttle for this insight.
v/v (of C minor, the global tonality) or as a de facto tonic of ii (again, of C minor). The last measure of the song recapitulates the opening and closing keys, C minor and D minor, hence, melodically as well as tonally, the move from C minor to D minor appears to be the point of the piece. It could be that

- the D is resolved (i.e., it is the final key of a progressive tonal sequence),
- the D is modal (wherein finals appears at the end), or
- the D is unresolved and a return to C is tacitly expected.

Based on the apt lyric, “As I was set to fall in,” hovering over an implied suspended ninth abyss at the end of the song (i.e., the third option from the list above) makes the most sense: neither does whatever is set to “fall in” actually fall in, nor does the D resolve down to C as it has been set up to do.

Thus the four aforementioned propositions are seen in action as follows:

- **Proposition 3**: The function of a note or chord is determined by context rather than by static definition.
  - The D minor harmony at the end is parsed retrospectively with respect to the opening/home key of C minor to render it as a macro-level suspension.
- **Proposition 4**: The order in the syntactical progressions allows for expressive use via deviation from the expected order.
  - Numerous unorthodox progressions obtain in this piece, including an abundance of deceptive cadences and even dominant chords of one key being followed by submedian chords in different keys (mm. 44-45). The deviation from orthodox syntactical rules here is perhaps not quite as striking because of the pedals undergirding all the harmonic action.
- **Proposition 5**: Consonance and dissonance engender a basic tension–resolution dialectic.
  - Long stretches of unresolved dominant seventh chords (which are de jure dissonant by virtue of the minor seventh between the root and the seventh and the tritone between the third and the seventh) obtain in “Psyche,” and the D minor harmony at the end can also be considered a “structural” dissonance in terms of its tacitly requiring an (unrealized) resolution.
- **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).
  - Although progressions like VI–iiø¾ over a dominant pedal serve to earmark the key of C minor early in the piece, the lack of tonal closure at the end represents a shift in the tonal hierarchy: no longer is the lack of resolution on a chord-to-chord level as it was with the unresolved dominants or (temporarily) ambiguous progressions, but now it is on a key-to-key level with the de facto key of D minor tacitly requiring a resolution which is never achieved.
Analysis – Wagner, “Ein Schwert verhieß mir der Vater” from Die Walküre Act I, Scene iii

Richard Wagner [(1813–1883)] is arguably the most influential composer of all time. His influence extended far beyond the field of his compositions into literature, drama, politics, philosophy, perhaps even into theology. – The Wagner Compendium, Barry Millington, ed. New York: Schirmer Books, 1992.

Wagner’s operatic tetralogy Der Ring des Nibelungen, WWV 86, is arguably the most ambitious individual undertaking in Western art. Some twenty-six years in the making, the sixteen-hour saga of four Musikdramen (Wagner himself rejected the term opera) are based loosely on the Norse sagas the Nibelungenlied. A special theater (the Bayreuth Festspielhaus) was constructed specifically for the inaugural performance of the Ring, another undertaking so ambitious that it nearly bankrupted Wagner multiple times.

Likely close to a thousand books have been written about Wagner. Explaining the full story of the Ring, the precise tonal mechanics of Wagner’s method, and the unique marriage of music and drama would indeed fill multiple volumes, so a brief exposition shall suffice here.

Die Walküre (The Valkyrie), the second of the four operas of the Ring, tells the tale of Siegfried’s conception and of Brünnhilde’s attempts to save Siegfried’s parents. “Ein Schwert verhieß mir der Vater” (“My father promised me a sword”) comes at the very beginning of Act I, scene iii, detailing Siegmund’s discovery of the sword pledged to him by his father Wälse. The 137-measure aria, typically lasting six-and-a-half minutes, is more complicated from a harmonic standpoint than any of the other pieces analyzed in this thesis. Despite an extended treatment of germane analytic points, the analytical vignette is not comprehensive, and the full background required to identify and corroborate the lexical referents of each key, place the aria in perspective with the rest of Die Walküre and the Ring, and consider the tropes of “Ein Schwert verhieß mir der Vater” as instantiations of fundamentally Wagnerian techniques is beyond the scope of this exposition.

The sheet music for the aria, taken from Karl Klindworth’s vocal score, is provided below. The relevant propositions for the discussion are:

- **Proposition 1**: A key can by identified by elements which need not include the tonic.
- **Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
- **Proposition 3**: The function of a note or chord is determined by context rather than by static definition.
- **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).

17 Vishnu Bachani’s answer to “How many books have been written about Richard Wagner?” on Quora, updated 23 February 2018. http://qr.ae/TU2W0.
Wagner

Ein Schwert verhiess mir der Vater

from Die Walküre

Mässig langsam.

(Sieg mund lässt sich, nah beim Feuer, auf dem Lager nieder, und brütet in grosser innerer Anregung eine
(Sieg mund sinks on a bench by the fire and broods silently for some time in great agitation.)

Zeitlang schweigend vor sich hin.)

(SIEGM.

Ein Schwert verhiess mir der Va-ter, ich fänd' es in höch-ster Noth._

A sword, my fa-ther fore-told me should serve me in sor-est need._

Waffen-los fiel ich in Feindes Haus;

Sword-less I come to my foeman's house;

seiner Rache Pfand raste ich hier;

as a hostage here helpless I lie.
40
SIEGM.

ein Weib sah ich, wondrifig und behr.

A wife saw I, wondrous and fair.

entzückend und gen

and blissful tremors

dolce — p

piu p

— p

zehrt mein Herz.

Zu der mich nun Sehnsucht zieht, die mit süßem Zauber mich

seized my heart.

The woman who holds me chained, who with sweet enchantment

mf — p

— p

sehrt, im Zwan ge hält sie der Mann, der mich wehr losen

wounds, in thrall is held by the man who mocks his weaponless

poco a poco cresc.

— piu —

p

höhn.

foe.

Wäl sel! Wäl sel! Wo ist dein

Wäl sel! Wäl sel! Where is thy
Siegfried:

Sword? The sturdy sword, that in fight shall serve me, when from my bosom out.

Brust, was während das Herz noch blegt?

What breaks the fury my heart now bears?

Glüste dort hell im Glimmerschein? Welche Strahlbricht aus der Esche Stamm,

What a beam breaks from the ash-tree stem!

Blin-den Auge leuchtet ein Blitz; lustig lacht der Blick.

Sight-less eye beholds a flash; gay as laughter its light!
75
Wie der Schein so hehr das Herz mir sengt!

81
Ist es der Blick der blühenden Frau, den dort haftend sie hinter sich lose, als aus dem Feuer sie plötzlich herausdrang?

87
Saal hall sie schied?

92
(Von hier an vergilzt das Herze Feuer allmählich.)

95
deckte mein Auge; ihres Glanzes Strahl
Streif' mir's doch in warmes Licht und Tag.

Blessing came with the sun's bright rays; the gladdening splendor en-

Won-der-glänz, bis hinter Ber-gen sie sank. (Another flash, gleam, from the fire.)

Noch ein-mal, da sie...
114
SIEGM.

schielt, trat mich A-bends in Schein; selbst der
dolce
P. +
hence, fell a gleam on me here;

118
alten E-sche Stamm er-glanzt-te in gold-ner Gluth; dan
an-orient asb-tree's stem shone forth with a gold-en glow.

123
bleicht die Blüthe, das Licht verlischt; nächtiges Dunkel decktmir das Au-ge:
tief in des Bu-sens
dlison the splendour, the light dies out; darkening shadow gathers a-round me:

tief in my breast a-

131
Ber-geslimm't nur noch licht-lo-so Gluth.
loose yet glimmers a dim dy-ing glow.

Linear Harmonic Analysis of “Ein Schwert verhieß mir der Vater”

<table>
<thead>
<tr>
<th>Function</th>
<th>Measure</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>iv/6</td>
<td></td>
</tr>
<tr>
<td>iii (e)</td>
<td>IV (F)</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>iv (f)</td>
<td>i (c)</td>
</tr>
<tr>
<td></td>
<td>i (E)</td>
<td></td>
</tr>
</tbody>
</table>

|   | iv/6    | vii7 | V | IV6 | V | i7 = VI7 | i7 | V | i = vi | I | i vi7 = ii7 | i | V4-3 | VI | N ii7 | V4-3 | I | V vi | vii7 | V7 | I vi | IV V7 |
|---|---------|------|---|-----|---|---------|---|---|-------|---|---------|---|------|---|------|---|---|------|------|---|-----|-----|------|
| Fr i | iv/6 | vii7 | vii7 | iv = i | i i7 | i i7 | N | V V7 | i | vii7 | i vii7 | i vii7 | i = iv | vii7 | i V | I vi | I | I = VI | I V I iii | I | i7 vi |
| 43   | 44     | 45   | 46  | 47   | 48 | 49     |   | 50  | 51  | 52-53 | 54  | 55  | 56  | 57-58 | 59  | 60-67 | 68  | 69-70 | 71  | 72  | 73  | 74-76 | 77 |
|...zieht, | ...sehrt, | ...Mann, | ...höhnt. | Wäsle! Wäsle! | Schwert! | ...schwänge. | ...hegt? | ...Blitz: | ...Blick. |

<table>
<thead>
<tr>
<th></th>
<th>v (g)</th>
<th>V (G)</th>
<th>iii (e)</th>
<th>V (G)</th>
<th>iii (e)</th>
<th>I (C)</th>
<th>v (g)</th>
<th>V (G)</th>
<th>iii (b)</th>
<th>i (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>III6</td>
<td>VI6</td>
<td>V</td>
<td>I</td>
<td>V</td>
<td>IV6 = VI6</td>
<td>V</td>
<td>i7 = VI7</td>
<td>i7</td>
<td>V</td>
</tr>
<tr>
<td>78</td>
<td>79</td>
<td>80</td>
<td>81-83</td>
<td>84</td>
<td>85</td>
<td>86</td>
<td>87</td>
<td>88</td>
<td>89-90</td>
<td>91-92</td>
</tr>
<tr>
<td>...Herz mir sengt!</td>
<td>...Frau,</td>
<td>...Saal sie schied?</td>
<td>Nächtes...</td>
<td>...Aug',</td>
<td>...Tag.</td>
<td>Selig schien...</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

|   | iii (b) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) | iii (e) | i (c) | vi (a) | I (C) |
|---|--------|-------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|
| i7 = VI7 | i | vii7 | V | i | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 | V | i | i vii7 |
| 107 | 108   | 109  | 110 | 111 | 112-114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 |
|...Glanz. | ...sank, | ...schied, | ...Schien; | ...Gluth: | ...Blüthe, | ...mir das Auge: | ...Gluth. |
The aria starts in E minor and falls down to Eb minor where Siegmund cries out his father’s name twice (“Wälse!”) in mm. 51-52. Eb minor is—aptly, given that the key is a half step below the prevailing E minor—the “pit” that Siegmund has to dig himself out of, drawn directly from the Völsunga saga where he has to dig himself out of pits twice. The sword appears in mm. 60ff in C major, in accordance with the Ring’s established associative tonality with C major = light = sword. After the introduction of the sword, the remainder of the keys are arpeggiation of a C major/minor chord (E major, G major, E minor, G minor, etc.) with a few brief excursions to B minor (subsumed under a G major tonality) before the end. The light dies (mm. 129ff) in C minor.

The modulation to F major occurs at the vocal entrance “Ein Schwert…” at m. 23. The progression is iii–i–V–iii in F major (another version of arpeggiating 135 as chords). Minor i is borrowed, and iii is the pivot chord between E minor and F major (both in and out).

The aria is striking in that the principal tonality of C major is approached and left by other keys rather than acting as a left-branching or right-branching arbiter of tonal action. The E minor approach is logically determined by the associative significance of E in the Ring as magic (cf. Tarnhelm motif, the Magic Sleep motif, etc.), and the C minor departure is determined by the associative significance of the dying embers of lights, i.e., C minor as darkness.

The middle ground is made up of the keys I, i III, iii, V, v, of a global C major tonality, i.e., an arpeggiation of the tonic chord in major-minor transformations. This is precisely what allows for the effective transition from the brilliant C major revelation of the sword at m. 60 to the dying embers of light in C minor at m. 129. In fact, the most salient principle of tonal action in this aria is the multi-level propounding of key—despite a seemingly chromatic surface, every transient modulation is actually subservient to one of the aforementioned middleground keys, creating large-scale tonal unity. A multi-level analytical approach (e.g., linear harmonic analysis) is needed to uncover this information; indeed, without it, one could easily draw the conclusion that Wagner’s chromaticism is no different from Chopin’s.

Absent the possibility of discussing the provenance of lexical tonality, the significance of plagal relationships and Siegmund’s plagally nested “pit,” and the reasons behind the specific choices of keys in this aria, we recapitulate the demonstration of the four relevant propositions.

- **Proposition 1:** A key can by identified by elements which need not include the tonic.
  - Although tonic notes abound in tonally closed (i.e., within one key) sections of the aria, note that tonic chords are relatively scarce. For example, there is not a single root-position tonic chord in the E minor section from measure 1 to 20—the key is propounded through others means (syntactical progressions, pedals, etc.). Indeed, the carefully measured usage of unambiguous root-position tonic chords and perfect authentic cadences in Wagner’s late style is a hallmark of his cadential rhetoric and a feature that allows for creating different levels of structural closure.
• **Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
  o The most important takeaway from this analysis is the exploitation of nested tonalities to create large-scale tonal action. The key signature is C major for the entirety of the aria, but C major is propounded more often by means of transiting keys native to its tonality’s orbit as opposed to remaining in the key of C major itself (which is reserved for the sword). Keys and tonalities are used to create a chromatic surface texture that nonetheless remains subservient to a clear and coherent macro-level harmonic structure.

• **Proposition 3**: The function of a note or chord is determined by context rather than by static definition.
  o This proposition is actually extended by this analysis, demonstrating that the function of a key is also contextual. For example, in mm. 21–22, why are D minor and E minor successively tonicized? The E minor tonicization in m. 22 is *not* a regression to the same E minor of mm. 1–20—rather, it is functioning locally as a v of a minor. This is not possible to ascertain without looking both backwards and forwards at the flanking harmonic action.

• **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).
  o A rigorous exposition of every individual place that this aria makes use of this proposition is beyond the scope of this analytical vignette. Proposition 2 accounts for the bulk of the examples germane to this proposition, viz., shifting unresolved conflicts across the tonal hierarchy from a chord-to-chord level to a key-to-key or tonality-to-tonality level. Of particular interest is the double and triple nesting of keys which obtains in the aria.
Analysis – Anton Bruckner, Symphony No. 4 (1880 version), coda (fragment)

Anton Bruckner (1824-1896) was a composer of unparalleled erudition and academic accomplishment. When asked to improvise a fugue at his organ-playing Matura in the Piaristenkirche Maria Treu in Vienna on 19 November 1861, one of his examiners, Johann von Herbeck, remarked “Er hätte uns prüfen sollen!” (“He should have examined us!”).

Bruckner did not write his first numbered symphony until his early forties. He took years of harmony, counterpoint, fugue, form, and orchestration lessons with Herbeck, Simon Sechter, Otto Kitzler, and others, studying a great deal of the music before him and performing deep structural analyses on them. He was known to have marked up copies of Mozart and Beethoven scores with numbers everywhere (indicating phrase rhythm and harmonic structure), and he did this with his own symphonies as well. Bruckner’s nine numbered symphonies display an immaculate attention to detail, and the Fourth serves as an excellent example.

Subtitled Romantic (after the artistic movement), the Fourth Symphony was composed in 1873–1874, and revised again to produce additional versions in 1878–1880 and 1887–1888. (The “Bruckner problem” is the colloquial name given to the vast musicological project of making sense of the numerous versions of Bruckner’s symphonies.) The 1880 version of the Fourth is examined here, although the changes to the coda between this version and the next one do not substantially alter the analysis (however, the 1874 version is markedly different).

Bruckner’s codas have acquired great renown for their economy, innovation, and effectiveness in serving as devices of formal closure in his symphonies. The Fourth Symphony is in Eb major, and the coda of the finale serves both to cement the finality of Eb as key and tonality. The precise way in which this structural resolution is achieved is expounded in the following analysis.

An orchestral score of the symphony can be found easily online on the International Music Score Library Project (imslp.org). For reference to this paper’s analysis, the last four pages of Karl Grunsky’s piano transcription of the Fourth Symphony are provided below. The coda proper begins at m. 477, but the excerpt most germane to our analysis begins at m. 517. Although the excerpt utilizes a number of the latent possibilities explored thus far, the two most relevant propositions for the following analysis are:

- **Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
- **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).

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zart, doch sehr bestimmt und feierlich

crescendo

crescendo
Linear Harmonic Analysis of Bruckner, Symphony No. 4 (1880 version), coda (fragment)

The large-scale harmonic motion (i.e., between tonalities) is $b^V - iv - I$, so the plagal motion between the tonalities of $A^b$ minor and $E^b$ major/minor prefigures the final plagal resolution ($N-I$, where $N$ is a IV substitute). The background organization of keys subservient to the $b^V$ tonality ($B^º$ minor = $A$ minor in the context of $E^b$ major) projects a Locrian background. Also of note is the consistency of the $V-I/i$ motion used to tonicize all the keys traversed: indeed, the entire span of this fragment is a sequence of $V-I/i$ motions applied to (nearly) every scale degree of the triads comprising the large-scale $b^V-iv-I$ motion; the series breaks form after sounding the $V$ of $5$ of the $A^b$ minor triad, after which the bass descends stepwise through root-position triads to the final peroration on $E^b$ major.

The sequential action from $A$ minor to $A^b$ minor, (down a half step from key to key) precedes the final half-step resolution from $F^b$ to $E^b$. The descending scale pattern in the final bars is also an extension of the prior sequential $V-I$ action:

- **A**: $V-I$  
- **A$^b$**: $V-i$
- **C**: $V-I$  
- **C$^b$**: $V-I$  
- **E**: $V-I$  
- **E$^b$**: $V-(iv-III-N)-I$

The fragment of the coda preceding the bit covered in the linear harmonic analysis above references the *Tristan* chord (a half-diminished seventh chord) and its variety of resolutions many times. Included are the resolutions to $E$ (mm. 502-507) breaking through to the “ocean of love’s endless delight”\(^{21}\) in the final plagal cadence ($E^b$), and the arpeggiating sequence of $A$ minor ($A-C-E$).

Another interesting observation results from considering the chords used in the fragment of the coda analyzed.

The tonic, $E^b$, sits at the summit of the keys defined by a diatonic scale built on fifths:

$$E^b - A^b - D^b - G^b - C^b - E - A$$

which, arranged in stepwise ascending order, leads to the scale

---

i.e., an $E_b$ Locrian ($H-W-W-H-W-W-W-H$) scale. The passage uses the keys/chords of $E_b$, $G_b$, $C_b$, and $F_b$ and the tonalities of $A = B\#$ and $A_b$. C major is the only local key that occurs outside this compass and is absorbed as part of the $A$ minor tonality. The $B_b$ major harmony in m. 526 is a local chord that occurs as a secondary dominant to the dominant of $A_b$ (namely, $E_b$).

Hence, the tonalities are $A$ minor and $A_b$ minor, and the last scale of descending chords is $A_b$ minor–$G_b$ major–$F_b$ major–$E_b$ major. Together, these define the descending scale of $B\#–A_b–G_b–F_b–E_b$, a Locrian structure based on $E_b$. Mode persists as a series of modulations without inflecting the integrity of local keys or their structures. However, using modal relationships as a source for background modulations allows access to a wider variety of modulations.\(^{22}\)

The propositions are demonstrated as follows:

- **Proposition 2**: Keys can be organized in larger structures called tonalities which are groupings of keys. The procedures for creating relationships among tonalities are identical to the list of syntactical chord progressions.
  - Tonalities are employed in this coda to propound large-scale key relationships, e.g., between $A$ minor, $A_b$ minor, and $E_b$ minor/major. In fact, without acknowledgement of the tonalities transited, the chord progressions on the surface level would be rendered incoherent by a superficial harmonic analysis (e.g., which key contains C major, B major, and $B_b$ major chords together?).

- **Proposition 6**: Resolution of a tonal “conflict” can occur at any level of the tonal hierarchy (scale, key, tonality, etc.).
  - Bruckner’s eventual resolution to $E_b$ major in m. 534 is no mere Neapolitan-to-tonic resolution. The prefiguring of the half step resolution is achieved by the half-step modulations between the tonalities of $A$ minor and $A_b$ minor. The multi-level harmonic action here is precisely what renders this “plagal” resolution so tremendously final—in fact, a traditional dominant-to-tonic (i.e., $B_b–E_b$), in spite of its syntactical orthodoxy, would be malapropos here because it would not cohere with the macrostructural harmonic action.

\(^{22}\) Credit for this insight goes to Marshall Tuttle. For an excellent treatment of modal modulatory superstructures in tonal music, see Marshall Tuttle’s *Modal Ethos and Semiotics in Tonal Music* (The Edwin Mellen Press, 2016).
Conclusion

A grammar should open up a realm of infinite possibilities. Bashō’s haiku

the summer moon
shines on transient dreams
in the octopus pots

should be as possible as Shakespeare’s A Midsummer Night’s Dream. In other words, style is not the business of grammar to foretell, predict or judge. Prescriptive approaches…are a priori self-defeating in the limitations they demand. – Marshall Tuttle, Harmony (forthcoming).

The above statement encapsulates the ethos of this thesis neatly. In expounding the axioms (viz., grammar) of tonality, exploring some consequences of them formulated as propositions (viz., possibilities latent in the grammar), and demonstrating exploitation of these propositions across disparate styles and eras (viz., historical usage), no effort is made to homogenize tonal music or demonstrate a rigid stylistic uniformity across the tonal corpus. On the contrary, the analyses demonstrate deep grammatical cohesion across extensive stylistic variety.

The results presented herein are neither revolutionary nor novel per se. Composers, performers, and scholars since the advent of tonality have been well aware of the versatility and flexibility of the tonal idiom—indeed, a reason for its ubiquity and longevity is the its ability to absorb and assimilate different influences. Hence the tonal practice of the Russian nationalists is earmarked by discursive modulations, Wagner’s late style is characterized by the manipulation of unstated tonics in motivically derived sequences, and Chopin’s roving chromaticism is explicable by expansions of syntactical progressions: three distinctive and idiosyncratic styles with a common underlying grammar. An infinite number of stylistic treatments can arise from a grammar—the axioms and propositions propounded here are not prescriptive, but rather, descriptive.

The takeaway that the tonal system—by virtue of its characteristic structure (comprised of the aforementioned axioms)—has the potential for such a wide variety of expression (as demonstrated by the four contrasting examples in this thesis alone) ought to suggest one reason for the ubiquity of tonality across various global musical styles, cultures, and genres today. No doubt anthropological factors (European colonialism, the political history of musical movements, et cetera) play a nontrivial role in the global diffusion of tonality as well, but the hypothesis is advanced that tonality’s near-universal spread is at least partially due to its protean utility as a musical language.
Glossary

All terms that were underlined throughout the thesis, in addition to a few others, are defined below.

- **axiom**: a statement which is regarded as being established, accepted, or self-evidently true
- **chord**: a set of pitches which may be sounded simultaneously or in sequence, built in thirds (i.e., major and minor thirds) from scale degrees
- **chromatic scale**: the twelve-note scale (thirteenth note is the starting pitch one octave up) with a half step in between each pitch
- **diatonic scale**: a seven-note subset of the chromatic scale (eighth note is the starting pitch one octave up) with five whole steps and two half steps in which the two half steps are maximally separated from each other. There are seven possible intervallic configurations for a generic diatonic scale, which—starting on each of the twelve notes—yield a total of 84 distinct diatonic scales, from which only 24 (twelve major and twelve minor) are used in the tonal system
- **dominant**: the chord built on the fifth degree of a major/minor scale, or simply the fifth scale degree of a major/minor scale, which syntactically precedes the tonic
- **equal temperament**: the tuning system wherein the frequency ratio between any two adjacent pitches in the chromatic scale is \(\sqrt[12]{2}\)
- **fifth**: (1) the interval of seven half steps, or (2) the uppermost note (in pitch class space) of a triad, (some octave of) which is seven half steps above the root of the triad
- **final**: in modal music, the note which appears at the end of a piece (somewhat akin to a tonic in tonal music)
- **first inversion** (of a triad): a configuration of a triad in pitch space wherein the third of the triad is the lowest sounding pitch
- **function**: the syntactical role of a chord (or note) with respect to the prevailing key, e.g., tonic, supertonic, mediant, etc. (see Axiom 3)
- **half cadence**: any harmonic progression ending on V (a dominant note/chord), called “half” because the traditional dominant-to-tonic syntactical progression has been initiated without being carried through to its completion
- **half step (H)**: the interval between any two adjacent notes in the chromatic scale
- **interval**: the pitch difference between any two pitches, named according to the number of diatonic scale steps in between them
- **key**: a set of notes and chords sourced from a particular major/minor scale upon which syntactical rules obtain. Tonal music is typically “in” a key or in the process of changing keys at any given moment
- **latent**: (of a quality or state) existing but not yet developed or manifest; hidden or concealed
- **major scale**: a diatonic scale with intervallic structure W-W-H-W-W-H
• (natural) **minor scale**: a diatonic scale with intervallic structure W-H-W-W-H-W-W
• **modulation**: the process of changing a key
• **octave**: the interval between one musical pitch and another with half or double its frequency
• **octave equivalence**: the assumption that pitches one or more octaves apart are functionally equivalent, asserted (*a priori*) in the tonal system
• **overtone series**: a naturally occurring phenomenon in physics detailing how a vibrating medium vibrates at nodes of oscillation in integer-ratio multiples of a fundamental node of oscillation
• **pedal**: a note held across multiple harmonies which can serve to cohere otherwise unorthodox chord progressions
• **pitch class**: the infinite set of all octave-multiples (simply referred to as octaves) of a particular pitch (see Axiom 1)
• **pivot** (chord): a double-functioning chord which is diatonic to (i.e., exists in) the preceding key and the following key and which typically serves to initiate a modulation
• **proposition**: a statement which is provable by recourse to axioms and logical reasoning
• **recapitulation**: a sonata form term denoting the reprise of a theme in the “home key” after a development of the theme in a key other than the home key
• **root**: the note upon which a chord is constructed (in ascending thirds), though not necessarily the lowest note of the chord in the case of non-root-position chords
• **scale**: any sequence of musical notes ordered by pitch (i.e., frequency), often defined by the intervals between its pitches
• **scale degree**: any element, i.e., a pitch or pitch class, of a scale
• **second inversion** (of a triad): a configuration of a triad in pitch space wherein the *fifth* of the triad is the lowest sounding pitch
• **syntactical rule**: any rule prescribing order or directionality among notes or chords in the tonal system. In English, an example of a syntactical rule is “subjects precede verbs”
• **tertian**: denoting an interval of a third. All chords are (by definition) tertian in construction
• **third**: (1) the interval between two notes, where minor third = three half steps and major third = four half steps, or (2) the middle note of a triad (or larger chord), below which (not necessarily in pitch space, but always in pitch class space) there is a root and above which there is a fifth
• **tonal system** (also **tonality**): a system of musical (particularly harmonic) organization characterized by a few essential principles, originating in 17th-century Western Europe and persisting to the present day across many genres
• **tonality**: a de facto set of keys generated by the surface activity of keys transited in a tonal piece (see Proposition 2)
• **tonic**: the pitch center and first scale degree of a key, after which the key is named
• **triad**: a three-note chord
• **whole step** (*W*): the interval comprised of two consecutive half steps
Bibliography


_____________. Forthcoming. *Harmony.*