Journal of Music Theory Pedagogy

Volume Twenty-Two 2008

Journal of Music Theory Pedagogy

Volume Twenty-Two 2008

SCHOOL OF MUSIC
THE UNIVERSITY OF OKLAHOMA

JOURNAL OF MUSIC THEORY PEDAGOGY

EDITORIAL & BUSINESS OFFICE

Journal of Music Theory Pedagogy
School of Music
University of Oklahoma
Norman, OK 73019

SUBSCRIPTION RATE *(1 issue/yr.)*

Individual	$35.00
Student/Emeritus	$15.00
Library/Institution	$40.00

(International: $5.00 additional)

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The Gail Boyd de Stwolinski Center
for Music Theory Pedagogy
James H. Faulconer, Director

ISSN 0891-7639

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Volume 22

In Memoriam

Bruce Benward

June 29, 1921 - September 15, 2007

The Bruce Benward Student Analysis Competition

Call for Papers

In honor of the life and work of the late Dr. Bruce Benward, the Gail Boyd de Stwolinski Center for Music Theory Pedagogy (University of Oklahoma) and the *Journal of Music Theory Pedagogy* are pleased to accept, for prize and publication, the submission of outstanding unpublished graduate student papers and articles related to any aspect of music analysis or music theory pedagogy.

Entries will be rated by a distinguished panel of judges appointed by the Editorial Review Board of the *Journal of Music Theory Pedagogy*, and results announced in April of 2009. Up to three entries adjudicated to be of the highest scholarship and originality may receive publication in vol. 23 (2009) of the *Journal of Music Theory Pedagogy* plus awards of $1,000, $750, or $500 for 1st, 2nd, and 3rd place winners respectively. Should the top submissions be judged to be of equal merit, the prize may be distributed in like amounts of $750 with no ranking. The panel reserves the right to award no prize, or contract for publication, if submissions are of insufficient depth, scholarship, or imagination.

In 1986 in cooperation with the de Stwolinski Center, Bruce Benward sponsored a similar competition with the winning papers receiving publication in the first issue of the *Journal of Music Theory Pedagogy*. In the following years Dr. Benward often expressed his hope that the competition would be repeated. The board of the Gail Boyd de Stwolinski Center and the editorial staff of *JMTP* are pleased, in thankfulness for Bruce Benward's life and work, to honor his wish.

Submissions may not exceed 35,000 characters (with spaces) plus four pages (4x6″) of graphics. Entries, postmarked by February 1, 2009, must be prepared and submitted according the *JMTP* contributor's guidelines at http://music.ou.edu/publications/jmtp/contributors.html. Five copies of each submission should be typed double-spaced on 8.5 x 11″ paper with one-inch margins and mailed to:

Journal of Music Theory Pedagogy
Bruce Benward Student Analysis Competition
Carnegie Building 100
University of Oklahoma
Norman, OK 73019

The Liability of Labels

Mary H. Wennerstrom

It is a great honor for me to have been awarded the 2006 Gail Boyd de Stwolinski Prize for Lifetime Achievement in Music Theory Teaching and Scholarship, and I am deeply appreciative of all those people who participated in the nomination and selection process. I am especially grateful to Mary Arlin, Chair of the Editorial Review Board of the *Journal of Music Theory Pedagogy*, for her work, including her presentation to me of an elaborate framed certificate at the 2006 meeting of the Society for Music Theory, and for her efforts to include the announcement in the general business meeting of the Society. As described in Volume 21 of this journal, the prize was established by Gail and her husband Louis de Stwolinski to recognize the role of the classroom music theory teacher. I was very pleased to be recognized as the fourth recipient of the award, and hope that my prize money will continue to be used to recognize outstanding teaching.

As part of the de Stwolinski Prize, I was asked to participate in a residency at the University of Oklahoma in September 2007. During that time the music theory faculty were exceptionally hospitable to me, and I visited classes and was part of a teaching master class session. James Faulconer and Alice Lanning from the Gail Boyd de Stwolinski Center for Music Theory Pedagogy were also very gracious in showing me the newly renovated offices of the Center (including the *JMTP* archives) and in arranging an enjoyable dinner with Mr. de Stwolinski. I had met Gail in the 1970's, when I was a visiting faculty member at the University of Oklahoma, and we had many conversations about the role of the music theorist in the academic community. Professor de Stwolinski's efforts to recognize outstanding teaching in the university (instead of an exclusive emphasis on faculty research) have been validated at many schools around the country, where tenure and promotion can be achieved through strong teaching, and pedagogical publications and curriculum designs are recognized as important scholarly contributions. This residency as part of the de Stwolinski award was indeed an honor and a pleasure.

Another part of the residency was a public presentation. As I thought about a topic for this presentation, I decided to focus on an issue of importance to both Gail and me: formal design in music and the parameters which contribute to musical structure. De Stwolinski's book, *Form and Content in Instrumental Music*,[1] emphasizes beginning a study of form by listening, and she incorporates in the book not only a wide variety of musical repertoire (including much twentieth-century music) but also good strategies for aural analysis. I also considered the pedagogical work of the previous winners of the de Stwolinski Prize: John Buccheri, who is well known for his workshops on teaching rhythmic concepts, Robert Gauldin, who among his many publications has written a comprehensive textbook[2] which includes formal designs in tonal music, and Dorothy Payne, whose widely-used book *Tonal Harmony with an Introduction to Twentieth-Century Music*[3] written with Stefan Kostka appeared in a sixth edition in the spring of 2008. I decided to choose a short composition analyzed in the de Stwolinski book, Beethoven's Bagatelle op. 119 no. 5 (see Example 1), and to focus on two aspects: the metric/rhythmic structure and the overall formal design. My goals were to do an informal survey of how groups of listeners respond to these two aspects, to highlight the labels given by different authors in each of these two parameters, and to suggest ways of using this information in the classroom.

Beethoven Bagatelle Op. 119 No. 5 (Risoluto): Listening results

This bagatelle is one of a group of eleven that Beethoven sketched at various times during his life and published between 1821 and 1823. I first played the composition (measures 1-16 only, with repeats) at around ♩. = 50, and second played a performance by Rudolf Serkin (♩. = c. 92). My questions to the listeners in Oklahoma (before they received a copy of the score) were (1) Is the piece in major or minor mode? (2) Is it in duple or triple meter? and (3) Is it in binary or ternary form? This listening exercise was repeated in October 2007 with a group of music theory faculty and graduate students at Indiana University.

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[1] Gail de Stwolinski, *Form and Content in Instrumental Music* (Dubuque, Iowa: Wm. C. Brown, 1977).

[2] Robert Gauldin, *Harmonic Practice in Tonal Music*, 2nd edition (New York: W.W. Norton, 2004).

[3] Stefan Kostka and Dorothy Payne, *Tonal Harmony with an Introduction to Twentieth-Century Music*, 6th edition (Boston, MA: McGraw Hill, 2009).

Example 1. Beethoven Bagatelle op. 119 no. 5

Not surprisingly, both groups unanimously identified the mode as minor. In this composition the answer is unambiguous aurally and visually because of the C minor triad presented both harmonically and melodically at the outset and confirmed in a strong cadence in measures 15-16 (and later in a C minor emphasis from measures 21-26). The results about meter and form however were considerably more mixed. At Oklahoma a majority of listeners identified the meter as triple at the slower speed; at the faster speed about half thought it was triple. At Indiana the vote at the slower speed was almost 70% for triple meter as contrasted to almost 75% for duple meter at the faster speed. The Oklahoma listeners were split almost equally between binary and ternary form on both hearings. Almost 90% of the Indiana listeners identified the form as binary at both speeds.

Duple versus triple: metric aspects

Even a quick review of the literature on rhythm and meter reveals evidence to support a metric classification of the Beethoven excerpt as both duple and triple. The points below are summarized from correspondence and discussions with John Buccheri:[4]

1. Compound and simple are not useful terms and should be eliminated from the basic vocabulary of rhythmic terms.
2. "Tempo is the chief determinant of the pulse that will be chosen as the beat, not the time signature notation appearing in the score." Tempo does not determine the type of meter, but does determine the rhythmic/metric character of the music.
3. Duple and triple are the two basic (most common) types of meter. "A metric structure with any grouping of three's in it is triple."
4. Meter signatures cannot be determined by listening.

By these guidelines the Beethoven example is in triple meter, regardless of its tempo, because of the groupings in three at the eighth-note level. Buccheri does not use the terms "compound" and "simple" in his discussion of meter and rhythm because he thinks they are confusing terms.

Edwin Gordon would agree. His example of "usual triple meter" (see Example 2[5]) includes the rhythmic patterns of the melodic lines in the Beethoven Bagatelle. Gordon indicates microbeats (the

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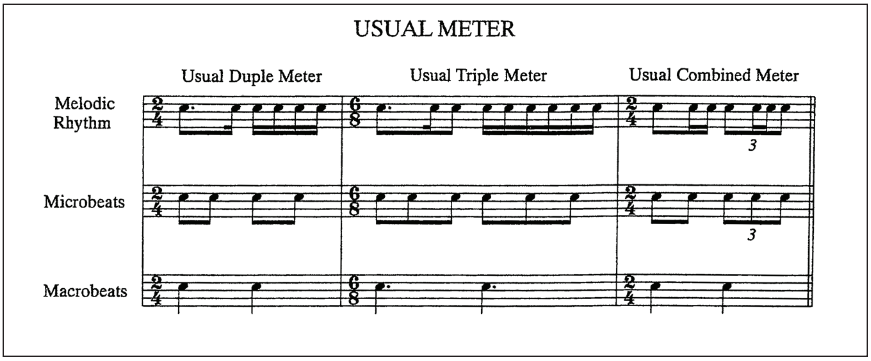
[4] John Buccheri, Notes from the author for a Workshop in Teaching Rhythmic Concepts in Undergraduate Music Theory and for presentations to music theory societies and the College Music Society.

[5] Edwin E. Gordon, *Learning Sequences in Music: Skill, Content, and Patterns* (Chicago: GIA Publications, Inc, 1993), 145.



Example 2. Edwin Gordon, Usual Meter

eighth note) and macrobeats (the dotted quarter) as part of a triple meter configuration. "The type of usual meter of a piece of music is not determined by how 'notes' are grouped in a measure, but rather, how macrobeats are divided into microbeats regardless of the measure signature."[6]

Justin London's book *Hearing in Time: Psychological Aspects of Musical Meter*[7] documents some reasons why listeners changed their opinion from triple to duple meter as the tempo increased. The two speeds at which I played the Beethoven example correspond to the metric trees at various tempos given by London in Figure 2.6 on page 44. His first (a) tree shows a tactus of 50 beats per minute, and his second (b) tree shows a tactus of 92 beats per minute, the two speeds of my demonstration. London comments that the trees demonstrate that at the slower speed there are more possibilities for subdivision and at the faster speed more possibilities for higher levels of meter. Listeners have demonstrated a preferred level of periodicity at speeds which include ♩. = 92 as the tactus; if the dotted quarter is the unit of measurement, its recurrent groupings in twos (within the measure and by two and four measures) create a duple meter, with one level of triplet subdivision. At the slower tempo the eighth note becomes a possible tactus, and its triple grouping thus suggests triple meter.[8]

[6] Gordon, 143 (presented in bold type).

[7] Justin London, *Hearing in Time: Psychological Aspects of Musical Meter* (New York: Oxford University Press, 2004).

[8] At this slower tempo both the speed of the eighth note (150 per minute) and the speed of the dotted quarter (50 per minute) are not in what London identifies as "the range of maximal pulse salience." "We are biased against triple meters (and to a lesser extent, triplet

Thus the question "Is this example in duple or triple meter?" depends on many factors, including the tempo, the definition of meter, and more importantly, the level of pulse (or beat) to which the listener is responding. In a classroom setting, a teacher might perhaps more profitably explore the following questions:

1. Tap what you hear as a regular recurring pulse.
2. How many pulses group together into bigger units?
3. Is the pulse you are tapping able to be subdivided? If so, into how many units?
4. Make (at least) a three-level diagram of pulse relationships (groupings). Indicate whether each level is duple (grouped in two) or triple (grouped in three) as related to the next slower level.

This process is described by Gary Karpinski in his book *Aural Skills Acquisition: The Development of Listening, Reading, and Performing Skills in College-Level Musicians*[9]. On page 21 he demonstrates three common responses to the request to "clap steadily" along with the music. (See Example 3). Karpinski suggests a protonotation system of vertical lines to represent pulses.

Example 2.1. Beethoven, Symphony No. 7, mmt. 2, mm. 3–10, three common responses to the request to "clap steadily" along with the music.

Example 3. Karpinski's Example 2.1 from *Aural Skills Acquisition: The Development of Listening, Reading, and Performing Skills in College-Level Musicians*, page 21

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subdivision) simply because there are fewer ternary options that lie comfortably within the range of maximal pulse salience." London, 46.

[9] Gary Karpinski, *Aural Skills Acquisition: The Development of Listening, Reading, and Performing Skills in College-Level Musicians* (Oxford and New York: Oxford University Press, 2000).

Karpinski rightly reminds the teacher that each of the three levels of response from students is correct, and that unfortunately aural skills textbooks most often do not "isolate meter perception as a separate fundamental skill."[10] Metric structure is usually defined as dependent on regular groupings by greater or lesser stress in at least two adjacent levels of pulse, but the aural results of these groupings are often not discussed in musical contexts. Karpinski summarizes:

> "[M]usic that exhibits . . . regular differentiation into primary and secondary pulses has *meter*." "Any relationship between two adjacent levels of pulse is either duple or triple at its simplest; otherwise, there is an intervening level that divides that larger number into some combination of twos and/or threes."[11]

As Karpinski indicates in a footnote on page 21, his pedagogical approach to meter is based on theoretical notions by several different authors. The system of dots presented by Lerdahl and Jackendoff shown in Example 4 relates exactly to the listeners' perception of the two different metric organizations of the Beethoven Bagatelle. At the slower speed, the metric organization is 2/3/2 (version a in Example 4, although the example uses the notation of eighth/quarter/dotted half instead of the bagatelle's notation of sixteenth/eighth/dotted quarter); at the faster speed the metric organization is 3/2/2 (version b in Example 4 on the following page).[12]

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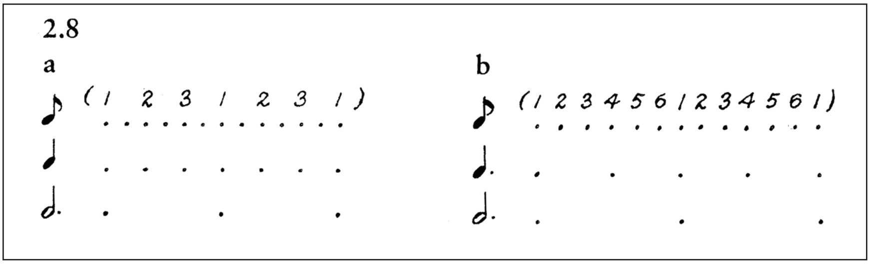
[10] Karpinski, 23.

[11] Karpinski, 22, 24.

[12] Fred Lerdahl and Ray Jackendoff, *A Generative Theory of Tonal Music* (Cambridge, MA: The MIT Press, 1983), 20. Note that Lerdahl and Jackendoff use "beat" to mean what Karpinski refers to as "pulse": "For beats to be strong or weak there must exist a *metrical hierarchy*—two or more levels of beats." (Lerdahl and Jackendoff, page 19). The duration between beats is a "time-span": what Karpinski calls "beats " (Karpinski page 23).



Example 4. Lerdahl and Jackendoff, *A Generative Theory of Tonal Music* Example 2.8 page 20

This discussion has avoided the widely-used terms simple and compound, to which Buccheri objects. These labels of course can be useful in describing the relationship between two adjacent levels of a metric hierarchy, but not in describing all the levels. As related to metric perception in the Beethoven Bagatelle, the meter is simple triple if the pulse is considered as the eighth note: divided in two and grouped in three. The meter is compound duple if the pulse is considered as the dotted quarter note: divided into three and grouped in two.[13] Miscommunication can occur if a label indicating a metric type is based on consideration of different pairs of adjacent levels.

A more complete metric description of the Beethoven Bagatelle would include several levels. 2/3/2/2/2 indicates the groupings of sixteenths, eighths, dotted quarters, measures, and subphrases. In contrast the Beethoven Symphony no. 7 excerpt (Example 3; Karpinski's Example 2.1) could be labeled as 2/2/2/2/2, indicating groupings of eighths, quarters, half notes, subphrases, and phrases. Although "duple meter" is an accurate description of the symphony excerpt, no matter which adjacent levels are chosen, the label "triple meter" for the bagatelle (unless used to indicate a three-grouping at any hierarchical level) can be potentially confusing.

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[13] My colleague Frank Samarotto reminded me of the 18th-century definition of "compound meter" (for instance in writings by Kirnberger and Marpurg), which could mean combining two measures of simple ("einfache") meter together ("zusammengesetzte") . In this definition both 4/4 (two measures of 2/4 combined) and 6/8 (two measures of 3/8 combined) could be regarded as "compound," a use of the term different from its meaning of a triple subdivision of the pulse or beat.

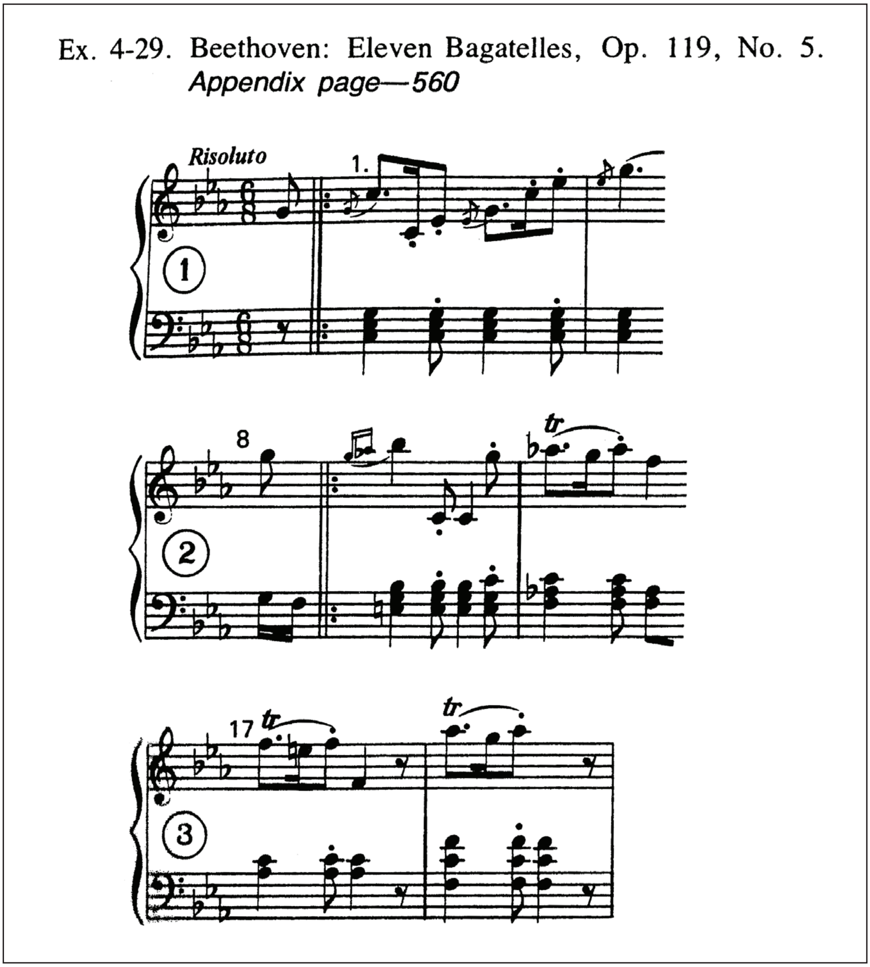
Binary versus ternary: formal aspects

The confusion of two and three is also evident in the formal design of the Beethoven Bagatelle. I concentrated on measures 1-16 because this section illustrates a pattern common in tonal music: two sections, each repeated, with a return of some aspects of the first section in the second section. De Stwolinski includes the bagatelle in her chapter on Part Forms (Ternary). To her this example is ternary because it has an A B A′ design.[14] She suggests listening to the piece by following the musical segments she gives on pages 226-227 (see Example 5 on the following page) and by plotting out a form diagram, considering the "arrangement, content, and apparent purpose of a musical idea. . . . After three to five listenings to a work, the analysis should reveal the following structural information: (1) the number and arrangements of parts; (2) the number of phrases within each part; (3) any use of auxiliary members [such as introduction, retransition, transition, and codetta]."[15] Students are then referred to the Appendix to check their work against the diagrams she provides; see Example 6 on the following page.[16]

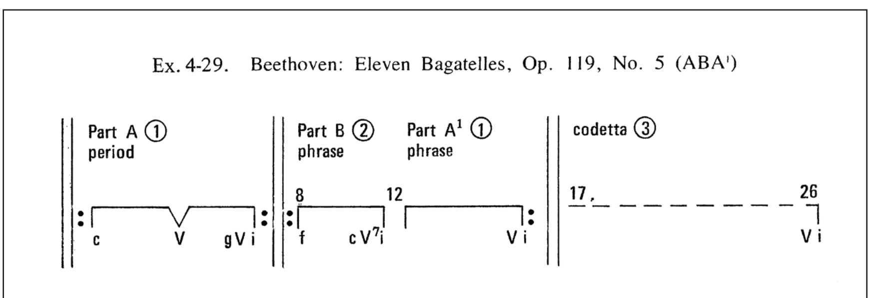
[14] See de Stwolinski, *Form and Content in Instrumental Music*, Chapter 4, Part Forms. On page 193, footnote 2, she indicates that the terms "rounded binary" and "incipient three-part form" are not used in her discussion. Binary form is discussed after ternary, as an AB pattern (two-part) with no return of material.

[15] de Stwolinski, 225.

[16] On pages 226-227 de Stwolinski provides for the listener musical cues from the Beethoven Bagatelle; she includes detailed diagrams for all the listening examples in an appendix. The Beethoven diagram on page 560 indicates an A B A′ form and shows that Part A is a period (divided by a half-cadence and ending with an authentic cadence in G minor) while Parts B and A′ are each phrases, ending with authentic cadences in C minor. Musical cue no. 3 functions as a codetta.



Example 5. de Stwolinski, Beethoven op. 119 no. 5 Musical segments, pages 226-227



Example 6. de Stwolinski, Beethoven op. 119 no. 5 Form diagram from Appendix, page 560

In giving this work a ternary label, de Stwolinski is following the exact model described by Arnold Schoenberg in *Fundamentals of Musical Composition*. In Part II, on Small Forms, Schoenberg describes the Small Ternary Form (A-B-A'):

> THE SMALL TERNARY FORM
>
> "The A-section of the A-B-A' form may be a sentence or a period, ending on I, V, or ~~III~~ (iii) in major; on i, III, V, or v in minor. The beginning, at least, should clearly express the tonality, because of the contrast to follow.
>
> The A'-section, the recapitulation, ends on the tonic if it completes an independent piece. It is seldom an unchanged repetition. The final cadence generally differs from that of the first section, even if both lead to the same degree.
>
> THE CONTRASTING MIDDLE SECTION
>
> The most effective factor in a contrasting section is the harmony. The A-section establishes a tonic; the B-section contraposes another region (one of the more closely related). This provides both contrast and coherence.
>
> Further coherence is furnished by the metre, and by using forms of the basic motive which are not too remote from those of the A-section.
>
> Further contrast can be achieved through the use of new variations of the basic motive, or change in the order of previous motive-forms."[17]

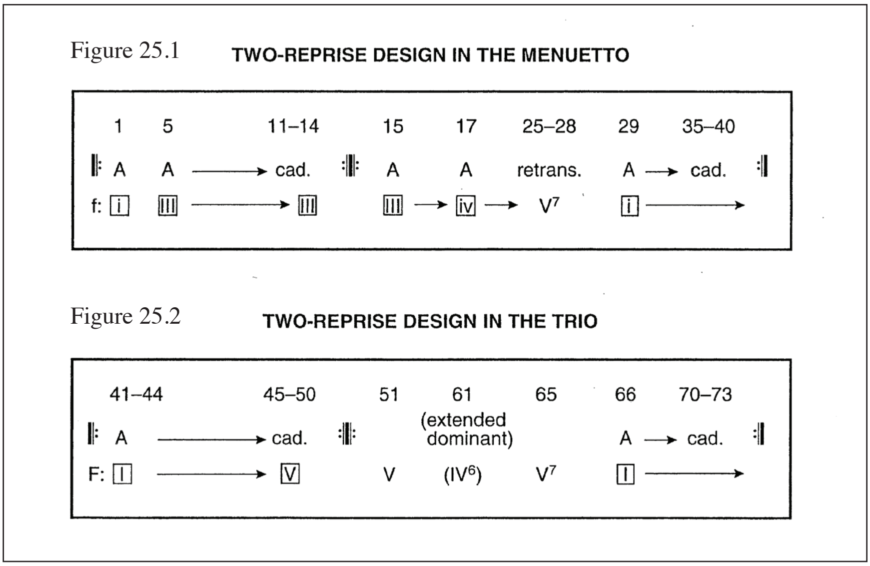
This description matches perfectly the musical processes of the Beethoven Bagatelle in measures 1-16. William Caplin, in *Classical Form: A Theory of Formal Functions for the Instrumental Music of Haydn, Mozart, and Beethoven*[18] adopts Schoenberg's terminology for pieces such as the bagatelle; he also emphasizes three main formal sections,

[17] Arnold Schoenberg, *Fundamentals of Musical Composition* ed. Gerald Strang and Leonard Stein (London: Faber and Faber, 1967), 119-120.

[18] William E. Caplin, *Classical Form: A Theory of Formal Functions for the Instrumental Music of Haydn, Mozart, and Beethoven* (Oxford and New York: Oxford University Press, 1998). See Chapter 6, Small Ternary (71-86) and his summary of three-part versus two-part labels in various writings in Note 1 to Chapter 6 (267-268).

expressing the functions of exposition (A), contrasting middle (B), and recapitulation (A′). Listeners in Oklahoma who identified the form as ternary pointed out the strong sense of return (in measure 13) which created a third part—a restatement of the opening material after a departure in measures 9-12 (although many elements of these measures are similar to those in measures 1-8).

Many currently-used music theory textbooks label this formal design as rounded binary, and emphasize the two-part nature of the form. Robert Gauldin's detailed analysis of the Menuetto and Trio from Beethoven's Piano Sonata op. 2 no. 1, includes diagrams of the two-reprise design of both sections of the movement (see Example 7).[19]



Example 7. Robert Gauldin, *Harmonic Practice in Tonal Music*, 2nd ed. Beethoven Piano Sonata op. 2 no. 1, Movement III. Two-reprise forms (rounded binary) in the Menuetto and Trio. Figures 25.1 and 25.2, page 455

[19] Robert Gauldin, *Harmonic Practice in Tonal Music*, 2nd ed. (New York: W.W. Norton, 2004), 455. See his detailed comments about this movement on pages 453-467, guiding the teacher and student from an overview into a progressively more focused study of tonality and motivic development, and Gauldin's descriptions of various types of "Simple Forms" in the preceding chapter (pages 426-452).

Steven Laitz, among other recent textbook authors, offers a comparison of ternary form and rounded binary form (see Example 8).[20] For these authors, the middle section of the Beethoven Bagatelle is more of a digression than a contrast. The two-part structure indicated by the repeat signs and the shortened return of A point more strongly to a binary design rather than a ternary one. The Indiana listeners, familiar with teaching this pattern as a "rounded binary form," overwhelmingly chose binary over ternary as a label for the form of the Beethoven example.

Kostka/Payne's *Tonal Harmony* is less consistent in its labeling of formal designs. Example 9 on the following page is a compilation of descriptions from the text of three different musical excerpts, all with two repeated sections, as indicated by the label "two-reprise."[21] In each case the first section is shorter and the second section returns some or all of the elements of the first section. The text's terminology includes the common

EXAMPLE 31.1

A. Ternary form

A	B	A or (A′)
° original material	° contrasting material	° literal repetition of A (or altered restatement, labeled A′)
° original key	° contrasting key: (major mode: IV, vi, iv, ♭VI, i) (minor mode: III, iv, VI, I)	° original key

B. Rounded binary form

‖: a :‖	‖: digression a′ :‖
° in one key I -- V //	I ------------------------------ V I

Example 8. Steven C. Laitz, *The Complete Musician, an integrated approach to tonal theory, analysis, and listening*, 2nd ed. Example 31.1, page 702

[20] Steven E. Laitz, *The Complete Musician, an integrated approach to tonal theory, analysis, and listening*, 2nd ed. (Oxford and New York: Oxford University Press, 2008), 702.

[21] Stefan Kostka and Dorothy Payne, *Tonal Harmony with an Introduction to Twentieth-Century Music*, 5th ed. (Boston, MA: McGraw Hill, 2004), 326-330.

distinction between continuous and sectional, indicating whether the structural cadence at the end of the first large section is open (not on tonic) or closed (on tonic). However, the binary or ternary labels depend on how much of the first section is returned. In Example 9A and 9B the restatement of the first section (in both cases somewhat varied) is as long as, or longer than, the first A section, leading to a ternary classification: two-reprise continuous ternary and two-reprise sectional ternary, depending on the cadences at the end of the A section. Example 9C on the other hand is a two-reprise sectional rounded binary form, presumably because the A section is not restated completely. Based on these examples, the Beethoven Bagatelle would probably be described by Kostka/Payne as a two-reprise continuous rounded binary form.

A. Ternary form: Two-reprise continuous ternary: Haydn Sonata No. 11, III, Minuet (p. 326-327)

	‖:	:‖:		:‖
	A	B	A	
	m. 1-8	9-16	17-24	
G:	I HC	HC	I PAC	

B. Two-reprise sectional ternary: Haydn, Sonata No. 11, III, Trio (p. 327-328)

	‖:	:‖:		:‖
	A	B	A	
	m. 1-10	11-19	20-31	
e:	i PAC	III PAC	i PAC	

C. Rounded binary: Two-reprise sectional rounded binary form: Mozart Sonata K. 331, I, Theme (p. 330)

	‖:	:‖:		:‖
	A	B	½ A	
	m. 1-8	9-12	13-18	
AM:	I PAC	I HC	I PAC	

Example 9. Stefan Kostka and Dorothy Payne, *Tonal Harmony with an Introduction to Twentieth-Century Music*, 5th ed. Summaries of formal discussions on pages 326-330, Examples 20-3, 20-4, and 20-7.

Clearly this common musical design has aspects of both binary and ternary patterns, depending on which musical elements are considered most structural. Rather than arguing about the label attached to a particular formal design, teachers could more productively help students to develop a list of questions to consider in a discussion of form of any musical composition. These questions might include: (1) Where are the most important divisions (cadences) of the work? (2) What musical elements characterize these places of division? Consider not only harmony and tonality, but all musical parameters (rhythm, dynamics, register, texture, etc.). (3) What creates musical contrast in the composition? Where does this contrast occur? (4) Is any material restated in the composition? If so, where? Does this restatement occur as a recognizable return of the opening material, or of other parts of the work? (5) Make a diagram of the work, including measure numbers, main divisions (include key areas and types of cadences, if relevant), and letters indicating relationships of sections or phrases (if relevant). (6) Examine the diagram and discuss the design or designs created, including the balance of sections.

For instance in the design of the Beethoven Bagatelle measures 1-16:

> What musical elements create a binary (two-part) design in this composition? Answers to this question could include: (a) the division into two equal parts by repeat signs (b) the lack of a strong rhythmic, textural, or tonal contrast at the beginning of the second large section (c) the strong cadences in measures 7-8 and 15-16 and (d) the identical rhythmic and melodic material of the cadential measure 8 (in the dominant minor) and measure 16 (in the tonic).
>
> What musical elements create a ternary (three-part) design? Answers to this question could include (a) the strong feeling of return in measures 13-14 of measures 1-2 (probably set off in performance by phrase articulations as indicated by Beethoven, separating the tonic chord ending in measure 12 from the tonic chord beginning in measure 13) and (b) the somewhat new material of measures 9-12, presenting a more disjunct melodic line, a wider melodic range, and a two-measure sequential pattern (de Stwolinski indicates that measure 9 begins in a new tonal area of f minor).

How do the lengths of sections relate to each other? The first section includes two four-measure phrases in a parallel modulating period relationship (m. 1-4, 5-8); the second section includes two four-measure phrases in a contrasting relationship. The simple diagram below is similar to the elements highlighted by de Stwolinski:

	a	a′	b		a″	
Measures	1 -4	5 - 8	9 -	12	13 -	16
c:	i----V	i -----v	(iv)	i	i---------i	
		(g: V-i)				(c: V-i)
	4	4	4		4	

Beyond labels: the individual musical composition

This discussion of meter and form has concentrated on only measures 1-16 because this part of the composition is the one which falls most recognizably into regular phrase groupings and into the formal pattern generally referenced as either "small ternary" or "rounded binary." After I played measures 1-16 at the two different tempos for the Oklahoma and Indiana listeners, we heard the complete composition. Several interesting events occur in measures 17-26 which challenge the predictability of the rest of the short composition. Measures 17-18 recall the F minor emphasis of measures 9-10, while restating the octave-leap cadential pattern of measures 8 and 16. Measures 20-23 restate measures 11-12 up an octave and then in the same register, and add three more measures to confirm the tonic cadence. The regular metric grouping is disturbed by the silence in measure 19, by the seven-measure length of the section from measures 20-26, and by the sforzando markings in measures 22-24. De Stwolinski refers to this section as a "codetta;" one could also see this as an expansion of the "b" phrase of measures 9-12, giving an overall formal pattern of:

a	a′	b	a″	b′
4	4	4	4	10
repeated		repeated		

Additional questions about this complete composition which might stimulate discussion in a class include:[22]

1. Measure 14 is the only measure in the piece which uses a regular pattern of three eighth notes. Why does this measure sound rhythmically less, instead of more, regular than the rest of the composition?

(The surface eighth-note pattern is not synchronized with the harmonic rhythm of this measure, which creates a hemiola pattern of three quarter notes.)

2. Measures 17-26 don't follow the four-measure groupings of measures 1-16. How are they grouped? How does this grouping contribute to suspense and closure?

(There are various possibilities for grouping within these ten measures, such as

[3-2-2-1-2], [2-1-2-2-3], or [5-5, based on an expansion of the four-measure phrase in measures 9-12]. Suspense is created by the silence in measure 19 and the unpredictability of the cadential extension in measures 24-26. Closure is created not only by the repeated V-i harmonic pattern but also by the metric placement of the final octave C: the first time in the composition that this octave leap has ended on the first beat of a measure.)

3. How do you think the composition is designed in terms of tension and relaxation? Where is the climax (point of greatest tension)? What musical elements contribute to these patterns?

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[22] Questions such as these are similar to those in the stimulating and thought-provoking section on Musical Analysis in Michael Rogers's book *Teaching Approaches in Music Theory: An Overview of Pedagogical Philosophies*, 2nd ed. (Carbondale, IL: Southern Illinois University Press, 2004), particularly Stage 6 at the end of Chapter 4, pages 93-99. The questions and discussions of the purpose of the questions that he presents are very useful guides both for teachers in the classroom and for students in music theory pedagogy classes, as they work to structure a meaningful discussion about a musical composition. I often ask pedagogy students to write their own questions based on a musical excerpt, to give possible answers to the question, and to discuss the purpose of the questions. De Stwolinski also suggests similar questions in her assignments at the end of the chapter on part forms (pages 235-236).

(One possible design is: presentation (m. 1-8), some tension (m. 9-12), return/relaxation (m. 13-16), climax/most tension/ conclusion (m. 17-26)[point of greatest tension in m. 19-20], based on the musical elements already discussed.)

This article has focused on one short piece to try to raise several issues which might be helpful to teachers of music theory. First, it is important to ask relevant questions about a specific musical composition. In the case of the Beethoven Bagatelle, my two-choice question about mode was relevant (although basic) and produced an unambiguous answer (which might not have been the case with another composition by Beethoven or a composition by Schubert written at the same time). However, my two-choice questions about meter and form were not unambiguous and should probably not come at the beginning of a discussion, or should not be asked at all. Too many students are anxious to immediately conclude "The form of this piece is A B A" without considering all musical elements.

Second, although some labels can be helpful in summarizing various structural aspects, students and teachers should be aware of the factors that underlie the labels and of the different labels that have been applied to the same structure. In some cases different labels are in fact trying to describe the same musical phenomenon. In the case of the Beethoven example, labels of type of meter (duple and triple) are both appropriate to the work (at least in some theorists' views), depending on tempo, perception of basic pulse, pulse groupings, and larger metric structure at the phrase level (hypermeter). Ternary and binary are also both appropriate in different ways as formal descriptions. To describe formal designs which combine two- and three-part patterns, authors of current texts employ terms such as rounded binary, balanced binary, ternary, small ternary, incipient ternary, and binary-ternary, combined with the modifiers two-reprise and sectional/continuous, in an often confusing attempt to create a relevant formal label for every type of piece.[23] These labels privilege different musical elements, which should be clearly identified by the teacher and student: two-

[23] William Caplin remarks that "One of the most vigorous debates in the history of theory concerns whether the simple form under consideration here [the small ternary form] (as well as its more expanded manifestation, the sonata) consists essentially of two or three parts." Caplin, *Classical Form*, 71.

reprise depends on a repeat pattern of the sections (does the formal design thus change if the sections aren't repeated in performance?); sectional/continuous depend on tonal goals at an important interior cadence; and the various binary and ternary labels depend on whether there is a return of opening material or of cadential material and, to some authors, on the length of the return.

Third, although more time-consuming in class and more ambiguous in an assignment and exam situation, analytical discussions which help students to think about important aspects of musical materials and structure and to justify their opinions are much more useful than simply applying terms. This understanding is the essence of informed performance, and students might perceive something very different from what the teacher has in mind.

The best teaching corrects wrong and unsubstantiated comments but challenges the student to think of different interpretations, to find what structural elements are common to other pieces of a particular genre or to other pieces written by the composer, and to uncover what aspects are unique to a particular composition. Labels can be liabilities if they are considered a final answer; they can also be the starting point of stimulating discussions in which the teacher and students are both learners.

Maximal Evenness as Conceptual Apparatus for a Course on Post-Tonal Theory and Analysis

ADAM RICCI

In "Music Theory's New Pedagogability," Richard Cohn observes that as recently as 25 years ago "the boundary between research and teaching at the introductory levels seemed inevitable and unbreachable…[and that]…we are at a somewhat different juncture now. A number of central concepts have emerged…that can be taught at the introductory level" (Cohn 1998, [3]). Among the central concepts that he mentions is Clough and Douthett's concept of maximal evenness. A maximally even set "is a set whose elements are distributed as evenly as possible around the chromatic circle" (Clough and Douthett 1991, 96). Each maximally even set is labeled ME(c,d), where c is the cardinality of the universe—in the case of the chromatic scale, 12—and d is the cardinality of the set contained within it. Timothy Johnson's textbook *Foundations of Diatonic Theory*, as if in answer to Cohn's call, puts maximal evenness front and center; indeed, Johnson himself acknowledges the connection in his Preface. As to the intended audience, the "material in this text was originally designed for use as a supplement in traditional Theory I courses, but…is equally appropriate for courses in the fundamentals of music…and for stand-alone courses [in]…mathematics and music" (Johnson 2003, vii). Maximal evenness can also profitably be used as a central concept for a course on twentieth-century music theory and analysis. In such a course, typically the final one in the undergraduate curriculum, students possess substantial music theory knowledge, and therefore maximal evenness can serve synthetic ends, as a means of consolidating (and expanding) what students already know. Such synthetic ends are appropriate in a course that often constitutes the conclusion of a student's formal training in music theory.

This paper will outline such a course, based on one that I teach at my own institution. In this course, instead of introducing theoretical concepts using musical examples, a typical strategy in required music theory courses, the focus is more on music theory—on exploring the underlying structure of the objects students have been studying and tasks students have been carrying out for the previous two years. What I offer here is a new way to organize the final course in the undergraduate theory curriculum, a way that suggests a different ordering and combination of topics—and manner of talking about topics—than that offered by current approaches. Central to the course is the concept of maximal evenness, but woven in are closely related ideas from neo-Riemannian theory and elementary combinatorial theory.

Using maximal evenness as a central concept has several benefits. First, it serves as a core idea about which students can integrate knowledge. The same sets are encountered in different contexts, each of which reveals a bit more about them.[1] Second, it fulfills a necessary component of what Ken Bain (2004, 100) terms a "natural critical learning environment": namely, "an intriguing question or problem" that students seek to answer/solve beginning with the first day of class. The intriguing problem is creating maximally even sets, then considering the ways in which they might be musically relevant. Third, since there is one and only one maximally even set-class of a particular cardinality, the family of maximally even sets is small.[2] Thus, these sets can serve as prototypes to which other sets may be related.[3] Fourth, maximal evenness can smooth the transition between familiar tonal objects—triads and 7th chords—and less familiar sets that are suited to both tonal and post-tonal environments.[4] Maximally even sets include both chords and scales, the difference between the two having to do with lesser or greater cardinality relative to the universe.

Maximally even sets can be expressed as pitch classes or durations, both of which will be explored in this paper. Part I. will outline the initial inquiry into maximal evenness, which proceeds by cardinality within the 12-pitch-class universe. Though Johnson proceeds similarly, the differences in my approach—including

[1] For a twentieth-century course, Rogers (2004, 73) argues "that some approach be chosen—that a rationale exists—so that a course…is bound together by a…governing philosophy that provides some bearings—and that students perceive what that philosophy is." For a different central concept, see Sallmen 2001.

[2] Maximally even sets can be conceived in a universe of any size, so the size of the family depends upon the size of the universe; in this paper, of course, the focus will be upon the 12-pitch-class universe, but I will also discuss some smaller universes that are musically relevant.

[3] Quinn 2006-07 argues for the prototypical status of ME sets.

[4] Mancini 1991 and Pople 2004 suggest some other ways to link set-theoretic concepts with tonal materials.

using students as pitch classes,[5] incorporating mode, and paving the way for pitch-class set theory—merit a brief synopsis. Because I will be discussing my interactions with students, the tone of Part I. will be somewhat informal. Part II. first explores maximal evenness in the 7-letter-name universe; second, through a comparison of sets in the diatonic and chromatic universes, illustrates a new method for teaching enharmonic modulation that has points of contact with recent neo-Riemannian theory; and third, studies maximal evenness in the rhythmic domain. Part III. discusses how, with the aid of elementary combinatorics, maximal evenness can be integrated with other set-theory topics typically covered in the twentieth-century theory course, including transpositional combination and transpositional and inversional symmetry.

I. The Initial Inquiry

The course begins with a determination of the maximally even (henceforth, ME) sets in the chromatic scale, proceeding by cardinality. I tell students we are going to conduct an experiment, and ask them to place 12 chairs in a circle.[6] As they arrange the chairs, I ask what significance the number 12 might have for our musical studies, and several students typically answer that there are 12 pitches in the chromatic scale. Next one student volunteer chooses a chair to sit on. I hand this individual a poster board with the letter "C" on it to hold up. This initial set illustrates the concept of a *trivial* ME set: there is only one way to create a one-element set, and it is *de facto* maximally even (Clough and Douthett 1991, 145).[7] I then ask a second student volunteer to take a seat as far away from the first individual and a third volunteer to choose the appropriate poster board from the pile to hand to this person (F♯/G♭). This second set is non-trivial because the second individual's position is strictly determined by where the first individual sits. Continuing

[5] Johnson instructs students to take pencil to paper, although he does use the dinner-table analogy at one point (pp. 13-14).

[6] At my own institution, I am fortunate to have a ready-made space, a large outdoor rotunda that contains 12 benches, each bench affixed in front of one of the 12 structural pillars supporting the organ hall above. Because the students are in the interior of the circle, they must continually turn around to visualize the sets, keeping them actively involved.

[7] Trivial ME sets include those of cardinality 0, 1, c–1 and c, where c is the size of the universe.

chronologically by cardinality, I ask the third student to take a seat such that each student has an equal amount of personal space. At this point, it becomes apparent that one or both seated students needs to move. Choosing the more efficient way, I say we should keep "C" in place. Once the other two students are correctly seated, another student hands the appropriate poster boards (E and G♯/ A♭) to them as F♯/G♭ is returned to the stockpile.

As we proceed by cardinality, I compile information for each set on a whiteboard, information that is later provided to students as a handout given as Example 1. Example 1a contains explanatory text, providing a "key" to the information in Examples 1b and 1c.

A maximally even set "is a set whose elements are distributed as evenly as possible around the chromatic circle" (Clough & Douthett 1991, 96).

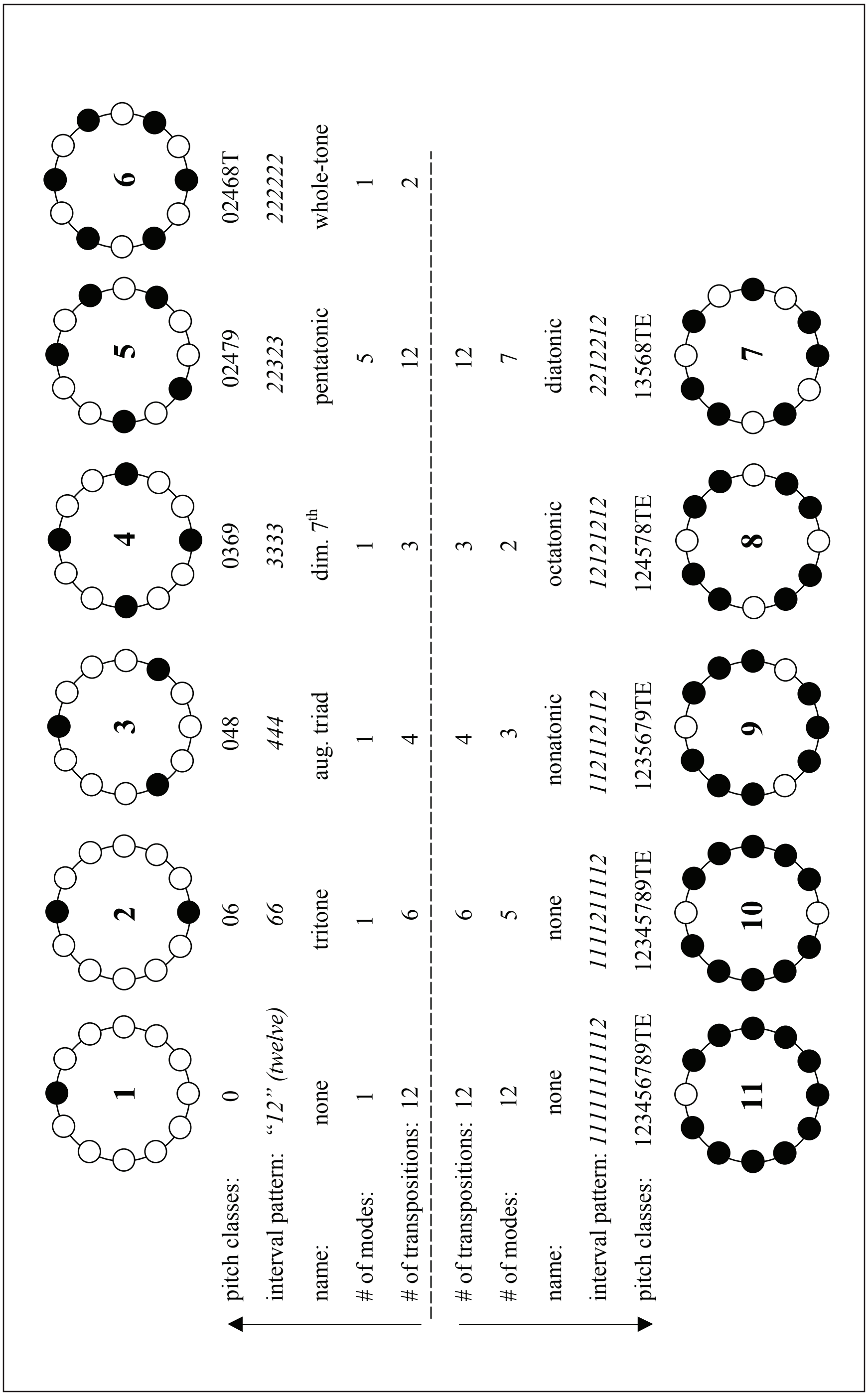
In Example 1b are all the maximally even (ME) sets in the chromatic scale, with the exception of the null set and the aggregate.

The cardinality of each set—the number of objects it contains—is indicated in the center of the circle. The filled circles indicate pitch classes in the set, and the unfilled circles indicate pitch classes omitted from the set.

Complementary ME sets are aligned vertically. ME(12,6)—the six-element ME set in the chromatic scale—is its own complement. Each remaining set is drawn so that filled and unfilled circles exchange places in complementary sets.

- pcs = pitch classes (the 12-o'clock position is "0")
- interval pattern = an ordered list of the distance between successive members of a set (0 = unison, 1 = half step, etc.)
- name = familiar name
- # of modes = the number of distinct rotations of *the interval pattern*
- The number of modes is equal to $\frac{s}{\gcd(c,s)}$, where
  - c = the number of chairs in the circle and
  - s = the number of students
  - gcd(c,s) = the greatest common divisor of c and s
- # of transpositions = the number of distinct rotations of *the seating position*
  - The number of transpositions of an ME set is the same as the number of transpositions of its complementary set
  - The number of transpositions is equal to $\frac{c}{\gcd(c,s)}$

Example 1a: Handout on maximal evenness: Explanatory text



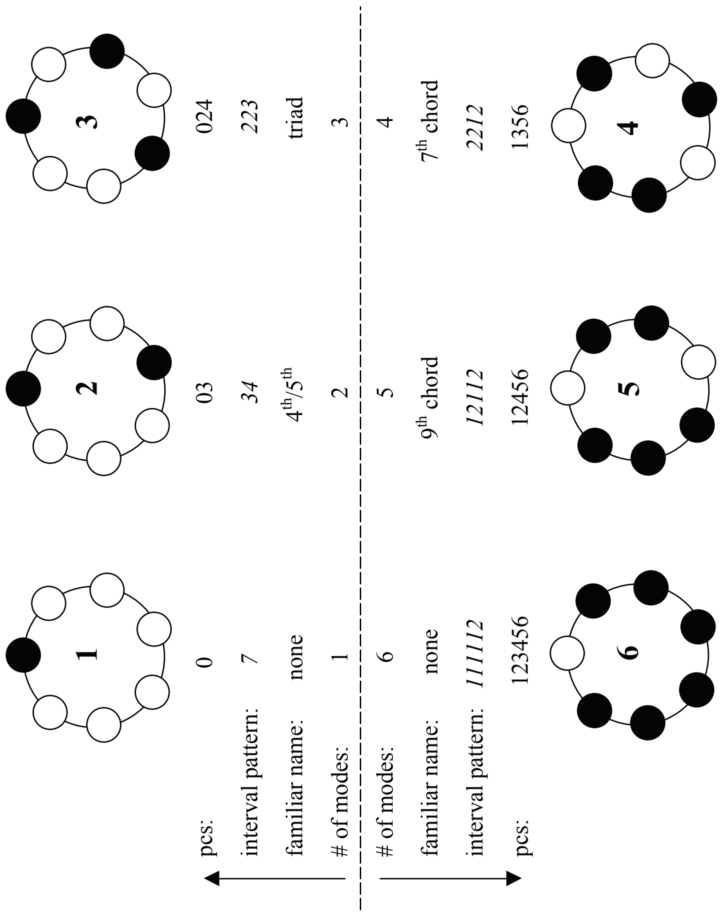
	1	2	3	4	5	6
pitch classes:	0	06	048	0369	02479	02468T
interval pattern:	*"12" (twelve)*	*66*	*444*	*3333*	*22323*	*222222*
name:	none	tritone	aug. triad	dim. 7th	pentatonic	whole-tone
# of modes:	1	1	1	1	5	1
# of transpositions:	12	6	4	3	12	2

	11	10	9	8	7
# of transpositions:	12	6	4	3	12
# of modes:	12	5	3	2	7
name:	none	none	nonatonic	octatonic	diatonic
interval pattern:	*11111111112*	*1111211112*	*112112112*	*12121212*	*2212212*
pitch classes:	123456789TE	12345789TE	1235679TE	124578TE	13568TE

Example 1b: Handout on maximal evenness: ME(12,n)

The number of transpositions of a ME(7,*s*) set is always 7, since the greatest common divisor of 7 and any other integer is 1. For this reason, this information is left out.

The number of modes of a ME(7,*s*) set is always *s* (i.e., the number of modes is equal to the cardinality of the set), for the same reason!



Example 1c: Handout on maximal evenness: ME(7,n)

In Example 1c are all the maximally even sets in the diatonic scale (again, with the exception of the null set and aggregate). All integers should be thought of in terms of seven total pcs, so, e.g., 024 = CEG.

First we list the pitch-class/name-class designations[8] given on the poster boards ("C", "C F♯/G♭", "C E G♯/A♭", etc.); second, the interval pattern for each set, measured by a student who traverses the spaces between seated students. In undertaking this measurement, the question naturally arises as to whether to count both, only one, or neither occupied chair in a pair. I suggest that it does not matter which way we count provided we are consistent. I remind the students that in tonal theory, we count both endpoints—what I call the "eight days a week" counting method (i.e., Monday-to-Monday equals an octave)—and tell them that in twentieth-century theory, we count only one endpoint, which makes interval addition easier. Thus, each interval is measured by starting behind an occupied chair and counting chair-to-chair "steps." The corresponding interval patterns for the first three sets are "12," "66," and "444."[9] Third, I ask students to determine both how many different rotations of the seating pattern there are and how many different vantage points there are from which to view the set—assuming one always stands behind an occupied chair. In order to count the different rotations of the seating pattern, the seated students all shift clockwise by one seat repeatedly until the same set of benches is occupied. In order to count the unique vantage points, one student walks around the circle reading off the interval pattern clockwise from each vantage point until they return to their starting point. I act merely as scribe, writing these patterns on the whiteboard; the number of unique interval patterns can then be counted by pruning duplicates.

I also ask what the familiar name of these two procedures are—"transposition" usually comes fairly easily; "mode" usually does not. Rather than supply the term right away, I continue to say "different vantage points" or "distinct rotations of the interval

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[8] Brinkman 1986 defines "name class" and outlines a representation of letter-name-plus-accidental labels in terms of a pair of integers, one representing the pitch class and one representing the letter-name class. Harrison 2002 calls such labels "notational tokens" for a particular pitch class.

[9] Rather than inserting commas between each interval, I clarify that "12" means "twelve" and not "one, two," the only case in which this potential ambiguity arises.

pattern" until the second class day to allow the students to furnish the term on their own and to teach them the benefit of terminology. At some point in the exploration, after some arguments about the spelling of particular pitch classes arise, I suggest that it might be handy to use a labeling system that does not require us to choose particular spellings, at which point I ask the seated students to turn over their poster boards, revealing integer labels. I continue to represent sets with letter names and accidentals as well, however, for the sake of familiarity (for reasons of space, these labels are omitted from the handout). Finally, I ask if any students recognize each set—whether it has a familiar name.

Like ME(12,2) and ME(12,3), ME(12,4) equally divides the chromatic; such sets are Clough and Douthett's Class A ME sets, whose interval patterns contain only one interval size. The three classes and their characteristics are given in Example 2.[10]

Class	Clough & Douthett (1991, 97)	Sample interval patterns	Cardinality
A	gcd(c,s) = s, s ≠ 1	xx, xxx, etc.	all possible
B	1 < gcd(c,s) < s	xyxy…, xxyxxy…, etc.	all possible
C	gcd(c,s) = 1	x	1
		xy	2
		xxy, xxyxy, xxxyxxyxxy	3 through c–1

Example 2: The three classes of ME sets

Class A ME sets contain two or more of a single interval size; Class B and C ME sets contain two different interval sizes that differ by one chromatic step. Whereas the interval pattern of any Class B ME set can be decomposed into a repeating pattern (e.g. *xy* times 2, *xyy* times 2), that of a Class C ME set cannot.

Because 5 does not equally divide 12, determining ME(12,5) is more difficult. Often multiple solutions are proposed, and I write all of them down. Upon examining the interval patterns, students

[10] Although I do not in the class invoke the three classes of ME sets outlined by Clough and Douthett, I will find it useful to do so in this paper. It is of course a singular advantage of the concept of maximal evenness that it includes both equal and unequal divisions of an equal-tempered space. Quinn (2006-07, 5-9) proposes a division of Class B into two subtypes: one in which gcd(c,s) = c–s ≠ 1, and another in which gcd(c,s) ≠ c–s ≠ 1. The latter subtype does not arise in the 12- or 7-element universes, the ones I focus upon here.

quickly realize that the multiple solutions are equivalent to within transposition. We observe that the interval pattern consists of two different intervals alternating irregularly (23223 or some rotation thereof), and I point out that the "3"s are as equally spaced among the "2"s as possible—and that this is a useful way to check that a set (whose interval pattern contains two different intervals) is indeed maximally even.[11] ME(12,5) constitutes a Class C ME set. ME(12,6) is Class A.

For sets of larger cardinality, I mention that there is a shortcut, providing an opportunity to introduce the idea of complementation. For this reason, complementary ME sets are aligned with each other in the handout; ME(12,6) is its own complement. Strictly speaking, the clockfaces in one half of the handout are not even necessary, because one can simply imagine the filled circles to be unfilled and the unfilled ones to be filled. Thus, although I encourage students to construct these larger sets on their own, I do not spend time in class actively constructing them but instead find them by way of their complements. After compiling all of this information in the first week of class, I casually mention that there are handy formulas for calculating the number of transpositions and modes of an ME set, and that these formulas involve the number of chairs, the number of students, and the greatest common divisor. That complementary ME sets have the same number of transpositions provides a big hint for figuring out the formulas, and one or two students usually figure them out.[12] The formulas are given in Example 1a. The existence of these simple formulas for the number of transpositions and modes of an ME set helps to reinforce these concepts.[13]

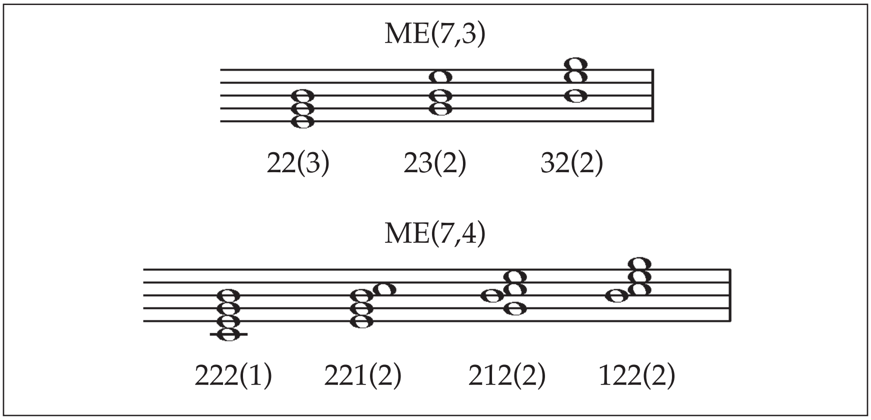
[11] Johnson has a more lengthy discussion of the problems arising in constructing ME(12,5) and ME(12,7). He foregrounds a solution in which equally spaced dots are first placed around the circle without regard to the 12 fixed positions—in other words, every 12/5 "hours"—then rounded to the nearest fixed position. In his discussion of the dinner table analogy (pp. 13-14), he suggests a solution that is equivalent to mine.

[12] The loose locution "complementary ME sets have the same number of transpositions" hints at the fact that ME sets point the way to the concept of set class.

[13] The formula for the number of distinct pcsets in ME(c,d) appears as Clough and Douthett's Theorem 1.9 (p. 113); the formula for the number of distinct modes of ME(c,d) appears as Lemma 1.15 (p. 114), which is defined as the number of pcsets in ME(c,d) that contain a particular pc. (The connection with mode is explained on p. 116.) The formula for the number of distinct pcsets in ME(c,d) appears prominently and early in Johnson 2003 (p. 6), but mode is not discussed at all.

II. Maximal Evenness in the Seven-Element Universe, Enharmonicism, and Rhythm

In order to illustrate the generality of the concept of maximal evenness, I explore the universe of seven elements as well; see Example 1c. Among the sets here are the triad (of indeterminate quality) and 7^{th} chord (of indeterminate quality), which are abstract complements of one another.[14] Examining maximal evenness in the seven-element universe helps students integrate knowledge in at least two ways. First, as shown in Example 3, the different inversions of close-position triads and 7^{th} chords are, from this perspective, their different modes.



Example 3: Triad and 7^{th}-chord positions as modes of ME(7,3) and ME(7,4)

Second, students' understanding of root motion can be used to teach the concept of pitch-class transposition. Example 4 demonstrates the connection using a normative tonal progression that incorporates the three most common diatonic root motions: by descending 5^{th}, descending 3^{rd}, and ascending 2^{nd}.

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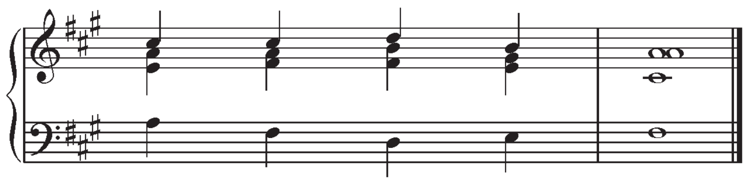
[14] Incidentally, the voice leading of the progression vii$^{\circ 7}$-to-I serves as a great model of these two sets as *literal* complements.



A:	I	vi	ii^6	V	vi
Root motion:	↓3rd	↓5th	↓5th	↑2nd	
Pitch-class sets:	{A,C♯,E}	{F♯,A,C♯}	{B,D,F♯}	{E,G♯,B}	{F♯,A,C♯}
Transposition, **mod 7**:	T_5	T_3	T_3	T_1	

Example 4: Diatonic transposition

Diagramming root motions on the 7-letter-name circle reveals an inconsistency in labels for root motions. While the labels "root motion by (ascending or descending) 2nd" and "root motion by (ascending or descending) 3rd" correspond to the shorter distance between the two locations on the circle, "root motion by (ascending or descending) 5th" corresponds to the *longer* distance around the circle. That we use "5th" rather than "4th" for such root motions no doubt relates to the harmonic series—to notions of moving from the fundamental to the second partial and vice versa. This inconsistency in root-motion labels provides an opportunity to point out that in twentieth-century theory pitch-class transposition is always reckoned *clockwise*; in that respect it is more consistent and therefore easier than the conventional method of labeling root motions.

The difference between ME sets of a given cardinality in the 7-element universe and in the 12-element universe provides a context for teaching enharmonic modulation, often the final harmony topic in tonal theory. Thus, maximal evenness can be used either to introduce the topic or to review and flesh out a recently treated topic. The main observation to be made here is that though ME(12,3) and ME(12,4) have undifferentiated interval patterns (444 and 333, respectively), ME(7,3) and ME(7,4) consist of an unequal mix of different intervals (223 and 2221, respectively). In order to *spell* any instance of ME(12,3), then, one must choose one of the three modes of ME(7,3), corresponding to the three "inversions" of an augmented triad. For example, pc set {048} can be spelled in "root position" (CEG♯, 223), "first inversion" (CEA♭, 232), or "second inversion" (CF♭A♭, 322). Similarly, in order to spell any instance of ME(12,4), one must choose one of the four modes of ME(7,4), corresponding to the four inversions of a diminished-7th chord.

This perspective on enharmonicism helps sensitize students to the importance of spelling for understanding enharmonic modulation, providing an entrée to that topic. It also helps students distinguish between "structural" enharmonicism and notationally convenient enharmonicism.[15] In the context of enharmonic modulations using augmented triads or diminished-7th chords, "structural" enharmonicism involves changing the mode (i.e., "inversion") of the chord. Thus, a transformation such as {F,A♭,C♭,E𝄫}→{E♯,G♯,B,D} would therefore *not* be considered structural, because it does not involve a change of mode.[16] Enharmonic modulation using the diminished-7th chord is well understood and prominently featured in most textbooks, so I need not review it here. Enharmonic modulation using the augmented triad, however, is rarely treated in current textbooks,[17] but recent work in neo-Riemannian theory suggests a systematic framework for teaching it. Example 5 lists all possible parsimonious voice leadings between augmented triads and major and minor triads.[18] By parsimonious voice leading, I mean voice leadings in

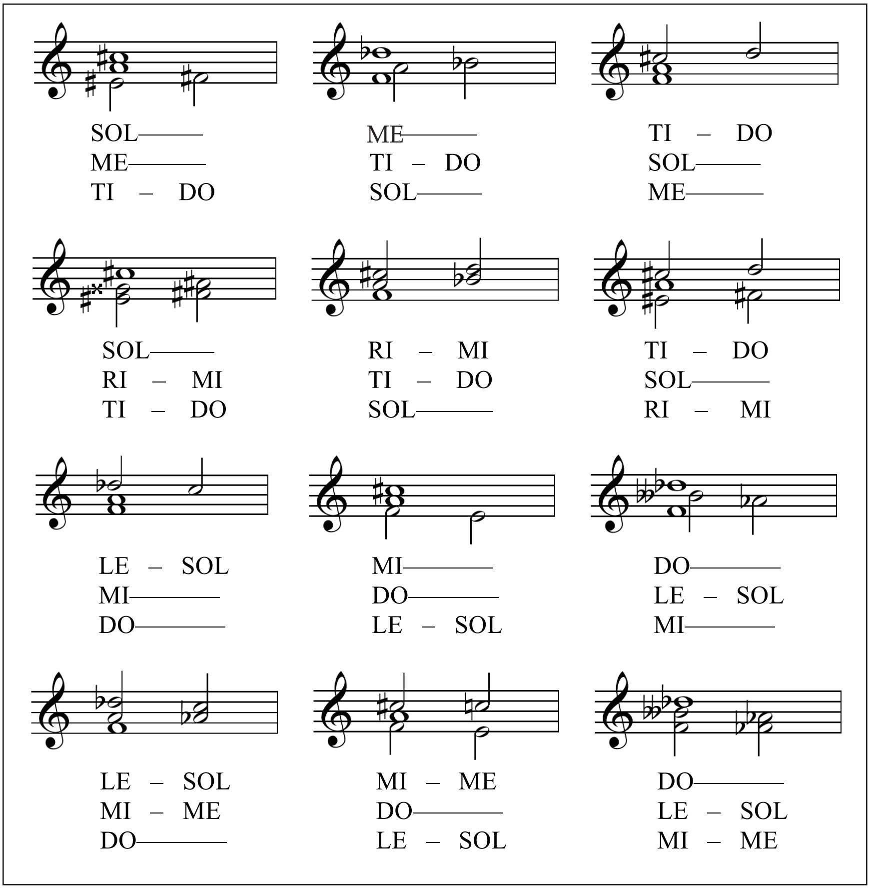
[15] See Harrison 2002 for a rich discussion of the issues involved in interpreting enharmonic passages.

[16] Some textbooks list more than four notational exemplars of a particular transposition of ME(12,4) in an attempt to be relatively comprehensive—but without clarifying the differences between the two types of enharmonicism. The example above would be structural enharmonicism only in the context of an equal division of the octave, in which enharmonic reinterpretation is necessary to return notationally to one's starting point. See Cohn 1996, 9-11. Atlas 1983 calls this "type 2" enharmonicism, in which the precise point of enharmonic reinterpretation cannot be determined. An excerpt from Gabriel Fauré's song "Toujours" that I will discuss (see Example 8) includes one example of type 2 enharmonicism.

[17] A notable exception is Roig-Francolì 2003 (830-34), which discusses how augmented triads can be reinterpreted as V^+ of different tonics and illustrates such an enharmonic modulation in Wolf's "Das verlassene Mägdlein." This text is also the first to include the neo-Riemannian operations P, L and R (pp. 863-71).

[18] Weitzmann 1853 lists these twelve voice-leading possibilities in six different examples (pp. 10-11, 11, 18, 23, 24 and 28, respectively), but groups them in four different ways, none of which matches the organization of my Example 5. Two of his examples begin with consonant triads, while the remaining ones begin with either a single

which each moving voice shifts by only one semitone.[19]



Example 5: All parsimonious voice leadings from pcset {159} to a major or minor triad

The first row lists voice leadings in which one voice ascends, and the second row those in which two voices ascend; the third and fourth rows list the complementary voice leadings involving descending voice motion. Stationary voices are realized as unisons (whole notes), while—with one exception—moving voices are

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augmented triad or all four augmented triads in succession. Various of Weitzmann's examples are reproduced (some with changes) in Todd 1996 (Example 1, p. 157 and Example 2b, p. 159) and Cohn 2000 (Examples 3 through 5, pp. 93-94).

[19] There are different definitions of parsimonious voice leading in the neo-Riemannian literature. Douthett and Steinbach 1998 provide a useful generalization of the concept.

realized as minor seconds, adhering to the principle that horizontal semitones are usually heard as different diatonic degrees.[20] The solfège patterns listed below each voice leading interpret the major or minor triad as a tonic.[21] Voice leadings in which moving voices ascend may be classified as *dominant*-type voice leadings (primary voice TI–DO), and those in which moving voices descend *subdominant*-type voice leadings (primary voice LE-SOL).[22] In textbooks, dominant-type voice leadings from augmented triads to major or minor triads are usually found in discussions of altered dominants, the augmented triad being interpreted as a major triad with chromatically raised 5^{th} (V^{+}).[23] Subdominant-type voice leadings are not easily reconciled to a root-based perspective, since interpreting a subdominant-functioned augmented triad with a Roman numeral would depend upon a chromatically lowered root (in which case the analogous symbol might be "IV_{-}"). Using root-neutral "*D*" and "*S*" designations obviates this difficulty.[24]

Representing these voice leadings on the clockface reveals pairwise relationships between voice leadings to major triads and

[20] The one exception is MI–ME, which I use in order to accommodate a solfège interpretation; most of Weitzmann's examples represent all moving voices as minor seconds. Cohn 2004 follows suit in his representations of voice leadings between hexatonic poles and mentions the principle on p. 306. In most conceptions of the chromatic scale as an embellished diatonic scale, there is no such object as $\downarrow\hat{4}$ (at least one student always cheekily suggests using "FE"). The interpretative problem here may be why of the four voice leadings, the one in which two voices descend is the rarest—indeed, I know of no examples in the literature. Interestingly, Louis and Thuille (1908, 319) exclude the three voice leadings in which 2 voices descend, perhaps an implicit acknowledgment of its musical rarity.

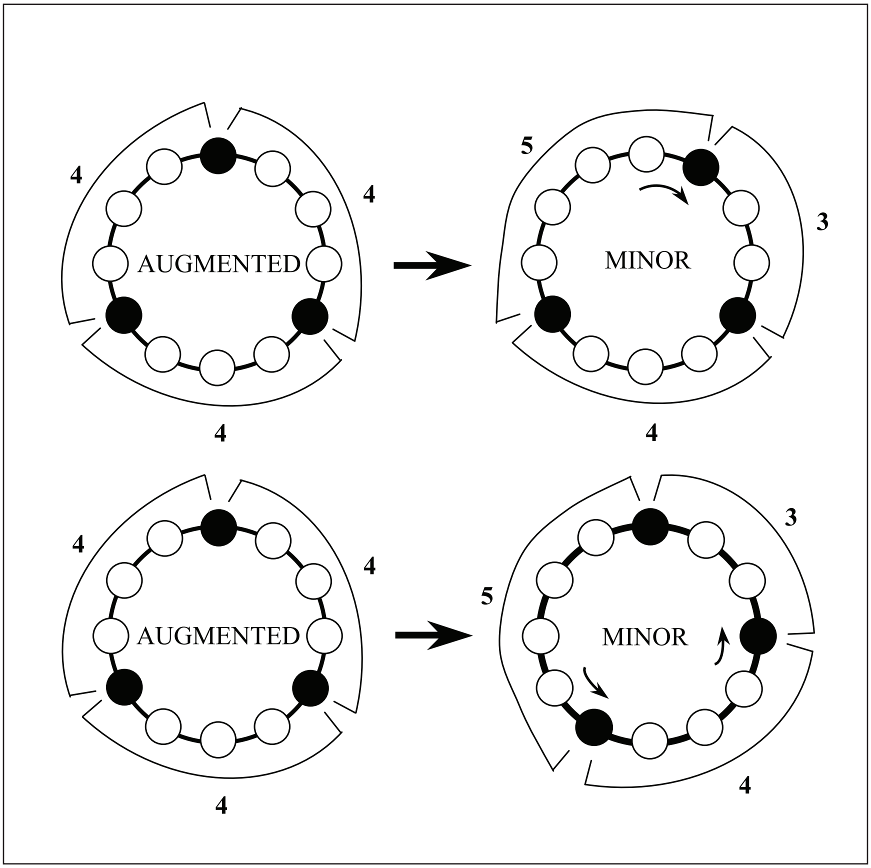
[21] Louis and Thuille (1908, 319) interpret the major triad reached by one descending voice as V in minor mode; the mixed scale degree in this case is the leading tone (in minor mode) instead of the lowered submediant (in major mode). Weitzmann (1853, 17) implicitly supports a tonic interpretation of the major triad in this voice leading by comparing the voice leading with that of vii^{o7} to I.

[22] As Cohn (2000, 92) explains, these functional relationships are inherent in Weitzmann's conception and in the dualist theoretic tradition in general.

[23] This interpretation runs into difficulty if the augmented triad resolves to a minor triad, however. Either the augmented triad must be spelled with $\sharp\hat{2}$ (as part of V^{+}) respelled as $\hat{3}$ (as part of i), or the augmented triad must be interpreted as III^{+}, a symbol and interpretation that has become outmoded.

[24] See Harrison 1994 for a recent revival of these functional labels.

to minor triads, respectively. As shown in Example 6, there are two ways to lead parsimoniously from an augmented triad (with interval pattern 444) to a *minor* triad (interval pattern 345)—by moving one voice upward or two voices downward. Similarly, there are two

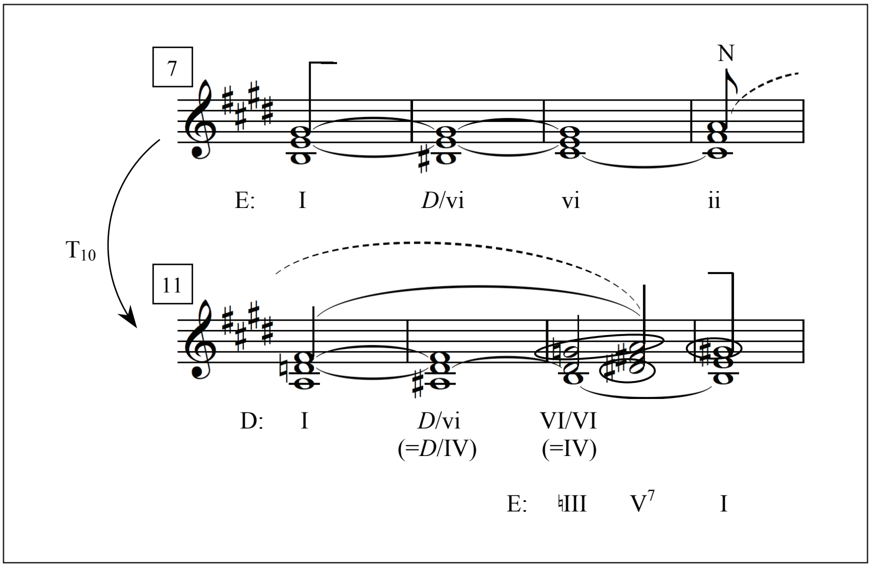


Example 6: Two ways to voice lead from an augmented triad (444) to a minor triad (345)

ways to lead parsimoniously from an augmented triad to a *major* triad—by moving two voices upward or one voice downward.

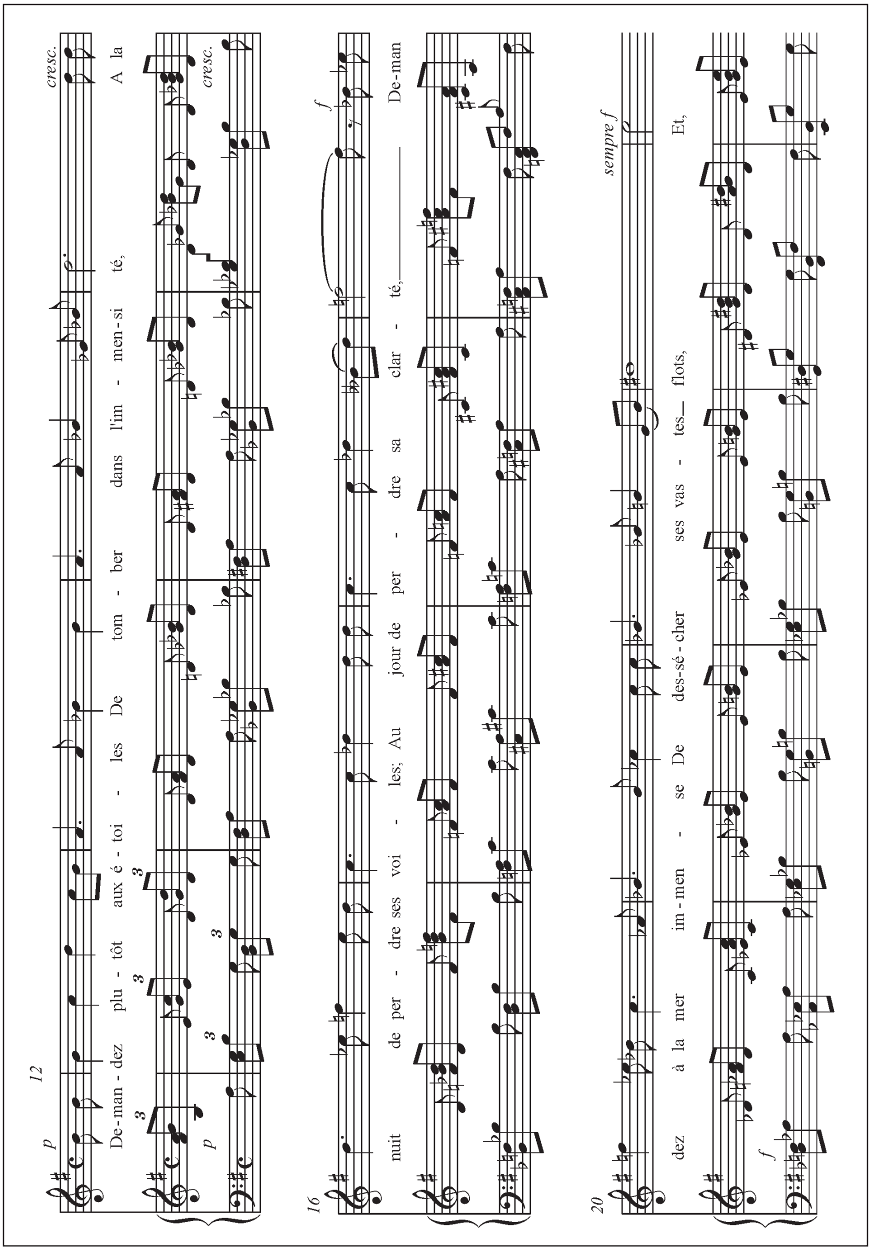
Two excerpts that feature enharmonic modulation using the augmented triad will serve to illustrate how the framework given in Example 5 proves useful. Each excerpt consists of a sequence whose successive patterns undergo alterations. A score and reduction of the first excerpt, from Liszt's *Sonetto 104 del Petrarca*, are given in Examples 7a and 7b, respectively. Although the reduction omits the bass line, the harmonic analysis reflects the actual bass.

Example 7a: Score of Liszt, "Sonetto 104 del Petrarca," mm. 7-14

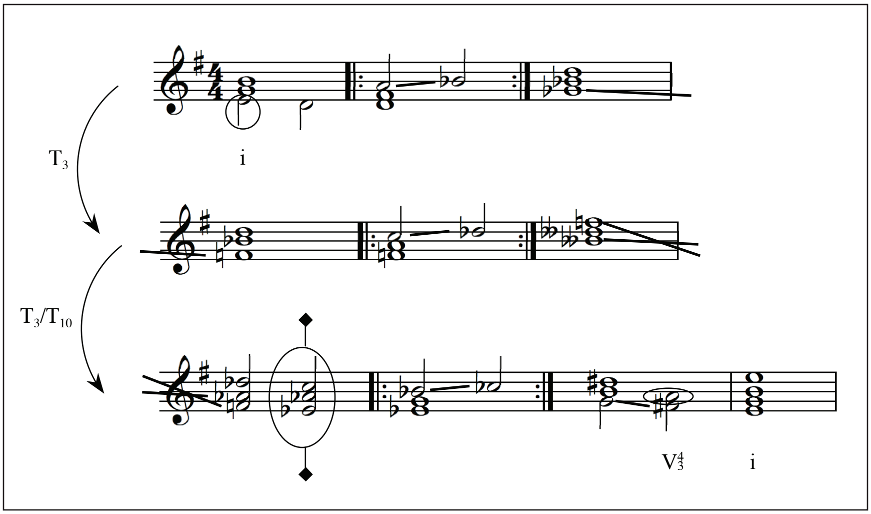


Example 7b: Reduction of Liszt, “Sonetto 104 del Petrarca,” mm. 7-14

This excerpt consists of two four-measure subphrases that are transpositionally related; alterations in the second subphrase are circled on Example 7b. A dominant-functioned augmented triad appears in the second measure of each subphrase. In the first subphrase, only the bottom voice ascends (B♯–C♯); in the second subphrase, the bottom voice ascends as expected (A♯–B, respelled on the reduction to reflect the structural voice leading), but the upper voice unexpectedly ascends as well (F♯–G), producing a G-major triad on the downbeat. Whereas the first subphrase’s augmented triad functions as *D* of vi, the second subphrase’s augmented triad resolves deceptively to VI of vi, thereby functioning locally as *D* of IV. (The B♭ in the score conforms to the bass line, which prefigures IV through the descending arpeggiation D–B♭–G.) The other alterations to this measure include D♯ and A, both of which enable the heretofore-real sequence to return to tonic. Contrapuntally, the G♮ is a passing tone between F♯ (m. 11) and A (m. 13, b. 3), the latter of which is an upper neighbor to the structural G♯ that opens and closes the phrase. Though the melodic G♮ is contrapuntally subsidiary, its arrival corresponds to the most marked harmonic event of the passage, where IV in D major is reinterpreted as modally mixed ♮III in E major.



Example 8a: Score of Fauré, "Toujours," mm. 12-24



Example 8b: Reduction of Fauré, “Toujours,” mm. 12-24

A score and reduction of the second excerpt, from Fauré’s song “Toujours,” op. 21, no. 2, are given in Examples 8a and 8b.[25] This excerpt exclusively employs the less common *S*-type voice leading.

In the poem, the narrator complains to his beloved, who has asked that he go away and forget about her. He indicates that he cannot possibly fulfill her request by comparing it to various unreasonable requests of nature: asking the stars to fall from the sky, the night to lose its darkness, the day to lose its light, and the sea to dry up.[26] The excerpt sets the first three requests; the enharmonic modulations come between each request, thereby linking each imagined upheaval in the natural world with tonal disorientation. The narrator’s increasing agitation as he proceeds down the list is reflected in the sequence’s ascending interval of transposition (up by minor third). As in the reduction of the Liszt excerpt, the bass line is omitted and circled pitches indicate alterations relative to the model. The second subphrase serves as the model for the sequence,

[25] This passage is singled out by Charles Burkhart as worthy of investigation in the 5th edition of his anthology (1994, 390); the piece does not appear in earlier or later editions.

[26] “Demandez plutôt aux étoiles / De tomber dans l’immensité, / A la nuit de perdre ses voiles, / Au jour de perdre sa clarté! / Demandez à la mer immense / De dessécher ses vastes flots.”

with alterations occurring in the first and third subphrase.[27] In order to reveal the enharmonic modulations, the reduction spells moving voices with two different letter names and non-moving voices with the same letter names, following the same process used to construct Example 5.[28] In the first enharmonic reinterpretation, F♯ is reinterpreted as G♭; thus, *S* of D major is reinterpreted as *S* of B♭ major. The second enharmonic reinterpretation involves respelling A as B𝄫 to transform *S* of F major into *S* of D♭ major. The third pattern of the sequence inserts an A♭-major triad in its first measure, changing the interval of transposition beginning with that chord to T_{10} and enabling the phrase to cadence in the tonic.[29] The third enharmonic reinterpretation involves an intermediate

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[27] It may seem counterintuitive to treat any pattern other than the first one as the model; a model in the sense used here is the pattern that contains no unique features. In employing the second pattern as the model of a three-pattern sequence, this sequence matches the opening of the Tristan Prelude (see Bass 1996, 282). The adjustments to the "Toujours" sequence, like those in the Tristan Prelude, similarly aid in reconciling a real sequence to a diatonic context.

[28] I do not mean to suggest that the spellings in the score are somehow wrong or invalid; it is often more expedient to spell an enharmonically reinterpreted chord only once in a score, which is what makes enharmonic modulation especially difficult for students. Recognizing this difficulty, Clendinning and Marvin (2005, 604) advise the student in a sidebar that "An enharmonic pivot chord can be spelled as it functions in the first key or as it functions in the second key. It may also appear twice, spelled once each way." The first and second augmented triads are spelled only one way: the spelling of the first reflects its *second* function; the spelling of the second reflects neither of its functions. That the latter is spelled in root position suggests a different kind of expediency: root-position augmented triads are easier to read (here I refer only to the right-hand voicings in mm. 17-18). The third augmented triad is spelled two ways, the first of which follows the expedient spelling of the second augmented triad, and the second of which—like the first augmented triad—reflects its *second* function. These spellings may not be Fauré's: the manuscript is in F♯ minor, and the two editions I have been able to examine (those in E minor and F minor) are inconsistent in their spellings of the augmented triads.

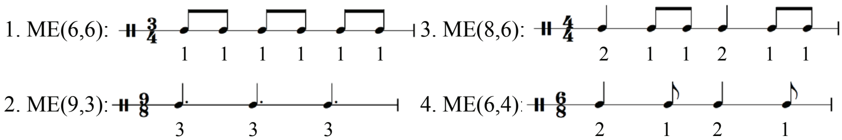
[29] It is a commonplace of Fauré's style to travel to distant tonal regions within a phrase, only to suddenly return to tonic at the very end. The adjustment of chord position on the D♭-major triad—root on top instead of chordal 3rd, as in the first two patterns—allows for smooth voice leading into the E♭-major triad with chordal 5th on top.

stage not shown in the reduction: G is respelled as A𝄫 in order to reinterpret *S* of E♭ major as *S* of C♭ major. The indicated change from flats to sharps allows the music to return notationally to its starting point.[30]

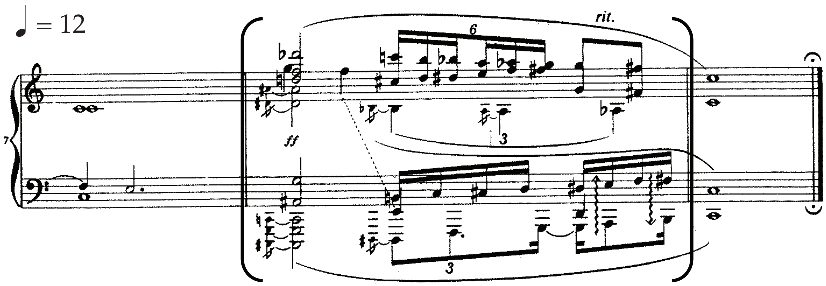
Maximal evenness can also usefully be studied in connection with rhythm, which naturally opens up the possibility of various other universes. Set members are durations, and the universe consists of the number of timepoints in a (notated or conceptual) measure. A shortest allowable duration must be chosen, analogous to the smallest interval in the pitch domain. Considering ME duration sets prompts the use of integers for durations, which is unfamiliar to even advanced students, who likely have not considered such a model since they first learned durations. (Here I am thinking of fundamentals exercises that ask, for example, how many sixteenth notes are in a doubly-dotted half note.) Various Class A and B ME duration sets are given in Example 9a; the eighth note is assigned a duration of length 1.

[30] See note 16.

a. Various Class A and B duration sets (♪ =1)



b. Charles Ives, "Bad Resolutions and Good Wan," mm. 7-9:
ME(12,2) + ME(12,3) + ME(12,4) + ME(12,6) + ME(24,3)



c. ME (8,3): first half of "son clave" pattern

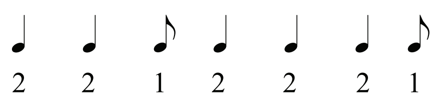
timepoints: 036

interval pattern: 332 or 

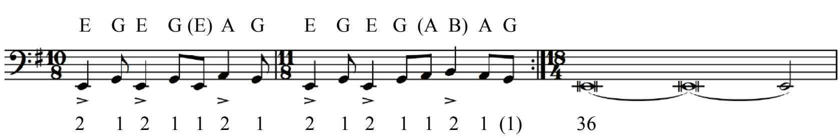
# of transpositions: 8

# of modes: 3

d. ME(12,7): Agbekor



e. ME(10,7) and ME (11,8): Naked City, "You Will Be Shot"



Example 9: Some ME rhythms

Sets 1 and 2 belong to Class A: they consist of equal divisions of measures that are six and nine eighth notes long, respectively. Sets 3 and 4 belong to Class B: each consists of a repeated pattern made up of two different durations. Example 9b provides the last three measures of Charles Ives' "Bad Resolutions and Good Wan" (1907), which superimposes several Class A sets: beats 3 and 4 of m. 8 collectively contain four equal divisions of a quarter-note beat and one equal division of a half note. More interesting are Class C duration sets, some examples of which are given in Examples 9c through 9e. Such duration sets are especially common in non-Western musics as well as Western popular music and jazz, providing an opportunity to draw on music outside the canon. A relatively common Class C rhythm is ME(8,3), which appears in Example 9c. The transposition and mode given in the example correspond to the first half of a "son clave" pattern, and is also the rhythm that students often produce when first attempting to perform 2-against-3 patterns.[31] As Traut 2005 shows, all three of its modes occur as accent patterns in 1980s popular music. Example 9d illustrates ME duration set (12,7), which is found in Agbekor, a music of the Ewe people of Ghana and Togo.[32] Finally, Example 9e is a transcription of an ostinato from Naked City's "You Will Be Shot," a piece that juxtaposes heavy metal and country genres.[33] The ostinato dominates the heavy metal sections, which frame the piece; the country sections are exclusively in (squarish) common time. The bar lines in my transcription reflect the two-fold repetition of pitch-class segment <EGEGAG> and duration segment <2121121>. The differences between the first two measures are indicated by the letter names and durations in parentheses: the pitch material of measure 2 modifies that of measure 1 in replacing the third E with

[31] The first half of a clave rhythm is usually represented by a quarter note, eighth rest, eighth note, quarter rest, quarter note in common time. Students produce this rhythm in a 2-vs.-3 context by trying to fit a threefold division into simple meter—8 is the first power of 2 that can be split into three integral parts that are roughly equivalent (3, 3, and 2).

[32] See Locke 2002 for an exposition of this tradition; this duration set is played by the gankogui, a type of bell. Hall (2005, 160-65) includes examples based upon ME(12,7) and other rhythms from the West African tradition. See Pressing 1983 and Rahn 1987 for other examples of duration sets that are isomorphic to familiar pitch sets; Cohn 1998, [7]-[8] also mentions these connections, referring to Pressing 1983.

[33] *Naked City*, Elektra/Nonesuch 979238-2, 1989. Naked City was a band led by John Zorn, active from 1988 to 1993.

A and B; the duration pattern of measure 2 adds an eighth note relative to measure 1. The integer model for rhythm that can be smoothly introduced by way of ME sets proves useful for studying rhythmic procedures in the music of Messiaen (see Hook 1998) and of Steve Reich, as both Cohn (1992) and John Roeder (2003) have shown.

III. Integrating Maximal Evenness with Other Topics: Combinatorics

The course continues by examining particular ME sets in detail, linking each set to musical excerpts and procedures: analytical forays are interspersed with continuing theoretical investigations.[34] In the continuing theoretical investigations, transpositional combination (henceforth TC) acts as a bridge to the complete roster of set classes.[35] A brief detour into combinatorics sets the stage; although knowledge of combinatorics is not crucial to an understanding of TC, I introduce the topic formally at this point because of its relevance to later concepts.[36] Having already manually counted transpositions and modes of ME sets and employed formulas for doing so, students are ready and open to the subject by this point in the course.

There are two things to keep in mind in counting objects selected from a (usually larger) set: whether the objects are *ordered* or *unordered*, and whether or not a given object can appear more than once in a set. Example 10 follows the usual order of introduction of the four categories, listing their associated formulas along with problems that we work through in class.

The boxes on the right side of the example are not part of the handout proper, but indicate some relevant applications of the concepts to which I will return.

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[34] For a recent approach to the analysis of post-tonal music, see Alegant and Sly 2004.

[35] Transpositional combination is introduced in Cohn 1987.

[36] Enumeration is a long-standing tradition in music theory. See Hook 2007 for historical precedents and a thorough primer on combinatorics in music theory.

PERMUTATIONS and COMBINATIONS

$\downarrow$ **ordered** objects

$\downarrow$ **unordered** objects

n = the set of objects from which we're selecting

r = the number of objects we're selecting from n objects

$n! = n \times (n-1) \times (n-2) \ldots \times 1$ (n! = "n factorial"; 4! = 24; 0! = 1, by def.)

- PERMUTATIONS: $\frac{n!}{(n-r)!}$; if $n = r$, then $n!$

  twelve-tone rows

  - Example: n = 4, r = 4
  - Example: n = 4, r = 2

- COMBINATIONS: $\frac{n!}{(n-r)!r!}$ "n choose r" or $\binom{n}{r}$

  transpositional combinations
  ic vector
  subsets of a given cardinality

  - Example: n = 4, r = 4
  - Example: n = 4, r = 2
  - The number of double ice cream cones with **2 different** flavors, 31 total flavors

- PERMUTATIONS **WITH REPETITION**: n^r

  pitch-class sets in a universe

  - Example: the number of ways to light this classroom
  - Example: the number of double ice cream cones, 31 flavors (vanilla + chocolate ≠ chocolate + vanilla)

- COMBINATIONS **WITH REPETITION**: $\frac{(r+n-1)!}{(n-1)!r!}$ or $\binom{r+n-1}{n-1}$

  harmonic sequences

  - Example: the number of double ice cream cones, 31 flavors (vanilla + chocolate = chocolate + vanilla)
  - Example: the number of lighting *levels* in this classroom

Example 10: Handout on permutations and combinations

I first spend some time in class deriving the first two formulas. Again using students, I ask a volunteer—let's call him John—to stand at the front of the room. How many different ways can John form a line? Obviously only one way. I then ask a second volunteer—let's call her Mary—to join John. How many different ways can John and Mary form a line? There are two possibilities: either John can stand in front or Mary can stand in front. Thus, for two objects, there are two possible orderings. Then a third volunteer—let's call her Robin—joins John and Mary. The situation grows slightly more complicated at this point: with John at the front of the line, there are two possibilities for the rest of the line (Mary, then Robin or Robin, then Mary); with Mary at the front of the line, there are again two possibilities; and with Robin at the front of the line there are two possibilities. Thus, for three objects there are six possible orderings. It gradually becomes clear that the number of orderings of n objects is the product of n times $n - 1$ times $n - 2$ and so on down to 1. This product is given by $n!$ (n factorial). If one wishes to know the number of orderings of a certain number of objects *selected from a larger number of objects*, then one multiplies only the number of products that one is selecting. For example, in selecting three objects from five, the number of permutations is 5 times 4 times 3, or n times $n - 1$ times $n - 2$. A shorthand for this is n times $n - 1$ and so on until $n - r + 1$, which may be abbreviated using factorial as the first formula given in the handout.

The only difference in the second formula—that for combinations—is the $r!$ in the denominator, which eliminates the different permutations of the r objects selected. The case of $n = 4$ and $r = 2$ will serve to illustrate. There are $\frac{4!}{(4-2)!}$ (= 12) permutations of 2 objects selected from 4 objects, but $\frac{4!}{(4-2)!2!}$ (= 6) combinations of 2 objects selected from 4 objects.[37]

I then give an assignment reproduced as Example 11. This assignment integrates students' knowledge of ME pitch sets in the chromatic universe with their new understanding of counting theory.

[37] For other derivations of these formulas, see, for example, Bose and Manvel 1984, Chapter 1 and Hook 2007.

<u>a. assignment</u>

1. Determine which sets can be produced by combining any two transpositions of ME(12,2).
2. Determine which sets can be produced by combining any two transpositions of ME(12,3).
3. Determine which sets can be produced by combining any two transpositions of ME(12,4).

Play all the resulting sets (as chords) on a keyboard and (as melodies) on your instrument.

Be sure to try all possible combinations! Some of the different combinations will produce identical results; prune these duplicates. In other words, if you happen upon a transposition of a set you've already produced, do not repeat it.

List the new sets in terms of their pc numbers, then enumerate these properties of each new set:

- How many distinct transpositions does it have?
- What is its interval pattern?
- How many modes does it have?
- Does it have a familiar name?
- If you produce another ME set, include it as well, identifying it as such. You need not list its properties, since we all know them now. (This means that there are some relationships between ME sets of different cardinalities other than complementation!)

<u>b. answer to assignment (1. only)</u>

Combining two transpositions of ME(12,2), the tritone:

There are six transpositions of ME(12,2): 06, 17, 28, 39, 4T, and 5E.

There are fifteen ways to combine six objects two at a time: $\binom{6}{2} = 15$

Combining two tritones that differ by 1 produces a transposition of [0167]: {0167}, {1278}, {2389}, {349T}, {45TE}, {56E0}.

Combining two tritones that differ by 2 produces a transposition of [0268]: {0268}, {1379}, {248T}, {359E}, {46T1}, {5702}. Familiar names: French augmented-sixth chord, dominant-7th chord with lowered 5th.

Combining two tritones that differ by 3 produces a transposition of [0369], i.e., ME(12,4): {0369}, {147T}, {258E}.

Example 11: Assignment on transpositional combination of (some) ME sets

The relevant formula is the one for combinations, which is known informally as "*n* choose *r*." Combining all possible pairs of transpositions of Class A ME sets uncovers new sets of musical interest whose properties can then be examined, and also reveals interconnections between certain ME sets of different cardinalities. As shown in the bottom half of the example, ME(12,2) at T_1 produces members of set class [0167], a set class featured in music of Bartók and Webern, among others; ME(12,2) at T_2 produces members of [0268], the prime form of the French augmented-sixth chord or the dominant-7th chord with lowered 5th; and ME(12,2) at T_3 produces ME(12,4). Combinations of ME(12,3) include ME(12,6) and hexatonic.[38] Combinations of ME(12,4) produce only ME(12,8).

Transpositional combination also dovetails nicely with the concept of transpositional symmetry. All ME sets in Class A and B are transpositionally symmetric (as can be seen in the sample interval patterns given in Example 2), as are some TC sets with ME constituents, including all the sets produced in the above assignment.[39]

In addition to its value for TC exercises, "*n* choose *r*" also proves useful in connection with creating interval-class vectors. In this case, *n* equals the cardinality of the pcset and *r* equals 2. The formula serves as a helpful "check step," ensuring that the interval-class vector contains the correct number of ics for that set cardinality. That *r* can take on any value from 1 to *n* reinforces the concept than an interval class is a subset of cardinality 2. While it is relatively easy to count subsets of cardinality 2 without the aid of the formula, counting subsets of larger cardinalities is somewhat more difficult. In listing all the trichordal pcsets of a particular hexachordal pcset, it is helpful to know that there are "6 choose 3" (= 20) trichordal pcsets in any hexachordal pcset.

A useful heuristic that summarizes information about subset counts is Pascal's Triangle, a modified form of which is given in Example 12.

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[38] See Cohn 1996 and 2004 for a generous sampling of excerpts that employ the hexatonic collection.

[39] Transpositionally symmetric sets can be produced by transpositional combinations of one or more complete interval cycles: see Cohn 1991. TC sets that are not constructed from complete interval cycles are not transpositionally symmetric. For example, pcset {0347}, which can be understood as 2 interval-class 3s at T_4 or 2 interval-class 4s at T_3, is not transpositionally symmetric because neither a single ic 3 nor a single ic 4 constitutes a complete interval cycle. The converse and more difficult exercise of disassembling larger sets into possible TC constituents—as given, for example, in Straus (2005, 117)—is made easier by the introduction of TC early in the course.

How many subsets of various sizes are contained within a set of a certain size?

As you know, the number of combinations of n things taken r at a time equals $\dfrac{n!}{(n-r)!r!}$.

n is the cardinality of the set, and r is the cardinality of the subset.

The total number of subsets of a set of cardinality n is 2^n (since a pitch class can either be present or absent)—the number of pitch-class sets of cardinality 0 through n.

cardinality of subset (r)

cardinality of set (n)

	0	1	2	3	4	5	6	7	8	9	10	11	12	total (2^n)
1	1	1												2
2	1	2	1											4
3	1	3	3	1										8
4	1	4	6	4	1									16
5	1	5	10	10	5	1								32
6	1	6	15	20	15	6	1							64
7	1	7	21	35	35	21	7	1						128
8	1	8	28	56	70	56	28	8	1					256
9	1	9	36	84	126	126	84	36	9	1				512
10	1	10	45	120	210	252	210	120	45	10	1			1024
11	1	11	55	165	330	462	462	330	165	55	11	1		2048
12	1	12	66	220	495	792	924	792	495	220	66	12	1	4096

Problem:

List all trichordal pcsets in pcset {014589}. To what set class does each pcset belong? How many representatives of each SC are there?

Solution:

How many trichordal pcsets are contained within a hexachord?

$$\frac{6!}{3!(6-3)!} = \frac{6!}{3!3!} = \frac{6 \times 5 \times 4}{3 \times 2} = 20$$ (shaded value in table above)

Pcset {014589} contains {014}+{589}; {015}+{489}; {018}+{459}; {019}+{458}.
{045}+{189}; {048}+{159}; {049}+{158}.
{pc sets} {058}+{149}; {059}+{148}.
{089}+{145}.

[014][014]; [015][015]; [015][015]; [014][014].
{set classes} [015][015]; [048][048]; [037][037].
[037][037]; [037][037].
[014][014].

Any pcset in set class [014589] thus contains 6 pcsets in set class [014], 6 pcsets in set class [015], 6 pcsets in set class [037], and 2 pcsets in set class [048].

Example 12: Handout on subsets

Each number is the sum of the one above it and the one above and to its left, making it easy to construct.[40] Summing the numbers in each row gives the total number of subsets of a given cardinality. For instance, the total number of subsets of a set of cardinality 4 equals 16 (= 1 + 4 + 6 + 4 + 1). That the total number is always a power of 2 is not a coincidence, and a useful analogy can be made to light switches in a room. The problem may be framed as follows. Assume that there are three sets of lights, each controlled by a different switch. How many different ways to light the room are there? Each set of lights may be on or off, and the switches are independent of one another. In this case, the set of objects n is {ON, OFF}, from which three selections are made (three light switches). Since each switch is independent, there are 2x2x2 = 8 possible ways to light the room. Returning to Example 10, the formula for the number of permutations *with repetition* is n^r. Counting "1" as ON and "0" as OFF, the 8 possibilities are given in Example 13.

Complementary Pairs	Binary Representation	Number of Lights On
Pairs	Representation	Lights On
	000	0
	001	
	010	1
	100	
	011	
	101	2
	110	
	111	3

Example 13: Light-switch analogy for pcsets

[40] The vertical columns in the table correspond to the left diagonals of the triangle as it is usually represented. In the triangle, each interior number is the sum of the two numbers above and to its left and right. This is given by a well-known binomial identity; see Tucker 2002, 214.

By extension, on the clockface a pitch class is either present or absent, two states that are modeled by filled and unfilled circles, respectively; there are thus $2^{12} = 4096$ pitch-class sets.[41]

Such a broad perspective can be helpful in teaching the concept of the set class, a concept with which many students struggle. That there are far fewer set classes than pitch-class sets goes a long way towards selling the concept. A very rough approximation of the number of set classes can be obtained by dividing 4096 by 24 (= 170 2/3), the maximum number of pcsets in a set class (12 transposed forms plus 12 inverted forms); the result is less than the actual number of set classes (224) because a small number of set classes have non-trivial transpositional symmetry (16) and a much larger number of set classes possess inversional symmetry (96).[42] Of the eight non-trivial ME sets in the chromatic universe, six have transpositional symmetry; three other transpositionally symmetric sets are familiar from the TC assignment. Thus, nine of the sixteen transpositionally symmetric sets have already been introduced.[43] Inversional symmetry, on the other hand, is unfamiliar—at least in pc space—but ME sets can serve as test cases since they are inversionally symmetrical by definition.[44] The concept of the set class has thus been lurking since the initial investigation of maximal evenness, in which each ME(12,*n*) set-class was referred to as a single object.

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[41] This view of pitch-class sets is often the basis for programming routines that take pitch-class sets as their objects. See Brinkman 1990, 625-28 for a discussion. That the sum of all subsets is a power of 2 is given by another binomial identity. See Tucker 2002, 216-17 and Hook 2007, [30]-[31].

[42] All sets have trivial transpositional symmetry: T_0 preserves any set. Calculating the number of set classes from the cardinality of the universe, the cardinality of pcset, and the nature of the canonical operations is fairly complicated and therefore properly lies outside the scope of the class. See Hook 2007 for an explanation of the underlying mathematics and Nolan 2003 for a fascinating survey of historical precedents.

[43] The 7 others include [012678] and [013679]; the complements of [06], [0167] and [0268]; and the null set and aggregate, which are trivial.

[44] Clough and Douthett give a proof in Theorem 1.8 (pp. 109-10).

In teaching inversional symmetry, it is helpful to imagine that the clockface is a necklace. Indeed, a well-known counting problem in mathematics involves counting the number of different necklaces containing a certain number of beads that come in a certain number of colors. The number of set classes (under transposition and inversion) is equivalent to the number of necklaces of 12 beads that come in two colors—the two colors corresponding to the presence or absence of a pitch class, respectively. Transposition corresponds to rotating the necklace, while inversion corresponds to flipping the necklace over.[45]

From the pictures of ME sets in the 12-element universe (Example 1b), it is apparent that Class A and Class B ME sets are inversionally symmetrical. The inversional symmetry of non-trivial Class C ME sets is less obvious, so carefully demonstrating the inversional symmetry of ME(12,5) and ME(12,7) by trying out different inversional axes can prove beneficial. The same can be done for all non-trivial ME sets in the 7-element universe, which all belong to Class C.

Another common way to demonstrate inversional symmetry is by examining the interval pattern: a palindromic interval pattern represents an inversionally symmetric set.[46] For students who have trouble visualizing axes on the clockface, this method is useful and often quicker, though it has two drawbacks. First, set classes fall into three different categories with respect to the way in which the palindromic interval pattern may be represented:

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[45] Such a problem is a subset of those involving counting the number of colorings of faces, sides or corners of various geometric figures; solving such problems involves determining all the rotational and reflective symmetries of the figure being colored. See Tucker 2002, Chapter 9 and Hook 2007.

[46] See, for example, Straus 2005, 87. This method is also used to determine if two pcsets are inversionally related.

1. The palindrome necessarily involves *all* intervals in the pattern. Example: [027], with interval pattern <525>. This category includes 12 of the 80 set classes of cardinality 3 through 9 (15%).

2. The palindrome necessarily involves *all but one* of the intervals in the pattern. Example: [0268], with interval pattern <242> or <424>. For such sets, there are always two ways to represent the palindrome, both of which exclude one interval in the pattern. This category includes 36 of 80 set classes (45%).

3. The palindrome can either involve all intervals in the pattern or all but one interval. Example: [01348], with interval pattern <1441> or <41214>. This category includes 32 of 80 set classes (40%).

Thus, if the palindrome is not immediately apparent in the way the interval pattern is initially represented, it is necessary to consider the other possibility. Only one ME set in the 12-element universe falls into the second category above, and for that reason serves as a useful foil to the rest: the only representations of ME(12,8)'s interval pattern as a palindrome are 2121212 and 1212121, both of which exclude one interval. All other ME sets in the 12-element universe fall into the third category: for example, ME(12,9)'s palindromic interval pattern may be represented as 11211211 (excluding one interval) or 121121121 (including all intervals). Trying out the two possibilities for ME sets helps prepare students for encounters with sets that fall into the first two categories.

The second drawback to using the interval pattern to identify inversional symmetry is that the palindrome is not always apparent in the normal form of a pcset. Again, ME(12,5) and ME(12,7) serve as two examples: for ME(12,5), the normal-form interval pattern is 22323, but the palindrome is either 23232 (including all intervals) or 3223 (excluding one interval). ME(7,4) and ME(7,5) serve as further examples.

The two enumeration formulas not yet linked with a musical application involve counting permutations (*without* repetition) and combinations *with* repetition, the first and last formulas in Example 10. The last formula is least relevant in the course, and I do not spend time in class deriving it, but include it for the sake of completeness.[47] Permutations, on the other hand, are relevant for counting ordered sets of any cardinality—most particularly for twelve-tone rows. Spending time working out that there are 12! = 479,001,600 distinct twelve-tone rows gives students a perspective that can later be modified upon the introduction of twelve-tone operations and the equivalence classes that result. It turns out that an approximation of row classes, 479,001,600 / 48 (= 9,979,200), is much closer to the actual number of row classes (9,985,920) than the corresponding approximation of set classes.[48] That there are far more twelve-tone rows than set classes drives home the point that all unordered sets can be ordered in multiple ways. This perspective leads to fruitful discussions about what constitutes an "interesting" row class—there are, after all, many "boring" rows—and how to construct row classes with compositionally useful properties.[49]

As the full apparatus of pitch-class set theory is erected, ME sets continue to serve as landmarks. There is one (and only one) ME set in each column of the set-class table, and with the exception of ME(12,5) and (12,7), ME sets appear at the bottom of the column. Sets of minimal evenness—chromatic clusters—appear at the top of each column. Other sets can be related to ME sets in various ways. Set class [0148], used frequently in the music of Schoenberg, is easily viewed as ME(12,3) plus an "extra" pc that lies adjacent to one of the pcs of ME(12,3). Scriabin's "mystic chord," a member of set class [013579], can be conceptualized as a "minimally perturbed" version of the whole-tone scale: a whole-tone scale with one pc nudged up or down a half step.[50]

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[47] There are musical contexts in which multisets are relevant: see Lewin 1998 (62-67) on pcsets with doublings; see Ricci 2002 and 2004 for a discussion of harmonic sequences conceived as concatenations of root motions.

[48] See Hook 2007 for a proof of the number of twelve-tone row classes.

[49] See Hunter and von Hippel 2003 for a study of the extreme rarity of symmetry in twelve-tone row classes in general.

[50] See Callender 1998. Another well-known minimal perturbation of an ME set is [0258] (major-minor and half-diminished 7th chord), a perturbation of ME(12,4); see Childs 1998. Such relationships have significant implications for voice leading, as demonstrated earlier in connection with enharmonic modulation using the augmented triad.

According to Bain, another essential component of the natural critical learning environment is to leave students with a question. Whether or not we explicitly seek an answer to the question within the framework of the course, it is certainly implicit throughout, providing strong motivation for our continuing investigations: Why *are* maximally even sets so prevalent, both in the pitch and rhythmic domains? Exploring and enumerating their properties and relating them to each other provides part of an answer. Of course, there is as yet no definitive answer to this question, and it is probable that no such answer exists. And letting students know that there are such open questions in the field of music theory seems a fitting way to conclude the music theory core sequence.

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Pedagogic Applications of Fourier Analysis and Spectrographs in the Music Theory Classroom

JOHN LATARTARA

INTRODUCTION

Over the last twenty-five years, computer technology has transformed the teaching environment. This is especially true for the field of music theory. Software programs designed for ear training, notation, and interval/chord spelling have been helpful in allowing students to improve their musicianship skills rapidly. There is another type of software program that can also be extremely beneficial for music theory students, which has direct applications in musical analysis—Fourier analysis and spectrographs. Fourier analysis and spectrographs can be used in a variety of ways to elucidate specific musical concepts and generate discussion in the theory classroom at both the undergraduate and graduate levels. Spectrographs are images of musical sound generated by Fourier analysis, which show not only the fundamental pitch, but also the overtones and complex noise-like sounds as well. These images are related to the way we hear and perceive sound, making them extremely relevant for all musicians.[1]

There are a number of recent published analyses that use Fourier analysis and spectrographs. Robert Cogan uses Fourier analysis and spectrographs as the basis for a theory of tone color based upon

[1] Jean-Claude Risset and David L. Wessel, "Exploration of Timbre by Analysis and Synthesis," *The Psychology of Music*, ed. Diana Deutsch (San Diego: Academic Press, 1999), 113-169. As Risset and Wessel state (p. 153):

> The significance of Fourier analysis has a multiple basis. Clear evidence exists that the peripheral stages of hearing, through the mechanical filtering action of the basilar membrane, perform a crude frequency analysis . . . . The distribution of activity along the basilar membrane relates simply to the Fourier spectrum. Thus features salient in frequency analysis are of importance to perception.

See also Max Mathews, "The Ear and How it Works," *Music Cognition and Computerized Sound: An Introduction to Psychoacoustics*, ed. Perry R. Cook (Cambridge: MIT Press, 2001), 1-10; John Pierce, "Sound Waves and Sine Waves," *Music Cognition and Computerized Sound: An Introduction to Psychoacoustics*, ed. Perry R. Cook (Cambridge: MIT Press, 2001), 37-56.

thirteen sonic "oppositions" and specifically for the analysis of compositions.[2] I have used spectrographs to explore sonic differences in multiple performances of a Hildegard chant, a classical Chinese piece for the qin, and keyboard works by C.P.E. Bach and Beethoven.[3] Many of the essays in Thomas Licata's (ed.) *Electroacoustic Music: Analytical Perspectives* and Mary Simoni's (ed.) *Analytical Methods of Electroacoustic Music* make extensive use of Fourier analysis and spectrographs to analyze non-notated electroacoustic music.[4] None of these publications, however, specifically addresses ways in which a teacher might use this technology in the music theory classroom. How should one introduce the technology to students, and in what context? What musical concepts can be clarified, and how can this technology benefit music theory students? This essay addresses these questions by providing three specific pedagogic applications of Fourier analysis and spectrographs in the music theory classroom. Throughout, I draw upon my personal teaching experience of using this technology with students, focusing on the approaches I have found most successful.

Three specific pedagogic applications are discussed using three different pieces. First, two different performances of Chopin's *Prelude in C minor*, op. 28, no. 20, are discussed in relation to the spectrographic images. Fourier analysis can be extremely useful in highlighting performance differences for students. Second, a spectrographic image of *Hyojo Netori* from the Japanese *Gagaku* piece *Etenraku* is analyzed in relation to instrumental tone color. Fourier analysis can help illuminate the concept of timbre or tone color by providing students with acoustic images, enabling them to

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[2] Robert Cogan, *New Images of Musical Sound* (Cambridge: Harvard University Press, 1984); Robert Cogan, *Music Seen, Music Heard* (Cambridge: Publication Contact International, 1998); Robert Cogan, *The Sounds of Song* (Cambridge: Publication Contact International, 1999).

[3] John Latartara, "Multidimensional Musical Space in Hildegard's 'O rubor sanguinis':Tetrachord, Language Sound, and Meaning," *Indiana Theory Review* 25, nos. 1-2 (2004): 39-74; John Latartara, "Theoretical Approaches Towards Qin Analysis: 'Water and Clouds over Xiao Xiang'," *Ethnomusicology* 49, no. 2 (2005): 232-265; John Latartara and Michael Gardiner, "Analysis, Performance, and Images of Musical Sound: Surfaces, Cyclical Relationships, and the Musical Work," *Current Musicology* 84 (2007): 53-78.

[4] Thomas Licata, Ed., *Electroacoustic Music: Analytical Perspectives* (Westport, CT: Greenwood Press, 2002); Mary Simoni, ed., *Analytical Methods of Electroacoustic Music* (New York, New York: Routledge, 2006).

"see" the sounds of a particular musical passage or piece. Third, spectrographic images are used to explore the non-notated computer piece *Untitled #8* by Markus Popp, in relation to form.[5] Rather than relying solely upon aural perceptions, spectrographs can provide students with pictures of the non-notated computer piece, allowing them to examine, visually, the intensity of frequencies and the progression of the work over time. These three examples highlight what I have found to be the most useful pedagogic applications for this technology in the music theory classroom. I begin with an explanation of Fourier analysis and spectrographic images followed by a brief survey of Fourier analysis and spectrographs in relation to musical analysis.

Fourier Analysis and Spectrographs[6]

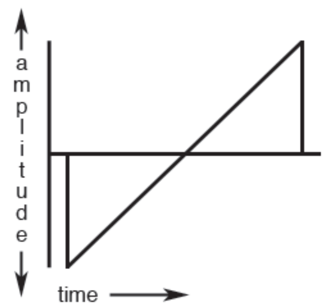
Fourier analysis (also called "spectral" or "spectrum analysis"), named after the mathematician and scientist Jean-Baptiste Joseph Fourier (1768-1830), is the separation of complex phenomena into simple units that, if added together, would re-create the original. Before discussing Fourier's theory in more detail, however, I will explain a few basic acoustic concepts and terms. Sounds can be categorized as simple, harmonic or complex. Simple sounds or sine tones have a single frequency or fundamental with no overtones. For example, a pitch played on a piccolo flute approximates a simple sine-tone sound. Harmonic sounds have two or more partials (fundamental plus one or more overtones) vibrating in whole number ratios. For example a string vibrating harmonically at a fundamental frequency of A 440 Hz (cycles per second) might have two overtones vibrating at 880 Hz (twice as fast) and 1320 Hz (three times as fast). This harmonic relationship is caused by regular or periodic wave motion. Complex or noise-like sounds have irregular or aperiodic wave motion and, therefore, do not

5 Although my musical examples come from a variety of cultures, eras, and genres, I have purposely limited these analyses to instrumental music, as opposed to vocal music or instruments with voice. The unavoidable complexity of language meaning and language sounds require a special focus that would extend beyond the confines of this paper.

6 I am indebted to Dr. Stephen V. Rice at The University of Mississippi and Dr. James P. Chambers at the National Center for Physical Acoustics for their valuable advice and suggestions regarding this section of the paper.

reinforce a single fundamental frequency. White noise is aperiodic and is characterized by all frequencies at equal intensities.

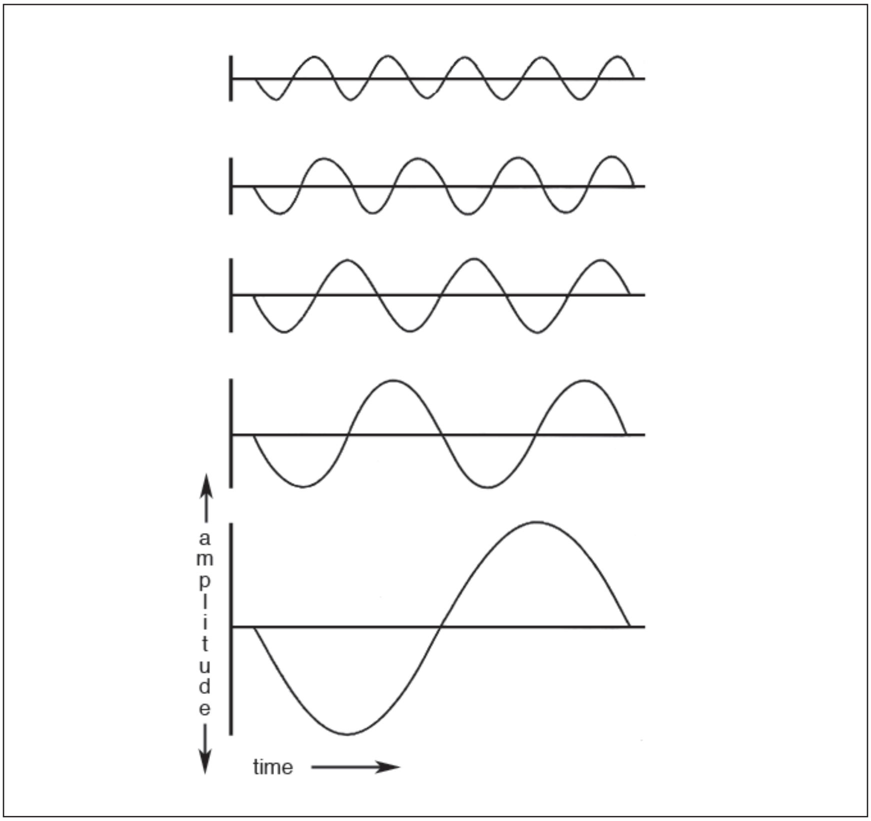
In relation to sound, Fourier's analytical theory states that any harmonic or periodic sound can be separated into simple sine-tone waves that, if added together, would re-form the original harmonic or periodic sound. For each simple sine tone, amplitude and phase are also calculated. Specifically, Fourier analysis is the separation of harmonic or complex sounds into constituent simple sine tones, and Fourier synthesis is the addition of simple sine tones re-creating the original harmonic or complex sound. Examples 1a,b and c show a waveform representation of Fourier analysis.



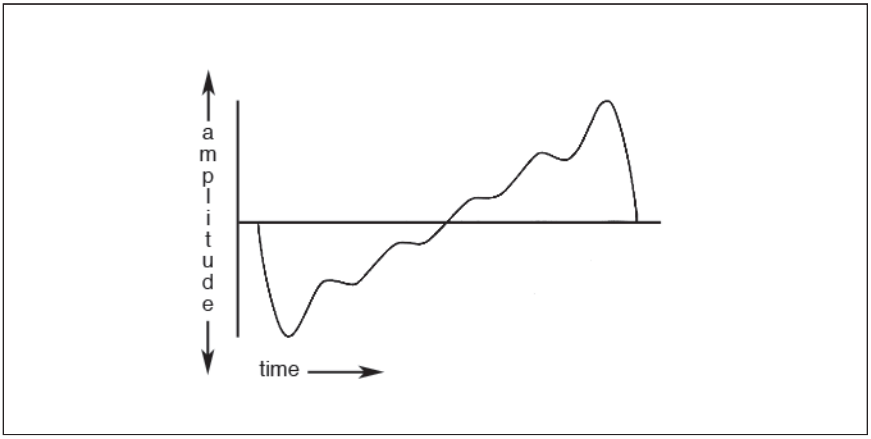
Example 1a - Original Sawtooth Wave

Example 1a shows the original saw-tooth wave and Example 1b separates the original saw-tooth wave into five simple sine tones. Example 1c shows the recombined five sine tones of Example 1b, which approximates the original saw-tooth wave (Example 1a). The concept of "approximation" is an important point. Fourier's theory actually describes the analysis of a wave into an infinite number of partials, but for practical calculation, this infinite number is changed to a finite number. Therefore, Fourier analysis is conceptually exact, but practically an approximation. The more sine tones used for the analysis of the original saw-tooth wave, the closer the approximation is to the original.

There are a variety of ways in which computers can image Fourier analyses of sound, including both static and time-varying images. Static images are like a snapshot of sound, showing the presence and

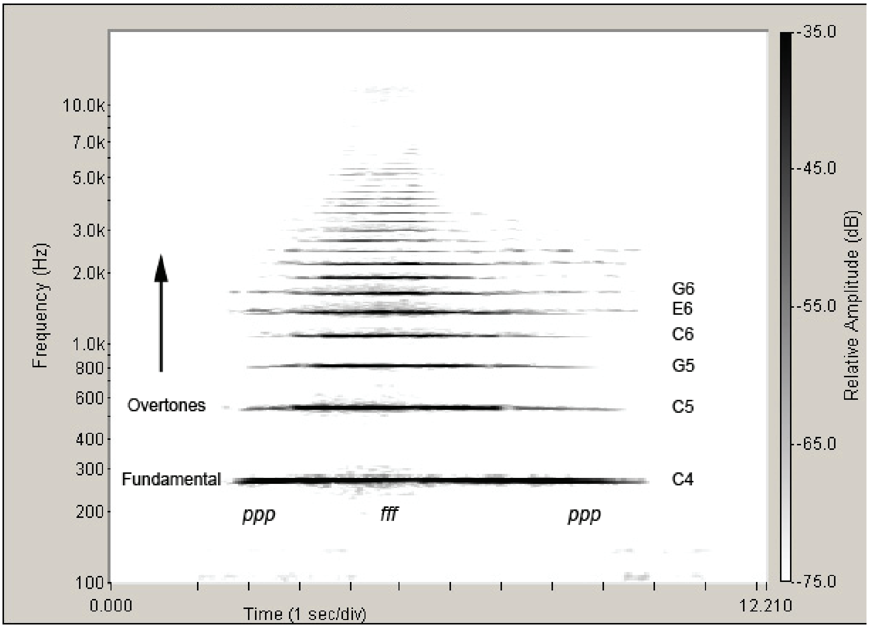


Example 1b - Five Simple Sine-Tones



Example 1c - Recombined Five Sine-Tones

strength of each partial, often displayed as a bar graph. These static analyses, however, are not so musically useful since the spectrum of even the briefest musical sound can change dramatically over time. Time-varying images display the changes of a sound's spectrum over time.[7] One of the most popular and useful time-varying images used today is the spectrograph (also called "sonogram" or "spectrogram"). Spectrographs are three-dimensional Fourier analyses of sound that show frequency and amplitude change over time. Example 2 displays a spectrograph of a flute playing the single pitch C^4, and is the first spectrograph I show when introducing Fourier analysis and spectrographs to students.



Example 2 - Flute playing single pitch C^4

The horizontal axis is time, read from left to right, and the vertical axis is frequency, moving from bottom (lower frequencies) to top (higher frequencies). Also, the relative amplitude or intensity scale is shown on the right side, with black representing the most intense sound, and light grey representing the least intense sound. As indicated in Example 2, the lowest horizontal line is the fundamental of the pitch, C^4, and the upper horizontal lines are the overtones or upper partials,

[7] This is achieved using the Short Time Fourier Transform (STFT). See Eduardo Miranda, *Computer Sound Design: Synthesis Techniques and Programming* (Oxford: Focal Press, 2002), 53.

C^5, G^5, C^6, E^6, G^6, etc. This pitch was played with a dynamic change from *ppp* to *fff* to *ppp*. Notice as the dynamic gets louder, the intensity and number of partials increases, and complex noise-like breath sound, seen as light grey, emerges near specific partials.

There is, however, a critical distinction that students need to understand in relation to the spectrographic image and musical hearing. Spectrographs provide a visual representation of a physical sound signal, while hearing is a human perception. Spectrographs, therefore, do not show us *what* we hear, but rather provide acoustic reasons *why* we hear the sounds we do. For example, a spectrograph may show (like Example 2) a fundamental pitch at 262 Hz with an accumulation of overtones above, as well as complex noise-like sound surrounding specific overtones. This would be perceived as the single pitch C^4 in a crescendo from soft to loud on a flute. The accumulation of many overtones above the fundamental 262Hz, with a strong intensity, and complex breath noise surrounding specific overtones, is the acoustic reason why this particular sound is perceived as the pitch C^4 played soft to loud on a flute. Having explained what Fourier analysis and spectrographs are, I will now present a brief history of Fourier analysis and spectrographs in relation to musical analysis. I usually do not cover these historical details with students, but I have found that understanding the origins of Fourier analysis and spectrographs, conceptually and practically, can help answer many questions students have regarding the technology.

Fourier Analysis, Spectrographs and Musical Analysis[8]

In 1822, Fourier published his landmark thesis entitled *Analytical Theory of Heat*. In this publication Fourier proposed a general theory for the propagation of heat in solid bodies, and extended the wave equation results derived in the eighteenth century to show that any arbitrary function or periodic sound can be represented as an infinite summation of sine and cosine terms.[9] Georg Ohm, in 1843, was the first to apply Fourier's theory to sound analysis. It was not, however, until the second half of the twentieth century that Fourier analysis and spectrographs became practically useful for musical analysis.[10]

In the second half of the twentieth century, Fourier analysis was greatly enhanced both theoretically and technologically by the rediscovery of Gauss's Fast Fourier Transform and the development

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[8] For in depth mathematical treatment of Fourier analysis see David W. Kammler, *A First Course in Fourier Analysis* (Upper Saddle River, New Jersey: Prentice Hall, 2000); Elias M. Stein and Rami Shakarchi, *Fourier Analysis: An Introduction* (Princeton: Princeton University Press, 2003); Loukas Grafakos, *Classical and Modern Fourier Analysis* (Upper Saddle River, New Jersey: Pearson Education Inc and Prentice Hall, 2004). For a more general overview of the mathematical formulas and concepts behind Fourier analysis see Philip Greenspun's Appendix in Curtis Roads, *The Computer Music Tutorial* (Cambridge MA: MIT Press, 1996), 1073-1112; Elena Prestini, *The Evolution of Applied Harmonic Analysis* (Boston: Birkhauser, 2004), 31-63. For biographical information on Joseph Fourier see I. Grattan-Guinness, *Joseph Fourier 1768-1830: A Survey of his Life and Work, Based on the Critical Edition of his Monograph on the Propagation of Heat, Presented to the Institut de France in 1807* (Cambridge MA: MIT Press, 1972), 1-25; John Herivel, *Joseph Fourier: The Man and the Physicist* (Oxford: Clarendon Press, 1975), 5-147; Prestini, *The Evolution of Applied Harmonic Analysis*, 1-29.

[9] Joseph Fourier, *The Analytical Theory of Heat* (New York: Dover, 1955). Fourier first developed his theory on heat in 1807 in a lecture presented to the French Academy of Sciences. The Members of the Academy, however, were not receptive and criticized his ideas. See Roads, *The Computer Music*, 1075 and E. Robinson, "A Historical Perspective of Spectrum Estimation," *Proceedings of the Institute of Electrical and Electronics Engineers* 70/9 (1982): 887.

[10] For early twentieth century developments see Dayton C. Miller, *The Science of Musical Sounds* (New York: MacMillan, 1916); Norbert Wiener, "Generalized Harmonic Analysis," *Acta Mathematica* 55 (1930): 117–258; Carl Seashore, *The Psychology of Music* (New York: Dover, 1938).

of the digital computer.[11] Fast Fourier Transform, or FFT, is an algorithm that calculates the frequency and intensity content of a sound. It is interesting to note that the use of computers specifically for musical analysis coincides with creation of the first computer applications for Fourier analysis in the 1940's.[12] Shortly before World War II, and continuing through the 1940's, groundbreaking results were achieved in the visual representation of Fourier analysis. These advances emerged from the field of phonologic research. Potter, Fletcher, and George and Harriet Kopp, all working at Bell Telephone Laboratories, utilized Fourier analysis technology to create spectrographs or spectrograms of human speech, as well as other sounds, including short musical excerpts.[13] These images are the immediate precursors to contemporary Fourier analysis of music.

In his 1960 attempt to "explain the physical, physiological and psychological portions of the musical happening," Winckel created a number of sonograms to analyze brief musical sounds and passages, including the beginning of Beethoven's Symphony no. 8.[14] In 1965 Cooley and Tukey, also working at Bell Telephone Laboratories, popularized one of the most important theoretical contributions to Fourier analysis (developed by Gauss in 1805), the Fast Fourier Transform or FFT.[15] It is in large part due to the work

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[11] Calculating the orbit of a comet in 1805, the mathematician Karl Gauss used Fourier techniques and employed a modern algorithm now known as the Fast Fourier Transform. This algorithm was revolutionary for Fourier calculation, but remained unpublished and ignored until its rediscovery in 1965 by Cooley and Tukey. See Roads, *The Computer Music Tutorial*, 1076; Elena Prestini, *The Evolution of Applied Harmonic Analysis*, xi.

[12] See Ian Bent, *Analysis* (New York: W.W. Norton and Company, 1987), 64. Bernard Bronson used a computer with punch cards in 1949 to analyze "range, metre, modality, phrase structure, refrain pattern, melodic outline, anacrusis, cadence and final of folksongs..."

[13] Ralph Potter,"Visible Patterns of Speech," *Science* (November 9, 1945); Harvey Fletcher, *Speech, Hearing and Communication* (New York: Van Nostrand, 1953); Ralph Potter, George Kopp and Harriet Kopp, *Visible Speech* (New York: Dover, 1966). See also W. Koenig, H.K. Dunn and L.Y. Lacy, "Sound Spectrograph," *Journal of the Acoustical Society of America* 18 (1946): 19-49.

[14] Fritz Winckel, *Music, Sound and Sensation: A Modern Exposition* (New York: Dover, 1960), 4.

[15] J. Cooley and J. Tukey, "An algorithm for the machine computation of complex Fourier series," *Mathematical Computation* 19 (1965): 297–301.

of Cooley and Tukey, coupled with the speed of digital computers, that Fourier analysis has become a useful and practical option for music analysts today.

With advancements in technology in the late twentieth and early twenty-first centuries, musical analyses using Fourier techniques have become increasingly prevalent. In 1978 Meyer used Fourier analysis to create sonagrams of more extended musical passages, such as mm. 51-71 from Bruckner's Ninth Symphony. Meyer also investigated instrumental spectra and the effect that seating location has on orchestral sound in concert halls.[16] Cogan (1984) became the first to publish a book based solely upon the analysis of complete musical works through Fourier analysis. Using technology developed by IBM's Watson Research Center, he created spectrographs of a variety of pieces from different eras and cultures.[17] By the end of the twentieth century, and beginning of the twenty-first, digital computers and software applications utilizing Fourier imaging techniques improved resolution, accuracy and even added color to the images.[18] Today anyone with access to a computer and the Internet can easily download a variety of software applications to create spectrographic images using Fourier analysis.

Pedagogic Applications of Fourier Analysis and Spectrographs

The following section describes three distinct pedagogic applications of Fourier analysis and spectrographs that I have found to be most useful in the music theory classroom. Analytically, my discussions of the pieces are similar; spectrographs show the entire frequency content for a sound and my analyses, therefore, detail specific frequency content of each performance and piece. In general, this is the important virtue of this technology for theory students – the images allow students to visualize the entire frequency content of any piece they are studying. Pedagogically, my focus is different for each piece. Chopin's *Prelude in C minor*, op. 28, no. 20, focuses on performance differences, the Japanese *Gagaku* piece *Hyojo Netori* from *Etenraku*, explores instrumental tone color, and the computer work *Untitled #8* by Markus Popp examines the form of a non-notated work.

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[16] Jurgen Meyer, *Acoustics and the Performance of Music* (Frankfurt: Verlag Das Musikinstrument, 1978).

[17] Cogan, *New Images of Musical Sound.*

[18] Cogan, *Music Seen, Music Heard*; Cogan, *The Sounds of Song*; John Latartara, *Instrumental Tone Color: A Spectrographic Exploration* (D.M.A. Dissertation, New England Conservatory of Music, 2002).

Before showing students a spectrograph of a complete musical work, however, I have found it essential to stress another important concept. Fourier analyses and spectrographic images are best thought of as *models* of each performance or work. The approximations inherent in Fourier analysis calculation, as well as the variety of settings possible for most Fourier software programs (including dynamic sensitivity, frequency range, and micro or macro perspective), force us to concede that each spectrograph is a possible image of the given recording, but certainly not the only one. I try to create a balance between what the image displays and what the listener perceives, while highlighting the salient features of the work.

Score and Performance: *Prelude in C minor*, op. 28, no. 20 by Chopin

Traditionally, the study of form and analysis, especially at the undergraduate level, has been oriented toward the score. While this approach is certainly useful, and in many instances necessary, it can also have the detrimental effect of marginalizing other important elements such as the sound of the piece, and/or performance decisions. One effective way to engage students with these performance issues is to play and show them images of two different performances of the same piece.[19] The following discussion

[19] An increasingly rich body of literature within the analytic community has emerged that specifically attempts to draw connections between analysis and performance. These publications have included Janet Schmalfeldt, "On the Relation of Analysis to Performance: Beethoven's Bagatelles Op. 126, Nos. 2 and 5," *Journal of Music Theory* 29/1 (1985): 1-31; Wallace Berry, *Musical Structure and Performance* (New Haven: Yale University Press, 1989); Cynthia Folio, "Analysis and Performance of the Flute Sonatas of J. S. Bach: A Sample Lesson Plan," *Journal of Music Theory Pedagogy* 5/2 (1991): 133-59; Cynthia Folio, "Analysis and Performance: A Study in Contrasts," *Integral* 7 (1993): 1-37; Carl Schachter, "Chopin's Prelude in D Major, Opus 28, No. 5: Analysis and Performance," *Journal of Music Theory Pedagogy* 8 (1994): 27-45; Jonathan Dunsby, "Performance and Analysis of Music," *Music Analysis* 8/1-2 (1989): 5-20; Jonathan Dunsby, *Performing Music: Shared Concerns* (Oxford: Oxford University Press, 1995); Nicholas Cook, "Structure and Performance Timing in Bach's C major Prelude (WTC I): An Empirical Study," *Music Analysis* 6/3 (1987): 257-272; Nicholas Cook, "Analyzing Performance and Performing Analysis," *Rethinking Music*, ed. Nicholas Cook (Oxford: Oxford University Press, 1999), 239-261; John Rink ed., *The Practice of Performance: Studies in Musical*

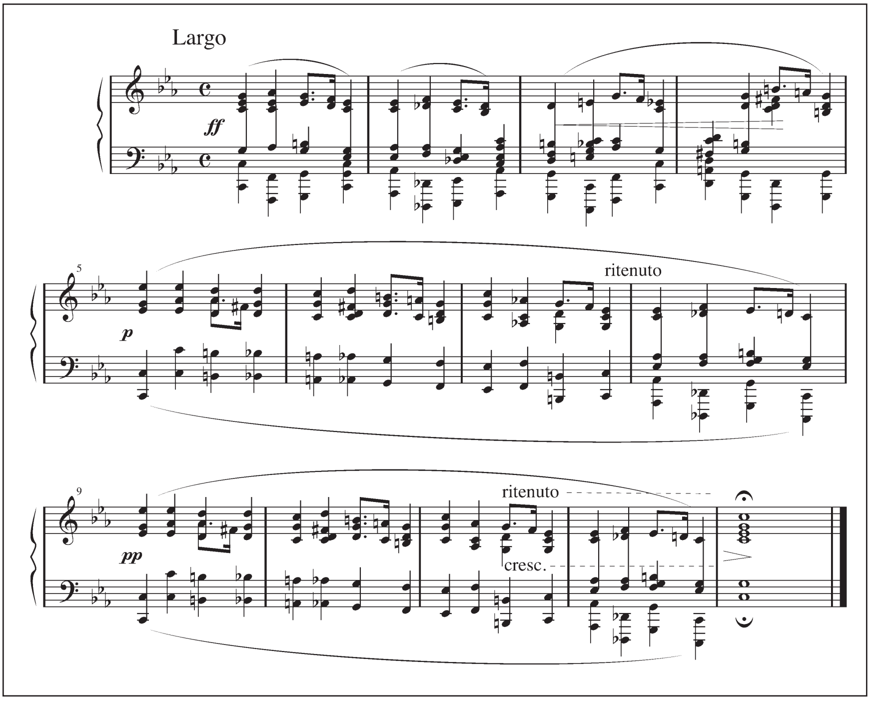
compares two performances of Chopin's *Prelude in C minor*, op. 28, no. 20 played by Cortot and Pollini. I have found these images extremely helpful for my undergraduate Form and Analysis class. The images help to reinforce not only what is aurally perceived by the student (dynamic and tempo differences), but also to reveal the acoustic reasons for their perceptions. Through the spectrographic images, parallels and discrepancies between each performance, and between performance and score are highlighted.[20] A useful distinction between score and spectrograph lies in their functional differences. In terms of performance, the score is *prescriptive*, but the spectrograph is *descriptive*.

Interpretation (Cambridge: Cambridge University Press, 1995); John Rink ed., *Musical Performance: A Guide to Understanding* (Cambridge: Cambridge University Press, 2002); John Latartara and Michael Gardiner, "Analysis, Performance and Images of Musical Sound."

[20] Over the past thirty-five years, Chopin studies have used an extraordinary variety of analytical methods. See Edward T. Cone, *Musical Form and Musical Performance* (New York: W.W. Norton and Co., 1968), 34-35; Robert Cogan and Pozzi Escot, *Sonic Design: The Nature of Sound and Music* (Englewood Cliffs NJ: Prentice Hall, 1976), 2-14; Lawrence Kramer, *Music and Poetry: The Nineteenth Century and After* (Berkeley: University of Berkeley Press, 1984), 91-117; Jim Samson, ed., *Chopin Studies* (Cambridge: Cambridge University Press, 1988); Harald Krebs, "Tonal and Formal Dualism in Chopin's Scherzo, Op. 31," *Music Theory Spectrum* 13/1 (1991): 48-60; Carl Schacter, "Chopin's Prelude in D Major, Opus 28, No. 5: Analysis and Performance," *Journal of Music Theory Pedagogy* 8 (1994): 27-45; John Rink and Jim Samson, eds., *Chopin Studies 2*, (Cambridge: Cambridge University Press, 1994); William Rothstein, "Ambiguity in the Themes of Chopin's First, Second, and Fourth Ballades," *Integral* 8 (1994): 1-50; John Rink, "Chopin's Ballades and the Dialectic: Analysis in Historical Perspective," *Music Analysis* 13 (1994): 99-115; Rose Rosengard Subotnik, *Deconstructive Variations: Music and Reason in Western Society* (Minneapolis: University of Minnesota Press, 1996); Laurie Suurpaa, "The Path from Tonic to Dominant in the Second Movement of Schubert's String Quintet and in Chopin's Fourth Ballade," *Journal of Music Theory* 44/2 (2000): 451-485; J.A. Sloboda and A.C. Lehmann, "Tracking performance Correlates of Changes in Perceived Intensity of Emotion During Different Interpretations of a Chopin Piano Prelude," *Music Perception* 19 (2001): 87-120. I am unaware of any attempt to approach the music of Chopin using Fourier analysis and spectrographs. For a critical score and historical context specifically regarding the preludes Op. 28 see Thomas Higgins ed., *Frederic Chopin Preludes, Opus 28: An Authoritative Score, Historical Background, Analysis, Views, and Comments* (New York: W.W. Norton & Company, 1973). For a general overview of Chopin and his music see Jim Samson, *Chopin* (New York: Schirmer Books, 1996).

Before analyzing the spectrographic images, I play both performances and ask students for their initial aural impressions. While one or two students usually point out the dynamic differences created by Cortot and Pollini, most seem unsure or hesitant about the performance differences. After analyzing the performance images, students immediately recognize the striking differences between each performance and appear more confident in their aural impressions. The images reinforce and help guide the student's listening.

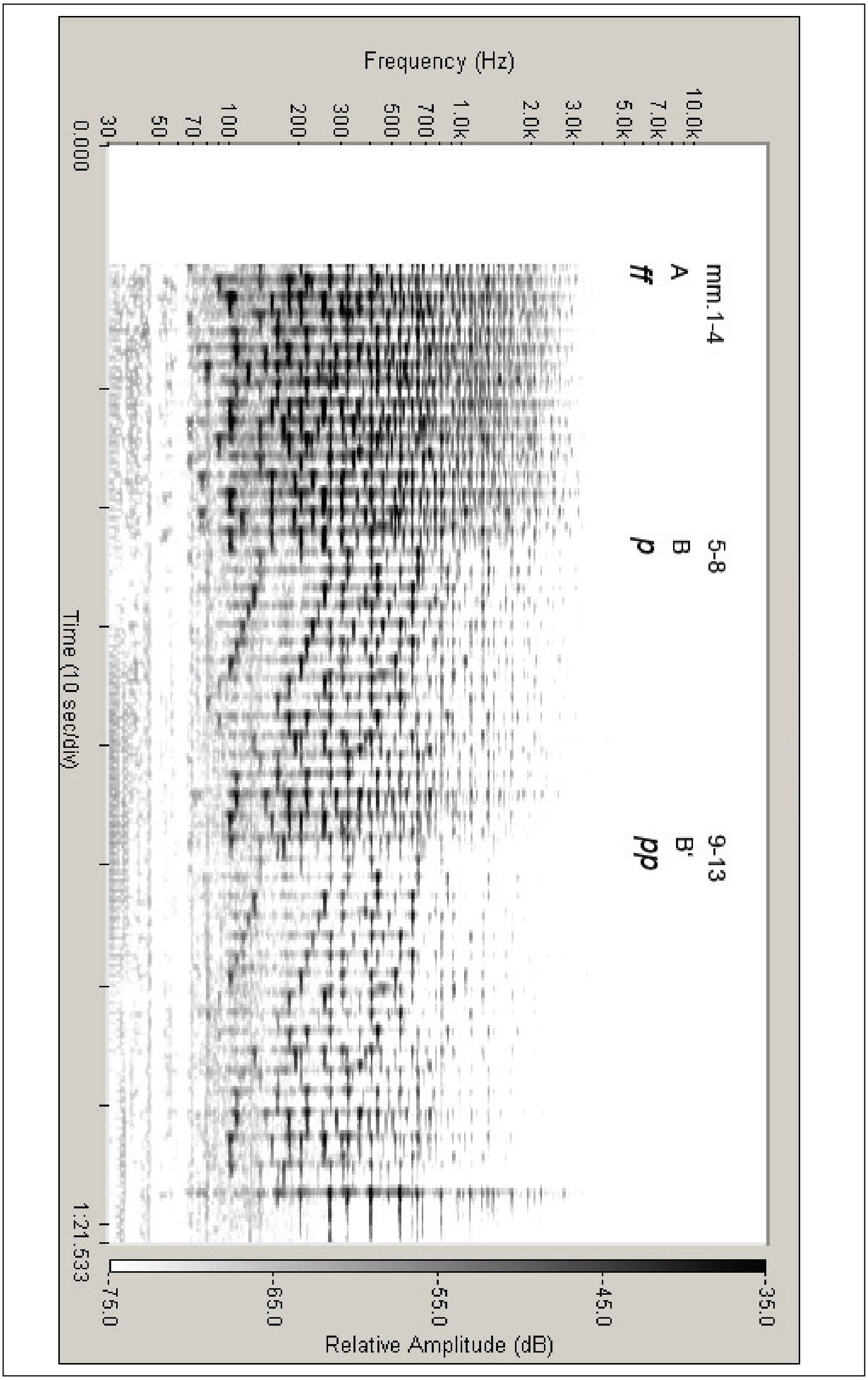
Example 3 shows the score of Chopin's *Prelude in C minor*, op. 28, no. 20 and Example 4 shows a spectrograph of a performance of that work by Cortot.[21]



Example 3 - Score of Chopin's *Prelude in C minor*, op. 28, no. 20

The prelude consists of two, four-measure phrases (A, bars 1-4, and B, bars 5-6) of different musical material, with the second

[21] Frederic Chopin, *Cortot plays Chopin: The Legendary 1925-1929 Recordings* (recorded 1926 for HMV), Alfred Cortot (Berkeley: Music and Arts Programs of America, Inc., 1987), 317. 0-17685-48712-5 (reissue of discontinued CD-317). I created all spectrographic images using Soundtechnology software.



Example 4 - Spectrograph of Cortot performing Chopin's *Prelude in C minor*, op. 28, no. 20

phrase B repeated (B′, bars 7-13).[22] Each of these three phrases is aligned with a different dynamic level, *ff*, *p*, *pp*, as shown in the score and revealed by the spectrograph.

Cortot's performance (Ex. 4) clearly projects three different dynamics, one for each phrase. Section A, mm. 1-4, is the loudest, as revealed by the intense spectra of black or dark grey, reaching as high as 2.5-3.0 kHz. Section B, mm. 5-8, is played softer with spectra becoming less intense (light grey) and predominating in the 2.0-2.5 kHz region. Finally, Section B′, mm. 9-13, is the softest section, shown by even less intense spectra (lighter grey) reaching only as high as 1.5-1.8 kHz. At each successive section Cortot decreases the intensity of the sound equally, resulting in a steady reduction in the number of upper partials by about 500 Hz (3.0kHz, to 2.5 kHz to 1.8 kHz). Notice also that the final chord in m. 13 is played much louder than Section B and B′, equal in intensity to Section A with spectra reaching just under 3.0 kHz.[23] Overall, Cortot creates an equal reduction of intensity for each section, ending with a suddenly louder final chord. How does Chopin's score indicate

[22] Although the rhythmic motive of section A is also present throughout section B, the differences in outer melodic motion, dynamics, register, and density justifies the "section B" label. The repeat of mm. 5-8 at *pp* was added later at the suggestion of the French writer on music Francois-Henri-Joseph Blaze. Chopin in the autograph of this prelude wrote, "note for the publisher of the rue Rochechaurt: small concession made to Mr. XXX [Blaze] who is often right." See Higgins, *Frederic Chopin Preludes*, 68 and Frederic Chopin, *Complete Preludes and Etudes for Solo Piano: The Paderewski Edition*, eds. Paderewski, Bronarski, and Turczynski (New York: Dover, 1980), 190. In certain editions for students Chopin crossed out mm. 9-13. This would lend credence to the analysis of the C minor prelude as essentially binary in nature. Even with the addition of mm. 9-13, the exact repetition of material and subtle dynamic shift help to corroborate this binary viewpoint.

[23] Cortot's interpretation of this last chord is not surprising as we read from his own writing, "Two interpretations of the last chord are allowed – the first savagely definite, the second *piano* and indecisive." See Alfred Cortot, *Alfred Cortot's Studies in Musical Interpretation*, ed. Jeanne Thieffry (New York: Da Capo Press, 1989), 51. In Cortot's own edition of this Prelude he indicates a decrescendo in m.12 and what appears to be another short decrescendo, or accent, in m.13. Cortot apparently interprets this mark in m.13 as either a decrescendo or accent, thus providing two performance options. See Frederic Chopin, *24 Preludes Op. 28*, ed. Alfred Cortot (Paris: Editions Salabert, 1926). I wish to thank pianist Dr. Jon Sakata for his perceptive comments regarding not only this final chord, but also Chopin's C minor prelude in general.

the dynamic contrasts just described?[24]

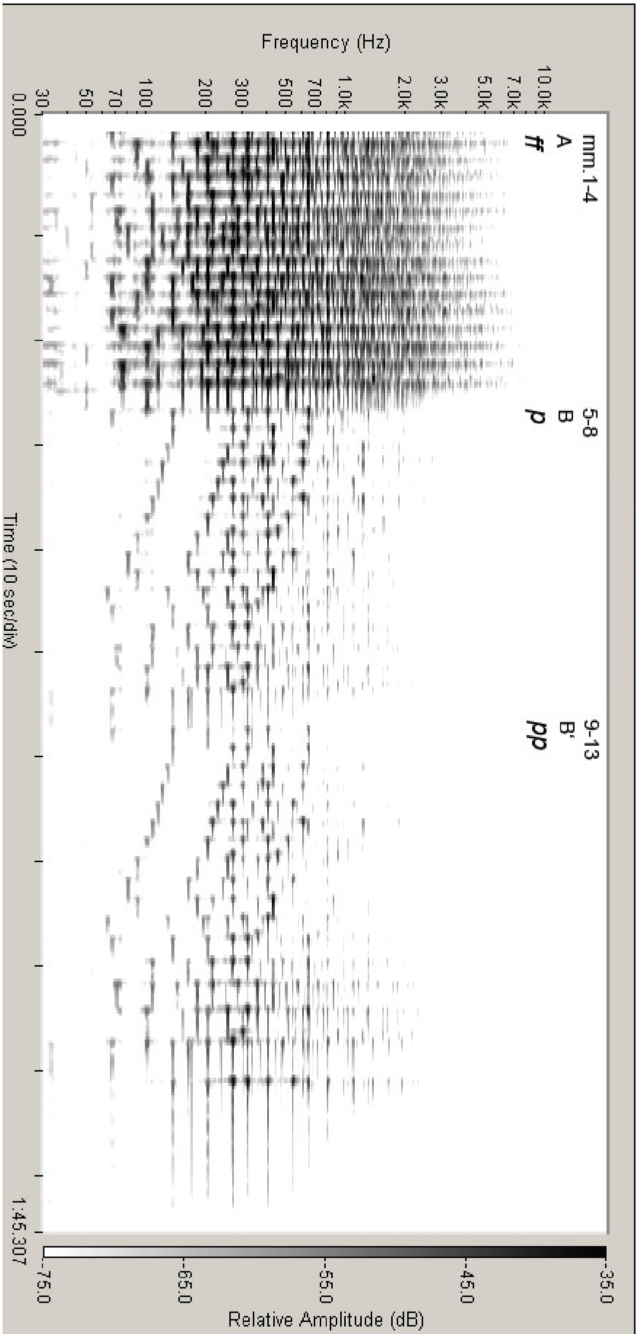
Rather than an equal decrease in intensity, the score indicates an extreme dynamic drop from *ff* to *p* between Sections A and B, and then a subtle dynamic drop from *p* to *pp* moving from Section B to B′. As discussed above and shown by Example 4, Cortot chooses to create an alternate dynamic structure of equal contrasts. Furthermore, the score indicates a crescendo at mm. 3-4 and mm. 11-12. Cortot subtly projects a crescendo in mm. 3-4 as seen by the slight increase in upper partials towards the end of Section A, but ignores the crescendo in mm. 11-12. Finally, the last chord in m. 13 is marked with a decrescendo or, according to Cortot, an accent, as a whole note with fermata. Cortot plays this chord accented, but with a duration of one half note. Cortot's performance systematically alters what is indicated in the score, creating an interpretation defined by a gradual decrescendo, resulting in a gradual darkening of sound, followed by a suddenly loud accent on the final chord, which is quickly released.

Example 5 shows the same prelude performed by Pollini.[25] In Pollini's performance, Section A is played loudest, seen as black with intense spectra reaching as high as 6.0-6.5 kHz.[26] Section B, however, is played much more softly, seen as grey, with upper partials reaching only as high as 1.5-2.0 kHz. Section B′ is played slightly softer than Section B, seen as slightly lighter grey, decreasing the upper partials to a peak of 1.0-1.5 kHz. Unlike Cortot, Pollini

[24] It is important to make clear that I am not equating the "score" with the "work" and do not place any final authority with the score over a performer's interpretation. In relation to this analysis, I am comparing the indications of the score, specifically regarding dynamics, with each performance. Just as each spectrograph is a model of the performance, each performance and score is a model of "the work".

[25] Frederic Chopin, *Chopin Preludes*, Maurizio Pollini (Deutsche Grammophon, 1975), 413796-2.

[26] Differences in upper partial peaks between Cortot (3.0 kHz) recorded in 1926 and Pollini (6.5 kHz) recorded in 1975 are related to recording equipment used at the time, and not a measurement for absolute spectral/dynamic content between the two performances. As opposed to modern recording equipment, earlier equipment captured a narrower spectral/dynamic range with an upper partial peak at approximately 5.0 kHz. The relative spectral/dynamic relationships revealed within each performance, however, are still valid. See Peter Johnson, "The Legacy of Recordings," *Musical Performance*, ed. John Rink (Cambridge: Cambridge University Press, 2002), 197-212.



Example 5 - Spectrograph of Pollini performing Chopin's *Prelude in C minor*, op. 28, no. 20

creates a dramatic dynamic/spectral drop from section A to B, followed by a subtle dynamic/spectral drop from B to B′. In addition, Pollini projects a slight crescendo at mm. 3-4, shown by the increase in partials at the end of Section A from 5.0 to 7.0 kHz, and also at mm. 11-12, shown by the increase in intensity and partial peak at the end of Section B′ moving from 1.0 to 2.0 kHz. Like Cortot, Pollini plays the final chord louder and slightly accented. Rather than a sudden dynamic increase, he smoothly leads into it from the crescendo beginning at m. 11. Finally, as indicated by the score, Pollini holds the final chord for the entire whole-note duration. Overall, Pollini projects more literally what is indicated in the score. If an accurate translation from score to sound is the main criterion for a good performance, Pollini's interpretation might be preferred. This viewpoint, of course, places ultimate authority with the score. If sensitive and creative playing are the main criteria for a good performance, certainly both Cortot and Pollini are fine.

Spectrographic images provide a useful pedagogic application for performance analysis, allowing the visualization of detailed frequency and intensity content that help reinforce and guide aural perceptions. It is important for students to connect the sound with the image, and the image with the sound. Sometimes I will play the second recording and ask them to surmise what they think the image will look like, or show them the image and have them describe how it will sound. This helps to sensitize students to both the acoustic sound and their own musical perceptions, encouraging them to hear beyond the score into dramatic and subtle performance differences.

Tone Color and the Japanese *Gagaku* piece *Hyojo Netori*

Tone color is both ubiquitous and elusive. It is a constant element in all music, but has been historically and pedagogically difficult to discuss in any comprehensive way. Classroom discussions of tone color tend to rely only on aural perceptions and score analyses of instrumentation and texture. By examining the musical sound through Fourier analysis, students can see the acoustic reasons why a certain passage or piece may sound bright or dark, simple or complex. This helps to demystify the concept of tone color by making it more concrete, allowing the teacher and student to discuss tone color in terms of specific frequency strength and weakness. The following analysis, which I have used in graduate music theory seminars, explores the Japanese *Gagaku* piece *Hyojo Netori* from the perspective of tone color. I use a non-Western piece when introducing tone color for two reasons: in order to expose students to non-Western music, and to minimize cultural biases students may have regarding Western composers and music they feel they already know. In this way I create a more even playing field for musical discovery (as long as there are no ethnomusicology students in the seminar!). Following *Hyojo Netori* I move on to the more familiar Western repertoire. Using spectrographs, Cogan presents a theory of tone color based upon thirteen sonic oppositions.[27] While his theory is certainly useful, I do not teach it to my students because its detailed nature requires more time and explanation than a general graduate analysis seminar usually allows.

I begin our tone color discussion by asking students to describe in words the way the piece sounds. Responses like "bright, dark, mellow," and "sharp" are typical. While these descriptions are important, after examining the spectrographic images students begin connecting their descriptors with the acoustic bases for their perceptions. Later in the discussion I often encounter students discussing the "higher, stronger overtones" that relate to the "brighter" sound, or the simple "sine-tone like" sound relating to a "duller" sound. This is an important accomplishment because it gives students the technical language that they need to connect the percept of a sound with the physical sonic signal.

Gagaku or "elegant music" is a form of traditional Japanese court music, and stems from an aural tradition that emphasizes the transmission of music from teacher to student.[28] *Gagaku* can be

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[27] Cogan, *New Images of Musical Sound*.

[28] Haruko Komoda and Mihoko Nogawa, "Theory and Notation in Japan," *The Garland Encyclopedia of World Music Volume 7: East Asia: China, Japan and Korea,* eds. Robert C. Provine, Yosihiko Tokumaru, and J. Lawrence Witzleben (New York: Routledge, 2002), 573; Naoko Terauchi, "Gagaku," *The Garland Encyclopedia of World Music Volume 7: East Asia: China, Japan and Korea*, eds. Robert C. Provine, Yosihiko Tokumaru, and J. Lawrence Witzleben (New York: Routledge, 2002). As Terauchi states, "In *gagaku*, as in Japanese music in general, oral transmission is of primary importance; written scores are secondary" (626). *Syoga* is a type of transmission system used by Japanese musicians that is unique for each instrument and is considered the first step towards learning a traditional instrument. Although some parallels to Western *solfege* can be drawn, *syoga* syllables do not necessarily correspond to absolute or relative pitch.

divided into three categories. The first is indigenous songs and dances such as *mikagura* and *azuma asobi*. The second is foreign music and dance such as *togaku* and *komagaku*. The third is vocal music of both indigenous and foreign origin such as *saibara* and *roei*. Dating back to the sixth century, *Togaku* pieces are from Chinese origin, and exist as instrumental music called *kangen*, or as accompaniment to dance called *bugaku*.[29] *Hyojo Netori* is an introductory piece from the famous *togaku* work, *Etenraku*. *Hyojo* indicates a specific mode, and *Netori* indicates a short composition in free rhythm played prior to a longer piece.[30] The title *Hyojo Netori*, therefore, describes the type, rhythm and mode of the work. Although the entire work reiterates the same pitch-class set of the *Hyojo* mode, three distinct sections are created, largely through instrumental combinations that result in three distinct tone-color profiles. What emerges is a fascinating variety of tone-color differences, achieved through instrumentation, which ultimately defines the form of the work.[31]

Example 6 shows a spectrograph of a performance of *Hyojo Netori*.[32]

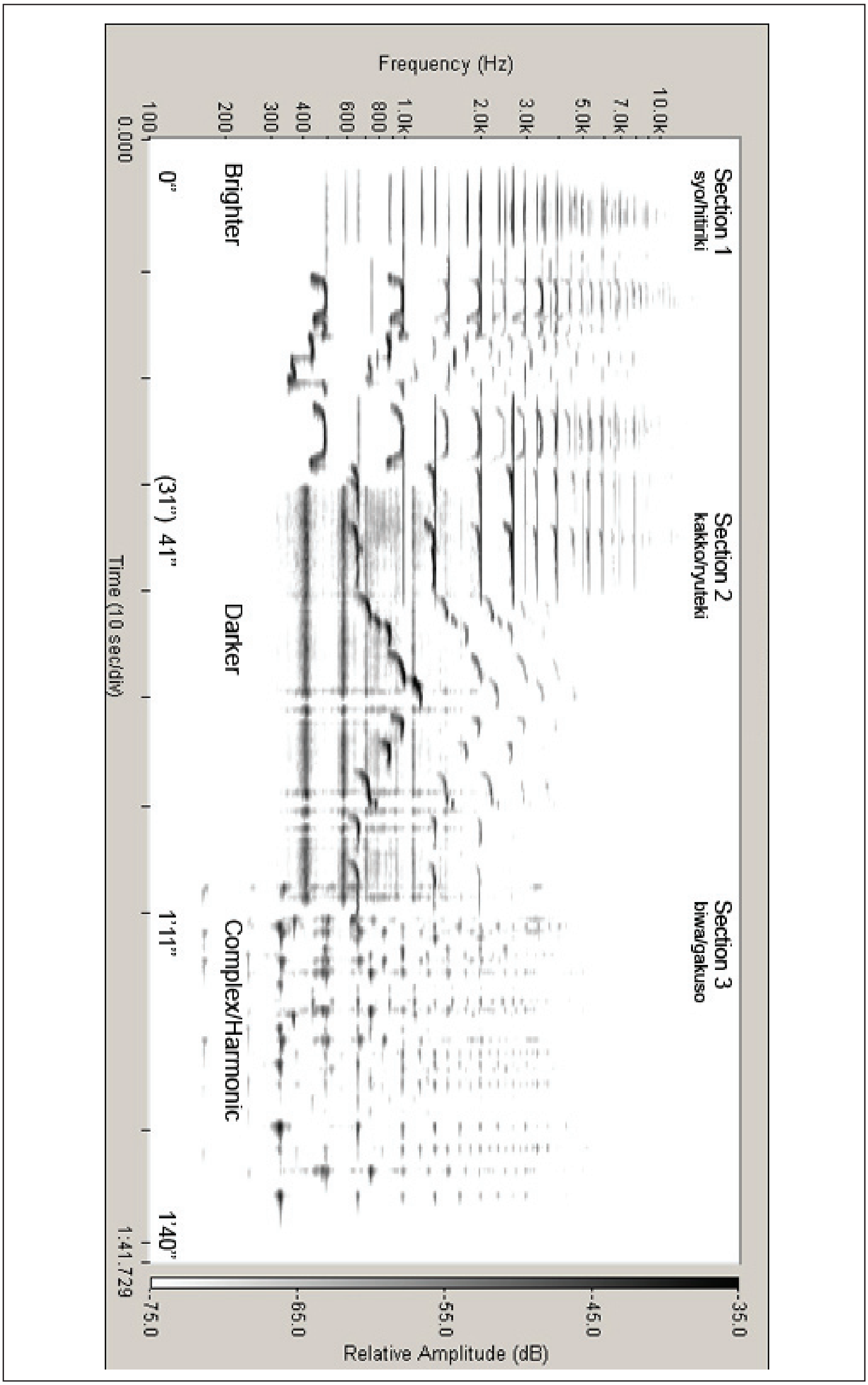
In addition, *syoga* syllables also indicate tonal range, tone color, melodic ornamentation, and playing technique. See Yuko Kamisango, "Oral and Literate Aspects of Tradition Transmission in Japanese Music: With Emphasis on Syoga and Hakase," *The Oral and the Literate in Music*, eds. Tokumaru Yosihiko and Yamaguti Osamu (Tokyo: Academia Music LTD, 1986), 288-299.

[29] Terauchi, "Gagaku", 619-620.

[30] *Hyojo* is one of the "six modes" from the *ritu* group of modes. The mode of *Hyojo*, as a pentatonic collection in the tuning for *gagaku* instruments, contains the pitches E, F#, A, B, and C#. This pentatonic collection, however, may also be expanded to include the pitches G and D creating a heptatonic collection. See Komoda and Nogawa, "Theory and Notation in Japan," 566-567.

[31] For detailed discussions of *gagaku* instruments see Terauchi, "Gagaku," 620-625 and Robert Garfias, *Music of a Thousand Autumns: The Togaku Style of Japanese Court Music* (Berkeley: University of California Press, 1975), 35-56.

[32] *Gagaku: Traditional Japanese Music*, King Records Kich (Tokyo, Japan, 2001, recorded 1990).



Example 6 - Spectrograph of a performance of *Hyojo Netori*

Section 1, lasting from 0′′ to approximately 41′′, is characterized by two distinct instrumental spectra. The *syo*, a mouth organ, begins by playing chords that result in rich harmonic spectra, seen as grey horizontal lines extending from 500 Hz up to 10.0 kHz. The *hitiriki*, a double reed instrument, enters next playing the main melodic part and is shown by thicker, black horizontal lines. This melody also uses glissandi (called *embai*) to slide into and out of notes, a typical technique for the instrument.[33] The *hitiriki* also has a rich spectral profile creating a large amount of partials stretching from the first fundamental at 500 Hz to the upper partials reaching 8.0 kHz. Section 1 overlaps into the next section with the introduction of the *kakko*, a double-headed cylindrical drum, and the *ryuteki*, a transverse flute. The *kakko*, which enters at 31′′, creates two strong harmonic partials seen as straight horizontal lines between 400 and 600 Hz, but also as complex spectra between 600 Hz and 1.0 kHz. The *ryuteki* also enters at 31′′, but on the same pitch as the *hitiriki* reinforcing the harmonic spectrum.

Section 2 lasts from approximately 41′′ to 1′11′′ and uses the *ryuteki* (transverse flute) and the *kakko* (drum). The *ryuteki*, like the *hitiriki*, plays the melody, and is shown by harmonic spectra with glissandi arching upwards and then down, creating a pyramid-like shape. The *ryuteki*, however, is much less spectrally rich than the *hitiriki*, displaying only 3-4 partials and dramatically reduces the upper partial peak, from 10.0 kHz (created by the *syo*) in Section 1, to 4.0 kHz in Section 2. This results in a shift from a brighter to darker sound. The *kakko*, as discussed previously, combines harmonic spectra in the lower region, from 400 to 600 Hz, with more complex spectra in the upper region, from 600 Hz to 1.5 kHz. From Section 1 to Section 2, therefore, a spectral shift occurs from rich, brighter harmonic spectra created by the *syo* and *hitiriki*, to less rich, darker harmonic/complex spectra created by the *ryuteki* and *kakko*.

Section 3, lasting from 1′11′′ to 1′40′′, is characterized by two plucked string instruments, the *biwa* and *gakuso*. Together these instruments create harmonic/complex spectra at the attack, and shorter harmonic spectra for the body and decay. Unlike the previous two sections, which use longer sustained pitches, Section 3 creates shorter pitches with more space between. It is interesting to note that the initial plucking or percussive attack of the *biwa* and *gakuso* is reminiscent of the attack of the *kakko* drum. The *kakko's*

[33] Terauchi, "Gagaku," 622.

spectral profile could be viewed as a foreshadowing of tone color, which leads into the *biwa* and *gakuso*. The spectrum for Section 3 encompasses a total range from 300 Hz to 3.0 kHz, but there are also resonating lower octaves that extend down to 150 Hz.

Overall, therefore, Section 1 begins with a brighter sound and predominance of harmonic spectra with many partials. Section 2 exhibits a darker sound, with a dramatic reduction of upper partials, and the introduction of harmonic/complex spectra. Finally Section 3 presents a mosaic of complex/harmonic attack sounds, followed by a brief harmonic body and decay with a sparser density. Each distinct instrumental pairing creates a unique tone color, which can be heard in performance and also seen in the spectrographic image.[34]

Tone color is, perhaps, the most difficult musical domain to discuss and teach. These images can be used to focus both the concept of tone color and classroom discussion, elevating the level of discourse from individual perceptions to concrete acoustic understandings. What at first seems to students a somewhat mystical musical element is clarified through the spectrograph into an acoustic representation of musical sound. By visually analyzing the frequency and intensity content of a musical work, students gradually move beyond mere descriptors of tone color to analyses of the physical signal. These physical analyses, made possible by

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[34] *Zyo ha kyu* is a three-section form concept found in Japanese books on art theory. *Zyo* acts as the introduction, *ha* the exposition, and *kyu* the conclusion. This three-section form also applies to music, and is a fundamental part of *gagaku* and Japanese musical structure in general. See Mari Shimosako, "Philosophy and Aesthetics," *The Garland Encyclopedia of World Music Volume 7: East Asia: China, Japan and Korea*, eds. Robert C. Provine, Yosihiko Tokumaru, and J. Lawrence Witzleben (New York: Routledge, 2002), 546-547 and 554; Komoda and Nogawa, "Theory and Notation in Japan," 571. As shown by the figure below, *Hyojo Netori* can be viewed in two ways; as the *Zyo*, or the beginning part in a much larger form, and as a projection of *zyo ha kyu* itself expressed through the systematic use of each instrumental combination.

Section	1	2	3
Instruments	syo/hitiriki	ryuteki/kakko	biwa/gakuso
Form	zyo		
	(zyo	ha	kyu)

Hyojo Netori projects this *zyo ha kyu* structure, revealing a direct link to Japanese art theory.

the spectrographic image, can then be used to formulate structural models of the musical work and performance. Both student and teacher can intelligibly explore the tone color design of any musical work.

Computer Music Without Score: *Untitled #8* by Markus Popp

Unlike traditionally-notated Western music realized by a performer, or music learned and sustained through aural traditions, music created using computers is often completely non-notated, rarely transcribed, and exists only in playback or as a digital file.[35]The computer and other digitized mediums have created a culture of composers whose works exist entirely in the digital realm. This type of music presents many challenges for the music theory teacher and student. How can these non-notated computer pieces be discussed and analyzed in the classroom without relying completely on aural impressions? One way would be to ask students to transcribe the piece using conventional or invented symbols that they feel best represents the sounds they hear. This can certainly be useful as a first step in the analytical process, but the results are still students' impressions, though now more formally organized. Fourier analysis and spectrographs can be of help by allowing us to make images of the work that provide acoustic evidence to explain our musical perceptions. Once imaged, the precise frequency content of the piece can be studied and both small and large-scale issues of form can be discussed through both aural and visual analyses. The computer generated piece *Untitled #8* by Markus Popp from his CD *Ovalprocess* is analyzed in relation to both small-scale content and the large-scale form.

Having used this piece in graduate music theory seminars, I have found the visualization of non-notated computer music to be one of the most useful pedagogic approaches for this technology. Before analyzing the spectrographic image, my students' first aural impressions of this piece are always extreme. They describe it as "just noise" or "chaos" or "sounds like a dentist drilling my teeth!" After examining the image the structure and even the harmonic elements of the piece are much more easily recognized. The images help to clarify the initial onslaught of frequencies and sounds that students hear, enabling both detailed classroom discussion and analytical projects.

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[35] Issues of performance practice for computer music are, however, still relevant, placing the emphasis on the quality of the source file (sample and bit rate) and quality of playback equipment.

(One student who chose the piece for her final project admitted that, after a while, she even "enjoyed" listening to it.)

Ever since the CD's *Diskont* and *Systemisch*, German composer Markus Popp, working under the name Oval, has been at the forefront of the laptop computer music revolution.[36] *Diskont* and *Systemisch* were created using, among other things, sampled sounds of skipping CD's. These skipping sounds were used to create pulses in the music. Popp intentionally scratches CD's in order to record these skips for his music. Journalists, therefore, label his music and the musical genre he created "glitch music". *Ovalprocess* is both a CD and software designed as, "…a model of how I work."[37] Popp views computer code and operating systems rather than artistic or musical concepts as more influential on the sonic outcome of his work.[38] As Popp has stated, "I'm less of a composer than I am a navigator, or a person who's working with a certain setup where it's more about coming up with a strategy in this setup, than creating innovative electronic music as part of an aesthetic."[39]

This strategy includes the editing and assembling of small audio files gathered from his collection of thousands on his Macintosh laptop to create longer files. These longer files are then arranged in standard audio sequencers (Logic Audio, Digital Performer, etc.), often as repeating loops, to create musical works. With *Ovalprocess*, Popp intentionally limited himself to certain parameters, including the use of guitar, organ, and feedback sounds. No score was created for *Untitled #8*, and it exists only on CD or as a digital file.

Example 7 shows a spectrographic detail from the beginning of *Untitled #8*. The work begins with complex spectra extending from 20 Hz to slightly above 2.0 kHz, seen as bands of black and grey,

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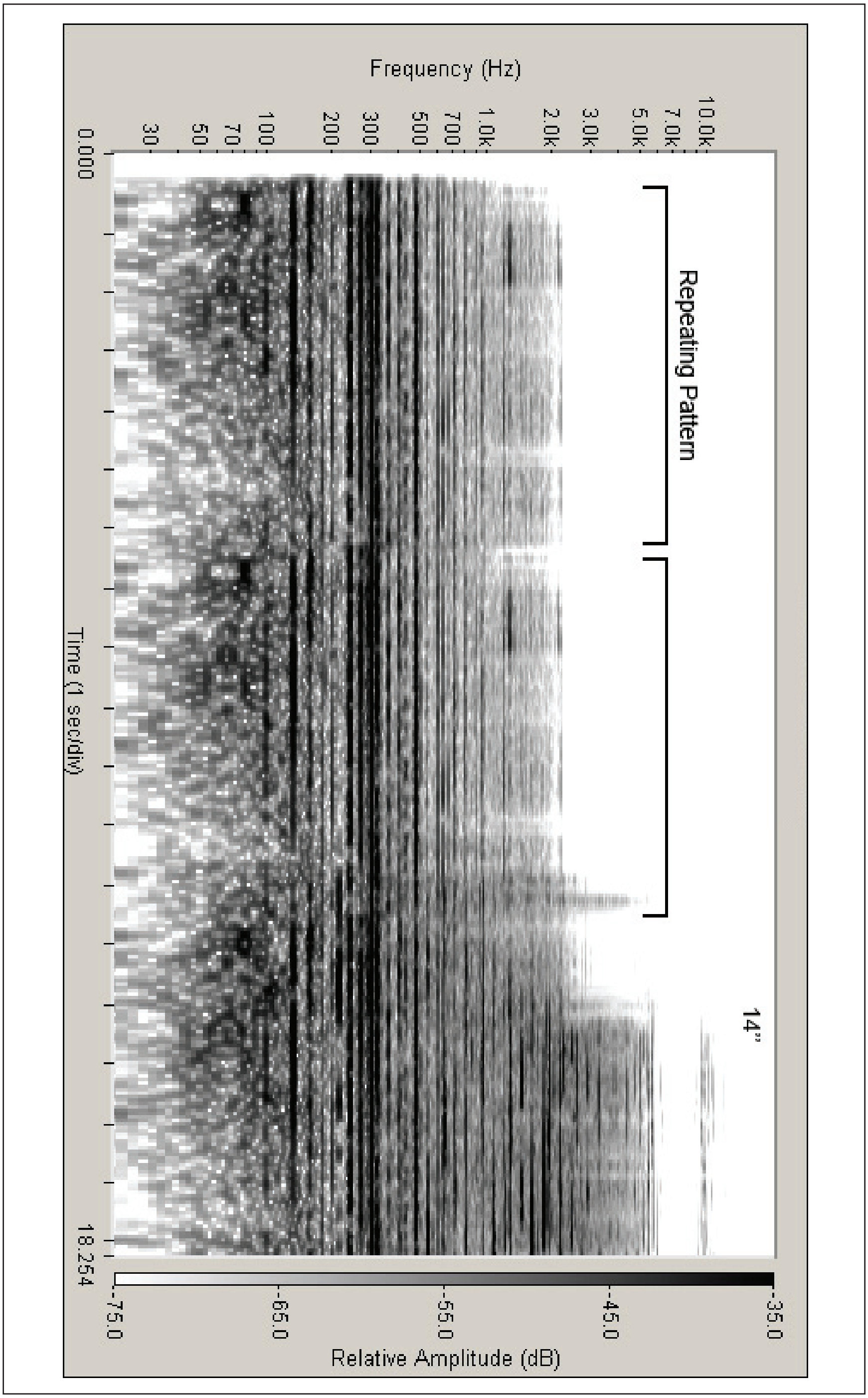
[36] Oval, *Diskont*, Thrill Jockey, 28736, 1994 reissued 1996; Oval, *Systemisch*, Thrill Jockey, 28732, 1994 reissued 1996. Oval was originally comprised of three individuals, Markus Popp, Sebastian Oschatz, and Frank Metzger, but gradually Popp became the sole musician for Oval.

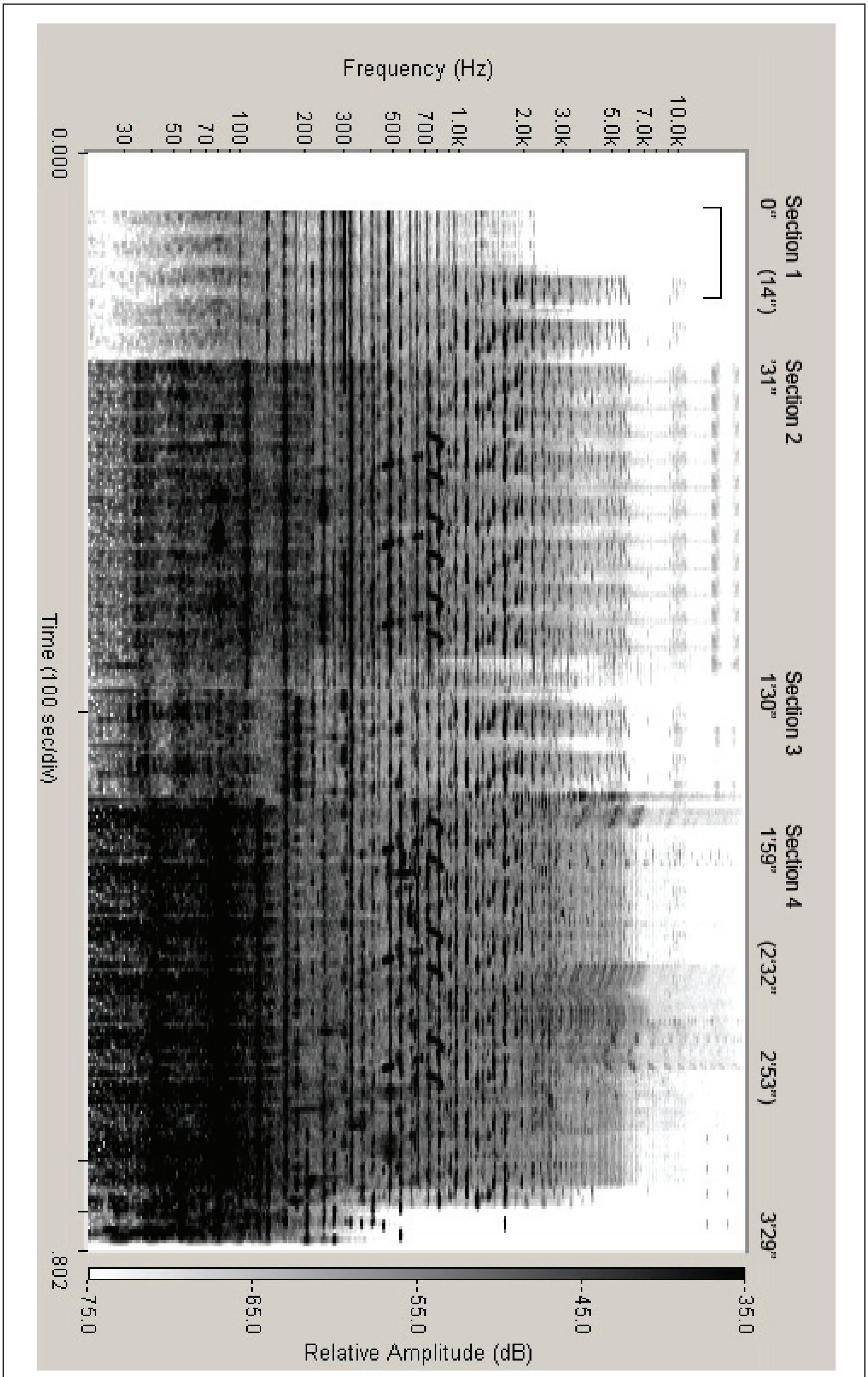
[37] Oval, *Ovalprocess*, Thrill Jockey, 81, 2000. Sam Inglis, *Markus Popp: Music as Software*, 2002 (Accessed September 3, 2005). www.soundonsound.com/sos/oct02/articles/oval.asp.

[38] Marc Weidenbaum, *A Conversation with Markus Popp, of Oval and Microstoria*, 1997 (Accessed September 5, 2005) www.disquiet.com/poppscript.html.

[39] George Zahora, *Oval Processed*, 2002 (Accessed September 5, 2005) www.splendidezine.com/features/oval/. Although often emphasizing the process side of his work, Popp has also readily admitted that the music he created under the name Oval "…was completely musical." See Walt Miller, So: *The Power of Contentious Collaboration*, 2003 (Accessed September 15, 2005) www.splendidezine.com/features/so/.



Example 7 - Spectrographic detail from the beginning of *Untitled #8* by Popp



Example 8 - Complete *Untitled #8* by Popp with harmonic spectra emerging strongly between 150-500 Hz, seen as black horizontal lines. As indicated in the spectrograph, a repeating pattern can be seen, stated twice, and initiated by a louder frequency at about 1.3 kHz, seen as a black line. As part of this pattern, the lower frequencies create a V-shaped, wave-like arch. The second statement of this repeating pattern ends with a short spectral spike, which reaches up to 6.0 kHz, foreshadowing new material to come. At 14″ an intense, complex, brighter sound enters, part of which was heard briefly at the end of the second statement of the initial repeating pattern. Dense bands of grey extend spectra upwards to 6.0 kHz, and upper partials appear between 9.0 and 10.0 kHz. This new material is also characterized by repetition, adding to the opening repetitive pattern. Popp's use of repeating loops is visible from the spectrographic image.

From this detailed view of the beginning, Example 8 zooms out revealing a spectrographic image of the complete *Untitled #8*. The opening detail of example 7 can now be seen as the beginning part of Section 1, in a larger four-section design. Example 9 summarizes this four-section design, along with durations and function labels for each section.

Section	1	2	3	4
Time	0-30″	31″-1′29″	1′30″-1′58″	1′59″-3′29″
Function	Introduction	A	Transitional	B

Example 9 - Summary of four section design with functions of *Untitled #8* by Popp

Section 1, which I view as an Introduction, lasts from 0″ to 30″, and is characterized by a gradual buildup of spectral complexity through the addition of repetitive figures. As previously discussed, the work begins with two statements of a repeating pattern, seen by the arrangement of the upper and lower partials, and at 14″ a brighter repetitive pattern appears, also sounding twice in Section 1. The bracket at the beginning of Example 8 represents the entire spectrograph in Example 7, now within the context of the complete piece.

Section 2 or A, lasting from 31″ to 1′29″, is immediately more intense, seen by the shift from grey to black. A brighter, repetitive CD skipping loop is added, extending the upper partial structure to 20.0 kHz (the upper limit of human hearing), and the lower region is also intensified down to 20 Hz (the lower limit of human hearing). In addition, nested in the middle of this band of dense spectra between 400-800 Hz, there appears a repeating sine-tone like glissando pattern, displayed as black curved lines. Notice, however, that Section 2 does not subtract anything from Section 1, but rather adds material that increases density. So far, the piece has exhibited a layering of different repeating patterns and an accumulation of density and complexity.

Section 3, which I view as transitional, lasts from 1′30′′ to 1′58′′. Section 3 reduces intensity and the upper partial peak, from 20.0 kHz to 3.0 kHz, and is characterized by two appearances of repetitive material from Section 2. The two appearances of repetitive material display two spectral peaks with the same spectral profile that extends up to 20.0 kHz. Section 3 ends with a loud, complex, bright sound that activates the entire human hearing range from 20-20.0 kHz. This powerful moment leading into Section 4 foreshadows material to come.

Section 4 or B, lasting from 1′59′′ to 3′29′′, is the most intense section of the piece, as seen by the dominance of black spectral bands in the lower region from 150 Hz and below, and the dense grey band in the upper region from 1.0-5.0 kHz. Unlike Section 2, however, the highest and brightest frequencies from 8.0-20.0 kHz are not consistently activated in Section 4. Between 2′32′′ and 2′53′′, there is a return to the same intense 20 Hz-20 kHz frequency activation heard at the end of Section 3. Also, the repeating sine-like glissando pattern between 400-800 Hz is consistently present throughout Section 4. Section 4 and the entire piece conclude with a quick subtraction of material, ending on sine tones in the highest register, and complex lower-frequency bands in the lowest register.

Untitled #8, therefore, reveals a cogent structure of increasing intensity and complexity. Moving from Sections 1 to 4, the work continuously intensifies and increases in complexity, with Section 3 acting as a temporary de-intensification. Within the seeming chaos of the sound and spectrographic images, *Untitled #8* creates a carefully constructed four-part design built upon patterns of repetition. The spectrographic images allow students to see the connections between their aural musical perceptions and the frequency content of the work. This can function at both the small-scale (opening repetitive material) and at the large-scale level (4 section design). Like a score, but different in function, these images provide an analytic constant to which both teacher and student can refer. The pedagogic advantage of Fourier analysis and spectrographs for non-notated computer works in the music theory classroom cannot be overstated. In this particular application, they allow students to analyze scoreless pieces using visual images to support and supplement their aural perceptions.

Concluding Thoughts

Music theory students are asked to do many things, from harmonic analysis and part writing, to Schenkerian graphs. Any tool that can aid in their musical education should be seriously considered. As a way of highlighting performance differences, elucidating the concept of tone color, and aiding in the analysis of non-notated computer works, I have found Fourier analysis and spectrographs to be tremendously beneficial. Spectrographs of Chopin's *Prelude in C minor*, op. 28, no. 20 highlight performance differences, revealing specific dynamic changes over the course of the work, and temporal durations for specific attacks. The spectrograph of *Hyojo Netori* reveals three specific tone colors created through instrumental pairings, allowing students to see the reasons for their "bright" and/or "dark" perceptions. Finally, the images of *Untitled #8* by Markus Popp provide students with a visual roadmap into both the small-scale repetitive structure and large-scale formal design of the non-notated work.

Paradoxically, the advantage of this technology lies in its simplicity and complexity. These images can be easily explained by the teacher and easily understood by the student. If well focused, classroom analysis and discussion can yield useful and comprehensible results. This technology, however, can also be used to raise more complex philosophical issues regarding the nature of music and the musical work. Does imaging musical sound destabilize the notion of the "Urtext" edition of the work? Where does the musical work reside—in the score, the performance, or the performance image? What should the music theorist analyze to derive plausible musical "theories"—the score or the performance? The answers to these questions are not as important as the questions themselves, and the questions themselves are not as important as getting our students to ask these questions.

Elements Associated with Success in the First-Year Music Theory and Aural-Skills Curriculum

M. Rusty Jones and Martin Bergee

Abstract

A total of 156 students enrolled in first-year music theory and aural-skills courses at the University of Missouri during the fall semesters of 2004 and 2005 were asked to participate in a study intended to determine which elements of their prior musical or scholastic training might be associated with success in freshman-level music theory and aural-training courses. We employed multiple regression analysis to determine results and provide implications for teachers of these courses. The following elements were studied: high school class rank percentile, composite score on the American College Test (ACT), mathematics score on the ACT, prior music theory experience, prior experience with solfège or scale-degree numbers, major (music or non-music), performing medium (vocal or instrumental), prior experience with a chording instrument (e.g., piano, guitar), and score on a theory diagnostic exam administered at the beginning of the first semester of theory study. Results were analyzed separately for the music theory and the aural-skills courses. For the music theory course, the general scholastic elements of high school class rank percentile and ACT-math scores emerged with the strongest associations, followed by prior experience with solfège or numbers, music major status, and prior theory experience. Diagnostic exam scores, performing medium, and chording instrument experience were not associated with final scores in the music theory course. With regard to the aural-skills course, associated with final scores were the diagnostic exam, ACT-composite scores, high school class rank percentile, and chording instrument experience. Prior experience with solfège or numbers, prior theory experience, performing medium, and major were not associated. Among other things, these findings suggest that it would be advantageous to begin the aural-skills sequence a semester later than the first-semester written theory course, thus allowing time for the students to familiarize themselves with the written concepts.

Introduction

Every year, teachers of music theory at numerous institutions of higher education face the challenge of presenting an introduction to musical structure and syntax to a new group of first-year students. The experience often proves to be frustrating; while many students flourish in the music-academic environment, a disproportionate number seem to struggle with the material and are at risk of abandoning their music studies, in part because of the challenges presented by their introductory experiences with music theory. While some of these students may discover that they lack the intrinsic motivation necessary for the rigorous study of fine art music, others present a more complex case in that they are quite successful in music performance, but considerably less so in their music-academic studies. This unfortunate lack of connection between performance ability and classroom success raises an important issue: perhaps elements of pre-college experiences or training of first-year music students might accurately predict their success in university-level theory courses. If this is so, what are these elements?

The present study examines the following questions in the hope of providing broader solutions for students and teachers alike. Are there associations among general academic indicators and academic performance in first-semester music theory and aural-skills courses? Specifically, is there an association between mathematical and musical skills? Does declaring a major in music make a difference? (At this university, non-majors can take the first-semester theory course as well.) Does it matter whether a student is an instrumentalist or a vocalist? Is a diagnostic exam covering prior knowledge of rudiments (intervals, scales, keys) related to academic performance in theory and aural skills? Are prior experiences with music theory course work, a chording instrument, or a solfège or number system related to performance in written theory or aural skills? If these types of associations can be established, perhaps college and pre-college music educators can use this information to prepare students for success in music theory course work.

The current reader may find that she/he has formulated *a priori* judgments about a number of the topics addressed in our study. One hears statements such as "of course I'm terrible at theory. I'm a singer . . . ." from students on a regular basis, and they become the sources for popular misconceptions. The results of our study will likely contradict a few of the readers' personal assumptions about the pedagogy of undergraduate theory. It is hoped that the reader will keep an open mind in her/his evaluation of our data, and, more importantly, towards the ramifications that our findings might have upon teaching and curriculum design.

In this study, multiple regression analysis, a statistical technique for determining associations among given variables and quantifying the strength of the associations, was employed.[1] The following variables were selected and examined for their associations with final scores in music theory and aural-skills course work: high school class rank percentile, composite score on the American College Test (ACT), mathematics score on the ACT, prior music theory experience, prior experience with solfège or scale-degree numbers, major (music or non-music), performing medium (vocal or instrumental), prior experience with a chording instrument (e.g., piano, guitar), and scores on a theory diagnostic exam administered at the beginning of the first semester of theory study. This paper relates the methods, results, and implications of the two-year study.

Most of the variables selected for the study are self-explanatory. Others, however, warrant further comment. Prior experience with a chording instrument was selected as a variable primarily to analyze the potential advantage gained from a student's experience in reading chords rather than single melodic lines. More extensive experience with a chording instrument was anticipated to yield improved facility with the perception of sonorities and greater preparation for harmonic dictations. Many teachers assume that prior experience with a solfège system yields improved comprehension of the structural implications of melodic lines and the relationship between melodies and scales.

Method

Description of Courses

A brief description of these courses is necessary, because there is generally a wide diversity of pedagogical approaches between universities. At the University of Missouri, first-semester music

[1] Knowledge of multiple regression analysis is not required to understand our findings. Readers well versed in this technique are encouraged to review the Appendix, which includes greater detail about the development of the regression model.

students enroll concurrently in separate classes for music theory (entitled Syntax, Structure and Style 1—hereafter Theory 1) and aural skills (Aural Training and Sight Singing 1—hereafter Aural Training 1). Theory 1 meets twice a week for 50 minutes per class. The first class session of the semester consists of a diagnostic exam, which tests the students' facility with fundamental written theory concepts, such as key signatures, scales, intervals, and chord spelling.[2] The course material itself begins with the rudiments of music (scales, intervals, and chords) and progresses into the study of diatonic harmony and an introduction to musical form (phrase structure). Activities for the entire semester include part writing, analysis, and composition of a double period in Classic style. Aural Training 1 meets three times a week for 50 minutes per class session. This course presents strategies for the identification of meter and interval types, the written dictation of rhythm, melody, and harmony, and regular work with sight singing via movable-*do* solfège. Tables 1 and 2 in the Appendix provide greater detail about the weekly organization and content of each course.

Participants

University of Missouri students enrolled in the first semester of Theory 1 and Aural Training 1 in the fall semesters of 2004 and 2005 were asked to serve as participants. A mix of music majors, minors, and non-majors had enrolled in Theory 1. Its two-year enrollment (N = 156) was larger than the enrollment in Aural Training 1 (N = 90 for the same period), whose enrollees typically are music majors only. The 156 students who agreed to participate in the project constituted 95% of Theory 1 enrollees.

Procedures for Data Collection

At the conclusion of the Fall 2004 and 2005 semesters, students enrolled in Theory 1 were asked to complete a brief questionnaire. They were informed that completing the questionnaire was optional and that their course grade would not be affected in any way. In addition to asking students for their name and student number, the form asked students to indicate (a) whether or not they were a

[2] The Theory 1 diagnostic exam does not evaluate aural skills in any way. There is no diagnostic exam for Aural Training at our institution, although this paper will argue that the Theory 1 diagnostic is an excellent predictor of success in the Aural Training course.

music major (performance, education, or bachelor of arts in music); (b) whether prior to Theory 1 they had completed with a passing grade at least one music theory course in high school (*music theory course* was defined for them as a non-performance class dealing with such concepts as scales, chords, harmonic movement, etc.) or whether they had completed with a passing grade at least one college music theory course[3]; (c) how many years they had played piano or another instrument capable of chording, such as guitar; and (d) whether they had had prior experience with movable-*do* solfège or using scale-degree numbers to sing melodies.[4]

Results

Student Demographics

Of the 156 students who completed and turned in the questionnaire, 104 (67%) indicated a major in music, while the remainder (52, 33%) indicated music minor, non-music major, or undecided. Vocalists totaled 40 (26%) of the participants, while instrumentalists comprised the remainder. About two-thirds of the students (105, 67%) had no prior theory course experience, whereas the remaining third (51, 33%) did. Regarding prior experience with solfège or numbers, 96 (62%) indicated yes, and 60 (38%) indicated no. Students were about evenly divided into the three chording-

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[3] Although this study evaluates students in the first-semester theory course, the questionnaire included "a passing grade in a college-level music theory course" to address the possibility of transfer students enrolled in the course. (Our university does not automatically exempt transfer students from the core theory curriculum courses taken at other institutions.) Additionally, it is possible (although unlikely) that some non-majors enrolled in the class could have taken a preparatory fundamentals course, which is not required for our music majors.

[4] For the item concerning major, we scored a response either 0 if the student indicated minor, non-major, or undecided, or 1 if the student indicated a music major. For the question regarding prior music theory experience, we recorded responses 0 if a student indicated no and 1 if yes. The third question, years playing a chording instrument, had three response options: "zero years", scored 0; "1 to 4 years total (all chording instruments combined)", scored 1; or "5 or more years total", scored 2. The final question, concerning prior experience with solfege or scale-degree numbers, was scored 0 if "no" and 1 if "yes". We obtained the remainder of the information from the university's student records database or directly from music theory area faculty members.

instrument experience categories: 53 (34%) indicated 0 years, 43 (28%) 1-4 years, and 60 (38%) 5 or more years.

Among the participants, the mean composite ACT score was 27.1 (36 maximum, standard deviation [sd] = 4.3), while the mean math ACT score was 26.2 (36 maximum, sd = 4.7). The mean high school class rank percentile was 80.8 (sd = 18.1). The diagnostic exam mean was 63.6 (100 possible, sd = 23.9). The mean of the final Theory 1 scores (*N* = 156) was 79.2 (100 possible, sd = 12.7), while the mean of the final Aural Training 1 scores (*N* = 90) was 85.4 (100 possible, sd = 11.9).

Pairwise correlation coefficients are found in Table 3. Few strong relationships were found among the independent variables. Exceptions were the anticipated close relationship between the first-day diagnostic exam and prior experiences with theory and solfège/numbers. We also anticipated the relatively strong negative correlation between performing medium and prior experience with solfège/numbers, indicating that vocalists (coded 0) had more experience than had instrumentalists (coded 1).

Table 4 Part A presents the preliminary regression model for Theory 1 final scores. The model as a whole appears to be moderately strongly associated (the R^2 value, statistically significant, demonstrates that the model as a whole accounts for almost 50% of the variability in Theory 1 final scores). The strongest associations, in order, were high school class rank percentile, ACT-math scores, and prior experience with solfège or numbers. Prior theory course experience and major emerged with modest associations. Performing medium seemed to have contributed weakly to the model, and diagnostic exam scores and chording instrument experience did not appear to contribute at all. Consequently, we dropped these variables from further analyses and focused on high school class rank percentile, ACT-math scores, prior experience with solfège/numbers, prior theory course experience, and major for the final Theory 1 association model.

Table 4 Part B presents the preliminary model for Aural Training 1 final scores. Only two of the variables, high school class rank percentile and ACT-math scores, reached the .05 level of statistical significance. For statistical reasons (a relatively high *beta* coefficient), the diagnostic exam variable was retained as well. Although the chording instrument variable did not seem to be strongly associated at this point, we decided to retain it based on its potential to influence aural-skills performance. The other variables (prior experience with solfège/numbers, prior theory experience, and performing medium) did not contribute substantively and were dropped from further analyses.

Based on an examination of various versions of the Aural Training model, we determined that the ACT-composite score was more strongly associated than ACT-math scores and as a consequence used it (ACT-composite) for subsequent Aural Training analyses. Accordingly, we retained high school class rank percentile, ACT-composite scores, diagnostic exam scores, and chording instrument experience for the final Aural Training 1 model.

The final models are found in Table 5. The models account for 47% and 40% of the variability in Theory 1 and Aural Training 1 final scores respectively (cf. the R^2 values at the bottom of the tables. *Adjusted* R^2 values adjust the value to reflect more accurately the true difference found in the population). For Theory 1 final scores (Table 5 Part A), in addition to high school class rank percentile and ACT-math scores (Model 1), the variables of prior theory course experience, prior experience with solfège or numbers, and music major status (added in Model 2) emerged with strong and unique associations. Associations in order of strength were high school class rank percentile, ACT-math scores, prior experience with solfège or numbers, major, and prior theory course experience.

For Aural Training 1 final scores (Table 5 Part B), the general academic variables were similarly blocked and entered in the first step. The two remaining variables—diagnostic exam scores and chording instrument experience—were entered in the second step. Diagnostic exam scores and ACT-composite scores were associated about equally strongly; high school class rank percentile and chording instrument experience were associated less strongly, but of about equal magnitude. The Aural Training outcomes need to be interpreted with some caution, however, as the Aural Training 1 sample was smaller than the Theory 1 sample.

In addition to specifying a set of associations, regression yields a linear *prediction equation.* Equations for Theory 1 and Aural Training 1 final scores can be drawn from Table 5. The *constant* is the point on the regression slope that crosses the *y* axis. That is, the constant projects the final score with all predictor variables set to zero. As expected, a student whose ACT-Math score is 0, is at the very bottom of his or her class, is not a music major, and has no prior music theory course work or experience with solfège or scale-degree numbers will not do well in the first semester of written music theory (cf. the constant of 22.27 in the Theory 1 equation). Aural-skills predictors operated along similar lines. A student whose class rank and ACT-Composite scores are zero, who did so poorly on the diagnostic exam as to receive no points, and who has no chording instrument experience is not expected to perform well (cf. the Aural Training 1 constant of 40.17). On the other hand, a student who enters Theory 1 with a high school class rank percentile and ACT-math score of, say, 90 and 27 respectively, who has committed to a major in music, and who has had prior theory and solfège/numbers experience, is more likely to do well (cf. the Theory 1 prediction equation: 22.27 + .36(90) + .84(27) + 5.2 + 3.78 + 3.99 = 90.3). A student entering Aural Training 1 with a similar academic background, who did well on the diagnostic exam, and who has a minimum of five years experience with a chording instrument similarly is more likely to be successful (cf. the Aural Training 1 prediction equation: 40.17 + .13(90) + .84(27) + .15(90) + 2.72(2) = 93.5).

Implications of the Findings

Syntax, Structure and Style (Theory 1) Outcomes

A deeper look into the data reveals some trends and implications that might help both secondary and university-level educators better prepare their students for these types of courses. Most strongly associated with success in Theory 1 is high school class rank. Interestingly, this is positioned much higher than any *musically* related variable. Clearly, successful high school students have learned the necessary study skills and have the intrinsic motivation to succeed at the collegiate level. For the university adviser and professor, this would seem to stress the importance of encouraging student participation in freshman seminars in study skills and better acclimating students to the heightened academic challenges presented in the university environment.

Interestingly, the second strongest association with success in Theory 1, the ACT-math score, is again *not* directly related to prior musical experience. The degree of interrelationship between math and music has been frequently debated. Suggestions of a relationship between the two fields date to the time of Pythagoras and have continued throughout the history of music theory. Contemporary studies by Bahna-James (1991)[5] and Boettcher/

[5] Bahna-James, "The Relationship Between Mathematics and Music: Secondary School Student Perspectives."

Hahn/Shaw (1991)[6] corroborate this point of view. Bahna-James's study involves a sampling of 124 New York City high school arts students and finds that the "correlation between mathematics grade and music theory grade increases when the mathematics being taught is of a more elementary level and the numerical relationships are relatively simple."[7] Although their methodology is beyond the scope of the present study, Boettcher, Hawn and Shaw are noteworthy for investigating the possibility of common themes of pattern development relating to music, mathematics, and chess found in higher brain functions. While their work does not ultimately definitively correlate the fields, it does provide the implication for a deep physiological relationship.

A contrasting opinion is provided by Howard Gardner, whose 1985 *Frames of Mind* introduced the popular theory of multiple intelligences. His theory postulates the existence of seven distinct and separate intellectual regions, including music and mathematics. Gardner states that the "core operations of music do not bear intimate connections to the core operations in other areas; and therefore, music deserves to be considered an autonomous realm."[8] In short, although music might be inherently mathematical from an intellectual standpoint, musicians do not have an inherent affinity for mathematics.

So what does this mean for the theory professor? The assumption that non-motivated or underprepared students will take advantage of a university's tutoring programs is one that we dare not make, as these kinds of students tend to ignore such opportunities. The theory department can take more direct control over a predictably weak student's potential chance for success in the first year by developing a separate section of Theory 1, with enrollment being determined by class rank and ACT-math scores. Students in this section would cover the same material that is presented in the other Theory 1 sections, but might be required to attend an extra class session devoted to drills and review that the motivated student might perform on her/his own time. This solution will obviously not work for everyone, as the institution will need to have sufficient theory faculty to allow for the staffing of another section of the course.

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[6] Wendy S. Boettcher, Sabrina S. Hahn and Gordon L. Shaw, "Mathematics and Music: A Search for Insight into Higher Brain Function."

[7] Bahna-James, "The Relationship Between Mathematics and Music: Secondary School Student Perspectives," 481.

[8] Gardner, *Frames of Mind*, 126.

While high school class rank and math achievement were the highest associations with success in the Theory 1 course in our study, perhaps more interesting are the variables that did *not* prove to be associated. Most notably, a first-day diagnostic exam, which tests preexisting knowledge of musical rudiments such as key signatures, scales, intervals, and triad spelling, seems to have no particular relationship with a student's final results in the course.[9] While a mastery of musical rudiments is surely of utmost importance to a student's success in the music theory classroom, the present study seems to indicate that this is not a prerequisite to the first-year course.[10]

Furthermore, a student's primary performing medium does not seem to be pertinent to succeeding in freshman music theory. One might surmise that a harmony course would be biased toward students with experience on a chording instrument, but our study does not support this notion. A related study by Douglas Engelhardt investigates relationships between success in the music classroom and music performance.[11] In this study, Engelhardt sampled 144 students at Morehead State University from 1968-1971 to determine if there was a link between success in the classroom and success in the private studio (with performance success perhaps dubiously determined solely through earned GPA in the private studio). Engelhardt's findings somewhat dispute ours in finding that brass players earned a lower GPA in theory, history, and English than students studying other primary performance media; however, his study tracks the collegiate experience, rather than using pre-college variables to predict first-semester success. Ultimately, Engelhardt concluded that there is no link between success in studio performance and in the academic classroom.[12]

Many theory professors will simply not believe that a student's

[9] The MU diagnostic exam tests the students' knowledge of musical rudiments (key signatures, scales, intervals and chord spelling). The results indicated here are not meant to infer that *all* diagnostic exams do not have an association with success in the theory classroom, only that this specific exam does not seem to have a particularly significant association.

[10] Of course, the pacing of the first-semester course would typically require a motivated student to master this material.

[11] Engelhardt, "An Investigation of Levels of Achievement in Music Theory, Music History and Literature, and English as Predictors of Achievement in the Major Performing Medium."

[12] Ibid., 5.

instrumental medium is not related to her/his success in the theory classroom. A surprising number of colleagues have expressed personal biases over the years, with the primary assumption seeming to be that vocalists are weaker at theory than instrumentalists. A more likely scenario is not that vocalists have an *inherent* disadvantage at all; rather, they may become disenfranchised over time with the non-inclusive theory class that fails to include a more broad-based repertoire for study. A successful theory instructor should take great care to vary the repertoire studied in class. Many textbooks have acquired a heavily "piano-centric" approach, which will (perhaps understandably) yield a diminished enthusiasm for the course material by non-piano majors. The onset of the digital music age should make it extremely easy for the instructor to incorporate a variety of performance media into her/his musical examples in order to generate a greater intrinsic motivation among the student group.

Aural Training and Sight Singing (Aural Training 1) Outcomes

While the Theory 1 course consists of both music majors and a substantial number of nonmajors, virtually 100% of the students enrolled in Aural Training 1 are music majors, resulting in a smaller student sample for the present study.[13] Therefore, Aural Training findings should be interpreted with some caution. Unlike Theory 1, the essence of aural-skills training would seem to indicate that some students will have a natural predisposition to the material that might be hard to predict. Given this fact, one might surmise that a student's past academic success would not be as relevant in the aural-skills classroom. Indeed, our study shows that this assumption is true, as high school class rank percentile is not the strongest association with success in Aural Training.

Strangely, what *is* highly associated in Aural Training is the Theory 1 diagnostic exam. While one might discount this finding as an anomaly resulting from the smaller student sampling, perhaps this result stresses an important pedagogical concept: the need to stagger the aural-skills sequence a semester behind written theory. Many schools employ this pacing of courses with the belief that it is important to master the written skills before linking the aural reinforcement. For example, students with a full semester of written

[13] Music minors occasionally take the first-year Aural Training courses, although they are not required to do so.

theory would already have a nascent conception of basic harmonic function and progression, in addition to musical rudiments such as intervals and scales. This preexisting foundation might lead to greater success and confidence with the aural identification of these concepts.

Our belief that the Aural Training sequence should be staggered to begin a semester later than the written-theory sequence is certainly not intended to undermine the importance of relating written-theory concepts to their associative sounds. Rather, we believe that our data show the need to ingrain firmly the written concepts in a student's mindset before beginning rigorous Aural Training study. Of course, the role of the written-theory instructor does not (and should not) lie exclusively in the domain of conceptual knowledge. She/he should be incorporating sound as much as possible into the daily lectures. By doing so, the instructor also continues to show the relevance of the course to the student's performance studies, addressing a common student complaint about the practical utility of music-academic work.

Pre-college experience with a chording instrument (piano, guitar, harp, etc.) was also modestly associated with Aural Training scores. These students have perhaps a greater experience with listening to harmony, rather than melodic line exclusively, and therefore might have an advantage with harmonic dictation. The remaining variables studied (including prior experience with movable-*do* solfège and the student's gender) did not predict final aural-training grades.

Some colleagues have expressed assumptions that female students would have greater difficulty with harmonic dictations because they cannot match the low bass register with their own voices. On the contrary, our data do not show that a student's gender plays any role in determining Aural Training success. We suggest instead that difficulty with harmonic dictations stems more frequently from a lack of knowledge about paradigmatic tonal progressions. ("What do you mean, I, ii, iii isn't a good harmonization of this bass line?") Staggering the written- and aural-theory sequences is a step towards solving this problem. The aural-training instructor certainly should review these concepts in class, and the typical student will have a much greater comprehension upon this second presentation.

Although our Aural Training program relies heavily on a student's fluency in movable-do solfège, our data show that *prior* experience in this system is not a predictor of success. By no means does this indicate that successful students at the end of the semester are not fluent in solfège. Quite the opposite is usually true in our program. Instead, we interpret these data to mean that success with solfège is clearly related to fluency in music fundamentals (reading skills, knowledge of scales and intervals). Our proposal to stagger the Aural Training sequence behind the written-theory sequence once again addresses this predictable problem for many students.

Finally, although the data for both the Theory 1 and Aural Training 1 course clearly show that a student's instrumental medium is not strongly associated with success in the *first-year* curriculum, we do believe that certain groups might fare poorly *later* in the sequence at many institutions. We believe the reason for this subsequent lack of success is directly related to intrinsic motivation. Instructors who make an effort to vary the repertoire studied in class will keep the interest (and relevance) for a greater student group, and will almost surely find a higher rate of success in the classroom.

Implications for the high school music instructor

Thus far, our study has addressed the implications for the instructor of college-level music theory courses. How might the high school instructor use these data to help her/his music students? While the primary focus of most high school music programs is performance based, opportunities do exist in many schools for introductory music theory instruction. The implications of the data point to the necessity of including the rudiments of music in the high school music curriculum (including reading on the treble and bass clefs, in addition to scales, keys, and intervals), especially since most universities do not stagger the written- and aural-theory sequences. In our experience, many students entering our institution have only a performance-related background, with no music-academic preparations at all. Many of these students are then overwhelmed by the challenges presented in the theory classroom.

Additionally, the high school student would likely be better prepared with some exposure to a chording instrument. Although the data do not indicate this to be strongly associated with success, we believe that experience on a chording instrument yields a greater facility with reading music on two clefs: a fundamental skill that, when underdeveloped, is a significant hindrance for entering students in the music classroom. Exposure to movable-do solfège is not indicated to be strongly associated with success, but its use is encouraged at the high school level to yield an increased comprehension of tendency-tone functions, as well as presenting a clearer relationship between written-theory work (scales and keys at this level) and performance.[14]

Implications for future research

This discussion of elements associated with success for the first-year theory curriculum represents, in part, our attempt to identify some of the barriers to success faced by freshman students. We would be very interested to see a similar study exploring issues that arise after a student has had a year or two of theory study. Do students become uninterested? Does the material become too difficult too soon? Is the material sufficiently relevant to the modern-day student? Forward-thinking pedagogues always question their curricula, and the pursuit of a more effective strategy should be a lifelong journey. Studies such as this can guide our pedagogical development in the right direction.

Conclusions

The implications of our study are encouraging for teachers of music theory. According to our analysis, neither written theory nor aural skills seem inherently biased toward any specific performing medium (vocal or instrumental). Students' prior musical experiences also do not seem to be strongly associated with success in the classroom, although, not surprisingly, students with good academic records in high school tend to perform well at the collegiate level. There is a potentially important link between success in Aural Training 1 and the written-theory diagnostic exam, which supports the concept of beginning the aural-skills curriculum after a semester of written theory. We are encouraged, because the data show that the majority of students enter the first-year theory curriculum as

[14] Although the high school teacher might be able to help better prepare incoming freshman music students, the irony is that, in the vast majority of cases, only advanced and motivated students taking an AP music theory class would be enrolled. Our data indicate that this demographic has the highest predictability for success in freshman theory courses. It therefore seems incumbent upon the college instructor to change her/his pedagogy in order to most effectively help students to succeed.

tabulae rosa. All have the potential ability to succeed, regardless of their backgrounds in the study of music. By shifting the curriculum to allow students to grasp the rudiments of music before beginning with aural training study, we believe that students will begin their university music training on more solid ground and be better equipped to realize their musical potential.

Appendix: Development of the Regression Model

Developing a model of association using multiple regression usually involves a number of stages. At each stage, we based decisions on how to proceed on the empirical information available at a given stage and on informed judgment. The first stage involved a diagnostic examination of the variables we included in the analysis, followed by a perusal of a matrix of pairwise correlations among all the variables. Correlation coefficients range from -1.00 (a perfect negative linear relationship) through .00 (no relationship) to +1.00 (a perfect positive linear relationship). We studied correlations for evidence of *multicollinearity*, that is, evidence that some of the variables were too strongly related to function independently in a regression equation. The diagnostics indicated the extent to which variables met certain fundamental assumptions for regression analysis (see Berry & Feldman, 1985, for a description of these assumptions). Diagnostics indicated that the variables we selected for study met the assumptions for regression analysis.

Pairwise correlations (found in Table 3) labeled with an asterisk are statistically significant. Statistical significance indicates how often one would expect to find the observed sample value if the value in the population was actually 0. For correlations labeled with an asterisk, the probability is less than one in 100 that in a large population of similar first-year theory students there is actually no relationship between those two variables. The correlation between the ACT composite and math scores, of course, was quite high. Owing to this, and because ACT-math scores are a component of the ACT composite score, both variables could not be included in the same regression equation. Bivariate correlations between the other independent variables were not high enough to cause multicollinearity concerns.

The second stage involved the development and refinement of a preliminary regression model for Theory 1 final scores and then for Aural Training 1 final scores. Variables achieving statistical significance at the .05 level and showing a relatively high *beta* (a standardized weight that allows the influence of the different variables to be compared directly) were considered the strongest associations. We employed ACT-math scores rather than ACT-composite scores in these preliminary analyses, as the ACT-math scores seemed to function better.

The final stage was directed toward specification of the final model. Methodologists (e.g., Nunnally & Bernstein, 1994) often recommend that the effects of generalized associations identified in prior research be accounted for first. The ability of high school class rank and standardized test scores to predict college first-semester academic achievement has been well documented. Therefore, for both models we used a hierarchical approach in which the general predictors of high school class rank percentile and ACT scores were entered as a block in a first step and the remaining predictors entered as a block in a second step.

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Tables

Table 1: Weekly syllabus for Theory 1 course. (Text is Gauldin, Harmonic Practice in Tonal Music, 2nd ed.)

1	Diagnostic Examination
	Introduction to Course; properties of musical sound; notation, clefs Pg. 3-7
2	Half-steps and Accidentals; Intervals Pg. 7-19
	Rhythm and Meter I Pg. 20-23
3	Tonic, Scale and Melody Pg. 32-44
	Melody and Scale Degrees; Melodic Cadences Pg. 44-54
4	Triads and Seventh Chords Pg. 55-63
	Seventh Chords Continued Pg. 63-66
5	**EXAMINATION #1**
	Introduce Finale
6	Finale Continued
	Musical Texture and Chordal Spacing Pg. 67-81
7	Part writing in Four-voice Texture Pg. 82-93
	Melodic Figuration and Dissonance Pg. 94-113
8	Introduction to Diatonic Harmony; Tonic and Dominant Harmony; Cadences Pg. 117-125; 126-131
	Voice-leading Reductions Pg. 137-145
9	**EXAMINATION #2**
	The V7 Pg. 146-163

Table 1: *Continued*

10	Tonic and Subdominant Triads in 1st Inversion Pg. 164-178
	Phrase structure; contrasting and parallel periods Pg. 179-184; 193-197
11	Phrase structure continued; double period Pg. 184-199
	Keyboard Accompaniment Style
12	Linear Dominant Chords (Ch. 13) Pg. 201-221
	Predominant II and II7 Pg. 222-241
13	**EXAMINATION #3**
	Suspensions-Melodic Figuration II Pg. 242-266
	THANKSGIVING VACATION
14	The Six-four Chord and other Linear Chords Pg. 267-289
	The Six-four Chord and other Linear Chords Continued
15	The Vi, vi, III, and other Diatonic Chords Pg. 290-306
	Rhythm and Meter II Pg. 307-322

Table 2: *Syllabus for Aural Training 1 Course.*

Weeks 1-4:	
Aural Training:	Identification of simple and compound meters Rhythmic dictation: whole, dotted half, half, quarter and eighth notes Melodic intervals: P1 through P5 (ascending and descending) Melodic dictation: pitch sets, short melodies mostly conjunct, skips in tonic chord only
Singing:	Tetrachords Major scales, introduction to movable-*do* solfège Isolated scale degrees from tonic triad Intervals: same as above Assigned melodies from Berkowitz text
Weeks 5-8:	
Aural Training:	Rhythmic dictation: dotted quarters, sixteenth groups Melodic intervals: add m6--P8 + TT, emphasizing m6 and M6 Melodic dictation: some disjunct motion, tonic and dominant implied harmonies, introduction to minor keys Harmonic intervals: all
Singing:	Natural, melodic, and harmonic minor scales (with movable-*do* solfège) Isolated scale degrees emphasizing 6 and 7 Intervals: all (ascending and descending) Major and minor triads in root position Assigned melodies from Berkowitz text
Weeks 9-12:	
Aural Training:	Rhythmic dictation: eighth/sixteenth groupings, dotted eighth notes Melodic dictation: triadic outlines in various inversions, various final cadences (implied tonic, subdominant, and dominant harmonies) Melodic intervals: all, emphasizing m7, M7 and TT Harmonic intervals: all Sonorities: identification of M and m triads in root position Harmonic dictation: cadential patterns using 3-4 chords

Singing:	Major and minor scales Intervals: all, emphasizing 7ths and TT I, ii, IV, V Triads in root position (using appropriate syllables) Assigned melodies from Berkowitz text

Weeks 13-15:

Aural Training:	Rhythmic dictation: eighth/sixteenth groupings Melodic dictation: longer melodies with triadic outlines in various inversions Sonorities: M, M6, m, m6 and o6 Harmonic dictation: 4-5 chord patterns using I6,V6, ii6 and viio6
Singing:	Review all intervals and scales M, M6, m, m6 and o6 triads Assigned melodies from Berkowitz text

Examinations: Each four-week unit ends with exams in aural training and sight singing. Extra-credit opportunities are available for students who submit optional assignments using MacGamut software.

Table 3: *Correlations among Variables and Theory 1 and Aural Training 1 Final Scores*

Variable	Theory1	AT1	HS%	ACC	ACM	Diag	PM	Maj	ChEx	PrSN	PrTh
Final Score, Theory 1	---	.60*	.55*	.46*	.45*	.41*	-.05	.13	.24	.29	.23
Final Score, AT 1		---	.43*	.46*	.36*	.49*	-.14	.09	.34*	.27*	.21
HS Class Rank %			---	.48*	.36*	.21	-.14	-.10	.24	.03	-.07
ACT Composite				---	.81*	.35*	.08	.03	.09	-.05	.11
ACT Math					---	.30*	.25	-.08	.09	-.19	-.01
Diagnostic Exam						---	-.13	.11	.40*	.39*	.58*
Performing Medium							---	-.03	-.21	-.42*	-.16
Music or Other Major								---	-.04	.10	.09
Chording Inst Experience									---	.26*	.15
Prior Exp w/ Solf or Num										---	.35*
Prior Exp w/ Theory											---

*$p < .01$.

Table 4: *Summary of Preliminary Regression Analyses (Simultaneous Entry) for Variables Associated with Theory 1 and Aural Training 1 Final Scores*

Part A: Theory 1

	B	Std. Error	Beta	*t*	*p*
(Constant)	20.98	6.13		3.42	=.001
HS Class Rank %	.37	.05	.53	7.35	=.000
Prior Exp with Solf/Num	5.61	1.98	.21	2.84	=.005
Prior Theory Experience	3.85	2.22	.14	1.73	=.086
Major	3.73	1.88	.13	1.99	=.049
ACT Math	.74	.23	.24	3.09	=.002
Diagnostic Exam	.01	.05	.02	.27	=.790
Performing Medium	3.09	2.05	.11	1.51	=.134
Chording Inst Experience	-.05	1.07	-.01	-.05	=.961

Dependent Variable: Final Score, Theory 1. $R^2 = .49$, $p < .01$.

Part B: Aural Training & Sight Singing 1

	B	Std. Error	Beta	*t*	*p*
(Constant)	43.20	8.25		5.23	<.001
HS Class Rank %	.14	.06	.22	2.26	=.027
Prior Exp with Solf/Num	2.59	2.58	.11	1.03	=.319
Prior Theory Experience	.11	2.83	.01	.04	=.968
ACT Math	.76	.29	.27	2.62	=.010
Diagnostic Exam	.12	.07	.23	1.76	=.082
Performing Medium	-3.42	2.65	-.13	-1.29	=.200
Chording Inst Exp	2.12	1.46	.15	1.45	=.151

Dependent Variable: Final Score, Aural Training & Sight Singing. $R^2 = .41$, $p < .01$.

Table 5: *Summary of Hierarchical Regression Analyses for Variables Associated with Theory 1 (N = 156) and Aural Training 1 Final Scores (N = 90)*

Part A: Theory 1

Model		B	Std. Error	Beta	*t*	*p*
1	(Constant)	34.52	5.79		5.96	<.001
	HS Class Rank %	.35	.05	.50	6.87	<.001
	ACT Math	.62	.22	.20	2.80	=.006
2	(Constant)	22.27	5.95		3.74	<.001
	HS Class Rank %	.36	.05	.51	7.50	<.001
	ACT Math	.84	.21	.28	3.96	<.001
	Prior Exp w/Sol/Num	5.20	1.75	.20	2.97	=.004
	Prior Theory Exp	3.78	1.79	.14	2.11	=.037
	Major	3.99	1.69	.15	2.36	=.020

Dependent Variable: Final Score, Syntax Structure & Style 1. Model 1 R^2 = .37, Model 2 R^2 = .47. The difference between the two R^2 values is statistically significant. Adjusted R^2 for Model 2 = .45.

Part B: Aural Training & Sight Singing 1

Model		B	Std. Error	Beta	*t*	*p*
1	(Constant)	43.52	8.26		5.27	<.000
	HS Class Rank %	.17	.07	.27	2.53	=.013
	Comp ACT	1.05	.35	.32	3.03	=.003
2	(Constant)	40.17	7.58		5.30	<.001
	HS Class Rank %	.13	.06	.20	1.99	=.050
	Comp ACT	.84	.33	.26	2.58	=.012
	Diagnostic Exam	.15	.05	.27	2.76	=.007
	Chording Inst Exp	2.72	1.49	.19	1.93	=.056

Dependent Variable: Final Score, Aural Training & Sight Singing 1. Model 1 R^2 = .25, Model 2 R^2 = .40. The difference between the two R^2 values is statistically significant. Adjusted R^2 for Model 2 = .37.

Master Teacher Column*

Teaching Fugue à la Handel: Lessons for Princess Anne

PAMELA L. POULIN

Handel, while living in London, once told Dutch organist Jacob Wilhelm Lustig, who was visiting that city, "No power on earth could have moved me to resume teaching duties again—except Anne, the flower of princesses."[1] Anne, the daughter of George II, studied composition with Handel from 1724 to 1734. For this gifted keyboardist, Handel wrote a series of thorough-bass exercises, culminating in six fugue exercises, three fugue models and one sketch. These lessons later became part of Handel's bequest of his manuscripts to his friend John Christopher Smith, who acted as his manager. They are now preserved in the Fitzwilliam Museum at Cambridge.[2]

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*Editor's note: Volume twenty-one of this journal (2007) initiated the invitational master teacher column. We continue the format in this issue with Pamela Poulin's enlightening study of Handel's pedagogy for teaching fugal composition. Skeletons for Handel's six fugue exercises and three models, to which this column refers, can be downloaded at http://music.ou.edu/publications/jmtp/vol22/Handel.pdf.

[1] Jacob Wilhelm Lustig, *Inleiding tot de Muziekkunde* (Groningen, 1771), p. 172. An earlier version of the present article was originally presented as a paper at a meeting of the Society for Music Theory. The author would like to thank Robert Gauldin, Eastman School of Music, for his helpful suggestions.

[2] See the *Hallische Händel-Ausgabe*, suppl. vol. I, Alfred Mann's critical edition with facsimiles of the *Aufzeichnungen zur Kompositionslehre aus den Handschriften im Fitzwilliam Museum Cambridge* (Kassel, 1978). This volume comprises the Lessons for Princess Anne as well as complete canons and other material, including sketches for other compositions, for example, *The Messiah*.

See also David Ledbetter, *Continuo Playing According to Handel: His Figured Bass Exercises With a Commentary* (Oxford University Press, 1990). Ledbetter offers his own solutions to the fugue exercises; Mann also offers a few in the *Aufzeichnungen*.

Handel's teaching document of composition exercises begins with simple bass lines in slow note values, progressing from root position triads, through sixth chords, to solving various problems in voice leading and resolution: seventh chords ($^{6\text{-}4}_{5\text{-}2}$), suspensions involving the fourth (4-3, $^{6\text{-}5}_{4\text{-}3}$), the seventh (7-6) and the ninth (9-8, 9-6 and 9-3, i.e., 9-8 with a change of bass) and double suspensions ($^{9\text{-}8}_{7\text{-}6}$ and $^{9\text{-}8}_{4\text{-}3}$). Next come three longer practice examples incorporating the above.[3] The collection then proceeds with the six fugue exercises, three of which, Nos. 3, 5 and 6, are accompanied by the models mentioned above, on different fugue subjects and completed by Handel himself. These fugue models are invaluable teaching aids, demonstrating skills the student may put to use in the fugue exercise with which each is paired. Thus, Handel does not introduce fugue writing until the skill of thorough bass is first mastered. In other words, harmony and voice leading come first and only then fugue writing. For Handel, thorough bass is the basis of the art of the fugue.[4]

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[3] A parallel document to that of Handel is the "*Vorschriften und Grundsätze . . .*" or 'Precepts and Principles for Playing the Thorough Bass or Accompanying in Four Parts by the Royal Court Composer and Kapellmeister as well as Director of Music and Cantor of the *Thomas-Schule* Johann Sebastian Bach at Leipzig for his Students in Music, 1738," translated with commentary as *Precepts and Principles* by Pamela L. Poulin, with a Preface by Christoph Wolff (Oxford University Press, 1995). Bach dictated this document to a student at the *Thomas-Schule* in Leipzig, and a student worked out the sixteen figured bass exercises and five fugue exercises that comprise the fourth section of this document. In the case of the *Precepts and Principles*, however, we are not given the Master's fugue exercises, but exercises worked out by an unknown student, complete with errors, as they were not corrected by Bach. We do not know in what form the fugue exercises were given to the student.

Neither Handel nor Bach appears to have used species counterpoint in his teaching. In describing his father's teaching to Bach's first biographer, Johann Nikolaus Forkel, C.P.E. Bach wrote, "In composition he started the pupils right in with what was practical, and omitted all the dry species of counterpoint that are given in Fux and others." This could also be a description of Handel's teaching methods. See Hans T. David and Arthur Mendel, eds., *Bach Reader*, rev. edn. (New York, 1966), p. 279. See also Alfred Mann, "Bach and Handel as Teachers of Thorough Bass," in Peter Williams, ed., *Bach, Handel, Scarlatti Tercentenary Essays* (Cambridge, 1985).

[4] Other exercises exist of master composers studying with teachers, for example, Beethoven's studies with Albrechtsberger and Schubert's with

The fugue exercises were written on a single staff in a type of musical shorthand, with Handel writing a figured bass for each entire fugue, figures notated above the staff and entrances indicated below the staff using tablature: C for cantus (soprano), A for altus, etc., and the starting pitch in tablature. For example, in Fugue Exercise No. 3, Handel writes the fugue subject[5] and then continues with a figured bass. In measure two, beat three, he writes "A" below the staff and with a single stroke above the letter f, indicates that this alto entry should begin on f^1.[6]

The figured bass supplied the harmonic underpinning, thus ensuring a certain degree of success, as Handel's student, Princess Anne, would then complete the fugue from the sketch. In this series of six fugue exercises and three models, he led Princess Anne through a variety of fugal procedures that a student today may not have the opportunity to experience firsthand.

Thus, Handel provided his student with the fugue subject, the starting pitches for later entries, indicated in tablature, and the harmonies, indicated through a figured bass. For an assignment of today, an instructor might prepare such a skeleton in keyboard score,

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Sechter. Exercises also survive of students with master composers, such as Attwood's with Mozart. In these cases we have the student-completed exercises, and in some cases, for example, Attwood with Mozart, we have the master teacher's corrections. However, in the case of Princess Anne's studies with Handel, we have only the original exercises, neither the student-completed work nor Handel's corrections. See Alfred Mann, *Theory and Practice* (New York, 1987).

[5] The fugue subjects are original with Handel; he incorporates some of them in his other works. See Notes nos. 9 and 10.

[6] See Mann, *Aufzeichnunge*, p. 48, for a facsimile of this fugue. Tablature is very similar to the Helmholtz system of pitch designation, e.g., F = great *F*, f = small *f*, f with a single stroke above = *f*1. Also notated in this fashion, and probably intended for realization at sight, are the less complex fugues by Francesco Durante (1684-1755), included in his basso continuo exercises, "*Partimenti ossia Intero studio di numerati per ben suonare il cembalo*." Durante was a well-known Neapolitan teacher, who counted among his pupils Giovanni Battista Pergolesi (1710-36). Something similar, without tablature marking of entries (perhaps inadvertently omitted in publishing), appears in Niedt's *Musicalische Handleitung:* what appears to be an unrealized two-voice fugue on one stave (employing several different clefs) might well have originally been a fugue exercise employing this same system of notation (see Pamela L. Poulin and Irmgard Taylor's co-translation with Poulin's commentary of Friederich Erhardt Niedt's *Musical Guide* [Oxford University Press, 1989], pp. 48-49).

with spaces left for students to complete the fugue. An instructor might also make use of Handel's three completed fugue models. With any of these, it is possible to extract the fugue skeleton, consisting of all fugue entries, and prepare a figured bass (not included in the models). This has been done by the present writer for all six fugue exercises, as well as the three models, and may be found throughout this article. (Editor's note: Skeletons for both the exercises and fugue models can be downloaded at http://music.ou.edu/publications/jmtp/vol22/Handel.pdf.)

In a keyboard score skeleton of a Handel fugue, we have something with interesting potential as a teaching tool for the tonal counterpoint instructor of today. First, students may be given Handel's exercise skeletons in keyboard score to complete, followed by the instructor's corrections and suggestions. Later, they can proceed to working out one of these fugue model skeletons, finally comparing their results with those of Handel as they study his actual model. It is perhaps as though the master composer has been at the student's very elbow.

In a typical tonal counterpoint class, it is unusual for a student to compose more than one fugue. Usually all that is required is one simple fugue, and sometimes only an exposition. A student who is able to begin by fleshing out the skeleton of a relatively uncomplicated Handel fugue (not at first one of the double fugues or one employing modulating subjects and/or stretto), given the subject and the location of the subsequent entrances, guided by the harmonic underpinning, and able, later, to learn from the version completed by Handel, may go somewhat further and with a deeper appreciation of the tradition involved.

Overview of Handel's Fugues in the Lessons for Princess Anne

Handel's fugues range in length from nine to thirty-two measures and employ the keys of C major, E major, E minor, F major (twice), G major (three times) and G Dorian (twice). He begins the set of fugue exercises with simple fugue expositions. Fugue Exercise No. 1, in three voices, is in G Dorian, making the answer relatively easy to compose, because it is a real answer and does not modulate to the dominant. The fugue employs a harmonic sequence based on 7-6 suspensions. Fugue Exercise No. 2, also in G Dorian, in four voices (as are the remaining fugue exercises and models), consists of an exposition and a bridge based on double suspensions of 9-8 and 7-6. While the Fugue Model accompanying Fugue Exercise

No. 3 in F major introduces a modulating subject in the setting of a double exposition, a modulating subject does not actually occur in Fugue Exercise No. 3. However, a tonal answer is nevertheless required since the subject begins on $\hat{5}$. This fugue, which does have a counterexposition, employs seventh chords in harmonic sequence as its closing material. Fugue Exercise No. 4, the longest of the group, touches on new keys (other than dominant for the first time) of the submediant and supertonic after a counterexposition and employs true episodic material for the first time. Its subject is based on that of Fugue Model No. 3. Here Handel introduces the technique of stretto in the form of mock stretto. In the Fugue Model in F major accompanying Fugue Exercise No. 5, double fugue is introduced and mock stretto is continued, which includes an introduction to augmentation. In Fugue Exercise No. 5 in E minor, the techniques of double fugue and mock stretto are continued. The Fugue Model in G major accompanying Fugue Exercise No. 6 is enriched by suspension and, for the first time, real stretto. In this double fugue, Subjects I and II take turns being the leading voice. The double fugue of the last fugue exercise, No. 6, takes as its subject the opening of the chorale *Aus tiefer Not*, here in E major, and makes use of stretto. Subject II is Subject I in augmentation, and the subjects appear in double counterpoint at the twelfth as well as at the octave. Lastly, the sketch in C major features the subject in stretto and its final entry in augmentation.

Handel's Fugues in the Lessons for Princess Anne Briefly Described

Here follow brief descriptions of Handel's exercises and fugue models. The author has prepared a handout of skeletons of Handel's actual pedagogical materials, downloadable in a form that is suitable for student completion at http://music.ou.edu/publications/jmtp/vol22/Handel.pdf.[7]

No. 1 (Exercise)

This fugue exercise of nineteen measures is a simple fugue exposition in three voices, in G Dorian, on a short subject of five pitches. The use of Dorian rules out the usual modulation to the key

[7] In order to be specific as to the beginnings of entries and sections, portions of measures are counted instead of merely downbeats of measures.

of the dominant in the answer, i.e., the answer is *at* the dominant, but not *in* the dominant key. The opening subject is followed by two real answers (mm. 3-7). The subject's basic outline is $\hat{1}$ $\hat{7}$ $\hat{3}$ answered by $\hat{5}$ $\hat{4}$ $\hat{7}$.[8] The short sequential bridge (mm. 7-10) that follows is based on the eighth-note motive of the subject, which may also be adopted for the bridge of mm. 13-15, employing a sequence of 7-6 following the redundant entry of mm. 10-12.

No. 2 (Exercise)

The hallmark of the second fugue exercise's subject is the repetition of tonic: the outline of the subject is $\hat{1}$ $\hat{5}$ answered by $\hat{5}$ $\hat{1}$. The use of G Dorian again makes for no change of key to the dominant for the answer. The subject of this simple fugue exposition, in four voices, is first stated in the bass, followed by a tonal answer in the tenor, then the subject in the alto and an answer in the soprano (mm. 1-5). A brief closing section employing double suspensions (9-8 with 7-6) leads to the cadence (mm. 6-9). There are no real difficulties for the student to encounter either in this nine-measure exercise or in the first fugue.

No. 3 (Model)

This fourteen-measure fugue model in F major, in four voices, paired with the following Fugue Exercise No. 3, makes use of a modulating subject ($\hat{1}$ $\hat{4}$ $\hat{5}$) from tonic to dominant, answered by $\hat{5}$ $\hat{1}$ $\hat{2}$. Prior to the final entry in the bass, in mm. 11-12, we rarely hear four voices together, mostly only three. A counterexposition follows in which the second tenor entry is shifted from the first beat to the third beat of the measure (mm. 9-10). Tonally, the exposition (mm. 1-6) consists of an alternation between tonic and dominant, and the counterexposition, an alternation between dominant and tonic, so that the fugue comes to a satisfying close in the home key (mm. 12-14).

No. 3 (Exercise)

This joyful sixteen-measure fugue exercise in F major, in four voices, makes use of a repeated-note figure once again, this time on the fifth scale degree. A true modulation to the dominant takes place in the tonal answer (unlike those of Exercise Nos. 1 and 2). The subject can be reduced to $\hat{5}$ $\hat{4}$ $\hat{3}$ answered by $\hat{1}$ $\hat{1}$ $\hat{7}$. Though short

[8] See William Renwick's subject and answer paradigms (pp. 24-78) in his *Analyzing Fugue: A Schenkerian Approach* (New York, 1995).

in length, the fugue itself is quite challenging to realize, particularly because of the eighth-note activity in the bass line, which demands harmonization. For example, both the parallel sixths of m. 6 and deceptive resolution of m. 13 invite parallel fifths.

In terms of structure, the fugue consists of a double exposition, having voice entries of TASB ASTB, with a one-measure connection (m. 7). The exposition of four entries follows the plan of tonic, dominant, tonic, dominant, but the counterexposition is irregular: tonic, dominant, dominant, tonic. The second entry of the counterexposition is heralded with a deceptive cadence (m. 9) and the third and fourth entries, with 7-6 suspensions. The alternation of subject and tonal answer is interrupted briefly (m. 11) by the insertion of another answer (mm. 11-12), which paves the way for the final, tonic, entry of the subject in the bass (mm. 13-14). Lastly, a cadential extension featuring seventh chords in harmonic sequence concludes the fugue (mm. 14-16).

No. 4 (Exercise)

The subject of Fugue Exercise No. 4 in G major may be seen as an elaboration of that of Fugue Model No. 3, through an extension by melodic sequence: $\hat{1}$ ($\hat{1}$) $\hat{7}$ answered by $\hat{5}$ $\hat{4}$ $\hat{3}$. Instead of simply marking the entrance of the answer (m. 3) for his student, Handel writes the complete real answer. This thirty-two-measure fugue exercise is longer by far than any of the other exercises or models and may pose difficulties for the student because of the modulating subject. Another problem is the matter of what range to place the voices in to make them come out right at the cadences. The fugue consists of two expositions, opening with a two and a half measure subject. Both expositions follow an SATB SATB format. The first exposition (mm. 1-11) alternates between subject and (real) answer and the second exposition (mm. 13-23), between answer and subject. Both the second and third entries of the first exposition and the third and fourth entries of the second exposition begin in the middle of the measure. In the last entry of the second exposition, the fifth and last two pitches of the subject are omitted (mm. 22 and 23), so that the subject becomes two measures—instead of two and a half measures—long. The next statement enters early, in m. 23, in mock stretto, in the key of E minor (the submediant), and is further truncated, creating an additional mock stretto with the next entry (in the supertonic, m. 25). As indicated earlier, this is the first time mock stretto and keys other than tonic and dominant appear in either an exercise or model. One notes that Handel inserts the alto pitches of g^1 and e^1 in the score in m. 26, probably to guide the voice leading. An entry on D (mm. 26-27), preceding the final truncated entry in tonic (m. 28), is a return of the truncated fourth entry of the second exposition (cf. mm. 22-23 and 28-29). Thus, only the head motive is left intact. A short closing section concludes the fugue (mm. 30-32).

No. 5 (Model)

This eighteen-measure fugue model in F major introduces the student to writing both a double fugue and invertible counterpoint at the octave. The first subject may be reduced to $\hat{5}\ \hat{4}\ \hat{3}$ and the second subject to $\hat{1}\ \hat{5}$. The initial alto-tenor entry (mm. 1-3) is followed by a statement of the subjects inverted and remaining in F major (mm. 3-5). After a one-measure connecting passage to C major (m. 6), a tenor-bass statement in that key appears in mm. 7-8. (The root and third need to be doubled on the last beat of m. 7 in order to avoid parallel fifths.) Here, Subject I descends a second, instead of a third, between the second and third pitches, in three successive statements (mm. 7, 10 and 13) for a tonal answer. Subject II leads alone in the alto in m. 9, followed by Subject I in m. 10, with Subject II reappearing in its usual location in m. 11. A mock stretto of the first subject in two truncated entries occurs in mm. 12-15, i.e., the first statement of the stretto is shortened by one and a half measures (cf. mm. 1-3 and mm. 12-13). In m. 12, the tenor must move from c^1 to *a* in order to avoid parallel fifths, and mm. 12-16 present a rhythmic problem, i.e., how to maintain the eighth note motion of the preceding measures. The second statement of the stretto is shortened by three beats (m. 15) and is here accompanied by Subject II (mm. 14-15), also shortened by three beats. In mm. 16-17, an abridged statement in augmentation of Subject I, accompanied by Subject II (not in augmentation), concludes the fugue.

No. 5 (Exercise)

This twenty-four-measure fugue exercise in E minor is another double fugue.[9] The exposition consists of three paired entries, with a tenor-alto opening, followed in mm. 3-6 by a bass-soprano answer (with Subject I a tonal answer and Subject II real) and then another

[9] Evidently Handel liked these two subjects, since they also appear in *Israel in Egypt, the Utrecht Te Deum* and other compositions in slightly varied forms. See Mann, *Aufzeichnunge*, p. 49.

soprano-bass statement in invertible counterpoint. The first paired entries (mm. 1-2) progress from $\hat{5}$ to $\hat{1}$ and are answered by $\hat{1}$ to $\hat{5}$. The second and third paired entries (mm. 3, 6 [and also, later, one in m. 13]) are shifted to the fourth beat. A five-beat connecting passage (mm. 6-7) separates the second and third entries. After four beats, Subjects I and II, in the bass-tenor enter in the mediant, G major (m. 11), followed by a soprano-alto entry in D major, the dominant of the mediant (mm. 13-15). In m. 15, Handel changes the pitches of beats 2-4 in the alto of the D major statement. Mm. 16-19 comprise a sequential episode that returns the music to E minor for a final statement of the subjects in the alto-bass (m. 19-21) and a three-measure closing (mm. 22-24).

No. 6 (Model)

This pinnacle of the models Handel composed for Princess Anne, in G major, is twenty-one measures in length and makes use of double fugue. Its glorious sound devolves much from Handel's use of suspensions: 4-3 early on, in m. 2, followed by 2-3 in m. 3, 7-6 in m. 4 and two 4-3's in m. 5. (2-3 suspensions also appear in mm. 7 and 16; 4-3, in mm. 7, 16, 18, 19 and 20; 9-8 in mm. 9, 10 and 19; and a double suspension of $\substack{9\text{-}8 \\ 7\text{-}6}$ in m. 11.) Subjects I ($\hat{1}$ $\hat{4}$) and II ($\hat{5}$ $\hat{1}$) are answered in mm. 2-3 in the tenor-bass. In m. 4, Subject II is the leading voice in the soprano, followed by Subject I in the alto. The tenor-bass answers in the dominant in mm. 6-7. (Compare this with the answer in m. 3, which does not make use of a leading tone, C-sharp.) An episode follows in mm. 7-11, employing sequence and 9-8 suspensions in mm. 9-11. Another answer enters (without C-sharp, cf. mm. 3 and 6-7) in the alto-soprano (mm. 12-13). After a short connecting passage (mm. 13-14), another statement of the subjects, in G major, appears in mm. 15-16. The dotted quarter motive from m. 3 appears in the right hand in m. 16. Next, a real stretto (for the first time) of the answer to Subject I, in the soprano-bass, appears on D in mm. 17-18, with Subject II accompanying the leading entry of Subject I in stretto, in the alto. The bass entry in m. 18 is slightly altered and a melodic sequence in the bass (m. 19) leads to the brief closing section (mm. 19-21).

No. 6 (Exercise)

Handel's fugue exercises culminate in a fifteen-measure fugue based on the E Phrygian chorale melody *Aus tiefer Not*, here, as noted earlier, in E major. In this double fugue, Subject II ($\hat{5}$ $\hat{4}$) is an augmentation of Subject I ($\hat{5}$ $\hat{4}$ $\hat{3}$) .[10] The tenor-bass opening is followed by Subjects I and II in the soprano-bass, with real answers (mm. 3-4). Next, a chain of seventh chords appears as an episode (mm. 5-6) leading to a shortened version of Subject II, in mock stretto in answer form (mm. 7-8), accompanied in the bass with an incipit of beats 3-7 of Subject I (cf. the alto of mm. 1-2 with the bass of mm. 7-8). In mm. 9-10, the opening returns in the soprano on B and the alto, this time on E, for double counterpoint at the twelfth. Subject I appears in elaboration in mm. 10-11. Then, a true stretto of Subject II appears in mm. 11-13 and the fugue concludes with a two-measure closing featuring suspensions (mm. 14-15).

No. 6 (Sketch)

The Lessons for Princess Anne conclude with the sketch in C major, featuring a repeated dominant as a one-measure subject in stretto. The fugue opens with four entries: ATBS (mm. 1-6), after which the fifth and final entry appears in augmentation (mm. 6-8) and the sketch closes with a simple cadential extension (mm. 9-11).

We may be good instructors, but, after all, the student who has worked the above exercises, perhaps guided by one of us, has gone straight to the source and studied with the master teacher himself, Georg Frideric Handel.

[10] These two subjects are used in choruses from "Let All the Angels of God Worship Him" from the *Messiah*, in the *Foundling Hospital Anthem* and in *Samson*. The same double exposition is found in the aria "*Ti vedrò regnar*" from *Ricardo Primo* (1727). See Mann, *Aufzeichnunge*, p. 50.

A Comparison of Four Sight-Singing and Aural-Skills Textbooks: Two New Approaches and Two Classic Texts in New Editions

Review by William Marvin[1]

Carr, Maureen, and Bruce Benward. *Sight Singing Complete.* Seventh Edition. Boston: McGraw-Hill, 2007.

Karpinski, Gary, and Richard Kram. *Anthology for Sight Singing.* New York and London: W. W. Norton and Company, 2007.

Carol Krueger. *Progressive Sight Singing.* New York and Oxford: Oxford University Press, 2007.

Robert W. Ottman and Nancy Rogers. *Music for Sight Singing.* Seventh Edition. Upper Saddle River, NJ: Pearson Prentice Hall, 2007.

It seems that music departments throughout North America are perennially revisiting their curricula. Textbook choices are frequently part of those deliberations, as instructors strive to deliver the material efficiently, accurately, and musically. Even if one's department is not in the throes of reconsidering its approach to aural-skills instruction, current market forces might encourage such an exercise, for the year 2007 produced a wealth of sight-singing and aural-skills textbooks. Of the four texts under review here, two are new to the market, and two are revised editions of classic texts.

The two new books offer strong challenges to the established texts, and both provide more explicit pedagogical suggestions for students and instructors than the revised texts. (This statement may seem puzzling in relation to Gary Karpinski and Richard Kram's anthology, which contains very little prose; it refers largely to the companion volume by Gary Karpinski, *Manual for Ear Training and Sight Singing* (New York and London: W. W. Norton

[1] I give special thanks to Steve Laitz, Betsy Marvin, and Gregory Ristow for sharing their vast knowledge of aural-skills pedagogy with me as I wrote this review.

and Company, 2007). This latter volume, while devoted mainly to dictation, contains a tremendous amount of pedagogical material on sight singing, and can be used separately or as part of an integrated course with the sight-singing manual. While I will refer to both works in this review, I am mainly using the anthology for my comparisons with the other texts.) Carol Krueger incorporates exercise materials throughout her text, with explicit strategies for the teacher to implement, and for the student to practice. Krueger additionally offers an instructor's manual.

Lest the cynic believe that the melodies of the revised editions have merely been shuffled or renumbered yet again to thwart students searching for less expensive used textbooks, the revisions in question are by co-authors, and thus provide new pedagogical voices. Carr/Benward is the third edition of that text to be co-authored, and the first in which Maureen Carr receives primary billing; Ottman/Rogers is co-authored for the first time in its current edition. While Ottman/Rogers remains similar to earlier editions (but improved from them at the same time), Carr/Benward has been gradually transformed into a book that is quite different from its earlier incarnations.

Starting with the recognition that no single pedagogical approach can accomplish everything, and that a brief review cannot possibly do justice to every aspect of the texts under consideration, I have chosen to focus on pedagogical assumptions and how these shape the contents and learning outcomes for each text, rather than providing a survey of physical characteristics, repertoire used, layout, etc. I will also present my findings in relation to curricular considerations. My major contention is that while all four texts claim some degree of generality with respect to curricular and pedagogical approaches, close examination reveals that each is designed with a specific pedagogical and methodological approach, and failure to recognize and endorse those approaches can result in frustration for students and teachers alike.

Starting Points, Scope, and Output Goals

While all four of these texts deal primarily with a single musical skill, namely literacy, each has a highly individualized approach, and each is directed toward different student populations. This of course explains the differences in starting points, output objectives, and amount of material covered. I define literacy as the ability to translate symbol into sound. This includes rhythm (temporal placement of sound), pitch (the right notes), and so-called expression marks (tempo indications, dynamics, ornamentation, etc.). These are the very topics to which we will now turn.

Rhythmic exercises comprise an important feature of three of the texts under consideration. With the exception of the Karpinski/Kram anthology, each book provides introductory lessons on rhythmic pedagogy, addressing such topics as the maintenance of a steady pulse and the reading of exercises in simple time from rhythmic notation. In this reviewer's estimation, the initial and sustained focus of these three upon rhythm is not merely appropriate, but necessary; as any experienced aural-skills instructor is well aware, some students can be quite lazy about precise rhythmic performance, especially when they are concentrating upon pitch. The sequencing of rhythmic content in these three texts is variable, each effective in its own way. Individual instructors will have personal preferences, and any decision as to the advisability of one approach over another will likely consider sequencing as one of many relevant factors. Of the books surveyed, Carol Krueger's projects the most advanced rhythmic topics. Unfortunately, too many of the exercises involve unvaried four-measure groupings, as do the melodies composed for sight singing later in the text. This unremitting similarity of construction makes the exercises excessively predictable, and may cause some students to lose their concentration. Ottman/Rogers contains a large number of new exercises and rhythmic topics compared to earlier editions. Personal experience with the book suggests that most of the exercises (both old and new) are too short to be useful in successfully imparting rhythmic reading skills and steady pulse maintenance over time, and a separate book devoted to rhythmic pedagogy is necessary.[2] The rhythmic exercises by Carr/Benward are also integrated with melodic material throughout the text, and include both shorter and longer exercises in a variety of idioms and styles. None of the texts here addresses rhythmic pedagogy in the context of instrumental performance.

[2] Rhythmic pedagogy is dealt with in the following stand-alone texts: Anne Carothers Hall, *Studying Rhythm*, 3rd ed. (Upper Saddle River: Pearson/Prentice Hall, 2005); Daniel Kazez, *Rhythm Reading: Elementary through Advanced Training*, 2nd ed. (New York: W. W. Norton & Co., 1997); Robert Starer, *Rhythmic Training* (Milwaukee: MCA Music Publishing, 1969); Richard Hoffman, *The Rhythm Book* (Smith Creek Music, 2006) a textbook for aural skills development based on the Takadimi system of rhythm pedagogy (see *JMTP* vol. 10, 1996).

Turning to the realm of pitch, Carol Krueger's text is, in some ways, the most modest in scope. In consideration of its design, a one-year curriculum for beginners, and given the advanced rhythmic exercises in the book's first half, the disjuncture may seem odd. At a collegiate level, it certainly would not take students beyond the first year of study (perhaps not even beyond the first full semester at some institutions). Its audience includes junior-high and high school courses, two-year college music programs, adult continuing education and community music school programs, and four-year collegiate music courses that are looking for a text to address remedial aural training for students with weaker than expected backgrounds. Starting from the most basic musical problems, including maintaining a steady pulse, matching pitch vocally, and singing stepwise melodies confined to the major pentad, the text progresses through involved rhythms and diatonic melodies in major and minor keys, with emphasis on primary harmonies (I, ii, IV, and V). Many of these melodies arpeggiate the primary harmonies clearly, while others imply the target harmonies more subtly to students trained in traditional melody harmonization. The book concludes with a chapter on melodies in the diatonic modes. Of the four texts under review, Krueger's contains the largest proportion of melodies and exercises composed specifically for the text, with less than half of the content being drawn from the repertoire of folk music and the common-practice.

Gary Karpinski and Richard Kram's text overlaps with Krueger's in its coverage of rudimentary pitch material and diatonic melodies (major, minor, and modal), but also goes much further than diatonic harmony by including chromatic idioms and modulation. Carr/Benward and Ottman/Rogers are even more ambitious, for in addition to the tonal topics covered by Karpinski and Kram, these books conclude with extended chapters on twentieth-century tonal and post-tonal idioms.[3] Carr/Benward moves through the initial stages of training more rapidly than the other texts, and thus would be more appropriate for programs with advanced students. With their comprehensive inclusion of rhythm exercises, tonal melodies and ensembles, and post-tonal repertoire, Carr/Benward and

[3] The twentieth-century materials in Ottman/Rogers have been thoroughly revised; instead of a grab bag of melodies in haphazard order, there is now an effective pedagogical organization in this chapter. Karpinski/Kram advise a separate text for the study of post-tonal ear training.

Ottman/Rogers are appropriate stand-alone texts for an entire sight-singing curriculum; Karpinski/Kram will require supplementary texts for rhythm and twentieth-century music, and Krueger will be appropriate for the introductory contexts specified above.

The vast majority of material in all four texts involves single-line melodies for sight singing or for rehearsed singing. Canons are featured in all four texts as well, and all except Krueger include vocal duets and choral passages or movements for ensemble singing. Many of the duets in Ottman are quite difficult, especially at the earlier stages of study; frequently they consist of a folk song in which Ottman has composed an accompanying line that involves awkward vocal leaps or complicated contrapuntal interaction between the two voices. Carr/Benward has a clear advantage over the other texts in terms of ensemble singing, providing the greatest number of examples and the greatest variety of vocal textures (imitative, chorale style, duets, trios, SATB, sung string quartet movements, etc.)

Pedagogical Approaches

Most of the texts under consideration proclaim some degree of neutrality regarding solmization systems. This is a contentious subject, and opinions are often divided sharply within individual institutions, with applied faculty generally preferring a fixed-do approach, music theorists frequently advocating scale-degree numbers or *do*-based minor movable *do*, and music education faculty arguing in favor of *la*-based minor movable *do*. While this is not the place for a complete survey of the advantages and disadvantages of all available systems, it is important to recognize that not only the target repertoire, but the ordering of material, and the overall pedagogical approach, reveal that none of these texts is as ecumenical as the authors claim them to be. Indeed, a close reading of each author's description of the various methods available for rhythmic reading and sight singing explicitly indicates the preferred methodology for employing each text most effectively.

Ottman/Rogers proposes three tools for sight singing (p. 13): solfège syllables (meaning movable *do*), scale-degree numbers, or letter names (either uninflected, or with chromatic inflections).[4]

[4] It should be noted that the chromatic note-naming system espoused here is not explained completely. The authors advocate German note names (G# = gis, E-flat = es, etc.), but do not provide all of the options

The suggestions for movable *do* are refined when the minor mode is introduced (p. 66): "In modern practice, there is a growing preference for designating the tonic as *do* in minor keys. . . ." In short: *la*-based minor movable *do* is not recommended with this text, and fixed *do* is relegated to a footnote (p.13).

The Karpinski / Kram anthology contains no explicit pedagogical suggestions; this is because the pedagogy is spelled out in great detail in the companion volume, which advocates either solmization by scale-degree number or movable *do*. Karpinski further elaborates (pp. xviii-xix): "For the most part, the book uses a parallel, functional approach to movable *do* (including *do*-based minor), with two exceptions: *la*-based solmization is used . . . when the natural minor mode is introduced, and . . . when the modes are introduced. . . . But readers should make no mistake—this is not a *la*-based-minor book." In trying to have it both ways, Karpinski has virtually guaranteed that the curriculum will grind to a halt each time the solmization system is changed. If the texts truly are *do*-based minor texts, there is no compelling pedagogical reason for introducing *la*-based minor at all, and doing so will only lead to student confusion and frustration. Karpinksi makes no suggestions for singing on letter names or fixed *do*.

Carr / Benward gives a very brief explanation of several systems in chart form (movable *do* in both forms, fixed *do*, scale-degree numbers, chromatic fixed *do*,[5] and pitch-class numbers 0-11 in a fixed system (C=0). There are very few explicit pedagogical suggestions for the use of these systems in the body of the text, and the authors recommend that the instructor use "a system with which they feel comfortable" (p. xvii). This suggestion will result in most instructors uncritically defaulting to the system in which he or she was initially trained, as few musicians are inclined to work through several sight-singing manuals utilizing multiple systems in order to determine which one is most effective.

(35 are necessary, with each of the seven natural pitches sharped, double sharped, flatted, and double flatted). While the virtues of one syllable per articulated note are obvious in the German system, it needs to be fully explained for students and teachers to use it effectively.

[5] The authors appropriate the chromatic syllables from movable do to create a chromatic fixed do system. A movable system requires 17 syllables, whereas a fixed system would require 35 as mentioned in footnote 4. Here, aside from excessive overhead of this many sung signifiers, I cannot see how some of these might be named effectively. For example, how do you brighten the vowel of mi when confronted by an E#?

Carol Krueger provides the most thorough descriptions of the available systems in a series of useful appendices, and also integrates scale-degree numbers, movable *do* (with both *la*- and *do*-based minor) at every level of the text. The appendices include comparative charts for a variety of rhythmic syllables (Takadimi, McHose and Tibbs, Gordon, and Kodály), as well as clear descriptions and comparisons of all of the pitch systems mentioned above, plus a representation of the Guidonian hand, Curwen's hand symbols for movable *do*, and a modernized version of Glover's tonal ladder. Krueger's own preference is revealed in the following (pp. 457-8): "The la based minor approach allows inexperienced singers to sing in tonalities other than major without knowledge of chromatic syllables, notation, or music theory. It is the 'only tonal syllable system based on syntax.'"[6] [*sic*] Krueger's use of the word "tonalities" here is typical of *la*-based minor solmization advocates: for these musicians, modes (major, minor, phrygian, etc.) represent different tonal systems, and modal mixture is not emphasized as a theoretical construct.

What is missing from all four of these summaries is a broader framework that recognizes what each system accomplishes, and what it does not. Gary Karpinski provides such a framework in his seminal 2000 study, *Aural Skills Acquisition.* In surveying the available systems, he advises: "…practitioners must be extremely careful in choosing two simultaneous systems for pitch solmization, one modeling scale-degree function and another modeling letter names."[7] To elaborate: all of the available systems can be classified either as *phenomenal* methods, which name notes, or *conceptual* methods, which place the notes into a hierarchy. Karpinski implies, and I agree, that expert musical literacy requires us to engage both the phenomenal and conceptual aspects of music, and thus our pedagogy should highlight two systems–one from column A, one from column B.[8]

Training in musical literacy, by necessity, must address competency in specific musical repertoires. Unfortunately, explicit recognition of

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[6] Eric Bluestine, *The Ways Children Learn Music* (Chicago: GIA Publications, 1964), 92.

[7] Gary Karpinksi, *Aural Skills Acquisition* (New York: Oxford University Press, 2000), 90.

[8] Given his explication of phenomenal and contextual aspects of music, it is surprising that Karpinski advocates a completely movable (i.e., contextual) approach to sight singing in his texts.

the relationship between musical repertoire and choice of solmization system is missing from all four texts. Greater awareness and understanding of this relationship would minimize the passionate arguments between musicians who espouse different pedagogical approaches to sight singing and aural musicianship. For example, the Kodály tradition of *la*-based minor movable *do* solmization is related to the diatonic modal music that characterizes folk song, and is thus an effective tool for music that explores the diatonic set and moves freely between relative modes. The Curwen/Glover tradition of *do*-based minor solmization, on the other hand, privileges the parallel modal relation, and is thus more appropriate for major-minor modal mixture as a structural feature of common-practice tonal music. More specifically: a Russian folk tune that alternates between F major and D minor will be modeled more effectively using *la*-based minor solfège, while a Schubert song that alternates between D major and D minor will be modeled more effectively using *do*-based minor solfège. The strong preference for common-practice melodies found in Ottman/Rogers and in Karpinski/Kram, the extensive use of folksong in Krueger, and the eclecticism of repertoire found in Carr/Benward, help to explain the particular orientations espoused in each of these texts. In summary: if one's curriculum emphasizes folk music and Kodály's *la*-based minor solmization, Krueger's book will be the best fit; for common-practice music with *do*-based minor, either Ottman/Rogers or Karpinski/Kram provide the appropriate materials. For curricula that emphasize music in the widest variety of historical styles and idioms, Carr/Benward is the most appropriate choice, using either fixed *do* (which will allow a single method of solmization across the full spectrum of repertoire), or a series of different methodologies employed for different musical idioms. It should further be noted that while fixed-do solfège or note-naming could be successfully employed in conjunction with a conceptual system in Krueger or in Ottman/Rogers, there is no way that a phenomenal system can be used effectively with the Karpinski/Kram text due to the necessity for vocal transposition throughout the book; phenomenal systems are meaningless unless one is singing the pitches that are actually sounding.[9]

In addition to considerations of target repertoire and the appropriate solmization systems to best model that repertoire,

[9] The author of this review has successfully employed a scale-degree plus fixed-do pedagogy using earlier editions of Ottman, both at Oberlin Conservatory and at the Eastman School of Music.

instructors need to consider the desired outcome for their students after the full course of study. If students are to achieve the ability to shape musical phrases over the course of an entire movement, then an aural-skills curriculum must provide materials for developing instantaneous reading skills, and also for learning through the rehearsal of lengthier excerpts. Here there is an instructive contrast between all of the current texts and the melodies in the classic *Solfège des Solfèges* series that originated at the Paris Conservatoire.[10] There, one typically encounters melodies that are 40-70 measures long, even at the earlier stages of study. Through examples of such length, students are encouraged to develop important skills (navigating multiple sequential modulations, developing long-term tonal memory, observing good rehearsal/practice techniques, recognizing musical forms, performing real-time musical analysis, etc.) that are not accessed as effectively in any of the more modern texts.

Carol Krueger's text offers no clear progression from shorter to lengthier examples. Karpinski and Kram are even more problematic in this regard: far too many of the melodies throughout their text are less than eight measures in length, and many of these do not even conclude with a logical cadence. The revised texts by Ottman/Rogers and Carr/Benward offer clear advantages here, with many lengthier examples and full movements for study in the later chapters.

Theoretical Orientation and Sequencing of Material

Inevitably, the organization and sequencing of pitch materials in an aural-skills curriculum will progress in dialogue with other learning sequences, such as those found in written theory, music history, or performance. Many instructors of aural skills have experienced the tension between a harmonic organization of materials, which emphasizes coordination with written music theory classes, and the recognition that aural skills acquisition is often accomplished at a different rate of speed—more rapidly for a few advanced students, more slowly for the vast majority. Further, it is unlikely that any text will present materials in exactly the right order for a given curriculum and student population; instructors often find themselves attempting to re-order the materials in a

[10] A. Danhauser, L. Lemoine, and Albert Lavignac, *Solfège des Solfèges*, 34 vols. (Paris, Henry Lemoine, 1910-1923).

given text without rendering the exercises unperformable due to skipped steps in the revised pedagogy. The problems are most acute as departments decide which component of the theory curriculum addresses harmonic dictation: if placed in the written theory classroom, theory instructors are forced to address aural training (not necessarily a bad thing); if placed in the aural musicianship classroom along with sight singing and rhythmic reading, aural-skills teachers are constrained to move in lockstep with a written theory curriculum. Each of the texts under consideration takes a slightly different approach to these problems, and they are not equally flexible for differing curricular preferences.

Three of the texts share a common organizational approach for the initial stages of melodic study, in that they progress in a more-or-less tonally derived sequence. Specifically, the materials in Krueger, Ottman/Rogers, and Karpinski/Kram all begin with stepwise major-mode melodies, progress to leaps within the tonic triad, then leaps within the dominant triad, add leaps to pre-dominant functioning scale degrees (including $\hat{6}$), and move on to chromaticism. Within this common framework, the minor mode is addressed in slightly different ways in all three texts; this is related in part to the solmization preferences referred to above.

The Carr/Benward book is organized on quite different premises. Instead of emphasizing scale degrees and harmonic context as the primary strategy, this book is organized primarily around intervals, with harmonic context providing a secondary parameter of organization.[11] A third parameter is that keys are clustered together: students read several melodies in a row within a limited number of keys (a feature usually associated with fixed-do solmization).[12] As with the other three texts, Carr/Benward begins with stepwise melodies and leaps within the tonic triad, but limits those leaps to thirds, fourths and fifths, reserving leaps of an octave for later study, and sixths are not introduced until later yet. One appealing aspect of this organization is that it allows for clusters of

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[11] Carr/Benward is similar to Samuel Adler's book in this regard. See Samuel Adler, *Sight Singing: Pitch, Interval, Rhythm*, 2nd ed. (New York: W. W. Norton & Co., 1997).

[12] Examples of texts organized by key include David Damschroder, *Listen and Sing: Lessons in Ear-Training and Sight Singing* (Belmont CA: Schirmer Books, 1995); Arnold Fish and Norman Lloyd, *Fundamentals of Sight Singing and Ear Training* (New York: Harper and Row, 1964); and the 34 volumes of A. Danhauser, L. Lemoine, and Albert Lavignac, *Solfège des Solfèges* (Paris, Henry Lemoine, 1910-1923).

melodies by a particular composer, or within a given idiom (a series of chant melodies from Christian and Judaic sources appears in Unit 1; disjunct melodies by Baroque composers are grouped together, in Unit 11, to emphasize augmented seconds and diminished sevenths). These clusters, which have conceptually been a perennial feature of this text, are ideal for instructors who wish to teach across the curriculum, emphasizing repertoire, historical context, or performance practice within the aural-skills classroom. The approach may also result in a great deal of independence between aural training and written theory class. This is not necessarily a criticism, but instructors should be aware that this text is not the obvious choice if maximal theory/skills coordination is desired.

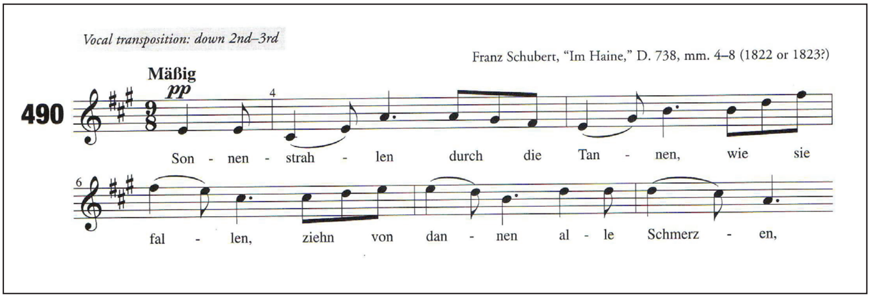
An additional feature of Carr/Benward's book is the merging of familiar and unfamiliar styles, clefs, tonal problems, and rhythmic problems throughout the book. The uneasy tension between intervallic and scale-degree strategies is part of this, and an unsympathetic teacher could find these systematic disjunctions to be a pedagogical inconsistency. It is clear from the Preface that these disjunctions are by design, and that the authors expect instructors to engage their students in the solving of problems together. Obviously, this places a tremendous emphasis upon planning and creativity. Instructors who are thoroughly committed to self-reflection in their own learning processes, and who are able to convey problem-solving strategies effectively to their students, should be able to use this book to great effect.

Karpinski and Kram order their fifty-four chapters mainly in terms of harmonic and scale-degree topics, but there are some unusual choices that may puzzle first-time users. For example, the same musical problem (namely, leaps within the dominant harmony) is spread out among four widely separated chapters: Chapter 4 (Skips to $\hat{7}$ and $\hat{2}$ as Prefix Neighbors), Chapter 12 (The Dominant Triad), Chapter 19 (The Dominant Seventh Chord), and Chapter 22 (The Leading-Tone Triad). This is complicated in that some of the most difficult melodies within this grouping are found in Chapter 4.[13] The logic of separating these chapters from each other has eluded this reviewer, and seems again to be an attempt to please everybody. While the book's organization may have been well intentioned, it requires extra work of instructors who prefer to introduce arpeggiations from the simpler to the more complex.

[13] Chapter numbers are provided only within the table of contents, and not within the body of the text.

The so-called prefix functions in Chapter 4 are an attempt to introduce Schenkerian hierarchy without the necessary theoretical scaffolding.

Another feature of the Karpinski/Kram text that will cause problems is the extremely late introduction to modulation. In the introduction to his companion ear-training manual, Karpinski indicates that this is intentional, because modulation "presents some of the most difficult challenges in tonal aural-skills training" (p. xviii). For this very reason, some instructors might assume that an earlier presentation, with more time to practice, would facilitate mastery of the essential skills associated with the topic. Further problems occur in the actual melodies chosen for some of the topics: for example, several of the melodies in Chapter 23 (The Supertonic Triad) involve arpeggiation between $\hat{2}$, $\hat{4}$, and/or $\hat{6}$, but the musical context does *not* suggest a supertonic harmony. Example 1 illustrates the problem: Schubert's melody clearly projects dominant harmony throughout measure five, in spite of the apparent arpeggiation of a supertonic triad on the third beat. To interpolate a ii chord at any level contradicts a student's efforts to connect harmonic syntax as taught in written theory classes with their aural experience of the music. By my calculation, approximately half of the melodies in Karpinski and Kram's Chapter 23 do not clearly articulate the target harmony suggested in the chapter title. The most common problem here is that the so-called supertonic arpeggiation implies two harmonies in many of the examples, usually a predominant moving on to a dominant.



Example 1: Melody from Karpinski and Kram, p.134, illustrating supertonic triad

Of the surveyed texts, the harmonic organization of the Ottman/Rogers provides for the most intuitive match of written and aural curricula. The sequencing of chapters and materials is generally quite compelling, but the actual pedagogical advice offered for rehearsal is minimal, and often incorrect. A typical example is the advice for performing a grace note "as quickly as possible" (p. 29). This advice has appeared in every edition of the book at least since the fourth, and does not help the student who needs to decide whether to place the note before or on the beat. (The advice is further inaccurate, given that a long appoggiatura is certainly the appropriate interpretation for the specified melody by Haydn). Topics that do not fit into a harmonic framework provide awkward moments within the sequence of materials in this book. For example, the chapter on alto and tenor clefs is inserted arbitrarily, and these clefs are only intermittently utilized from this point on. (Perhaps this is unavoidable, as clef reading is by nature a phenomenal problem, and the book itself is conceptually organized around scale-degree or *do*-based minor solmization). Instructors are always free to assign melodies, notated in treble or bass clefs from later chapters, as if they are notated in alto or tenor (with the appropriate change of key signature and accidentals), and teach students to address the appropriate transpositions. Also, the book cycles back to harmonic topics each time a new rhythmic or metric topic is introduced. This is understandable, given that rhythmic topics require their own logical pedagogical sequence that is independent from tonal pedagogy. Krueger solves this problem by presenting, in effect, two books: a sequence of eighteen chapters on rhythmic reading, followed by a sequence of eighteen chapters on melodic reading. Instructors are thus free to move at different rates based on the needs of individual classes.

What Should Music Look Like?

The appearance of music on the page has a tremendous impact on how we read. In this respect, all four of the texts have an internally homogenous appearance that represents a publisher's textbook house style, and none of the melodies, canons, ensembles, or rhythmic exercises has the true appearance of a score or orchestral part as musicians experience them in the real world.[14] Further problems appear in relation to font size and page layout: page turns in Ottman/Rogers are particularly awkward, and the small font size

[14] For sight-singing texts that print materials in a variety of fonts for this purpose, see Samuel Adler, *Sight Singing: Pitch, Interval, Rhythm*, second ed. (New York: W. W. Norton & Co., 1997) and Paul Cooper, *Dimensions of Sight Singing: An Anthology* (New York and London: Longman, 1981).

throughout Krueger for text and musical examples is particularly wearing on the eyes. Spacing issues within the melodies and rhythms also mar Krueger's book: poor layout to fill the margins frequently results in spatial distortions within individual measures that will ensure incorrect readings by students.

Regardless of repertoire, melodies appearing by themselves involve a *very* different skill from score reading in which the musician sees all of the sounding parts. Choral singers, vocal soloists, and instrumentalists must continuously tune against each other aurally and visually. While single-line instrumentalists typically read from their own instrumental part, vocalists almost never do (with the exception of singers training in the performance of early music), and keyboard players, guitarists, and harpists typically see the full musical texture in their notated music. The sight-singing manual, insofar as it rarely goes beyond unaccompanied excerpts that don't look like real music, falsifies the musical experience of many musicians here. While all of the texts include a good number of vocal canons, and each contains some ensemble singing exercises (Carr/Benward being richer than the others in this area), the textbook market has not served instructors well in providing graduated exercises and repertoire for visualizing music in a variety of score formats, or for concentrating on the problems of performing with an accompaniment (or with other voices; witness the violin player who gets lost while playing from the score with a pianist), tuning against other parts, or finding one's notes from contextual clues elsewhere in the score.[15]

Students and instructors should also know exactly what music they are singing. Here, Carr/Benward and Karpinski/Kram offer clear advantages, for they provide complete information about composer, title, opus or other catalogue number, movement, and measure numbers. In some cases, the actual edition is indicated as well, which is helpful in early music and folk music collections, where the instructor may wish to bring in alternative representations of the "same" music for comparison. Ottman/Rogers is a bit more variable in source attribution, and several of the melodies are editorially adapted for pedagogical purposes (transposition, cut-

[15] The sing-and-play exercises that are integrated throughout Sol Berkowitz, Gabriel Fontrier, and Leo Kraft, *A New Approach to Sight Singing*, 4th ed. (New York: W. W. Norton & Co., 1997) are superb models for developing coordination of multiple parts, and for intonation studies.

and-paste elimination of rests or repeated passages, etc.). Such adaptation is not a problem *per se*, but it would be nice to know what has been done, especially since students are taught about the importance of performing from accurate editions.

Karpinski and Kram make a point of using *Urtext* editions and providing "authentic" versions of every melody included. This decision results in some extremely awkward pedagogical problems. Many of the melodies appear in difficult vocal ranges for untrained and trained singers alike, and the authors thus suggest transpositions throughout the book. Such an approach undermines any attempt to use a phenomenal system in conjunction with this text, an issue addressed earlier in this review. Further, the student is introduced to all of the keys early on in the book, but will never actually sing in some of them due to the enforced transposition. Another advantage of singing music at pitch instead of transposing is that students gradually become aware of their own vocal range; this cannot happen if the student is constantly transposing. Notwithstanding the authors' goal of retaining "the most authentic versions possible" (p. x), the book betrays evidence of editorial decision-making at many levels. Given that the house style musical font will homogenize each melody's appearance, the authors' good intentions have not resulted in the pedagogical advantages that they claim.

Improvisation and Other New Features

Nancy Rogers and Maureen Carr have both added an emphasis on improvisation to their respective texts, which is then integrated with other materials throughout each book. Rogers's exercises are particularly helpful to students at the introductory stages, when they are frequently traumatized by the sheer prospect of creating melodies on the fly. It is hoped that instructors will expand upon these introductory exercises, and that future editions will provide additional materials to teach this important skill. What remains unarticulated at this stage is the *purpose* of improvisational studies. If improvisation is included merely to satisfy a NASM requirement, then these materials are sufficient; if the goal is to develop musicians who can improvise *Eingänge*, cadenzas, or variation sets on their instruments in real time in numerous specified styles, then we have a long way to go.

I have already mentioned the improved pedagogy for twentieth-century music and the increase in the number of rhythmic exercises that Rogers brings to her text; there are also several new and effective melodies scattered throughout the text that teachers and students will enjoy. It is expected that Rogers's considerable pedagogical sensitivity will exert even greater influence on the text in future editions. Maureen Carr also brings many new features to her classic text, including repertoire drawn from early music, Duke Ellington, twentieth-century classical music, and some beautiful vocalises in several styles in the later chapters. Ultimately the Carr/Benward text has become a graduated anthology that lives up to its title in the sense that students will be exposed to, and work through, problems of reading music in a great variety of styles and idioms. Some of the pedagogical assumptions make considerable demands on student and teacher alike, but a dedicated instructor could make much of this material.

The first edition authors have also contributed several pedagogical features that are unique to their texts, and provide genuine contributions to our ability to teach music literacy effectively. Krueger's pedagogical materials are particularly effective in helping students to internalize and embody the patterns of musical fundamentals: diatonic scalar orientation, intervals and chord qualities within various scale forms, and the hardwiring of scale degrees or solfège that is necessary for the tool to become useful at later stages of study. These exercises, which are described without notation at the beginning of many chapters within Krueger's book, are at risk of being overlooked by students and teachers who might be more inclined to skip directly to the melodies. This would be most unfortunate, for the exercises themselves are in many ways the most important and effective portions of this text, being based in part on learning sequences developed by Edward Gordon.[16] Use of these exercises as warm-ups and as tonal orientation before sight reading will solve many of the musical difficulties beginning students face in aural training.

[16] See Edwin E. Gordon, *Learning Sequences in Music*, [3rd ed.] (Chicago: GOA Publications, 1997).

Krueger also addresses many elements of notation that are ignored, or introduced tacitly in other texts; tempo, expression marks, repeat and *da capo* indications, and other important notational conventions all receive their due, and they don't feel like add-ons in the book–they are systemically reinforced in the exercises from all chapters after their introduction.

Karpinski and Kram also introduce several very effective chapters on musical topics that are ignored, or under-articulated, in other texts. Chapter 11 (Conducting Pulse Levels Other Than the Notated Beat) is wonderful: by forcing the student to conduct "in one", or in larger hypermetric patterns, it will be impossible for the student to revert to "sight-singing class tempo" (i.e., slower than real music should ever go). Chapter 40 (Melodic Sequence) contains many effective examples that are grouped well together (albeit a bit late in the text), and Chapter 44 (Reading in Keys Other Than the Notated Key Signature) is a unique contribution, helping students to find their tonal bearings in the middle of a composition. While Chapter 48 (Successive Modulations) delivers what it promises, it also conflates problems that should be maintained as distinct from each other, yielding a catch-all chapter that is too large as it stands.

Conclusion

Each of these texts has considerable virtues, and all provide a wealth of material for sight singing and practice–more than any curriculum could effectively use in a given course sequence. The first-edition texts contain much more explicit pedagogical material than the revised editions, and even if not adapted, they should provide the instructor working from other anthologies with effective lesson-plan materials and strategies to supplement their teaching. The revised texts leave the pedagogy up to the teacher to a greater extent, but have compelling advantages in terms of breadth of repertoire, and proven success in their use by many students and teachers over the years. While we all continue to revisit our curricular and textbook decisions, it is good to have choices.

Listen Up!: Thoughts on iPods, Sonata Form, and Analysis without Score

Brian Alegant

Introduction

In a recent textbook Gary S. Karpinski summarizes two kinds of activities that have proven useful for developing listeners' skills in attending to form.[1] One activity involves listening guidelines (or questions to be answered in prose); the other uses some kind of visual representation. Both have the potential to highlight features of a work that will become clearer through repeated listening. Karpinski makes three assertions about developing listening skills: first, that students should focus on the recurrence of motivic and thematic materials, textural changes, harmonic instability, and key areas; second, that students need to listen *repeatedly*; and third, that the skills gained through acquiring "intimacy with even only a handful of works" can be transferred to unfamiliar repertoire.

This essay summarizes a pedagogical approach that uses iPods to teach students to analyze sonata forms without score.[2] It discusses the advantages of iPods and outlines the organization of the course, paying particular attention to the learning outcomes and the roles played by graduated assignments. My primary aims are to stimulate thought about the topic of analysis without score, and to suggest that it is both possible and rewarding to teach this particular skill. The strategies I advocate resonate strongly with Karpinski's three assertions above, namely an emphasis on close readings of a handful of works in order to develop specific skills that can be generalized; the use of various kinds of visual representations (ranging from virtually blank scores to highly annotated ones); and an ideal device for repeated listening—the iPod.

An earlier version of this essay was read at the annual College Music Symposium conference held in San Antonio, Texas in 2006. I would like to thank my colleague Jan Miyake for her valuable feedback.

[1] Karpinski, *Aural Skills Acquisition*, 2000, pp. 136–137; emphasis his.

[2] While there are many writings on sonata form and aural skills pedagogy, to my knowledge none deal in any depth with the topic of teaching sonata form without score.

The course in question was Music Theory III, the third semester of a two-year sequence required of our undergraduate music majors.[3] I divided the course into two units, one on 19th-century song and the other on sonata form. The harmonic vocabulary included the standard items found at the end of most tonal-music textbooks: chromatic sequences, Neapolitans and augmented sixths, common-tone (embellishing) chords, advanced mixture, enharmonic reinterpretation, and symmetrical divisions of the octave into major and minor thirds.[4] These items were introduced through repertoire, and reinforced through analysis and part-writing assignments.

The main objectives of the sonata-form module were to provide students with the skills to acquire a non-trivial understanding of movements without score and to develop their ability to analyze in "real time." By the end of the unit students were expected to hear the formal divisions and subdivisions of a sonata form (ideally, in real time); recognize vocabulary items and the large-scale harmonic structure; and identify and write convincingly about "marked" features.[5] They also were expected to apply these skills to unfamiliar repertoire.

I began the unit by analyzing several sonata-form movements *with* score. Once students understood the small-scale and large-scale events, they listened to the works *without* score until they could recognize and identify (in real time) the analytical details. Gradually the movements became longer and more complicated, as formally transparent piano sonatas gave way to increasingly chromatic and formally ambiguous works for ensemble and orchestra. At the same time the assignments became increasingly more difficult: the first few assignments provided many hints; subsequent ones contained fewer hints; and the final ones provided no hints at all. Overall, the syllabus unfolded this way:

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[3] Theory III is the third and last tonal course in our "fundamentals" curriculum; Theory IV is devoted to post-tonal, atonal, and twelve-tone music. Students take zero, one, or two upper-division electives, depending on their specific degree program. Throughout the curriculum the theory courses are linked with aural skills courses that stress similar content and skills.

[4] Such as Aldwell and Schachter, *Harmony and Voice Leading*, 2002; Kostka and Payne, *Tonal Harmony*, 2004; Laitz, *The Complete Musician*, 2003.

[5] I borrow the term "marked" from Hatten, *Musical Meaning in Beethoven* (1994), and *Interpreting Musical Gestures* (2004).

Weeks 1 and 2:	Listening with score to major-mode sonatas; vocabulary
Week 3:	Major-mode sonatas with visual aids
Week 4:	Minor-mode sonatas with visual aids
Week 5:	Development sections, with and without visual aids
Weeks 6 and 7:	Consolidation: listening without any visual aids

The iPods proved to be tremendous assets. Every student received a 20-GB iPod for the duration of the semester. Each iPod contained everything needed for the course: syllabus, handouts, assignments, analytical reductions, articles, recordings, and scores.[6] Students thus had immediate and unlimited access to materials; when listening they could pause, rewind, fast-forward, and repeat as often as needed. (A built-in timer allows a user to identify events to the level of the second—so that it is possible to pinpoint, say, an augmented sixth in the key of the submediant precisely at 4'33".) I used the iPods to store and catalog hundreds of sound files, thereby facilitating both inside- and outside-of-class listening.[7] A final bonus: since the iPods were collected at the end of the semester, copyright permission for recordings became a non-issue.

There were some disadvantages to using iPods, too. Creating a master play list was quite time consuming, since it involved

[6] While one can also store these files on ERES or Blackboard, I found it much easier to move multiple files to iPods than to upload them to a remote server. Moreover, ERES and Blackboard accounts have space limitations and tend to be slow during periods of heavy use. I also found it best to store scores as pdf files and to store sound recordings as mp3 files (on our server, mp3 files—while not ideal sonically—are more reliable than AAC and require much less space than WAV files). In case readers are wondering about the logistics: each student signed a "contract" at the beginning of the unit stating that he or she would be charged the replacement cost of the iPod if it were lost, stolen, or damaged. All iPods were returned, in working condition, at the end of the semester.

[7] I found it useful to construct individual play lists containing multiple performances. For instance, I had nearly a dozen different interpretations of the first movement of Beethoven's "Ghost" Trio (op. 70, no. 1), and multiple performances of the fourth movement of Schubert's posthumous A-major piano sonata (D. 959). I then crafted assignments that asked students to evaluate different interpretations through various lenses or analytical filters. iPods are much better suited for such comparative listening than swapping CDs or downloading files from a remote source.

importing and classifying files, standardizing play lists, and transferring the playlists to the individual iPods.[8] And the devices are not cheap: a 20-GB iPod at the time was $260. (One can now purchase an 80-GB video iPod for the same price.) Certainly, some institutional backing is required, such as an internal grant. I received funding for 22 iPods, one for each student, one for me, and one reserved for an emergency. Since then I have "recycled" the iPods from one class to the next.

Are iPods necessary to teach students how to listen without score? In a word: no. Students could always listen the "old-fashioned" way—by visiting the library. Or they could connect remotely to a course management system like Blackboard or another electronic reserve platform. Nevertheless, students took full advantage of the iPods' portability and versatility. They listened significantly more with iPods than previous classes did without them; indeed, they reported an average of six hours per week of listening to material related to the class (and, presumably, additional time listening to other music). This amount of listening resulted in a substantial engagement with the subject matter and deeper learning.

A few words on sonata form

I will assume that readers are conversant with the principles of sonata form, and comfortable with some analytical approach or system (such as Caplin, Green, Hepokoski and Darcy, Ratner, or Rosen).[9] The terminology used here is based on the sonata theory of Hepokoski and Darcy. Theirs is a detailed and complicated genre-based approach to sonata form, one that places a premium on the notion of areas, or zones. My purpose here is not to rehearse its intricacies but rather to familiarize readers with its terminology.

Example 1 models a prototypical sonata form, with labels and

[8] I spent a considerable amount of time, for instance, standardizing the names of composers, works, and movements—in large part because students had difficulty finding movements if the key words were not coded in a similar fashion. Thus, I chose the tag "Mozart" instead of "Mozart, Wolfgang," or "Amadeus, Wolfgang Mozart," or "Mozart, W. A," etc. All in all, I estimate that it took about 50–60 hours to compile the playlists. While this start-up cost is daunting, it is a one-time expenditure: the playlist can now be instantly retrieved and easily amended.

[9] See for instance Caplin, *Classical Form,* 1998; Hepokoski and Darcy, "The Medial Caesura," 1997, and *Elements of Sonata Theory*, 2006; Ratner, *Classic Music*, 1980; Green, *Form in Tonal Music,* 1979; and Rosen, *The Classical Style*, 1997.

Exposition				Development //	Recapitulation		(Coda)
‖ P — Tr		S — Cl	‖ (stages)	Rt	P — Tr	S — Cl	‖
	MC		EEC		MC	ESC	

P = primary zone
Tr = transition (functions primarily to increase tension)
MC = medial caesura (the dividing point in most expositions)
S = secondary zone (may contain multiple components, which are labeled S1, S2, etc.)
Cl = closing zone (commensurate with the onset of EEC and ESC)
EEC = essential exposition closure (the definitive authentic cadence in the exposition)
Rt = retransition
ESC = essential structural closure (corresponds to EEC in the exposition)

Example 1. A typical sonata form with a two-part exposition.

abbreviations for what Hepokoski and Darcy refer to as a two-part exposition.[10] The first half of this type of exposition contains the Primary zone (P) and the transition zone (Tr); the second half contains the Secondary zone (S) and the Closing zone (Cl). The medial caesura (MC), a significant rhetorical device, bifurcates the exposition. The signal event of the exposition is the definitive arrival of a perfect authentic cadence (PAC) in a non-tonic key (most often V in major keys and III in minor keys). By definition, this PAC marks the essential expositional closure (EEC), which is commensurate with and initiates the closing zone. The corresponding event in the recapitulation is the essential structural closure (ESC), which ushers in the closing zone of the recapitulation. A coda may follow (although many early sonatas lack codas).

[10] By standard I mean the normative two-part exposition, as discussed in Hepokoski and Darcy 1997 and 2006. Of course, readers know that there is no such thing as a universal or definitive model of sonata form.

A sample analysis

I began the unit with the third movement of Mozart's Piano Sonata in G major, K. 283, iii.[11] Example 2 provides an annotated score of the exposition. The score outlines the large-scale formal design and offers a few observations on phrase structure, chromaticism, and voice-leading details.[12] In my experience, the analytical annotations match what most sophomores can reasonably apprehend in a single class. One advantage of the movement is its formal transparency: the exposition, development, and recapitulation are relatively straightforward. At the same time, it contains some interesting harmonic wrinkles, including modal mixture, augmented sixths, and applied chords.

The P zone of the exposition unfolds a sentence, with a clear-cut presentation phase that includes a four-bar basic idea and its repetition. A four-bar hypermeter is immediately established; this hypermeter governs nearly the entire movement.[13] The continuation phase of the sentence (mm. 9–24) changes figuration and character. It features an ascending bass line (mm. 9–16) that extends I6 harmony, an expansion of ii6 (mm. 17–21), and a cadential-6/4 that leads to a PAC (mm. 22–24). The latter portion of the continuation is characterized by syncopation and rhythmic instability. The transition (mm. 25–40) immediately reasserts a sense of squareness. It touches on the subdominant (IV), moves through a fleeting C♯ (m. 28), and lands on V, which I hear as a half-cadence in G. The MC (medial caesura) encompasses the two eighth-note rests, which release the energy built up during the transition. The S zone is twice as expansive as the P zone. It is also structured as a sentence, with an eight-measure basic idea (mm. 41–48), its repetition (mm. 49–56), and a sixteen-bar continuation (mm. 57–73). The PAC in the key of the dominant (m. 73) marks the EEC and initiates the Cl zone.[14]

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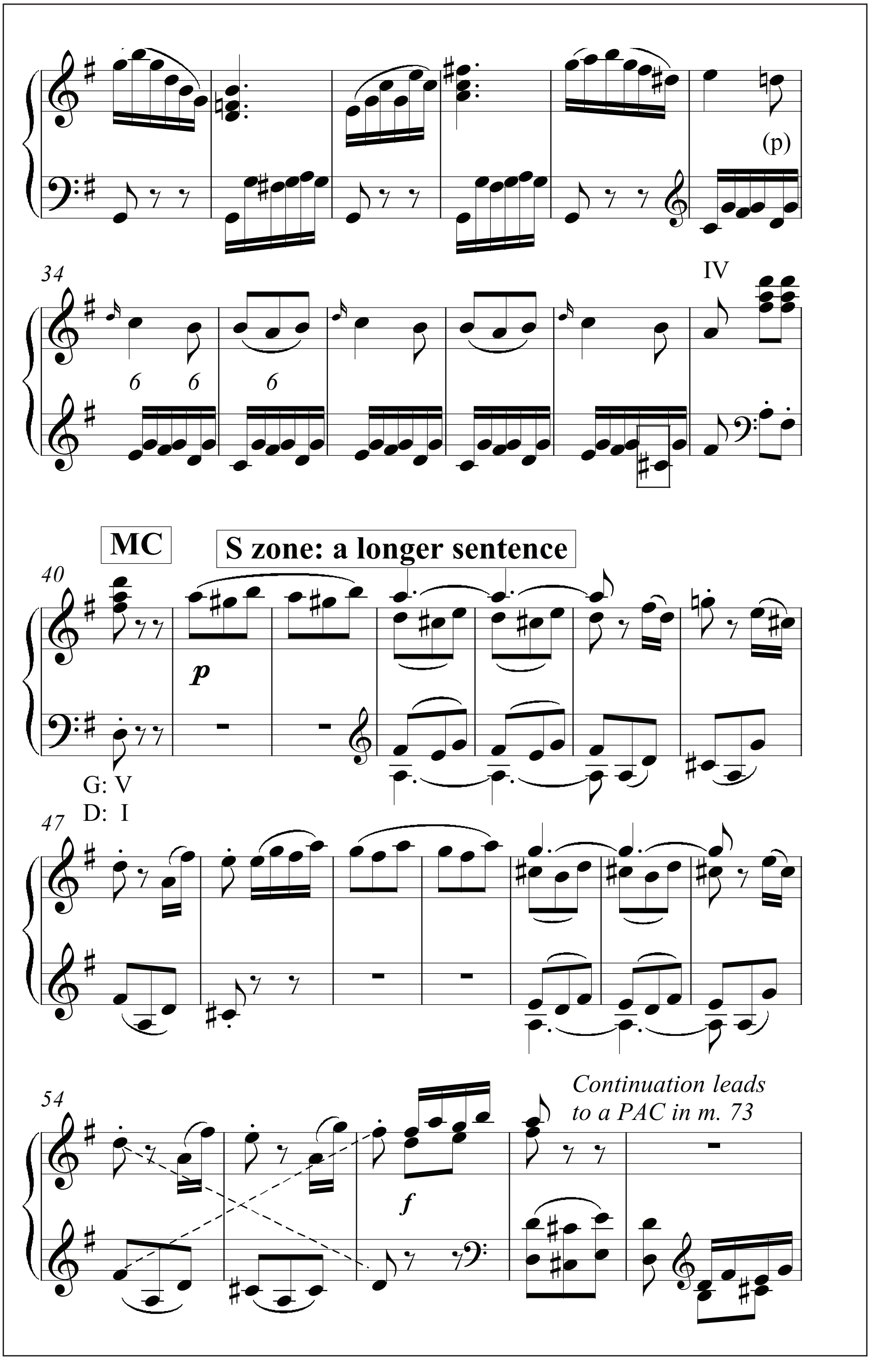
[11] Another ideal choice is the anthologized first movement of K. 333.

[12] Such chromatic events include the telling C♯$_4$ in m. 38, which points to V, and the fleeting instances of B♭$_4$ in mm. 65–68, which invoke modal mixture and foreshadow the inflection to d minor with which the development begins.

[13] Early writings on hypermeter and its analytical implications include Rothstein, *Rhythm and the Theory of Structural Levels*, 1981, and *Phrase Rhythm in Tonal Music*, 1989; and Schachter, "Rhythm and Linear Analysis," 1987.

[14] One could argue that m. 97 and not m. 73 is the EEC, in which case the C1 zone in Example 2 would function as S2. This is a good talking point in class. I prefer the former reading, in large part owing to the trill.

Example 2: Mozart, Piano Sonata in G major, K. 283, iii.



Example 2: Mozart, Piano Sonata in G major, K. 283, iii. *(continued)*

Example 2: Mozart, Piano Sonata in G major, K. 283, iii. *(continued)*

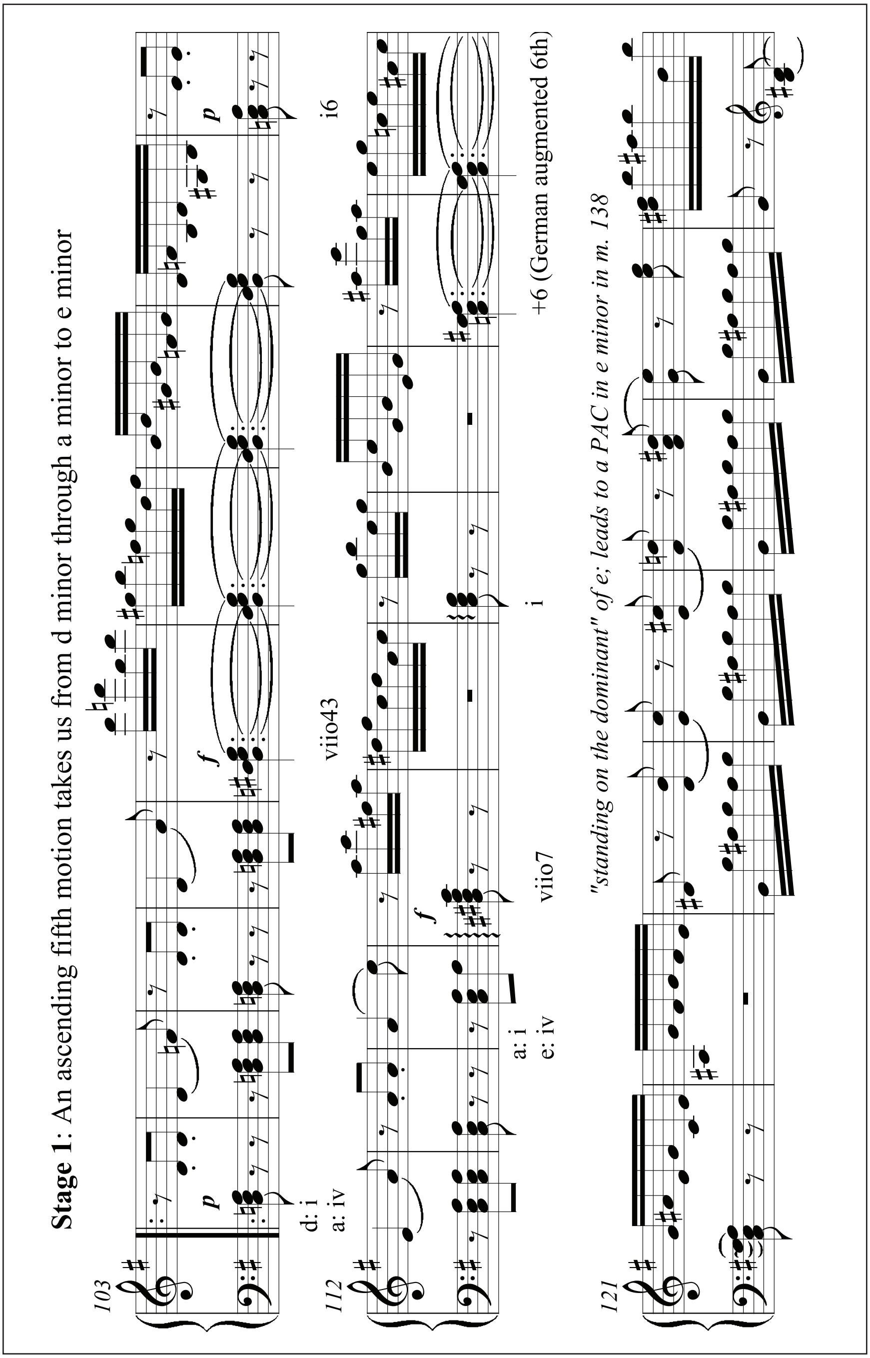
Example 2: Mozart, Piano Sonata in G major, K. 283, iii. *(continued)*

The Closing zone houses an eight-measure chromatic phrase (mm. 74–81) and a varied repetition of this phrase subject to invertible counterpoint (mm. 82–97). "Rocket" gestures (mm. 89–92) initiate a cadential flourish (mm. 93–96) followed by another V:PAC (m. 97). The C2 zone contains a four-measure chromatic idea (which is subsequently exploited in the development) and a two-measure cadential gesture that reaffirms, for the third and last time, a PAC in the key of the dominant.

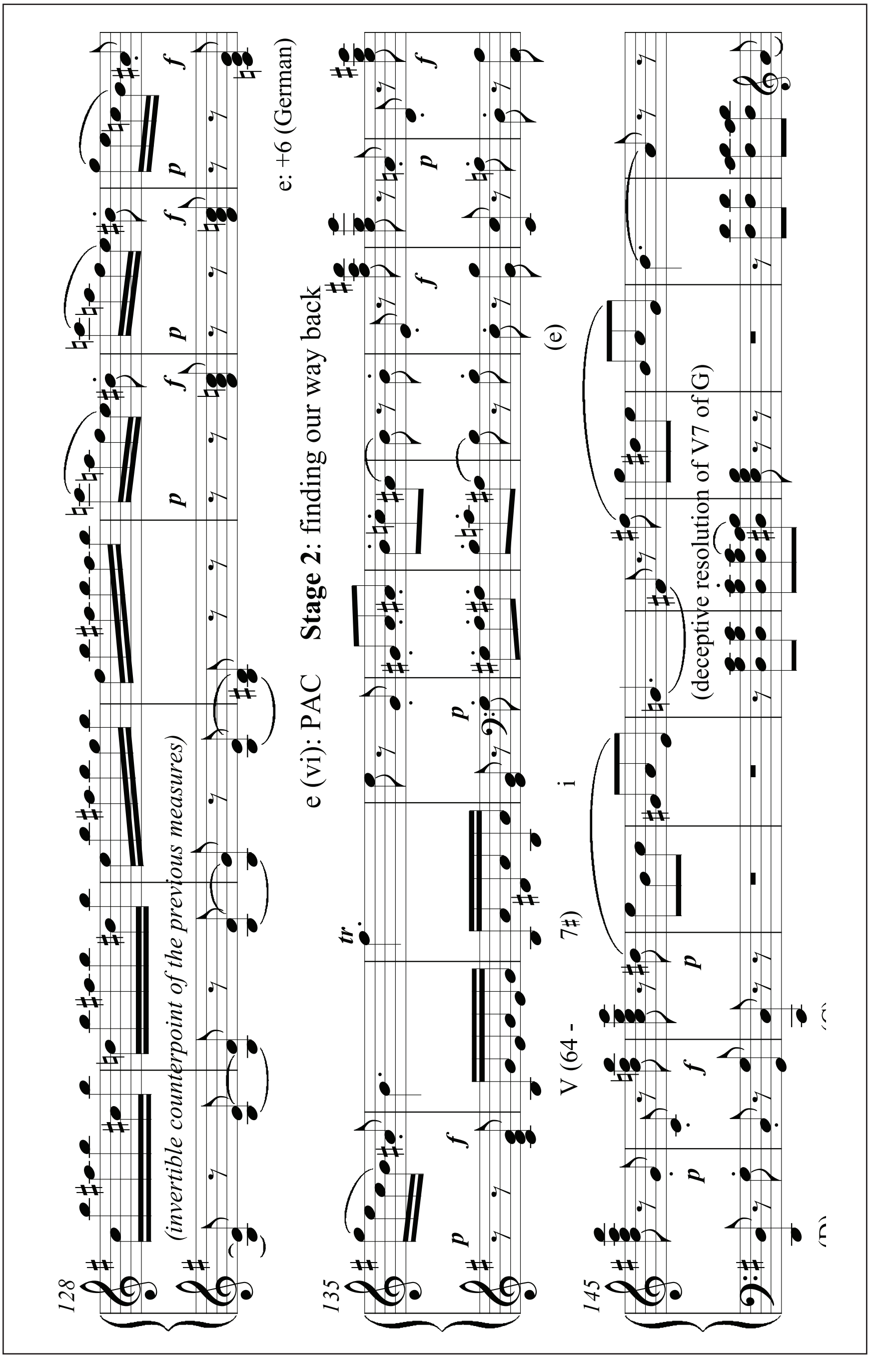
The development section is shown in Example 3.[15] (See the following pages.) I divide it into three stages based on motivic content, cadences, and changes in figuration, dynamics, register, and texture. (Parsing the development into autonomous "chunks" makes it easier for students to model the character shifts and large-scale harmonic organization.) Stage 1 unfolds a series of four-measure groupings. It begins on d minor (mm. 103–06), touches on a first-inversion a-minor chord (m. 111), and travels another fifth "sharpwise" in the direction of e minor (vi). The pull to e minor is enhanced by an augmented sixth (mm. 119–22) and an extended dominant expansion (mm. 123–31). There follows a brief detour (mm. 132–33), a re-gathering of momentum, and a conclusive PAC (m. 138). Stage 2 is fragmented and saturated by *p–f* juxtapositions and cadential gestures that allude to other keys. Stage 3 occupies the retransition, which interestingly enough lacks a strongly asserted C♮ (the 7th of V7).

The central issues of the recapitulation concern subtle changes in the P and Tr zones, the (mostly literal) transposition of material in the S and Cl zones, and the presence of a perfunctory coda.

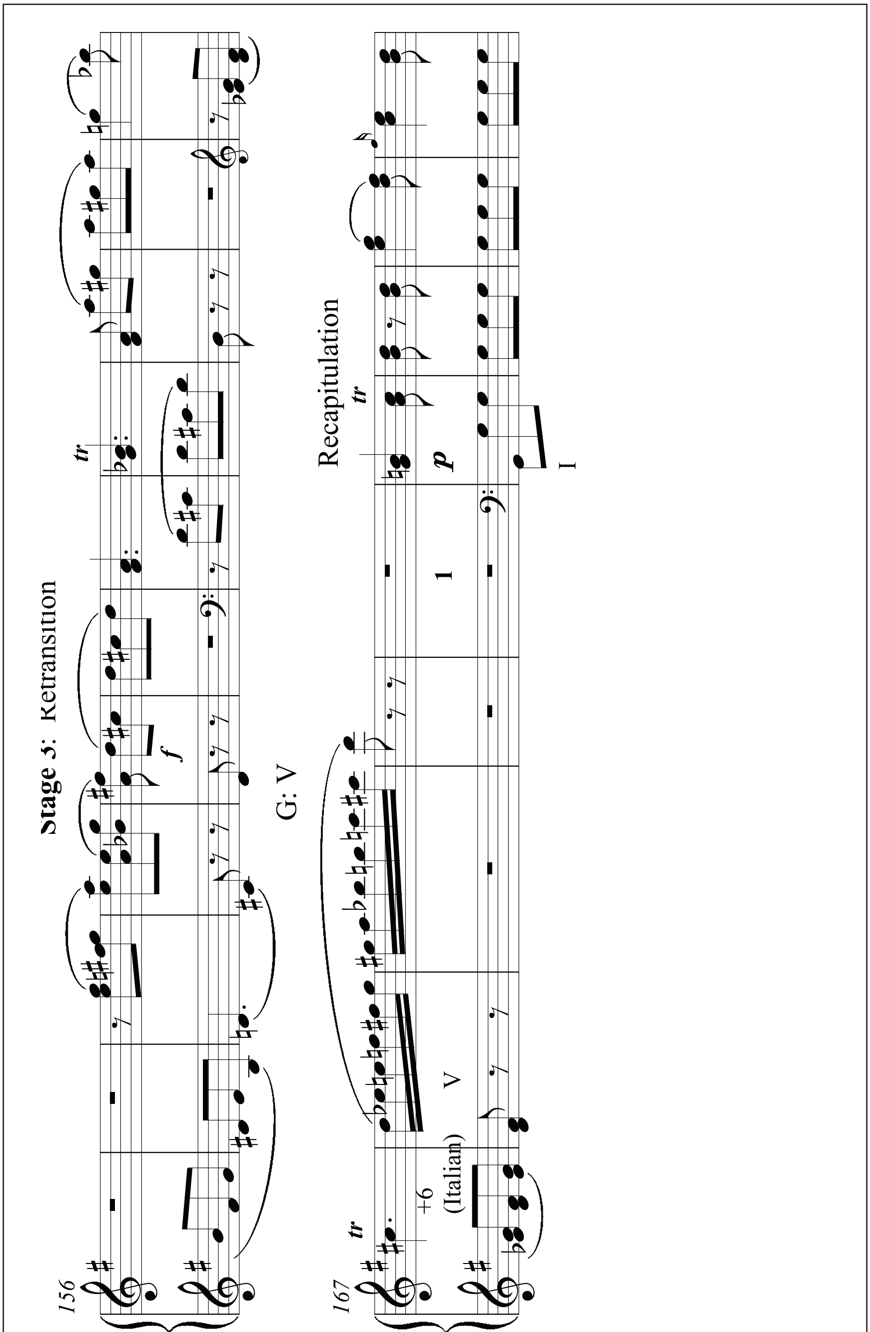
[15] In the interest of space I shall gloss over many analytical details, including the establishment of a four-bar hypermeter, the expansion of subsections, and several "extra" measures; the specific derivation of thematic material (most of which is taken from the transition zone and the cadential gesture at the end of the exposition; the absence of P and especially S zone material is intriguing); and the references in mm. 159–66 to the B♭ near the end of the closing zone of the exposition.



Example 3: Development Section of K. 283, iii



Example 3: Development Section of K. 283, iii *(contiinued)*



Example 3: Development Section of K. 283, iii *(contiinued)*

Listening with score, consolidating with visual aids

Once students understood the basic principles of sonata form and the characteristic features of this movement, I used visual aids to consolidate the analysis and help them internalize small-scale and large-scale features. To illustrate, Example 4 represents a timeline or flowchart for the movement.

Exposition		
P	0:00; 1:01	sentence: 4 + 4 + 8 measures
Tr	0:14; 1:15	
MC	0:23; 1:25	I: HC
S	0:24; 1:26	also a sentence, but longer
C1	0:43; 1:44	beginning of closing = EEC repeated w/invertible cpt.
C2	0:58; 1:59	another confirming PAC begins in d (v), modulates
Development		
	2:13	a *forte* +6th chord in e minor
	2:23	PAC in e minor (vi)
	2:24	Rt (back to V)
Recapitulation		
P	2:40	return to tonic and opening tune
Tr	2:59	
MC	3:09	
S	3:10	
C1	3:28	*ESC*: essential structural closure

Example 4: A sample early assignment: Mozart, K. 283, iii

The assignment asked students to provide times for the main formal divisions and harmonic arrival points. It also reinforced many of the analytical details that were addressed in class.[16] I included a

[16] The actual assignment did not provide the times; they are included for reference. These times match the performance by Ivo Pogorelich on Deutsche Grammophon 437762–2. His quirky, extroverted, and unconventional performance contrasts strikingly with the interpretations of Mitsuko Uchida (Philips 412 122–2) and Malcolm Bilson (Hungaroton HCD 31010). Such differences lead to lively discussions and provocative essays or reaction papers. I should add that students were on their honor not to use score to complete the assignment.

Listen to the movement several times *without score*, and enter times for the formal divisions at the spots indicated below. When finished, check your work by studying the movement *with score*.

EXPOSITION

P	0:00; 1:29	sentence; *ff* summary 0:20, 1:49
Tr	0:28; 1:58	wanders, moves to V of III
MC	0:42; 2:11	V of III extended
S	0:51; 2:19	sentence; III
EEC/C	1:18; 2:28	

DEVELOPMENT

Pre-core	2:59	begins in I (!)
Core	3:10	moves to iv (f minor)
Rt	3:43	standing on V

RECAPITULATION

P	3:51	sudden *ff*; sentence
Tr	4:14	note: a flat key
MC	4:28	V of iv/IV
S	4:35	IV (F major!)
	4:48	corrected to i; *sub. f*
ESC/C	5:17	
CODA	5:26	just two measures

* * *

Also: Write one paragraph on unusual features of the S zone in the recapitulation, and two paragraphs on hypermetric irregularities. Indicate the precise times of these passages.

Example 5. Beethoven, Sonata op. 10, no. 1, i

brief summary of the exposition at the top of the assignment, as a reminder of the large-scale structure; I am stating it below in the text rather than crowd the example. It read: The P zone is a sentence; you can conduct it (and nearly all of the movement) in a four-bar hypermeter. The move from to the Tr is somewhat tricky. The Tr zone begins at 0:14, with a change in figuration, and moves from the tonic to the dominant. The *medial caesura* (MC) is the noticeable break in the texture at 0:24. The S zone is also a sentence, but the basic idea and its repetition are *eight* measures apiece; the continuation is also expansive. The PAC in the dominant at 0:44 is the *EEC*, or essential exposition closure. This, the defining event in the exposition, confirms the new key area.

The first two weeks proceeded in this fashion: students analyzed major-mode sonata movements with score until they reached a satisfactory level of understanding, then reinforced their understand by listening with visual aids. A few students struggled with this step; soon, however, everyone was up to speed. (There were, of course, widely varying degrees of success in identifying voice-leading details, chords, sequences, progressions, and modulation schemes.) In week three I introduced minor-mode sonatas, with score. Example 5 is a filled-in version of an assignment that summarized the salient features of the first movement of Beethoven's piano sonata in C minor, op. 10, no. 1.[17]

Listening without score, but with visual aids

By the end of three weeks students were relatively comfortable listening without score. Thus, the subsequent assignments provided fewer crutches and signposts. At first they were asked to interpret movements without score, but with profiles of the P and S themes and a sketched-out template of the form. To illustrate, Example 6 was designed for the first movement of Mozart's sonata for violin and piano, K. 305.[18]

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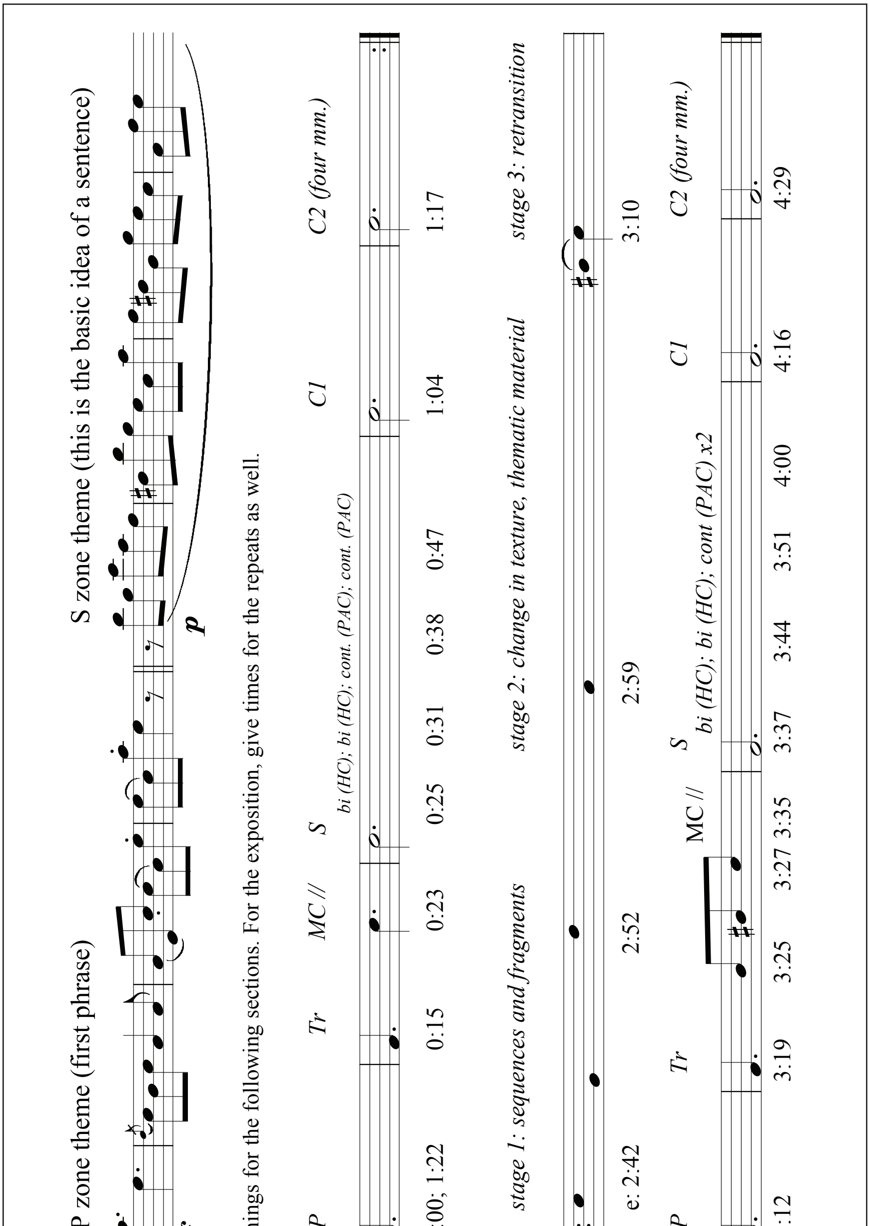
[17] This particular assignment did not provide times, and gave only a few hints in the far column. The times shown correspond to Richard Goode's performance on Elektra Nonesuch 79213–2.

[18] Times correspond to the performance by David Breitman (fortepiano) and Jean-François Rivest (violin) on Analekta AN 29821–2.



Example 6: Mozart, Sonata in A major for violin and piano K. 305, i

Example 7 was designed for the first movement of Beethoven's piano sonata in E major, op. 14, no. 1. It gives the broad outlines of the exposition and recapitulation (the skeleton of P, Tr, S, and Cl), plus selected bass notes and figured-bass symbols in the development. Students were asked to fill in the remaining materials. Students found these types of assignments challenging but manageable.

I would like to make one brief note about the assignments. The first time I taught the course I assigned Examples 4 and 5 early on in module; students were still finding their way. Thus, I gave all of the information on the page except the timings; this was the only information students were asked to provide. One could—with more advanced classes, or at a later point in the semester—remove some or all of the hints in the right-hand margin. One could also remove some or all of the structural signposts to provide less of a scaffold for students. The point is that there are many possible variations and degrees of difficulty. In a similar vein, Examples 6 and 7 provided nearly all of the information shown save the timings. Here, too, one could selectively remove some or all of the bass notes, formal markers, or hints.[19]

Soon, most students were able to ascertain the basic structure and the large-scale harmonic plan of a sonata form movement in two hearings. I then devised assignments that focused on specific passages: chromatic sequences, unusual progressions, mixture, or entire development sections or subsections. I spent a fair amount of time on development sections because they tend to give students trouble—no doubt due to their harmonic instability (rapid and distant modulations and highly figured sequences). I found the timer feature of the iPod to be inordinately helpful: I could merely ask students to notate in the key of A major the passage from 3:15 to 3:32. To illustrate, Example 8 is a worksheet designed to help students come to grips with the development section of Mozart's piano sonata in F, K. 332, i.[20]

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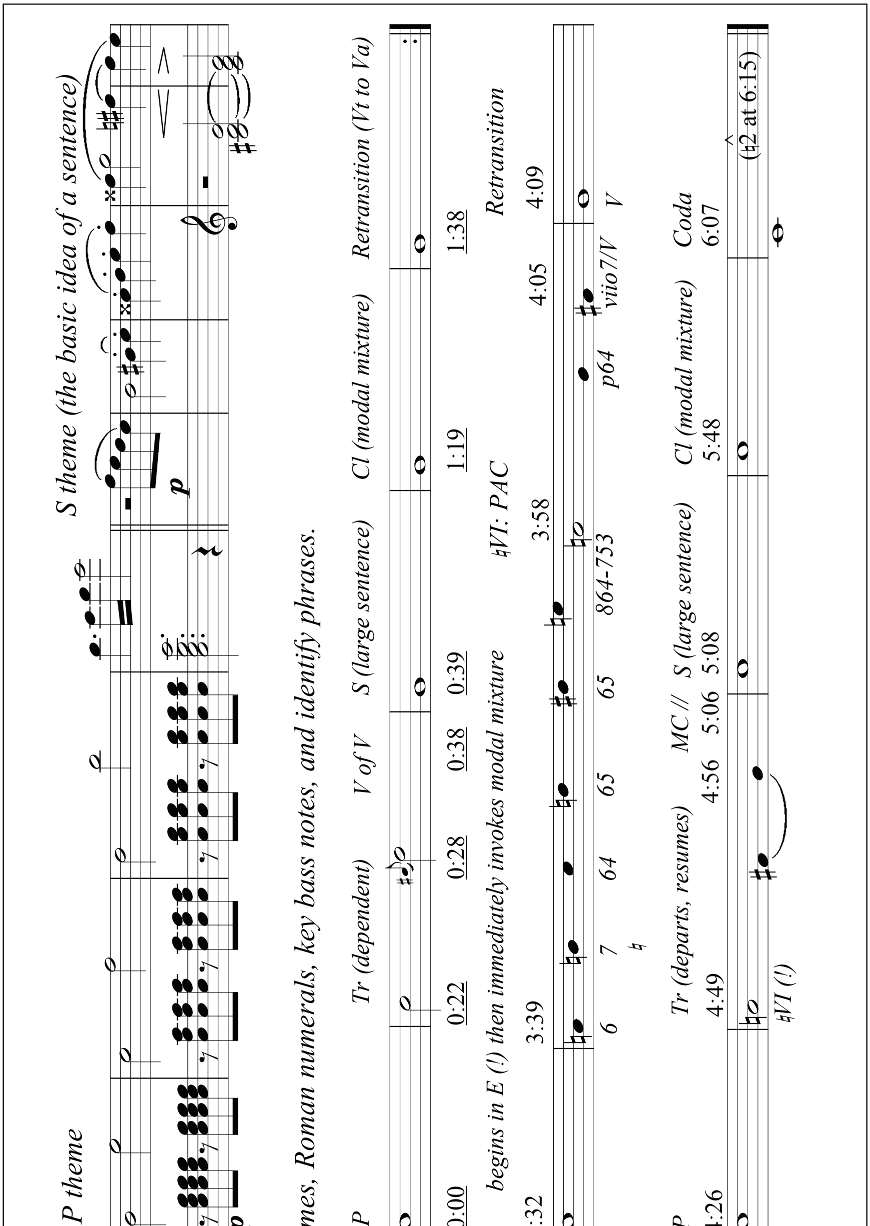
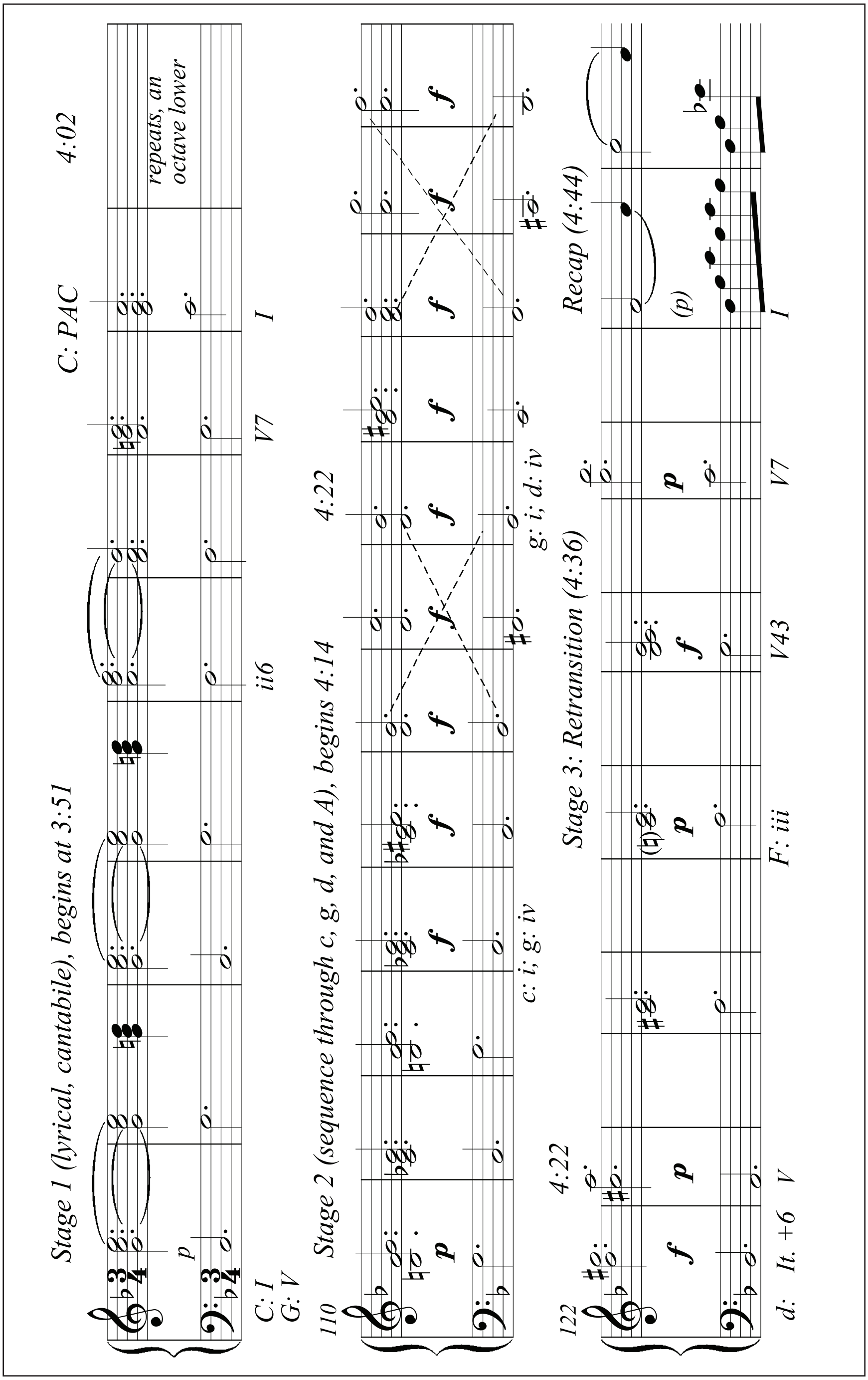
[19] For example, I gave these pointers for the Mozart: (1) in the exposition, the P zone is repeated twice; (2) the S zone begins as a parallel period (antecedent with a HC, then what would seem to be a consequent); however, its would-be consequent also ends with a HC, effectively turning the S zone into an extended sentence; (3) as a result, the closing zone does not begin at 0:45—the continuation phase of the sentence is immediately repeated, extending the S zone and delaying the Closing zone (and EEC).

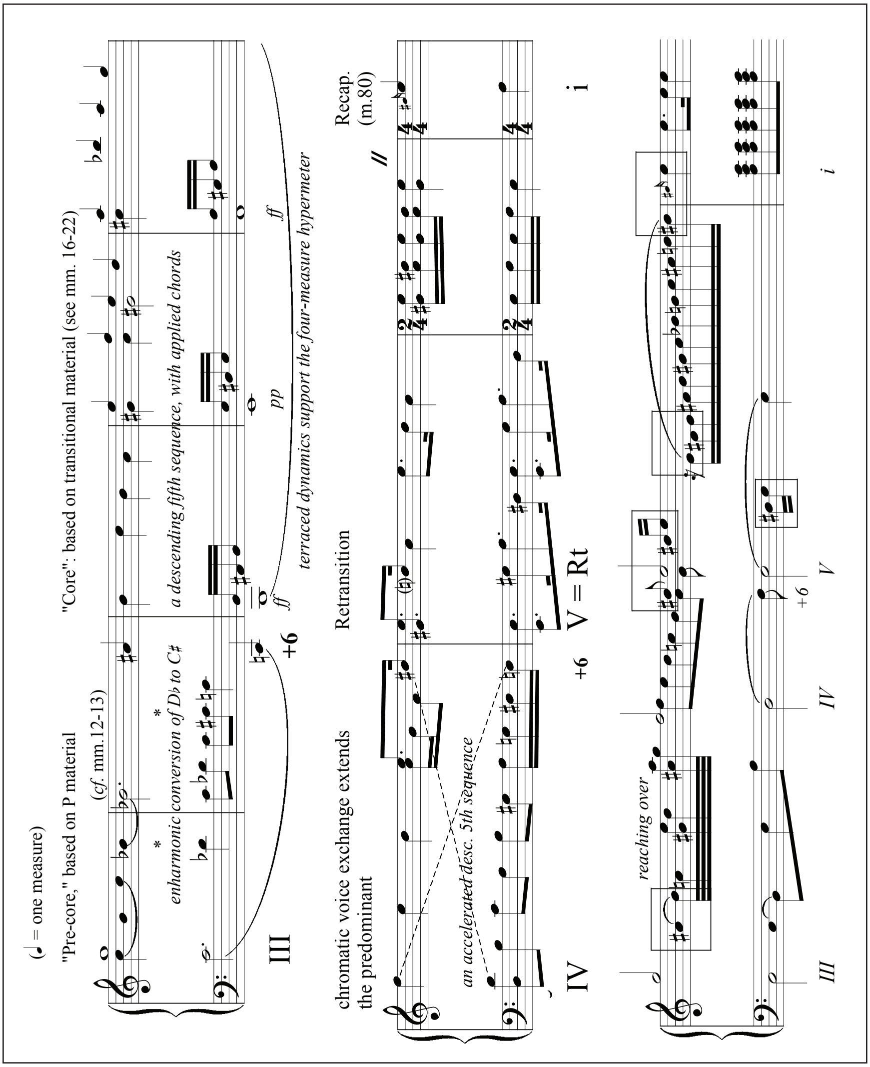
[20] Some of the registers have been normalized, and timings are for Andreas Staier's performance (Harmonia Mundi, HMC 901856). For purposes of space I have not included the score.



Example 7: Beethoven, op. 14, no. 1, i



Example 8: Development section for Mozart, K. 332, i



Example 9: Mozart, K. 310, i. "Road map" of the development, shown as a rhythmic reduction.

Briefly, I parse the development section of the first movement of K. 332 into three discrete stages. The first stage cadences in C major; the second stage initiates a large-scale fifth ascent that travels from c minor to A major, which I read as the dominant of d minor; the third stage is the retransition, which inflects or "corrects" C♯ to C and eases into V43 and V7 of F. This assignment, too, could receive variation, such as the following: reinforce the learning that occurred during class by asking students to supply timings; require students to identify the stages and the bass notes by providing Roman numerals and notating a chordal reduction of the retransition; or require students to sketch the entire development, using any means or symbols appropriate.

Example 9 provides a road map of another development section. This is the first movement of Mozart's sonata in a minor, K. 310, a quintessential illustration of a minor-mode III—iv—V development. The upper portion of the example is a rhythmic reduction that uses quarter notes to represent full measures. This development also divides into three stages: a "pre-core" that begins on III; a "core" that uses a descending fifth sequence to lead to iv; and a retransition that is ushered in by an augmented sixth.[21] The example also includes a few details on surface features. These observations are placed into a broader context in the "satellite view" in part II of the example. One intriguing issue concerns the dyads A♯–B and especially D♯–E, the latter of which plays a vital role in the sonata.[22]

[21] The terms "pre-core" and "core" are drawn from Caplin 1998.

[22] It would be a worthwhile exercise to "trace the history" of D♯ (and its enharmonic equivalent E♭) throughout the movement. D♯ is in fact the first melodic note we hear (it is strikingly asserted as the chromatic lower-neighbor of E_5). Throughout the movement it appears frequently as a chromatic lower-neighbor to E (see mm. 9, 11, 14, 80, 98–99, 107–08, 110, 113, 115–117), as a chromatic passing note to E (such as m. 7), as a "agent" of modal mixture (re-spelled as E♭ it colors mm. 16–21 of the transition), and as the bass note of the rhetorically-charged viio7/V (m.127) in the final cadential flourish that begins in m. 118. B♭ admittedly plays a smaller role: the conversion of B♭ to A♯ in the development section initiates the core of the development, and B♭ is highlighted in the Neapolitan chords in mm. 109 and 119.

Listening without score

Once students were comfortable—or, at least, less uncomfortable—with the challenges imposed by development sections, they were ready to tackle full movements without a score or visual aids. To foster this goal I devoted several classes to listening (without score) to several expositions. Students were asked to trace six events in each exposition—to take aural inventory of the harmonic and rhetorical structure. These are summarized in Example 10. I also instructed them to listen for other features, such as topics,[23] modal mixture, evaded or unusual cadences, augmented sixths, chromatic sequences, hypermetric irregularities, and striking changes in register, dynamics, or texture. By the end of the unit students became proficient at discovering and representing the main details of a sonata form. And by the end of the seven-week unit the majority of the class (roughly four of five students) was able successfully to analyze a sonata-form movement from "scratch": with no hints whatsoever.

‖ P	—	Tr	(MC) //	S	—	EEC	/	Cl	:‖
(1)		(2)	(3)	(4)		(5)		(6)	

(1) The phrase structure of the P zone (frequently a sentence or period)

(2) The cadence at the end of the P zone, and the point of departure for Tr

(3) The harmonic context for the MC—and the point of departure for S
(is it half-cadence in tonic? A PAC in the dominant?
Another possibility?)

(4) The phrase structure of S, and its subsections (if any)

(5) The precise onset of EEC

Example 10 - Taking inventory: a checklist of the exposition.

[23] The study of topics (or *topoi)* has emerged in the past generation as a powerful analytical tool for tonal music. A survey of the field would include: Ratner, *Classic Music*, 1980; Allanbrook, *Rhythmic Gesture in Mozart: Le nozze di Figaro and Don Giovanni*, 1983; Agawu, *Playing with Signs*, 1991; and, more recently, Caplin, "On the Relation of Musical *Topoi* To Formal Function," 2005. Semioticians have picked up this thread, too; see Hatten, *Musical Meaning in Beethoven*, 1994; Grabócz, "A. J. Greimas's Narrative Grammar and the Analysis of Sonata Form," 1998; Monell, *The Sense of Music*, 2000; and Klein, "Chopin's Fourth Ballade as Musical Narrative," 2004.

Final thoughts

I set out to teach a seven-week unit on analyzing sonata form without score. I began by teaching the principles of sonata form by analyzing several works with score. I then created a set of graduated assignments that steadily removed hints and landmarks. Class time was spent listening, doing close analysis, and modeling the act of writing about specific events. By the end of the term, students were able to recognize (in real time) relevant vocabulary elements, mixture, sequences, phrases and cadences, large-scale form, and deviations in hypermetric organization. The majority of students were able to parse development sections and write competently about topics, narrative, and implications for performance. The iPods provided a seemingly endless number of sonata-form movements from the 18th and 19th centuries; students also had the opportunity to hone their listening skills in hundreds of live performances on campus. (They could also transfer their own libraries to the devices.)

Example 11 (see the following page) lists the repertoire I chose for the unit. I realize that we all have our favorite pieces and that there is a multitude of sonata forms—in addition to suitable rondos and concerti. I suggest these pieces because I had success with them and because it is easy to find multiple performances. The works are arranged into categories of easy, medium, and hard, based primarily on length, the degree of formal and harmonic complexity and ambiguity, and the "tallness" of the score. The list allows one to gradually increase the level of difficulty during the unit. It also suggests pieces suitable for final projects.

Overall, I was delighted with the learning that took place in (and out of) the class, especially the final projects, which asked students to analyze a movement without score and write a short (three- to five-page) essay on features of the work they found striking. In my view, students in this class acquired a better understanding of harmonic vocabulary and a firmer grasp of large-scale structure than in previous years. Additionally, they reported in their informal evaluations that they detected benefits in their aural skills classes; that their real-time listening skills improved significantly; and that their listening habits had changed dramatically. (In fact, half of the class purchased their own iPods before they left campus at the end of the semester.) The experience convinced me that it is entirely possible to teach students to "listen up" by using iPods to analyze sonata forms without score.

Easy:	relatively transparent; fairly short; "thin" textures
Mozart	Piano Sonata K. 283, iii, I [Major mode]
Mozart	Piano Sonata K. 309, i, or K. 311, i, or K. 332, i
Mozart	Piano Sonata K. 333, i or iii
Beethoven	Piano Sonata op. 14, no. 1, i
Beethoven	Piano Sonata op. 2, no. 1, [minor mode]
Beethoven	Piano Sonata op. 10, no. 1, i; op. 49, no. 1, i
Mozart	Piano Sonata K. 310, i
Mozart	Violin + Piano Sonatas K. 305, i, or K. 306, i
Mozart	Violin and Piano Sonatas K. 377, i, or 378, i
Mozart	Clarinet Quintet, K. 581, i
Mozart	Symphony in A major, K. 201, i

Medium:	longer; more mixture; more formal ambiguity
Beethoven	Sonata op. 13, i ("Pathetique"); op. 53, i ("Waldstein"); op. 55, i ("Appassionata")
Beethoven	Sonata for Cello and Piano, op. 69, i
Beethoven	Symphony No. 1, 6: i
Haydn	Piano Sonata Hob. XVI: 50, i
Mozart	Sonata for Violin and Piano, K. 304, i
Mozart	Quartet (three strings and oboe), K. 370, i
Mozart	String Quartet, K. 464, i
Mozart	String Quintet, K. 516, i
Mozart	Symphony 36 ("Linz"), ii; Symphonies 39, 40, 41, i
Schubert	String Quartet in a, D. 804, i
Schubert	Piano Sonata in A, D. 664, i

Hard:	increased length, mixture, formal ambiguity
Brahms	Cello Sonata in e minor, op. 38, i
Brahms	Sextet, op. 18, i
Schubert	Symphonies 5 and 9, i
Schubert	Piano Sonatas in A and Bb, D. 959, i and D. 960, i
Schubert	*Quartettsatz* (difficult)

Extensions include concertos, rondos, and later 19th-century works.

Example 11: Suggested repertoire of sonata forms.

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Postscript to "Absolute Pitch Perception and the Pedagogy of Relative Pitch" (*JMTP* vol. 21, 2007)

BY ELIZABETH W. MARVIN

March 17, 2008

TO THE EDITOR:

I am writing to correct an omission from my article "Absolute Pitch Perception and the Pedagogy of Relative Pitch," published in the most recent issue of *Journal of Music Theory Pedagogy* (vol. 21, 2007). Among the strategies I suggested for teaching relative-pitch skills to students with absolute pitch were (1) the use of scale-degree and roman-numeral singing and dictation without staff notation or key specified, and (2) the use of dictation excerpts drawn from music literature (for the variety of timbres and textures). I discussed these strategies with reference to several sight-singing and dictation textbooks: Wittlich and Humphries (1974), Yasui and Trubitt (1989), Karpinski (2000, 2007), and Phillips et al. (2005).

Because the discussion focused on sight singing and dictation texts, I neglected to mention Laitz (2003, 2008), a theory and analysis text that integrates harmony study with musical skill development. These skills include the singing of pitch patterns, transposition and improvisation exercises, error dictation, keyboard exercises, and dictation both from the keyboard and from music literature. Throughout the two-volume workbooks (2008), Laitz asks students to listen to passages from the literature and to supply roman numerals only (no key specified). For examples in the second edition volume 1, see Exercise 8.7 (p. 171), where students identify tonic and dominant harmonies and cadence types in passages from Schubert, Handel, and Chopin; or Exercise 12.17 (p. 283), where students hear figurated textures from Schumann, Haydn, Bach, Schubert, and Loeillet and label the underlying harmonic progressions and cadence types. This type of exercise continues through more advanced topics, such as aural identification of sequence types without notation (p. 493). Other dictation exercises are drawn from music literature as well (though now with staff notation), including recurring bass-line dictations where students see the upper voices in diverse textures and instrumentation, and are asked to supply the bass line and roman numerals by a combination of dictation and analytical skills.

In sum, there are several excellent resources available on the market today for teachers whose classes include a mixture of absolute- and relative-pitch listeners. My discussion was not meant to be exhaustive, but rather was intended to demonstrate types of appropriate pedagogical strategies and a sampling of resources for addressing this learning issue.

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Eastman School of Music

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