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The Problem

Harmonic rhythm is one of those essential aesthetic aspects of traditional western harmony that begs for attention from scholars, demands to be taught to students, and yet frustrates teachers who attempt to explain it. The concept seems simple and a few well-chosen examples can demonstrate its obvious importance, but analytical technique for harmonic rhythm has never had sufficient precision and consistency to be of much practical value since Walter Piston first defined the term in 1944.[1] We have had precious little theory for it, and so no advice, no specifics such as those for voice-leading, that we can give to our students. In the following pages I would like first to explain how a new analytical technique for harmonic rhythm called dimensional analysis can address these problems and second to describe my experience using this technique to teach harmonic rhythm in the second semester of a traditional harmony course.[2] Dimensional analysis, the students agreed, provided a precise approach to harmonic rhythm that they could easily grasp, and at the same time amplified other fundamental aspects of harmonic practice by integrating them with rhythmic effects.[3]

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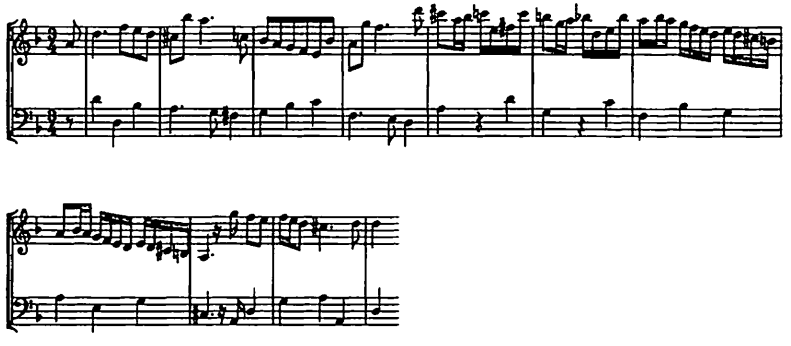
[1]*Harvard Dictionary of Music* (Cambridge, Massachusetts: Harvard University Press), p. 319. For a good survey of theoretical treatments of harmonic rhythm, a meager literature indeed, see Mary Irene Arlin, "Harmonic Rhythm in Selected Fugues from The Well-Tempered Clavier, Book I." M. M. Thesis. Indiana University, September 1965.

[2]For fuller theoretical discussion of this technique, see Joseph P. Swain, "Dimensions of Harmonic Rhythm" *Music Theory Spectrum* 20.1 (Spring 1998): 48-71.

[3]The citation of student reactions to dimensional analysis comes from a survey administered at the conclusion of the course, following the final

As it developed through the editions of his textbook *Harmony*, Walter Piston's concept of harmonic rhythm focused on the durations of chord roots. The first problem is that it is not always clear what is to count as a change of root and the beginning of a new duration. Should the third beat of Example 1, for instance, be tallied as two eighth-note durations (E diminished, B-flat major), or one quarter-note duration that includes a non-harmonic tone? If the latter, which triad? The same dilemma recurs in measure three, and in countless other instances of traditional western music.

Example 1: Handel, "Thou art gone up on high, (No. 36) mm. 1-5, from *Messiah*.



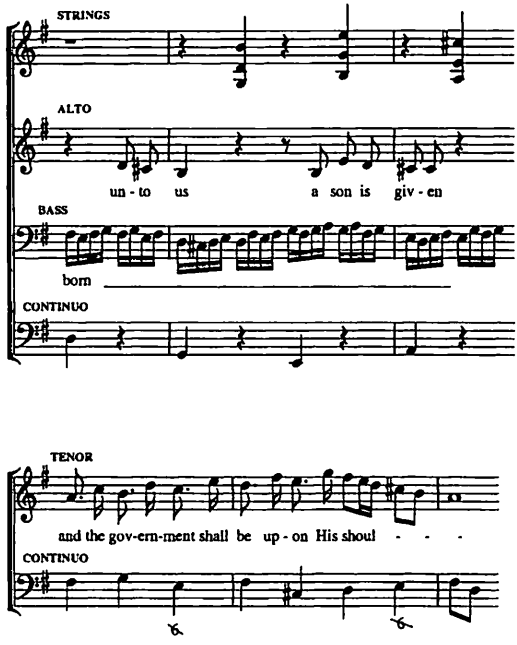
exam. All responses were anonymous. The questions were: 1. Do you believe that the dimensional analysis increased your understanding of traditional harmony? If so, how? 2. Do you think that aural skills (ear training) tied into the graphing process in any way? If so, how? 3. Do you believe that the class presentations by students were worthwhile? Did they increase your understanding of harmonic rhythm and *Messiah* as the semester progressed? 4. Did you feel adequately prepared to make the graph with the materials given to you and the two preparatory classes? If not, what would have helped you to be better prepared? 5. In making the graph, which dimensions seemed easy to develop, if any, and which were difficult, if any? 6. About how many hours did it require to make the graph?

Besides voice-leading ambiguity, should not changes in other harmonic aspects affect perceptions of rhythm? Is there not a perceptual change, therefore a rhythmic event, of harmonic character when the G minor triad moves from root position to first inversion in measure three? Or even more so when a chord function changes, as when the leading tone is canceled in measure five, negating its dominant tension, again without any new root? The point is quite simple: a chord has many facets; therefore harmonic rhythm is likewise multi-faceted. Representing rhythmic changes on one dimension only—the root—must oversimplify what is a complex musical perception.

The second problem with Piston's concept is that, even if harmonic rhythm were limited to root changes and even if that were a simple matter, there is no theory about how it informs the dynamics of a harmonic phrase, its tensions and resolutions. That is why it is easy to show students what harmonic rhythm is, but difficult to show them how to apply it either in analysis or composition.

And that is why Piston's own treatment of the issue is limited to a collection of examples showing only how varied harmonic rhythm can be, and why its application in analysis and criticism has been limited to comparisons. Now, comparisons can indeed inform and enlighten us, as they do in Example 2. Here, it is important to show students that even though the basses in the first quotation from "For unto us" sing a run of sixteenth-notes, the sense of pacing is faster in the second quotation because the harmonic progression moves in quarter-notes rather than half-notes, a sense that contributes mightily to the climax at "Wonderful, counsellor . . .". But from this we can only conclude that the function of harmonic rhythm is to lend one phrase some certain monolithic sense of speed which may then be contrasted with a sufficiently faster or slower sense in another phrase. A teacher can ask students to experiment with this idea; I assign contrasting arrangements of the same tune. But any subtler application of harmonic rhythm seems *ad hoc*, without general principles.

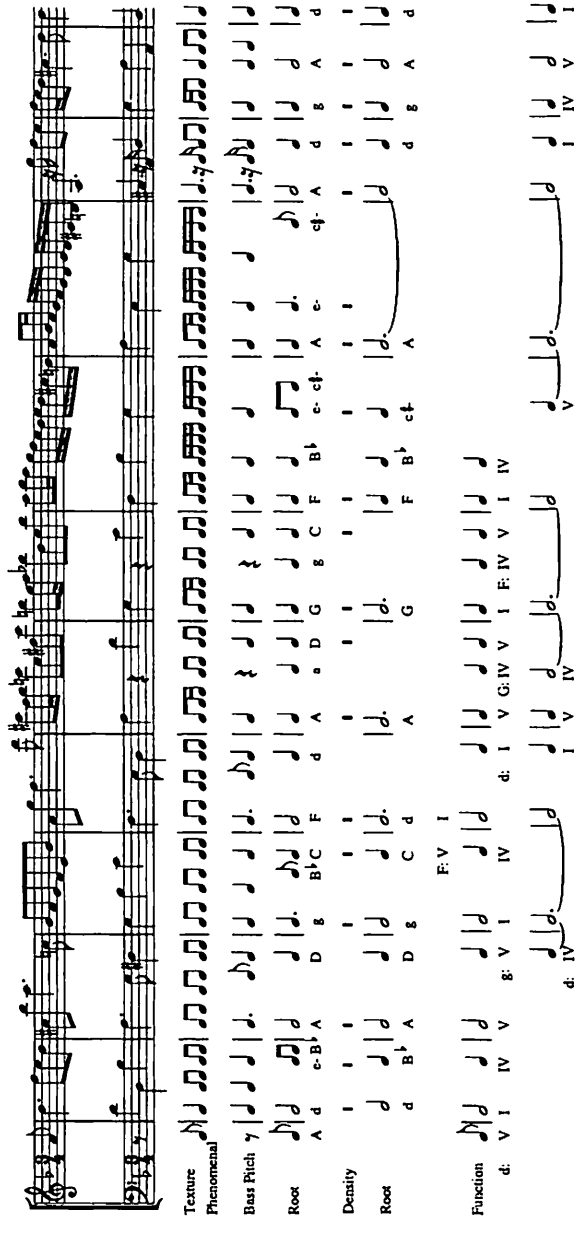
Example 2: Handel, "For unto us," (No. 12) mm. 20-22, 26-28 from *Messiah.*



A Solution

Dimensional analysis attacks the problem of multiple harmonic facets and effects simply by making graphs of each aspect—each "dimension"— and aligning them underneath the passage (see Example 3). This allows the retention of more than one interpretation, more than one harmonic aspect, of a single event. The resulting dimensional analysis can then address the second of the problems outlined above: what can harmonic rhythm tell us about the dynamic tensions and resolutions within a single passage? The following principles guide the interpretation: that rhythmic tension of one kind rises with increase in speed of changes (speed hypothesis); that rhythmic tension of another kind rises with increasing divergence—

Example 3: Dimensional analysis of Handel, ritornello (mm. 1-11) from "Thou art gone up on high" (No. 36) from *Messiah*.



independence of motions—among the dimensions (independence hypothesis).[4]

Both of these commonsense hypotheses above derive from the simple fact that at the end of a composition, when tension is resolved, the motion in all dimensions ceases and therefore convergence among them is at a maximum.

Using the Technique in Class

Each student was assigned to make a dimensional graph of a single ritornello from Handel's *Messiah* and to give a five-minute oral presentation of the results, which should point out particular problems in making analytical decisions and then some critical comment about Handel's harmonic rhythm in the excerpt. (Baroque ritornellos are especially appropriate for applying this technique because they are in some sense complete, miniature compositions where harmonic rhythm plays a decisive role in their articulation.) I prepared the students over two fifty-minute class periods by elaborating on the following instructions:

Brief Instructions for Making A Dimensional Graph of Harmonic Rhythm

Step 1. Transcription. Make a transcription of the ritornello, showing all contrapuntal voices. One system per page.

Step 2. Rhythm of the texture. This graph shows all the rhythmic attack points regardless of where they occur in the texture.

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[4]In his *Structural Functions of Music* (Englewood Cliffs, N. J., 1976), Wallace Berry, whose principal concern is the description of the course of "intensity" in music, essentially makes the same assumptions. See pp. 11, 86.

These principles are presented here in simplified formulation. They are refined significantly in Chaps. 9 and 10 of my *Harmonic Rhythm: Analysis and Interpretation* (New York: Oxford Univerisity Press, 2002). There human attention capacities account for various tensions of harmonic rhythm and the "coloring" of the musical texture that occurs when we attend to one focal dimension more than the others. The assumption that musical tension has differences in kind, as well as amounts, is developed at length in Joseph P. Swain, "The Concept of Musical Syntax," *The Musical Quarterly* 79.2 (1995):281-308; and in chap. 2 of Swain, *Musical Languages* (New York: Norton, 1997).

Step 3. Phenomenal harmonic rhythm shows the duration of every new vertical combination of pitches. An octave shift counts as a new pitch. The simple repetition of a chord (without changing any pitches in any voice) counts as no change. Before beginning to graph, inspect the music to see if all phenomenal changes might coincide with new attack points (textural rhythm changes). Often in Baroque music the two graphs are identical.

Step. 4. Bass pitch rhythm. Graph the rhythm of the bass part, adding together repeated notes. Octave shifts are new notes. Do not omit rests.

Step 5. Root/quality rhythm (level 1). Graph the duration of each harmonic root/quality change. For this first level, graph every reasonably audible change of root or quality. Below the rhythm graph, write in the letter pitch name for the root and symbol for quality (upper case = major triad (add + for augmented), lower case = minor (add - for diminished).

Step 6. Density. Graph the number of contrapuntal voices that create each new root. As long as a voice changes its note, it counts toward the density, even if that pitch was a factor of the previous chord. Octave shifts are new pitches.

Step 7. Root/quality rhythm (level 2). Graph the duration of each higher-level root/quality change.

Step 8. Functional harmonic rhythm. Use the first level Root/quality graph as a starting point. Decide on the prevailing key and each chord's function within that key. Declare the key in effect on a given level. Graph the duration of each function and label each duration below (I = tonic function; IV = subdominant; V = dominant). Secondary dominants establish a level embedded within the main key. The function of the secondary dominant area in the principal key depends on the function of the object chord. There may be two, or even three levels of harmonic functions.[5]

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[5]This is the verbatim instruction given students in Spring 1998. Since then these rules have been refined. See *Harmonic Rhythm*, chaps. 2-7.

Despite the brevity of these preparations, students reported almost no difficulty in generating the graphs. The average time spent was about four hours, and understandably, more care was needed with the more abstract, higher-level graphs whose values could not simply be transcribed from the score.

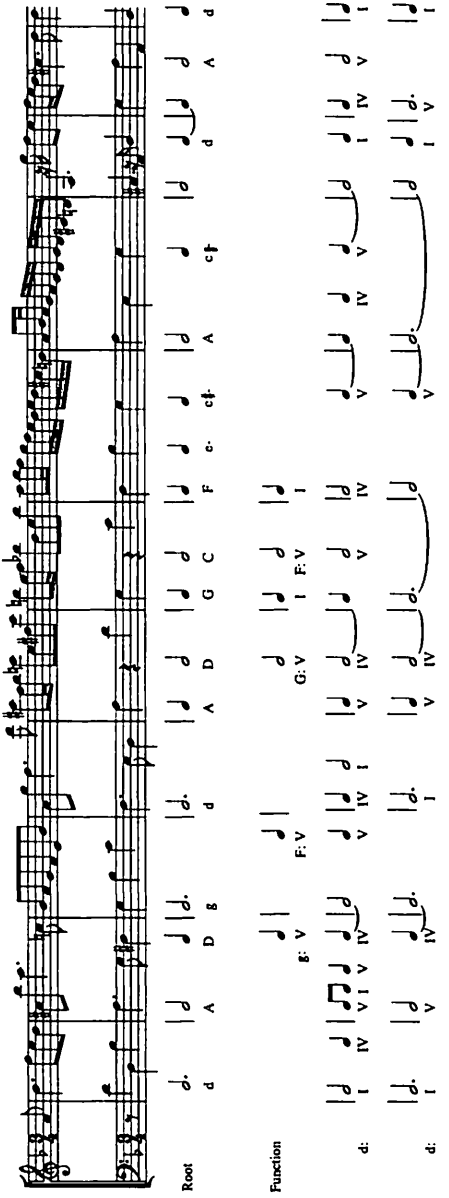
Analysis of the More Abstract Dimensions

Indeed, a good deal of class discussion arose from problems and inconsistencies in the students' graphs of the more abstract dimensions. To get them started, I reminded them of two familiar principles fundamental to traditional harmony. One is the principle of voice-leading, in particular that chords formed in conjunction with step motion can also be considered as purely melodic elaborations of a longer-lasting structural chord. The second is the secondary dominant principle, that it is possible to embed a dominant function chord borrowed from a foreign key whose object of resolution is a functioning member of the main key of the phrase.

How well did they do? Example 4 shows one student's analysis of the higher-level root/quality and function dimensions of "Thou art gone up on high." In the root dimension many of the differences, compared with my own analysis (Example 3) are reasonable alternatives to hearing the voice leading, such as in m. 1. Others are less justifiable (mm. 5-6, 10). Most of the problems arose in the function graphs, particularly in connection with embedded functions. Many students, including this one, neglected to retain a single function on the higher level for the entire length of the embedded key (mm. 3-4, 5-6). Another common error was a too slavish translation of the roots into functions without taking into account the context (example: a D minor chord in this ritornello always coming out as a tonic function even when it was inverted and led to a strong dominant.) Occasionally, as in this student's case, an entire functional level was graphed when none seemed required.

Nevertheless, the benefit of dealing in concrete fashion with the whole concept of different levels of harmonic syntax far outweighed the cost of errors made in students' first attempts. "The most interesting thing about traditional harmony that this analysis has taught me must certainly be the interplay between higher and lower level

Example 4: Student analysis of ritornello of Example 3, showing higher-level root and function dimensions only.



function and how they affect the overall nature of the piece," wrote one student on his survey and his reaction, while seldom expressed so succinctly, was echoed on many other responses. One reason why this notion of harmonic abstraction went over so convincingly, I believe, is that students could put flesh on it without having to learn and accept any radically new analytical concept or jargon. Another reason is the sheer perceptibility of the graphs. Many students commented that the higher-level analyses were the ones that connected most usefully with their aural training: "The better you can hear the music (chord changes) the better off you are in making root and function graphs." Multi-level analysis, a concept more common in advanced theory courses, can be introduced through the back door, as it were, since dimensional technique depends only on the concepts and terminology that they have mastered in the course of traditional harmony. At the same time, the interpretative results affirm and give value to those concepts.

And it is perhaps not too early to expose undergraduates to the war between bottom-up and top-down perceptual perspectives, the general role of musical context, one of the most truculent issues in analysis. Although it may appear at first glance that the dimensional graph develops logically from the "data" of the textural and phenomenal analyses in the step-by-step procedure given above, I advised the students to be open to revising analyses because of how they hear the higher levels. In Example 3, calling the third beat of the second measure a D major triad when no D pitch is sounded depends on the sense of the chord in the D minor context and the instant recognition of the F-sharp as a local leading tone moving to a G minor triad immediately.[6] Similarly, the decision to characterize the entire fourth measure as a single D minor chord in the higher-level root dimension depends on the perception of the overall key of D minor outweighing the local function in F major. Yet, the arrival of tonic *function* waits until the third beat because of the melodic motion in the bass. Of course, contextual issues come up regularly in traditional harmonic analysis, too; what dimensional

[6]The choice between the named D triad and the alternative, F-sharp diminished, is academic here since both would have the same function indicated below. In harmonic rhythm, the crucial fact is that the chord changes; sometimes it doesn't matter exactly what it changes into.

graphing seems to encourage is more precise articulation of reasons for making analytical decisions. "I had previously understood that these issues existed and were utilized, however I did not have the vocabulary to quantify them."

Interpretation

The students' oral presentations tended to be long on technique and short on critical interpretation. Despite the simplicity of the interpretative hypotheses, only a few took that step back to view the graph as a whole. This suggests that more emphasis on reading "vertically" as well as horizontally is probably required during class discussions. Nevertheless, the few students who attempted interpretation applied the hypotheses fairly well. The independence hypothesis supplies particularly clear results in the conclusions of ritornello after ritornello, as the various dimensions, after having proceeded at varying speeds up to the last cadence, suddenly converge in their motion (see Example 3). In any case a teacher can use even rather innocuous student observations to begin the exploration and discussion of sophisticated critical points.

Example 3 can tell us something about the subtlety of Baroque phrasing in Handel's ritornello. The downbeat of m. 4 suddenly brings a convergence of half-note durations in four dimensions (two root and two function levels). This lowering of a kind of textural tension is confirmed immediately by a lowering of harmonic tension: the weak tonic function on the third beat, just enough to make the phrase barely articulate without undermining the essential Baroque motor rhythm that continues unabated in the texture/phenomenal graphs. The feature that catches the eye (and, we hope, the ear) is the prolonged subdominant function that subsides into the weak tonic. Thus the phrase is articulate in one sense but incomplete in another, since it lacks the complete syntax of subdominant-dominant-tonic. The next phrase, much longer, resumes that prolonged subdominant, but this time progresses to a prolonged dominant. Its resolution on the weak third beat recalls m. 4, but then confirms that resolution decisively with a much faster, complete syntax in which nearly all the dimensions converge in speed for the first time.

One student wrote, "The dimensional analyses makes the concept of musical tension much clearer and easier to understand." The control of musical tension in its various forms is a key theoretical issue, and these graphs can help to make its marvelous complexity real for students.

Some kinds of musical tension can be understood by direct inspection of the score. In this ritornello it is obvious that the faster motion is reserved for the end of the second phrase in a well-crafted, composed accelerando which comes to a halt at the end of the prolonged dominant. This feature is reflected in the texture/phenomenal graph. But students learned to read tensions and resolutions in the graphs that are not immediately available from the score: the greater number of longer durations at beginning and end, the convergence of dimensions at the final cadence, and the areas of greatest textural divergence—dimensions moving at different speeds—in the center.

One could ask students to notice how the ritornello, while increasing its tension in various ways, does so fluidly, without sudden dissonances or any other abrupt articulations. Could this be due to the gentle process of acceleration, spread over various dimensions, and perhaps as well to the principal harmonic functions invariably beginning on offbeats?

One could point out, and ask students to verify by hearing, that the two sixteenth-note scales in the violin (mm.7-8), identical save for the octave transposition, have different effects. The first is the locus of greatest tension by pure speed (hypothesis 1 above) while the second has greater tension of textural divergence and prolonged dominant function.

One could even teach that music theory can be logically rigorous at times: an embedded key, as in measures 5-6, must produce a tension of divergent motions if we assume that its harmonic function, deriving from its object, must be prolonged for the length of the embedded key. Thus the quarter-note functional changes throughout the embedded keys of G major and F major translate into a seven-beat higher-level subdominant function because G major and F major themselves have subdominant function in relation to D minor, the home tonic.[7] Thus secondary dominant regions

[7]Subdominant function comes from the fact that G major and F major represent tonicization of triads IV and III in a D minor context.

have a rhythmic effect, in addition to the harmonic, that is precisely quantifiable.

Conclusions

Such are some analytical possibilities arising from the dimensional analysis of a single ritornello. Despite its infancy, at least three pedagogical advantages of the dimensional technique seem compelling enough to try it in undergraduate teaching:

1) Dimensional analysis makes Piston's concept workable in class. Much of its technique is specific and objective, which undergraduates like, so teachers can substantiate the proclaimed importance of harmonic rhythm with directions, advice, and a full-blown method of studying it. Yet the more abstract dimensions, to say nothing of the analysis taken as a whole, allow for interpretations that can make every student graph a unique creation. Because of this, my students felt satisfaction and a sense of achievement in making these analyses of Handel ritornellos, and this was especially effective coming at the end of the year-long course. Harmonic rhythm could not only review all of the harmonic concepts they had learned, but could put them into practice and show them that all their labors could indeed bear fruit.

2) Dimensional analysis forces students to deal with musical texture with a thoroughness rarely found in harmonic theory. Students found density most interesting because it called to their attention the contrapuntal weave that created the rhythms they were studying. Example 3 is not the best demonstration of this, being a two-voice composition, but students who analyzed more fully orchestrated ritornellos found things to say about density patterns, particularly when Handel drops the bass voice altogether as he is wont. Texture is also behind any consideration of convergent rhythms among the dimensions, since it is the handling of the counterpoint that affects the perception of the more abstract levels.

3) Finally, dimensional analysis forces students to engage their own musical experiences of a piece in a multiplicity of ways which, if they were considered heretofore, were probably not considered together, as they might affect one another. The most prominent among these is the realization of harmony as a multi-level phenomenon.

Other pedagogical strategies will certainly be discovered by other teachers who try the method. One that comes to mind from the compositional point of view, rather than the analytical, is to have students analyze their own composed phrases and arrangements. This exercise may make more palpable some very practical issues, such as when to use root position and when to invert, how to choose chords for their function within the phrase, and how to construct the cadence for the desired rhythmic effect. Another possibility is the comparison of harmonic rhythm in different musical languages and styles.

In any event, harmonic rhythm need no longer be one of those principles introduced with appropriate gravity and fervor only to be given short shrift for lack of anything specific to say. Dimensional analysis gives teachers plenty to say and, I expect, all of us plenty to learn.