'NEITHER TONAL NOR ATONAL'?: A STATISTICAL ROOT-MOTION ANALYSIS OF LIGETI'S LATE TRIADIC WORKS

Allow me to begin by playing a brief musical example—the opening of György Ligeti's fourth étude for piano, 'Fanfares,' published in 1985. **[slide]** One of the most salient features of this passage is that it is heavily triadic. As I play this example, please listen for the triads—they go by fast!—and the general harmonic structures in which they participate. **[slide] [slide]**

As I mentioned, one of the most salient features of this passage is that it is heavily triadic. Where melody and accompaniment intersect, the result is always a major or minor triad. Even as the movement progresses in time and increases in contrapuntal and harmonic complexity, the harmonic results are still primarily tertian—triads, seventh chords, added-ninth chords, and the like. However, it is also readily apparent, even from this brief passage, that phrases and larger formal divisions are not articulated by typical tonal cadences. Indeed, even an unambiguous tonic is hard to find in Ligeti's late triadic works, and when one does appear, it is short-lived. What, then, do we as analysts and critics do with these successions of triads?

Ligeti, himself, seeks to provide us with some assistance in our quest to make sense of these harmonic successions and others like them. In an interview from 1986, soon after the publication of 'Fanfares,' Ligeti states: **[slide]**

> [W]hat I am doing now is neither 'modern' nor 'postmodern' but something else. . . . I don't want to go back to tonality or to expressionism or all the 'neo' and retrograde movements which exist everywhere. I wanted to find my own way and I finally found it. . . . I have found certain complex possibilities in rhythm and new possibilities in harmony which are neither tonal nor atonal (Dufallo, pp. 334–35).

This neither/nor positioning is a recurring theme in Ligeti's words about his own music, particularly in the latter part of his career, as Charles Wilson has explored at length in his 2004 article, 'György Ligeti and the Rhetoric of Autonomy.' Wilson sees this as a rather commonplace technique by which composers seek to differentiate themselves from 'an otherwise impersonal and overcrowded

market' (p. 13); and, Ligeti was particularly adept at it. Wilson notes the great success Ligeti had in laying out the terms according to which his works would be received, as well as the terminology with which his works would be analyzed. As a result, Ligeti has wielded enormous influence over the way his works are interpreted, even for scholars who read Ligeti's words with a critical eye.

This can be seen in the way that this quotation and other like it have influenced the way that Ligeti's use of the triad in his later works has been interpreted by the scholarly community. Stephen Taylor, Eric Drott, Richard Steinitz, and Michael Searby have published substantial analyses of the harmonic structures of movements or passages by Ligeti that are heavily triadic. Though they express it with greater or lesser degrees of nuance, all three repeat the same mantra: **[slide]** in his successions of triads and other tertian sonorities, Ligeti uses the 'vocabulary' but not the 'syntax' of tonal music. That is, by using the verticalities of the tonal musical language and the horizontal patterns of atonal music, Ligeti finds his 'own way' into music which is 'neither tonal nor atonal,' but completely Ligeti. **[slide]** Steinitz calls Ligeti's triads an 'incidental byproduct' of other, non-harmonic processes; and Searby, who writes the most about this topic, states that in Ligeti's music, **[slide]** triads are 'essentially coloristic' (2010, p. 18), **[slide]** 'context-free' (p. 24), **[slide]** 'atonal' (p. 24), **[slide]** tonally 'isolated' (p. 104), **[slide]** and lacking 'a sense of harmonic function or a sense of history' (p. 24).

However, none of these authors support this interpretation with a detailed analysis of Ligeti's harmonic successions. **[slide]** In fact, we can trace all of these authors' tonal-vocabulary-but-not-syntax claims back to statements made by Ligeti (1994, p. 147). And thus the question remains open: how can we as analysts and critics make sense of and interpret Ligeti's works which make substantial use of the 'tonal' triad? In the remainder of this talk, I will analyze the harmonic structures of six movements from late in Ligeti's career that are heavily triadic throughout: **[slide]** *Hungarian Rock* and *Passacaglia ungherese* (both composed for harpsichord in 1978), 'Fanfares,' and the last three

movements of *Sippal, dobbal, nádihegedüvel*. This analysis seeks preliminary answers to two questions: **[slide]** 1) do these works present what we might call syntactic structures?; and **[slide]** 2) to what extent are those syntactic structures based in tonal procedures?

ROOT-MOTION ANALYSIS

To address these questions, first we need to consider a question of analytical methods. If Ligeti's triadic successions largely cannot be reckoned against clear, unambiguous tonal centers, we cannot use traditional methods of tonal analysis, such as Roman numerals, functional analysis, Schenkerian analysis, etc. Instead, we need a means of analysis that can be applied to triadic successions with and without a tonal center that can lead to meaningful comparisons of those successions. **[slide]**

With these goals in mind, I make use of what Dmitri Tymoczko calls a 'root-motion' paradigm. In an article from 2003, Tymoczko writes that root-motion theories (like those of Rameau (1722), Schoenberg (1969), Sadai (1980), and Meeus (2000)) 'emphasize the relations between successive chords rather than the chords themselves. **[slide]** A pure root-motion theory asserts that syntactic tonal progressions can be characterized *solely* in terms of the type of root motion found between successive harmonies' (p. 3). Thus, a 'pure' root-motion theory operates independently of a controlling tonic. **[slide]**

Tymoczko notes a number of limitations to pure root-motion theories. However, all of these limitations involve the failure of a root-motion theory to account for distinctive properties of tonal-harmonic progressions that are scale-degree specific. Of course, it is just such distinctive traits of tonal harmony that cannot be compared with triadic successions without a tonal center, and thus it is not prohibitive for the use of a root-motion theory to compare the harmonic structures of music with and without a clear tonal center. Rather, the specific benefits and limitations of root-motion

theories line up precisely with the limitations and desired comparisons of this project. Thus, for our discussion of harmonic-syntactic structures in Ligeti's triadic music, we will follow this 'root-motion' paradigm, looking specifically at the harmonic roots present in each movement and the intervals between successive roots. **[slide]**

TONAL SYNTAX

We will now look at the tonal structures to which we will compare Ligeti's triadic successions. In what follows, I perform a root-motion analysis on two corpora representative of tonal musics (J.S. Bach's four-part chorales and a set of 70 pop/rock songs). Comparing these analyses with the data from Ligeti's triadic pieces allows us to understand better the meaningfulness of Ligeti's harmonic successions, as well as the extent to which the syntactic structures of Ligeti's triadic music is related to syntactic structures in tonal musics. **[slide]**

TONAL CORPUS ONE: THE BACH CHORALES

Data on the harmonic successions of J. S. Bach's chorales is taken from Ian Quinn's (2010) analysis of the Riemenschneider edition of Bach's chorales. When we analyze all of the intervals between successive roots, we can calculate the probability of occurrence for each root interval. Those probabilities generate a root-interval probability profile that looks like this. **[slide]** Note that in this chart, the intervals are arranged as steps on the circle of fifths. This, as is clearly seen, emphasizes the prevalence of short root motions on the circle of fifths (perfect fifths, whole-tones—or two-fifth progressions—and minor thirds—three-fifth progressions) over distant root motions on the circle of fifths (such as semitones—or five-fifth progressions—and tritones—or six-fifth progressions). While we can see some interesting things about this probability profile right off, we get the best idea of the meaningful syntactic structures in these root successions by comparing Bach's root progressions to a

random succession of the same set of chords. This directs our attention to those properties of the harmonic progressions which are not mere consequences of chord choice. Thus, I generated a random succession of chords whose root distribution is the same as Bach's actual repertoire of chords in the chorales, and analyzed its root-interval content. **[slide]** Here is the root-interval probability profile for that random succession.

Comparing these two profiles, we see that Bach's actual progressions bear significant resemblance to the random succession of chords. We can use a common statistical test to measure this resemblance, known as the Spearman coefficient of rank correlation. Perfect correlation produces a Spearman coefficient of 1, inverse correlation –1, and no correlation a coefficient of 0. The coefficient of correlation between these two profiles is 0.93, very high. Specifically, Bach's actual progressions and the random succession both favor close over distant circle-of-fifths root motions. However, there are two key differences that are not accounted for in a measurement of rank correlation: First, Bach's actual progressions exhibit significant *directional asymmetry*; that is, where 11 and 1, 10 and 2, etc. are approximately equal in the random succession, in the actual succession, they are far from equal. Second, where intervals of short distances on the circle of fifths are privileged over distant circle-of-fifths progressions in the random succession, that property is exaggerated in Bach's actual progressions.

The differences between this profile and a random succession of Bach's harmonies, then, can be summed up by two general features: **[slide]** an over-privileging of root motions that are short distances on the circle of fifths, **[slide]** and directional asymmetry (which is particularly strong for the distances that are closer on the circle of fifths), and these two features can be taken as the definitive characteristics of tonal syntax in Bach's chorales, according to the root-motion paradigm. **[slide]**

TONAL CORPUS TWO: POP/ROCK MUSIC

Though the Bach chorales are a common stand-in for tonal music in general when considering harmonic structures, and though the Bach chorales are often the paradigmatic model of tonal harmony for undergraduate students of music theory, they form a particular subset within the broader repertoire of tonal music. Thus, it is worth looking at tonal music outside the Bach chorales to explore whether these two distinctives are operative in tonal music generally speaking, or whether they are idiosyncratic to J.S. Bach. Thus, I analyzed the root-motion content of a set of pop/rock songs, based on data shared with me by David Huron. **[slide]** I explore this in detail in my dissertation, but for the sake of time today, let me summarize that analysis. First, the Spearman coefficient of correlation between the pop/rock corpus and the Bach profile is 0.91, demonstrating that these two corpora generally privilege the same root motions. And though the pop/rock corpus demonstrates a weaker directional asymmetry than the Bach corpus, especially between the values for ascending and descending fifths, **[slide]** the pop/rock corpus confirms the above conclusions about the definitive tonic-agnostic markers of tonal syntax: **[slide]** *In tonal-harmonic music, closely related root progressions are more common than distantly related root progressions—as measured on the circle of fifths—and the closest circle-of-fifths root motions exhibit directional asymmetry*. **[slide]**

STATISTICAL SYNTACTIC STRUCTURES IN LIGETI'S TRIADIC PIECES

Let's now look at the root-interval probability profiles for the six movements by Ligeti in question. **[slide]** Here we see these profiles with root intervals arranged according to steps on the circle of fifths. At first flush, a visual comparison of these profiles with those of the two tonal corpora, or an evaluation of the coefficients of correlation between the profiles of these movements and the tonal corpora, is not promising for the search for tonal influence.

However, looking at specific aspects of the profiles of specific pieces, we find some interesting relationships. **[slide]** First, 'Fanfares' correlates moderately with the pop/rock corpus and moderately highly with the Bach corpus. **[slide]** Though the slope of its curve is not nearly as steep as those of the tonal corpora, there is a notable preference for close circle-of-fifths root motions.

A contrasting example is *Sippal, dobbal*, movement V. **[slide]** It exhibits moderate *negative* correlations with the two tonal corpora, suggesting, if not tonal structures, then composition in light of (or, rather, *opposite to*) standard tonal-harmonic syntax. *Passacaglia ungherese* exhibits the same property, though less pronounced. While the other three movements—*Hungarian Rock* and the last two movements of *Sippal, dobbal*—do not evidence tonal-syntactic structures or their opposite on the large scale, Ligeti clearly prefers some root motions over others in these movements; that is, these are not random structures but have meaning to the way in which harmonies are ordered. For example, in movement six of *Sippal, dobbal*, **[slide]** Ligeti generally prefers moderate circle-of-fifths distances over close or distant ones.

Analyzing all six movements in light of these tonal corpora, we find the following. **[slide]**

One of the six movements ('Fanfares') demonstrates a high degree of correlation with tonal syntax when considering its harmonic structures on the large scale; **[slide]** one movement correlates weakly with the tonal corpora but privileges some of the same root motions (*Hungarian Rock*); **[slide]** two movements demonstrate a *negative* correlation with tonal syntax (*Passacaglia ungherese* and the fifth movement of *Sippal, dobbal*); **[slide]** and the remaining two movements (the last two movements of *Sippal, dobbal*), though not evidencing relationships to tonal music, still bear some markers of meaningful syntactic structure. Thus, we can say that most of these movements demonstrate *potential* influence of tonal music in the large-scale statistical properties of the harmonic successions of these movements, if not the precise structures, and all movements exhibit preference for certain kinds of root motion over others. **[slide]**

There is one last point of comparison between the harmonic sequential structures of the tonal corpora and Ligeti's triadic pieces: directional asymmetry. In both tonal corpora, root motions—particularly the closer root motions on the circle of fifths—tend to favor one direction over another. Thus, descending fifths (11 fifths) are more common than ascending fifths (1), ascending seconds (2) more than descending seconds (10), and descending minor thirds (3) more than ascending minor thirds (9). The question, then, is whether Ligeti's triadic pieces exhibit directional asymmetry, and, if so, whether these pieces prefer the same specific kinds of motions.

On the first point—whether these movements exhibit directional asymmetry—we can perform a simple statistical procedure to quantify and compare this property between movements. We can quantify this directional asymmetry by taking a probability profile, generating its inverse profile, and taking the coefficient of correlation between the profile and its inverse. If the profile is symmetrical, then its inverse profile (the mirror image of its profile chart) will correlate highly with the original; if the profile is asymmetrical, it will have a low coefficient of correlation with its inverse. For example, we can take the Bach profile and reverse its values to generate its inverse. **[slide]** Notice that the probability value for descending-fifth progressions in the profile is equal to the value for ascending-fifth progressions in the inverse profile, and vice versa. Here are the coefficients of correlation between the two tonal corpora and the six Ligeti movements and their inverse profiles. **[slide]** Higher values mean greater symmetry and lesser asymmetry. As we can see from these values, a number of Ligeti's triadic movements exhibit directional asymmetry. In fact, only one of Ligeti's movements, the fifth movement of *Sippal, dobbal*, has a higher degree of directional symmetry than the Bach corpus (and none have a higher degree of symmetry than the pop/rock corpus). Thus, we can say with great confidence that Ligeti's harmonic successions in these triadic movements exhibit directional asymmetry, just as the tonal corpora do—in fact, this property is more pronounced in Ligeti's harmonic successions than in the tonal corpora.

However, as we look more closely at the specific profiles for specific movements, we see that Ligeti does not consistently favor the same directions of the same intervallic distances throughout these movements as we see in the tonal corpora. **[slide]** For instance, in *Passacaglia ungherese*, on the three key root-intervals (1, 2, and 3 fifths), Ligeti favors the opposite direction of the tonal corpora, and he heavily favors ascending over descending semitones where the tonal composers tend towards equality.

And when we look at all six movements in terms of their directional asymmetry, we may conclude that though Ligeti's successions of tertian harmonies in these movements exhibit directional asymmetry—as tonal music does—the specific directional preferences in these movements do not follow after the precedence of tonal-harmonic music. **[slide]**

SUMMARY AND ANALYSIS

Let me now summarize the findings of this statistical study. I have demonstrated that it is possible to analyze the harmonic successions of triadic music without recourse to a controlling tonic, and that such analysis allows for insightful comparisons between tonal-harmonic syntax and the syntactic structures of compositions that do not make use of global or local tonal centers. **[slide]**

By way of such tonic-agnostic root-motion analyses, we found that tonal music, exemplified by the Bach chorales and a corpus of 70 pop/rock songs, **[slide]** exhibits a privileging of short distances (on the circle of fifths) between successive chordal roots, **[slide]** and directional asymmetry that is particularly strong on the closest circle-of-fifths progressions. **[slide]** Further, we found that these properties are generally descriptive of Ligeti's triadic works, as well. **[slide]** These works, with some notable exceptions, exhibit a preference for close harmonic progressions on the circle of fifths (or the opposite—both being strong potential markers of tonal influence on his syntactic structures) **[slide]** and directional asymmetry (though of a different sort than that exemplified by the tonal

works). This suggests that Ligeti's triadic works possess a high degree of structuring to their harmonic successions, and that these structures exhibit significant relationships with tonal harmonic structures, sometimes in rather specific ways.

However, as we consider whether these movements can be said to have a syntax, and to what extent these works exhibit properties similar to *tonal* syntax, some questions remain. **[slide]** For instance, though we have seen clear preference for certain types of root motion over others in each of these movements, the statistical data presented today does not provide information about how these different progression types are employed within these movements. Is the root-interval content of these movements uniform? Or are certain progressions privileged in some passages and suppressed in others? Still more interesting: are certain chords or progressions privileged in some positions within phrases and suppressed in others? In other words, can these progression types be seen to play functional roles within the harmonic structures of the movement—articulating moments of stability and instability, mobility and closure? Such questions are fundamental to an understanding of Ligeti's harmonic structures and their potential relationship to tonal structures, and they cannot by fully answered by the present statistical analysis.

In addition to questions unanswered by this analysis are questions raised by this analysis. These are often specific to particular movements. For instance, the statistical analysis of this study may lead us to ask why over half of the progressions between tertian chords in *Hungarian Rock* **[slide]** involve root motions of one or two steps on the circle of fifths (like the tonal corpora) but very few of those progressions are descending-fifth root motions (the most common progression in the tonal corpora)? This question, as it turns out, is intricately tied to the question of function. *Hungarian Rock* is a ground-bass variation movement, with a 4-bar ground forming the foundation of the bulk of the movement. The ground, however, disappears seven bars before the end of the movement, and at this point, there is a marked change in root-interval content. Here is the root-interval prob-

ability profile for the last seven bars. **[slide]** Notice both the contrast to the profile of the whole movement, as well as the similarity to the profile for the Bach chorales. **[slide]** From these graphs, we might hypothesize that the descending-fifth root progression is accorded the same stability-generating function in *Hungarian Rock* that it possesses in tonal music, but that it is primarily reserved for the end of the movement, where a sense of harmonic closure is more greatly desired.

Such an analytical hypothesis is indeed confirmed by a broader analysis of the movement. In mm. 1–177, the rapid, breathless pace of the ground-bass harmonies combine with an improvisatory melody whose points of closure are weakly articulated and do not line up with any of the few descending-fifth progressions present. This generates a vaguely tonal wash of consonant harmonies throughout most of the movement. This is starkly contrasted by the last seven bars, where slow, deliberate progressions that we can easily hear as V^7–I progressions in a series of different keys coincide precisely with moments of melodic cadence. The result is a general avoidance of closure for the first 177 bars of the movement, followed by a demonstrative display of closure-articulating gestures in the final bars. The relative absence of descending-fifth root progressions in the first 177 bars, alongside the proliferation of such progressions in the last seven bars, contributes significantly to this very salient characteristic of the movement.

Let's listen to this contrast and the role that descending-fifth root progressions play in projecting it. **[slide]** Here is the opening of the movement, beginning with the unaccompanied ground in mm. 1–4 and continuing into the appearance of the melody in m. 5ff. Note the general consonance of the harmonies and the lack of descending-fifth root motions and other gestures of harmonic closure. **[slide]** And now let us skip ahead to the last five iterations of the ground **[slide]** (*ad lib. poco sostenuto*, m. 157) and play to the end. Here we will hear the contrast starkly between the music based on the ground with its lack of harmonic closure and the deliberate punctuating V^7–I gestures of the final bars. **[slide] [slide]**

This brief analytical example and the statistical analysis presented today are not enough to provide definitive answers to the two research questions proposed at the beginning of this presentation: do these six works demonstrate harmonic syntactic structures, and to what extent are those structures based in tonal structures? However, I believe that this analysis does provide significant evidence that suggests that these six movements contain harmonic structures whose chords are ordered in meaningful ways, that that there is a strong possibility of tonal influence on Ligeti's composition of the harmonic successions in these works. This analysis also suggests specific directions in which we might take future research in service of these questions. And finally, this analysis provides us with enough insight to revisit the claims made by Ligeti, Searby, Drott, Steinitz, and Taylor regarding the general harmonic structural properties of these triadic pieces.

CONCLUSION

We recall that Ligeti claimed that his new harmonic structures in pieces like these were neither traditional nor avant-garde, neither tonal nor atonal. Ligeti scholars have routinely repeated this notion with the more specific claim that Ligeti uses the vocabulary of tonal music (triads) but not the syntax of tonal music (the principles by which they are arranged in successions). Steinitz calls Ligeti's triads 'incidental byproducts,' and Searby goes as far as to claim that these movements are fundamentally atonal, and that the triads in them are 'essentially coloristic,' 'context-free,' and lacking 'a sense of harmonic function or a sense of history.'

The analysis presented in this paper contradicts the claims of Steinitz and Searby. While these movements may lack extended passages under the control of a single, unambiguous tonic, and while paradigmatic tonal cadential patterns may be few and far between, we have seen that these triads participate in meaningful successions with significant relationships (both positive and negative) to historic tonal patterns.

The analysis in this paper similarly works against the more general tonal-vocabulary-but-not-tonal-syntax claim. Yes, Ligeti incorporates the basic chords of tonal music in movements that lack certain other key markers of tonality. However, we cannot write off the presence of tonal-syntactic properties completely given the present data, nor the influence of tonal-syntactic structures on Ligeti's harmonic successions.

Lastly, we come to Ligeti's claim that these harmonic structures are 'neither tonal nor atonal.' In a sense he is correct; there are too many aspects of these compositions that would resist any of them being considered firmly within either a tonal or an atonal tradition. However, Ligeti cannot make his neither/nor claim unproblematically. As Schoenberg, Boulez, and Ligeti himself have stated, to introduce a musical element with as much history as a triad to a piece of new music is to introduce that history to the new work. We do not hear a triadic work without a tonal center as completely divorced from our knowledge of tonal practice; nor does Ligeti compose these works completely divorced from his knowledge of tonal practice, as the analysis I have presented today suggests. Rather, in Ligeti's own words, 'Musical syntax is transformed both *by* history and *through* history.' And these movements, however one may categorize them, belong to the histories of *both* tonal and atonal music. **[slide]**