

COMPOSITIONAL APPLICATIONS OF SONORITY: Analysis and
Discussion of Select Twentieth Century Works.

by

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ABSTRACT

The study discusses innovations in the application of sonority of eleven Twentieth century composers including Scriabin, Debussy, Webern, Schoenberg, Messiaen, Feldman, Kotonski, Ligeti, Takemitsu, Boulez, and Reich. The changing roles accorded the parameters of sonority suggest new possibilities for musical form and long range processes. Through a combination of orchestrational reductions, quantitative-graphic representations, and chord and interval analysis the study explores potential applications of sonority both as a perceivable process at the musical surface and in the articulation of musical structure. Sonority is loosely defined as an intersection of three basic parameters: timbre, register, and subjective chord quality. There are many sub-categories within the three large components. Register is examined in terms of registral extremes, the number of tones, and the number of distinct registral regions. Timbre change is referred to by several measurements including the total number of distinct timbres within a given sonority, the number of active timbres, and the number of sounding tones played by instruments of a given family. Chord quality is interpreted and utilized in many different ways by composers in the sample. These include contrasting modality, construction through arbitrary intervallic patterns, extended diatonic and quasi-functional harmonies, and even chord recognizability. While not intended as a study of harmony, suggestions as to the evolution of Twentieth century harmony in reaction to new applications of timbre and register are forwarded as a byproduct of the analysis. As a control factor, pieces are selected which are composed primarily of steady-state chords or sustained textures easily reducible as chords. As a final, subjective interpretation of the material, questions are raised and suggestions forwarded as to the perceptual importance of sonority as compared to melody and rhythm.

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Dedication

This project is first dedicated to my wife Lillian and daughter Cleo. Thank-you.

The study is also dedicated in memory of the enourmous contribution and unforgivable circumstances of Bela Bartok.

Introduction

Sonority is one of those terms which everyone uses but no one really knows what it means. The New Harvard Dictionary of Music defines sonority as, "A sound defined by some combination of timbres or registers, especially one that plays a significant role in the work."¹ But a third broad heading, subjective chord quality, must be included into the definition. Chord quality is itself a many faceted term which might include chord inversion, relative tension or dissonance, root motion, modality, and even chord familiarity. In twentieth century composition chord quality remains an important element of the musical vocabulary. It is integrated within a general pool of sound quality even though functional harmonic relationships have eroded. Sonority, then, is an elusive concept which lies at the intersection of three broad parameters; timbre, register and density, and subjective chord quality.

This study explores in rough chronological order innovations in the application of sonority of select twentieth century composers. It presents a variety of instrumental settings ranging from timbrally homogeneous solo piano and string quartet pieces up to chamber ensemble and full orchestra. Where possible musical examples are selected which correspond to complete phrases and larger sections of the work. This provides opportunity for discussion of phrase defining and cadential properties of sonority within complete sections. Analysis attempts first to identify the range of active parameters of sonority and then to articulate in quantitative terms any process or non-obvious progression within that parameter. Secondly one looks for consistent patterns and interruptions in the disposition of various parameters which suggest structural grouping and articulation. Parallel patterns emerging simultaneously in more than one parameter are given particular weight in defining structural units. Often in pieces which do not initially appear to subdivide into audible structural units global statistical change in the parameters of sonority still suggest large scale structural conception.

Sonority first becomes an important consideration at the structural level. Gradually, change in sonority is integrated with rhythm and melody into the musical processes at the foreground level, the major contributor for this change being Olivier Messiaen. It is arguable that sonority reaches its most heightened stage in the music of the mid to late 1950s. Generalizing, it is during this period that the musical importance of specific rhythmic or melodic gestures are minimized permitting focus on change in sonority at the musical foreground. The compositional application of sonority retreats after this extreme

point is reached. But even as melody, rhythm, and even functional harmony return as primary parameters the exploration of sonority maintains impact. The hierarchy of roles are not defined as before but are synthesized in a custom relationship for each individual work.

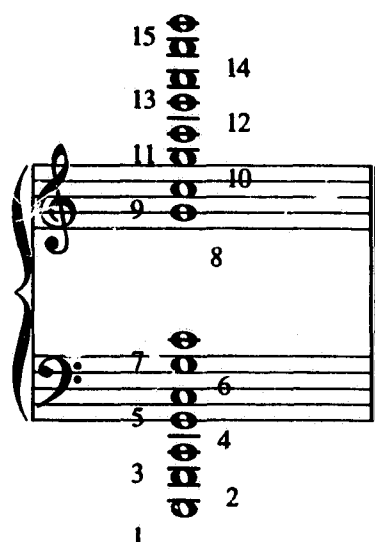
There are many subcategories within the main parameters of sonority. The number of sounding tones in any sustained sonority is simply referred to as note density. Registral density refers to the registral spacing or compactness of a given sonority, expressed in terms of the number of active registral regions. Timbre change is referred to by any of three quantitative measurements. These include the total number of distinct timbres within a given sonority, the number of active timbres within each instrumental family, and the number of sounding tones played by instruments of a given family. Another term, timbral voicing, is used to discuss the "top down" instrumental of a given chord.²

Chord quality is discussed in a number of different ways as appropriate. Some composers, beginning with Debussy, Webern, and later Messiaen and Boulez, work with a range of chordal sonorities distinguished by arbitrary patterns of intervallic construction.³ Also, the recognizability of extended diatonic harmonies or sonorities brought about through diatonic saturation of a given scale or mode is often utilized as a means of local contrast. This non-functional application of sonorities originating in conventional functional harmony begins with Debussy but is again prominent in the music of Ligeti, Takemitsu, and Reich. As was the case in traditional choral harmonization, voice leading, especially between soprano and bass voices, becomes for some composers a convenient means of continuity between adjacent sonorities. Voice leading is exposed as an important consideration for Schoenberg, Ligeti, and Takemitsu.

For some composers quasi-functional harmonies are still found to be "functional" in the tonal sense. For example, Takemitsu often employs traditional extended and altered dominant harmonies or disguised diminished seventh chords in moments of maximum tension. Root motion, either through circle of fifths or dominant relationships between the roots of inverted chords is another means of implying the forward motion of functional harmony without the explicit application of conventional harmony. The progression of sonorities in some of Steve Reich's music, for example, is largely informed by root progression. The applications of vertical sonority will naturally differ with each composer in context. Once an apparent logic of chordal derivation and progression is uncovered it is informative to synchronize this parameter with timbre change and density change.

For practical purposes an arbitrary scale of register is adopted which divides the piano keyboard into fifteen registral regions. Registral regions are either a perfect fifth or a perfect fourth in width and correspond to an ascending C major root-fifth arpeggio. Register is discussed in terms of large scale features corresponding to dramatic changes in visual-graphic contour. Limiting the scale to the fifteen regions permits convenient entry into the database and quick reference to approximate pitch levels, around C or G in consecutive octaves. 4

Figure I.1. Registral Regions.



Intervals are discussed in terms of traditional diatonic labels as opposed to interval class. As the wider palette of sonority on the whole evolves out of functional harmony it proves more efficient to conceive of chord tones and intervals in traditional terminology.

The selection of musical examples is biased towards pieces with a high percentage of sustained material. A study of the compositional applications of sonority might be considered the twentieth century equivalent of a treatise on harmony, and is largely concerned with means of progression from one chord to the next. As is the case with analysis of traditional harmony where arpeggios are reduced to an implied sustained harmony, some complex textures in contemporary music may be reduced as implied sustained sonorities. Pieces are selected which fit either of these two criteria; sustained

chords or sustained textures easily reduced to sustained chords. The application of sonority in pieces relying heavily upon rhythmic and motivic invention or which utilize complex textures which resist reduction to sustained sonorities of a manageable number of tones is beyond the scope of the present study. Works by Xenakis, Carter, and Berio are notably absent for this reason.

Luciano Berio once said, " If you wanted a really useful treatise nowadays you would have to transform it into something nearer to an encyclopedia with chapters on instrumental acoustics, timbre and harmony, (and) instrumental register, . . ." ⁵ Composition with sonority brings up an enormous variety of control and perceptual issues which are beyond the scope of a single study. Generalizations reached through the analysis and interpretation of this small sampling of twentieth century repertoire may easily be undermined by exceptional pieces and specific psychoacoustic studies. But by the same argument, conclusions from isolated psychoacoustic studies may be challenged for their inability to address a broad spectrum of actual repertoire. ⁶ Composers of the present set of musical examples were chosen first because they approach sonority in a unique way and secondly because they are representative of a particular period in the chronological unfolding of twentieth century music. From this select group issues are raised and conclusions proposed as to the role of sonority both as a perceivable process at the musical surface and in the articulation of musical structure. Out of necessity the study also examines changes in the construction and application of twentieth century harmony as it interacts with timbre and register. Finally, it considers the growth of new musical forms and new types of long range processes enabled by the heightened role accorded the parameters of sonority.

Footnotes

1. New Harvard dictionary of music. (Cambridge, Mass: Belknap press of Harvard University Press, 1986).
4. The terms enclosed, juxtaposed, and interlocking and sometimes used to describe different types of timbral voicing, especially for Schoenberg's Op. 16,#3. These terms originate in the Rimsky-Korsakov's treatise on orchestration.
3. Chords of artificial or "synthetic" construction by arbitrary intervals are prominent in Debussy's Jeux (1910), but are actually not prominent in the piano prelude considered by the present study.
4. Psychoacoustic research suggests register actually be divided into narrow registral filters termed critical bands. The concept is discussed in the " Further Research" chapter. The critical band concept is highly subjective and subject to numerous

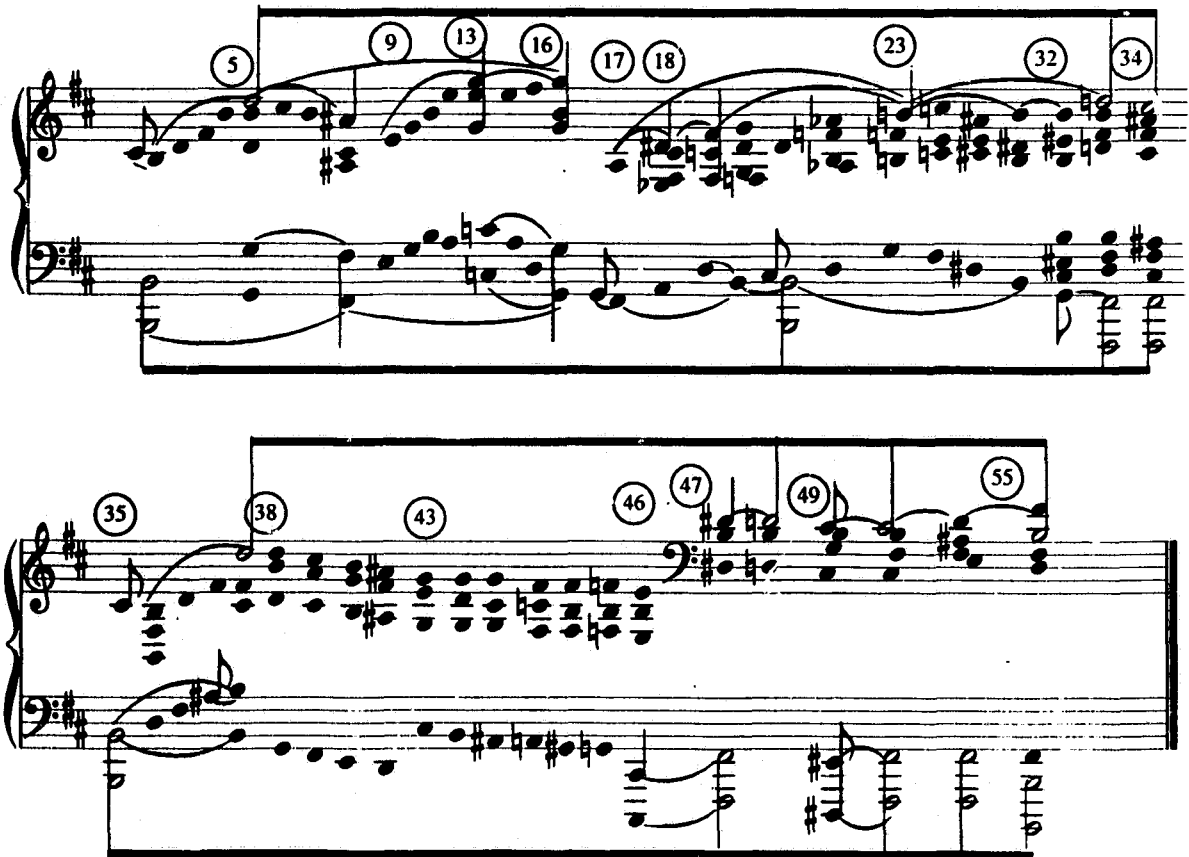
control issues. For this reason it was thought more practical to use an objective, quantitative measure of registral regions.

5. Luciano Berio, Interviews : Two Interviews with Rossana Dalmonte and Balint Andrase Varga, translated by David Osmond-Smith (New York, London: Marion Boyars, 1981) p. 37.
6. For an introduction to psychoacoustic studies refer to Diana Deutsch. Ed The Psychology of music. (New York: Academic press ,1982)

1. Alexander Scriabin. Piano Prelude Op. 11, VI. (1889)

The application of sonority above and beyond functional harmony has modest beginnings. While most agree that it is Claude Debussy who undertakes the first thorough elevation of the role of sonority, a change in the means of phrase punctuation is already evident in the music of Alexander Scriabin. The mid twentieth century scholar Karl Eschmann noted in Scriabin's piano sonatas the gradual disappearance of older means of phrase punctuation by harmonic cadences in favour of a phenomenon he termed "harmonic weight."¹ The concept is never fully defined but generally refers both to the repeated sounding of a given harmony and also an increase in the number of tones as a means of implying cadence. Increased numbers of tones and also register change emerge as parameters of structural articulation in the sixth piano prelude of Opus 11. Registral extremes move in a synchronous, consistent shape during the course of each phrase and may, arguably, be considered among the first examples of registral process as a main parameter of focus.

Figure 1.1. Scriabin. Prelude #6

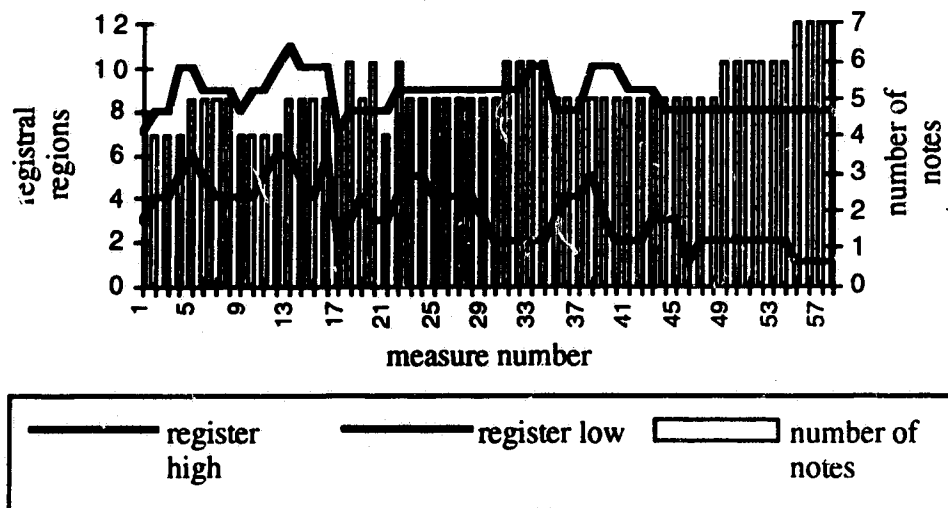


In spite of the extended chromatic interludes the sixth prelude remains solidly in the domain of tonal music. It is in binary form characterized by a large half cadence and interruption in measure 34, followed by a return to the tonic and ultimate authentic V-I cadence in measure 55. (Figure 1.1) The bulk of intervening episodic material involves the vigorous imitative play of a single rhythmic motive freely transposed through a kind of passing chromaticism. Aside from the pull of a chromatically descending bass line, as in measures 38-47, there are no intermediary harmonic functions guiding the music toward the two large cadence points. While the incessant rhythmic/motivic exchange propels the texture, note density and registral change have replaced harmonic progression and direct the large form towards the final cadence.

Without exception, each phrase in the piece is characterized by gradual change in register or note density. Changes in registral extreme and the number of simultaneously sustaining tones (figure 1.2) are sufficient to qualify as means of structural distinction. The first large section of the piece, culminating at the half cadence in measure 34, may be internally divided into two periods of approximately sixteen and eighteen measures. Each period is then divisible into phrases. The first period consists of four phrases of approximately four bars each, while the second period consists of two phrases of six and twelve measures. As there is no cessation of rhythmic eighth note motion nor articulation through silence phrase distinctions implied by sonority above will likely not be apparent to the listener on first hearing. Nonetheless, one gains an impression or memory of a journey through different regions based on the changes in register and density.

The first period reveals a four measure alternation of rising and falling extremes in register. This is coupled with alternations in note number from four to five every four measures. Likewise in the second period there are two statistical phases in note number and register. Measures 12-22 are characterized by consecutive alternations of four, five, and six note sonorities coupled with a mild increase in registral extremes. The second phrase, from measures 23-34, stays with five note sonorities before increasing to six at measure 31. The upper registral limit remains fixed while the bass descends. ²

Figure 1.2. Scriabin Prelude VI. Registral Extremes and number of notes



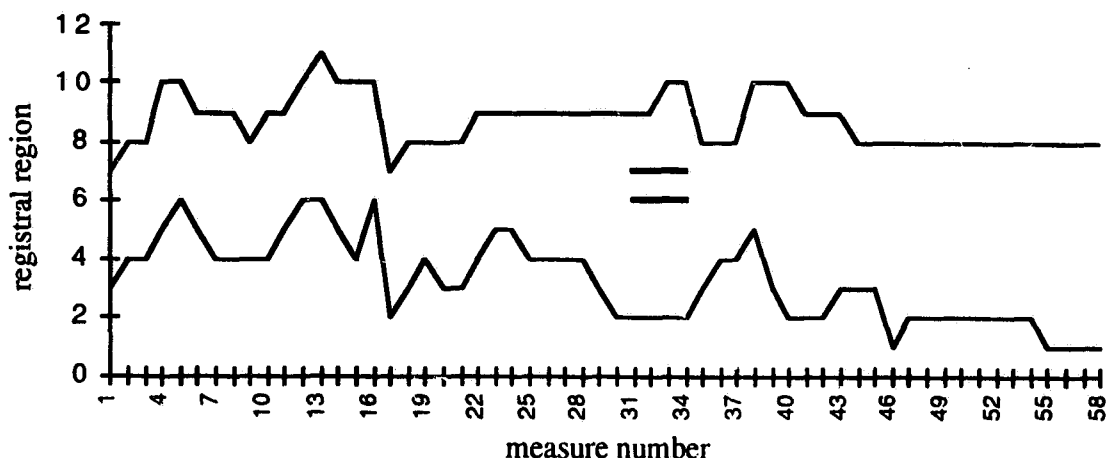
The second large section subdivides into phrases of fourteen and ten measures each based on the underlying changes in sonority. Admittedly, segmentation of the second large section into smaller periods is somewhat arbitrary as the strongest feature is a chromatically descending bass line toward the arrival at the dominant in measure 47. From the perspective of sonority, however, there are two distinct features. There is a parallel descent in registral extreme with no change in the number of notes until measure 48. Secondly, from measure 48 until the end the number of notes increases from six to seven, while the upper registral extreme remains constant. The overall form of the prelude from the perspective of register and density may therefore be outlined as follows:

1- 16	17-34	35- 58
A	B //	A
abab	cd	ab

There also appear to be global trends in the music with respect to register and density. Throughout the piece the registral span expands toward the bass. At the same time there is a general trend towards increasing numbers of notes. The final cadence serves as a climactic moment for both parameters. Another interesting aspect of the work, evident in figure 1.3, is the addition of independent mid register triads in measure 32. In all other instances the secondary voices are placed within the octave span framed by the melody. At the moment of half cadence Scriabin pulls out the inner voices and places them in an independent

middle register. The voicing change reinforces the structural importance of the half cadence, and possibly anticipates the final cadence in which the melody and tonic triad return to the same register.

Figure 1.3. Scriabin Prelude VI. Inner Voices and Registral Extremes



Clearly, the present analysis is biased toward changes in sonority in a piece which may also be explained in more conventional terms. A formal analysis based on the minor changes in rhythm and motive shape would yield the same design. Nonetheless, the importance of the sixth Prelude lies in the fact that register and density seem to modulate in parallel with changes in conventional parameters and play an heightened role in the punctuation of cadences. The rise in importance of these parameters together with the decline in harmonic motion to related key areas marks a significant departure from piano music of the first half of the Nineteenth century.

Footnotes

1. Karl Eschmann, Changing Forms in Modern Music (1945; Boston: Shirmer music company, second edition, 1968), p. 41-49.
2. Arguably the period divides into three phrases at measure 32, but the arrival here was felt to be a continuation of the second phrase.

2. Claude Debussy. Piano Prelude #6, Book I. (1910)

Pierre Boulez has said of Debussy's music, "There is a subtle relationship between the instrumentation and the structure of phrases, emphasizing their articulation and thus giving an immediate sensory significance to what may be in itself an abstract idea." ¹ In other words, phrases or structural units are in part defined by physical changes in the nature of the sounds themselves rather than by abstract or metaphoric means such as a conventional tonal cadence. ² In Prelude No. 6 (book 1) for piano, register change and note density participate in parallel with melodic and chordal changes in defining the overall progression and structure of the work. ³ The piece constructed through the juxtaposition and recombination of a set number of motive types, but a revolutionary change occurs in the means of development of these motives. As opposed to traditional techniques of development such as fragmentation and rhythmic diminution and subdivision, development, in a new sense of term, occurs in the manner of registral change and addition or subtraction of chord tones in musical gestures which otherwise remain intact. Rhythm tends to remain the same for all motive types throughout the course of the work. ⁴

The sixth prelude proceeds through the proliferation and loose variation of melodies. Phrase distinctions are based on the noticeable changes and configurations in the motives as well as changes in mode and general bass/ harmonic region. Formally, the piece divides into two approximately equal sections, A and A', from measure 1-15, and from 16 -36. (figure 2.1) Though there is not always a clear separation between phrases each large section may be internally divided into seven sub-phrases ranging from one to five measures in length. There is a one to one correspondence between phrases of the two sections and Debussy plays with commonalities and differences in motivic configuration and modality between the two halves. For each motive type there is a deliberate and ultimately logical pattern of registral change and to a lesser extent density change. The superimposition and registration of motives when combined with changes of sonority in terms of modality and root harmony creates a kind of continuous variation form light years ahead of his contemporaries.

Figure 2.1 present an overview of motivic transformations and accompanying modality and bass harmony throughout the piece. While the analysis is not aimed at a conventional exposition of motives it is impossible to discuss the compositional application of register

change without introducing and following the various motives throughout the piece. The overview is given first so that descriptions and frequent variations of motives may be read in context. There are four motive types: Ostinato, chordal accompaniment in half notes, melody - a mixture of quarter, eighth, and triplet eighth notes, and countermelody in quarter notes.⁶

Figure 2.1 Debussy Prelude #6. Formal/Motivic Design.

Measure Number	1-4	5-7	8-9	10-11	12-13	14	15
ostinato	a	a	a	a	d	d'	
melody	x	x'			xw	zx'	
countermelody			h	h'			s
chordal accomp.	y	by	cy	cy'	d	d'	
Modality	D Aeolian	D dorian	chr.	chr.	Db I.ydian	C Wl. Tn.	chr.
Bass/harmony	Dmi	G - dmi	C#7	C#7	Gbmaj7/Db	C+ 7(#11)	Bb
Measure Number	16 - 19	20-25	26-28	29-31	32-34	35	36
ostinato	a	a	a		a'		d'
melody	x''	xw'		xw''	rx'		
countermelody	h''		h'''	Q		st	
chordal accomp.	y	by'	bcy		y'		d'
Modality	Bb Lydian	Db Mixolyd.		chr.-dorian		Db Mixolyd	D harm.
min	5ths						
Bass/harmony	Bb13 Dmi	Db7	Gmi - Dmi		Db7	C# dim7	G

The Ostinato motive, arbitrarily labelled "a" is presented in the first measure in the mid range.

Figure 2.2 Ostinato Motive a



There are only two changes to this motive in the work; a transposition and pitch change two octaves lower to the bass register in measure 14, and a transposition two octaves higher in measure 32.

Figure 2.3. Ostinato motive da

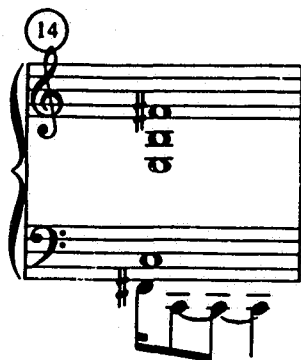


Figure 2.4. Ostinato motive a'



The "lead" melodic motive first occurs in measure 2.

Figure 2.5 Leading melody. Motive x



The lead melodic motives are transposed with each occurrence. Rather than thinking in terms of transposition to related key areas, consider motivic transpositions as the specific articulation of different registral regions. While the second occurrence of the lead motive at measure 5 stays in approximately the same register, the registral span of the melodic shape is extended in a lower direction.

Figure 2.6. melodic variation x' 

The third and fourth appearances of the lead motive move to even lower and higher registers respectively.

Figure 2.7. melodic variation in bass register. xw Figure 2.8. New gesture zx'
Doubling in high register and rhythmically related to x' 

One could generalize a calculated registral alternation in the melody from mid to low to high registers. A complementary registral process is evident in the melody in the second half of the piece. Again starting in the mid register, the high point at each occurrence increases successively to a high point in measure 30 before returning to the mid range in measure 32 and 33.

Figure 2.9. Melodic variation with mode change. x'' Figure 2.10. Transposition of bass melodic gesture xw to higher register. Highest point in the piece thus far. xw' 

Figure 2.11. Variation of xw' . New registral high point. xw''



Figure 2.12. rxz' . Derivative of x , returns to mid register.



The countermelodic motive first appears in measure 8, and is characterized by step wise motion in quarternotes.

Figure 2.13. New motive. lower countermelody. h

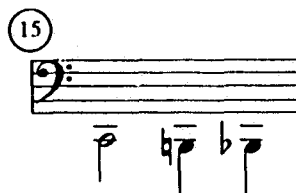


It is transposed to the mid range in measure 10, and then in the extreme low register as the descending C 2, B1, Bb1 figure in measure 15.

Figure 2.14. transposition and inversion. h'



Figure 2.15. Moving quarter notes in extreme low register, alone. s



The countermelodic motive resumes in the mid register in measure 17, and moves up slightly in its next appearance at measure 27. This is followed in measure 30-31 by a pronounced ascent in register coupled with an increase to a three note sonority. As a complementary gesture the countermelody again ascends to the extreme low register in measure 35.

Figure 2.16. variation and inversion of countermelodic motive h'. h''

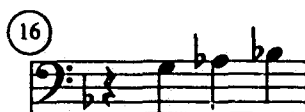


Figure 2.17. Inversion of countermelodic motive h''. h'''



Figure 2.18. New motive Q. Rhythmically related to countermelody h. Highest extension of accompaniment into upper register. Highest point in the piece so far.



Figure 2.19. Solo low register bass figure st, possibly in reference to the solo bass figure s which ends the first section.



Globally one could consider the countermelodic motion as expansion from the low-mid registers to both upper and lower extreme registers. The mid point of the piece may be viewed as an interruption, after which the countermelody resumes its trajectory, exceeds past barriers and reaches the high and low registral extremes.

The final motivic component, chordal accompaniment in half notes, is so subtle that one is often unaware that it is present. In addition to register, changes in the number of notes and intervallic spacing are parameters of variation. It begins in measure one as single halfnotes on the "tonic" D. The consistent use of half notes throughout the work suggest an independent stream rather than grouping these pitches with the ostinato. In Measure 5 the gesture is expanded to three notes spanning the mid-low register, recognizable as major and minor triads in an open inversion.

Figure 2.20. first chordal accompaniment figure, y.



Figure 2.21. chordal accompaniment by.



In measure 8 the chordal motive appears as a two note, minor seventh interval in the mid-low range before being transformed and inverted in measure 9 to a major second interval in the mid range.

Figure 2.22. Second chordal accompaniment motive, cy.

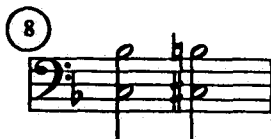
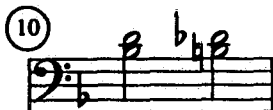
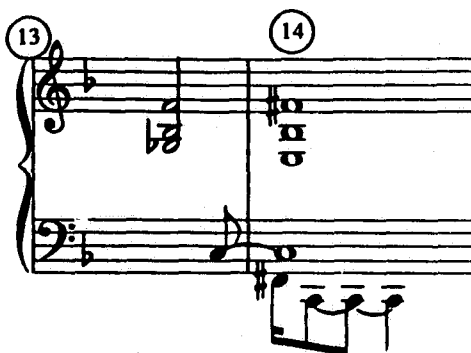


Figure 2.23. Inversion and narrowing of second chordal figure cy. cy'.



The sustained chords of measures 12-14, labeled d and d' may be considered the next transformation of the chordal motive, and possibly a fusion with the ostinato. The unique spacing of equidistant perfect fifths in measure 14 might also serve a phrase-defining function.

Figure 2.24. New motive d, a fusion of ostinato and halfnote gestures.
Five note sustained sonority d'



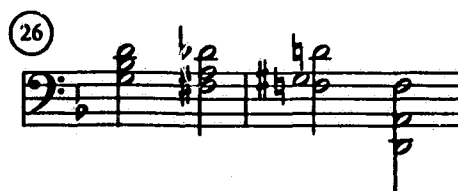
In the second half the figure returns to a single note D in the mid range. It again transforms to a three note triad in the mid-low register, but with two significant developments. One is the increase to and repetition of four-note chords in measures 21-23, and subsequent alteration in chord voicing in measure 24. It is subtle, but there is a clear and deliberate widening of the distance between the lower two tones of the three note sonorities.

Figure 2.25. Variation of first chordal accompaniment. by'



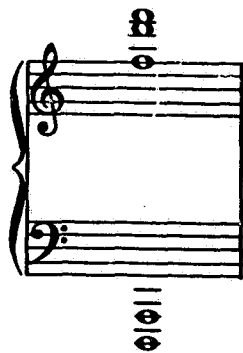
The next occurrence at measure 26 differs from its counterpart in measures 8-11 of the first phrase through in the increase from two to three tones. There is significance also in the succession of closed, root position triads, a unique feature of this phrase.

Figure 2.26. Variation of second chordal accompaniment. Voice leading and arrival at D minor also suggest fusion of first and second chordal accompaniment motives. bcy



In measure 32 the single note accompaniment is finally transposed up an octave to the upper-mid register. The final chord of the work, the last statement of this motive type, is placed in the both the highest and lowest registral extremes of the piece and frames vacant registral regions inhabited in all preceding phrases. The increase to a five note sonority may also indicate a cadential function.

Figure 2.27. Final chord, dd.



For quick reference the various transformations of each motive type are summarized in figures 2.28 through 2.31.

Figure 2.28 Summary of Melodic Motivic Stream

Figure 2.28 displays a sequence of eight melodic motifs, numbered 2 through 32, illustrating a stream of melodic material. The motifs are presented on a single staff in treble clef, with a key signature of one flat (B-flat major or D minor). The motifs are as follows:

- Motif 2: Labeled x . It begins with a circled '2' and contains a sequence of notes including a triplet of eighth notes.
- Motif 5: Labeled x' . It begins with a circled '5' and continues the melodic sequence.
- Motif 12: Labeled xw . It begins with a circled '12' and is written in bass clef.
- Motif 14: Labeled zx' . It begins with a circled '14' and contains a B-flat note.
- Motif 17: Labeled x'' . It begins with a circled '17'.
- Motif 23: Labeled xw' . It begins with a circled '23' and contains several B-flat notes.
- Motif 30: Labeled xw'' . It begins with a circled '30' and contains several B-flat notes.
- Motif 32: Labeled rxz' . It begins with a circled '32'.

Figure 2.29. Summary of Chordal Accompaniment Stream

The musical score consists of the following measures and their accompaniment labels:

- Measure 1: Treble clef, label **y**.
- Measure 5: Bass clef, label **by**.
- Measure 8: Bass clef, label **cy**.
- Measure 10: Bass clef, label **cy'**.
- Measure 13: Treble clef, label **d**.
- Measure 14: Treble clef, label **dd'**.
- Measure 16: Treble clef, label **y**.
- Measure 20: Bass clef, label **by'**.
- Measure 26: Bass clef, label **bcy**.
- Measure 32: Treble clef, label **y'**.
- Measure 36: Treble clef, label **dd** with a circled **8** above it.

At the bottom of the page, there are two vertical lines of musical notation: a double bar line followed by a circled **8**, and a circled **8** below it.

Figure 2.30. Summary of Countermelodic Stream

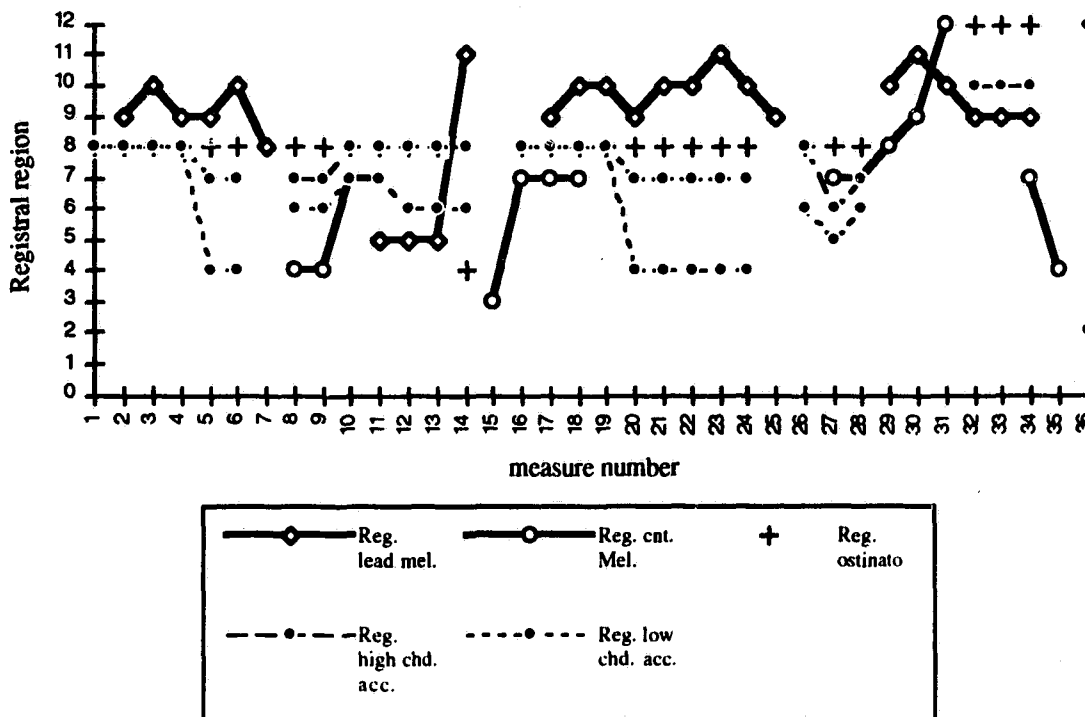
Figure 2.30 shows a summary of a countermelodic stream. The notation is presented in five staves, all in bass clef. The first staff (measures 8-10) is marked with 'h' and 'h'' above it. The second staff (measure 15) is marked with 's' above it and shows three notes with stems pointing down. The third staff (measures 16-17) is marked with 'h'' above it. The fourth staff (measures 30-35) is marked with 'a' above it. The fifth staff (measures 35-36) is marked with 'st' above it.

Figure 2.31. Summary of Ostinato Stream

Figure 2.31 shows a summary of an ostinato stream. The notation is presented in two staves, both in treble clef. The first staff (measures 1-32) is marked with '1' above it. The second staff (measures 32-35) is marked with 'st' above it.

The deeper compositional structure of the sixth prelude is revealed when registral progressions of all motive types are considered together. In a manner which revolutionizes traditional concepts of melody and accompaniment, large sections of the work are defined by registral configuration and registral tendencies of motivic strata, and may mark the beginning of a textural approach to compositional structure. A visual/graphic realization of the registral changes of the various motive types are given in figure 2.32. The work divides into four wholly contrasting phrases with divisions roughly at measures 8, 16, 26, and 30. Taken as a whole, there is a tendency in the first phrase to start in the mid-high register and move to the mid-low register. In the second phrase all voices begin in the mid to low range. There is a kind of crossover motion in the phrase as the ostinato descends from mid to low register while the lead melody begins in the low and ascends to the high register. The third phrase begins spread around the mid range and is characterized by a broadening in both directions. The last phrase has a pronounced three part collective movement low to high and to both extremes.

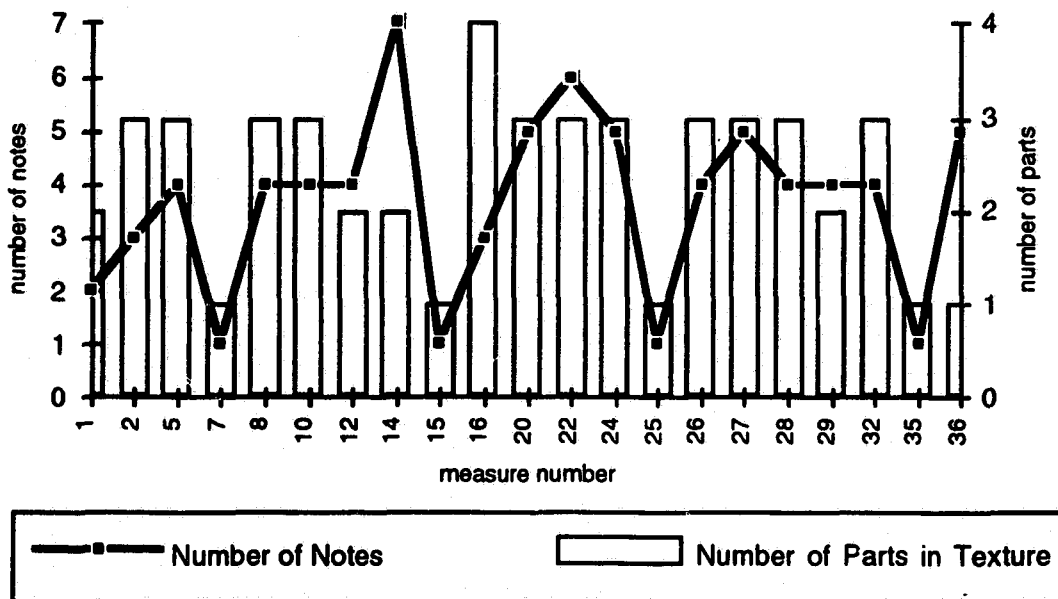
Figure 2.32. Debussy Prelude #6. Registers of various components.



Another curious feature of the piece is that the lead melody never reaches the extreme high register. By contrast, the countermelody, ostinato, and chordal groups each reach the extreme high register in rapid succession at the end of the piece, and at a slightly higher level each time. One could conceive of the entire work as no more than a movement of inner voices from the low-mid register to the higher regions.

Figure 2.33 gives a global perspective on fluctuations in note density in the sixth prelude, both in terms of the number of notes and the number of parts in the texture. Statistical trends subdivide the work into four phrases terminating in measures 7, 15, 25, and the end. Reduction to a single note line assumes a powerful phrase-defining function. A liberal interpretation of the data suggests the first and third phrase be grouped as smaller and larger examples of the same arching shape. By contrast, the inverted "spikes" in the representations of the second and fourth phrases suggest a complementary relationship.⁷

Figure 2.33. Debussy Prelude VI. Number of Notes, Number of Parts in Texture



In the early post-tonal period the term "sonority" still retains connotations of chord type and chord quality with reference to the tonal diatonic harmonies. While the sixth prelude does not reflect a functional tonality, sonority taken as a particular chord color or combination of mode and root harmony, is utilized both as a means of phrase distinction and of phrase variation. Debussy employs alternations in melodic modality in successive occurrences of similar motivic material. As one example melodic motives x and x' are presented in the first and second phrases using D Aeolian and Dorian Modes respectively, but are reinterpreted in Bblydian and Db mixolydian in x" and xw' in measures 16-19 and 20-25, the first two phrases of the second half. Mode and root harmony are consistently varied with respect to motivic configuration in each half of the piece.

While phrase-by-phrase root motion is not tonally functional there remain certain consistencies in the choice and number of harmonic areas which reflect a final flirtation with tonality. The piece gravitates around Dmi. While there are no cadential V-I progressions, plagal motion IV-I from G to Dminor occurs in measures 5-7, 20-25 and at the end, and retains a weakened key-defining function. Debussy consistently dwells over a Db pedal in three phrases each of the first and second sections. The fifth phrase in the first section is a second inversion GbMaj7 sonority while its counterpart in the second phrase suggests a C#dim7. All other Db phrases prolong a Db7 sonority. It may be that the leading tone C# retains some significance for Debussy as a closely related key area. The third and final root region in the piece centers around Bb, the traditional submediant. Its use in the Prelude on both sides of the center of the piece may reflect a bias towards the conventional tonal progression and return to and from the dominant. It is important to clarify, however, that the vocabulary of chordal sonorities defined by Debussy are incapable of functioning in a manner akin to tonal harmonic motion. It is a means of sectional variation only. The musical surface of Debussy' music is still governed by the rise and fall of melody.

A final though somewhat unscientific analytical perspective on the sixth Prelude is achieved from the aggregate of all pitches occurring in a given phrase, figure 2.34. It clearly illustrates changes in modality and register between each phrase and moreover between like phrases of the first and second sections. When paired with the graph of registral trajectories one gains a compositional map of pitch collections, spacings, and registers appropriate for the more systematic music of a Jannis Xenakis or a Georgi Ligeti , so advanced is Debussy.

Figure 2.34. Cumulative pitches occurring within a given phrase

For late twentieth century composers the possibilities of timbral and registral change as structural parameters are taken for granted. While the expansion of the compositional palette was likely inevitable, it is Debussy who was the first to fully exploit the new possibilities of Sonority. Debussy rose to prominence as a composer at a time of fundamental and profound changes to the musical language. The unresolved chromaticism of Wagner and the early works of Schoenberg had eroded the pull of functional tonality, setting the stage for a musical renaissance. With mastery and boldness decades ahead of his contemporaries Debussy was able to create a personal sound, synthesizing elements of the functional harmonic vocabulary with other parameters associated with sonority such as density, register, and voicing. This exponential broadening in the materials of music goes on almost unnoticed in support of the ever present lyricism of his melodies.

Footnotes

1. Pierre Boulez, Orientations, Trans. by Martin Cooper, Ed. by Jean Jacques Nattiez. (Cambridge, Ma: Harvard University Press, 1986.) p. 271.
2. Register and density change on the piano are the equivalent of instrumentation change in an orchestral piece such as Jeux
3. It is really not possible to say sonority participates equally. Changes in sonority are adjectives for changes in melody, chordal accompaniment, and ostinato, but are truly neither the subject nor object of the musical dialectic.
4. An ongoing concern for composers is the need to freeze certain parameters to permit greater focus on particular aspects of sonority. Rhythmic invention in particular is often kept to a minimum, the exception being Messiaen.
5. One of the easiest descriptions of Debussy's music and perhaps impressionism in general pertains to the divorcing of harmonic function in chords such as a dominant ninth and employing this divorced sonority in the parallel accompaniment of melody. "Parallelism", as the term is commonly used, is not at all in evidence in this Prelude with the exception of two variations in countermelody, at measures 26-27 and 30-31.
6. The categorizations and generalization of motives are certainly open to discussion, but does facilitate a qualified registral map of the piece.
7. The inversion results from a change in the order of the chordal accompaniment and countermelodic motives.

3. Anton Webern. Five Pieces for String Quartet, Op. 5, II (1909)

Webern's compositions in a pre-twelve-tone idiom do not seem to attract the same attention as the serial works of the late 1920's and early 1930's. Composed by the twenty six year old Webern in 1909, the five movements for string quartet show seeds of his revolutionary approaches to intervallic construction, formal structure, and symmetry fully exploited in later works. Small groups of chordal sonorities linked by common tones and intervals begin to be treated as self contained structural units. Organic growth of motivic material within these cells is replaced by local processes in register change. In addition, Webern's use of chords based on a synthetic intervallic construction further expands the vocabulary of chordal sonorities away from extended diatonic harmonies. Eric Salzman describes Webern's compositional approach during this period as follows:

The pitch successions, whether isolated or grouped in small cells, form a series of points which tend to fill up a distinct and very carefully defined musical space. Thus a succession will be divided between various registers and between various instruments and instrumental groupings.¹

The sonorities of the second movement reveal a series of subtle common tone and interval connections, suggesting a kind of organic growth. Growth is realized, however, through voicing rather than motivic play. The sonorities comprising the first seven measures are given in figure 1.1 below.

Figure 3.1 Common tone and interval connections between sonorities.

The figure shows a musical score with two staves, treble and bass clef. Five sonorities are marked with circled numbers 1 through 7 above the notes. Sonority 1 is in the bass clef. Sonorities 3 and 5 are in the bass clef. Sonorities 6 and 7 are in the treble clef. A slur connects the notes of sonorities 6 and 7. The notes for each sonority are: 1 (F, A, C#), 3 (F, A, C#, E), 5 (F, A, C#, E, G), 6 (F, A, C#, E, G, Bb), and 7 (F, A, C#, E, G, Bb).

The sonorities in measures 1 and 3 each contain a common F A C# augmented triad. Around this common triad, the sonority in measure 3 is developed through addition of one

tone and an adjustment in the registral region with the greatest note density. The "close" interval moves from the top two notes in measure 1 to the mid-low region of the sonority in measure 3. The sonority of measure 5 develops this compact section of the voicing in measure 3 which gravitates around the pitch D. Measure 5 maintains the cluster around D and adds a minor second D-Eb cluster one octave lower and the single note D one octave above. In other words, both measure 3 and 5 contain quasi symmetrical voicings but in measure 5 the outer intervals have been widened. From another perspective the restriction to minor second intervals and the inversion major seventh in measure 5 is in keeping with the use of a single generating interval in measure 1. The chord in measure 6 maintains in the soprano register the D-Eb minor second clusters and major sevenths spacings of measure 5 but adds a new four-note, evenly spread fifths voicing in the bass clef. Again, there are both common and growth elements, all defined in terms of interval, spacing and register. In measure 7 the fifths voicing is maintained intact while the minor second cluster in the higher registers are supplanted by an E-Eb minor second, spread to two octaves apart.

From a visual perspective both the registral extreme and note density charts suggest a binary division around measure 8. The registral spread starts with narrow values at measure one, increasing to a maximum spread in measure 6 which is maintained through measure 7. At measure 8 the register is again confined and spreads once more at measure 11, which is maintained until the end. The introduction of imitative melodic figures at this point lends support to a structural division at measure 8. The parameter of total number of notes (figure 3.3) also exhibits a binary pattern of rising , then falling, though less extreme in the registral parameter. The structural division at measure 8 is less clear for this parameter, suggesting instead a new beginning delayed until measure 10.

Figure 3.2. Webern Op 5, #2 Registrational extremes

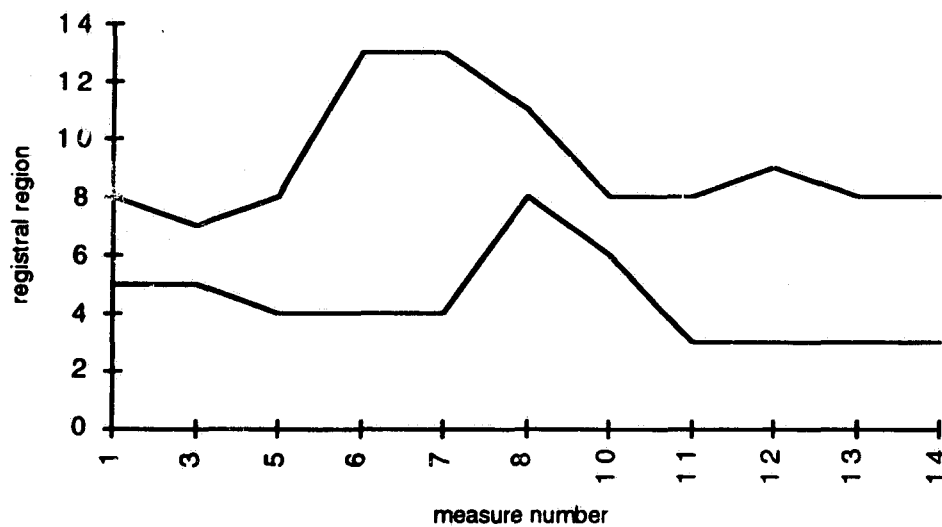
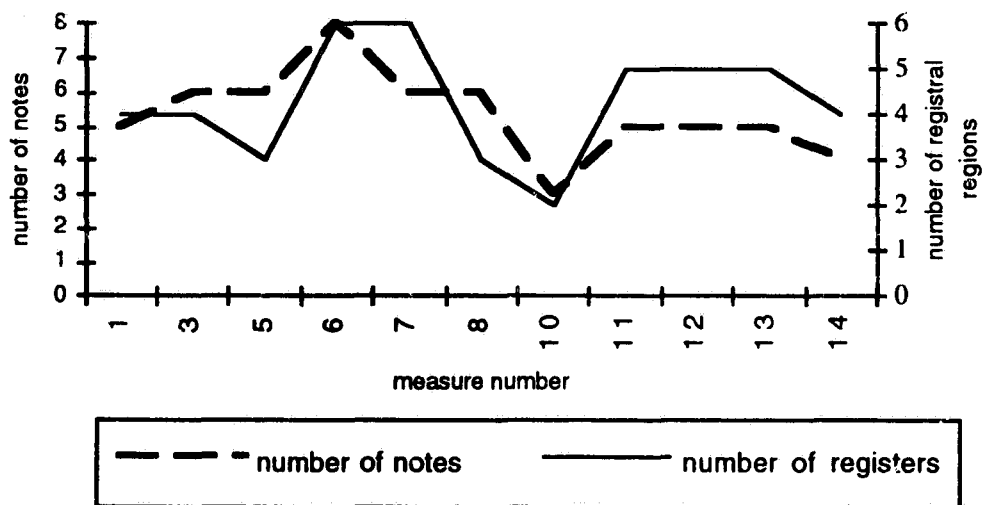


Figure 3.3. Webern Op. 5, #2 Number of notes and registrational regions



--- number of notes — number of registrational regions

Figure 3.4. Webern, String Quartet Op. 5

Mvt. II

A revolutionary change is underway in these modest movements for string quartet. Certainly the chordal vocabulary of music is expanding. Sonorities need not resemble functional harmonies but may be defined by interval and register alone. But of greater significance are the possibilities of formal organization other than the tonal prototypes of either variation form or a through composed organic form. The proliferation of symmetrical forms in twentieth century music is due in no small way to the new emerging vocabulary of sonorities which are self contained entities defined by interval and register alone.

Footnotes

1. Eric Salzman, Twentieth Century Music, An Introduction, (Second edition, Englewood Cliffs, New Jersey : Prentice Hall, 1974) p. 41.

4. Webern, String Quartet Op. 5, Movement IV.

There are actually very few static vertical sonorities in movement IV, but intervallic comparisons of sonorities are still valid as each gesture is constructed with specific regard to register and spacing regardless of whether it occurs in solid or broken form.¹ Melodic gestures remain prominent but density, register, and the weight of instrumentation are continuously varied in support. The intervallic construction of sonorities also suggests a separation into three and possibly four distinct voicing types. Intervallic makeup of sonority emerges as a thematic element.

Webern employs a range of pitch sonorities justified only by interval spacings and with absolutely no reference to tonal harmony. Some sonorities are developed upon repetition but only in terms of the placement and size of intervals within the sonority. Figure 4.2 reveals three general types of voicing in operation which will be termed equidistant, quasi-symmetrical, and synthetic.² Equidistant spacings such as occur in measures 1, 2, and 12, typically involve fourths and fifths. In this case the three equidistant sonorities are each qualified by an additional registral gap between the lowest two pitches. The interval between the first and second notes in measure 1 is an augmented twelfth, a minor seventh in measure two, and with no gaps larger than a fifth in measure 12. (refer also to figure 4.1)

Figure 4.1. Webern, String Quartet Op.5

Mvt. IV

The musical score for Webern's String Quartet Op. 5, Movement IV, is presented in two systems. The first system contains measures 1 through 6, and the second system contains measures 7 through 13. The instruments are violin 1 (vln1), violin 2 (vln2), viola (vln2), and violoncello (vlc). Measures 1, 2, 3, 5, 6, 7, 10, 11, 12, and 13 are circled. The score shows various voicings and intervallic relationships between notes. In measure 1, the interval between the first and second notes is an augmented twelfth. In measure 2, the interval is a minor seventh. In measure 12, there are no gaps larger than a fifth. The score also includes dynamic markings such as 'ah' and 'p'.

Quasi-symmetrical voicings such as occur in measures 3, 6, and 10, tend to reflect the same types of intervallic spacing above and below a middle point. Note the presence of relatively wide intervals in measure 3 such as the major sixth and augmented fourth in the bass with the perfect fifth and augmented fourth in the soprano, with an inner region composed of thirds and seconds. The chords of measures 6 and 10 each contain major third/minor second combinations which are spread either a tritone above or a perfect fourth below.

The term "synthetic" voicing is used to describe sonorities derived from a specific pattern of intervals. The sonorities of measures 5 and 11 are derived from a minor second/major third combination. The sonority of measure 13 is derived from major second clusters separated by a slightly increasing interval from top to bottom; major third, perfect fourth, and tritone. The voicing of measure 7, corresponding to the ostinato thematic unit, is a unique voicing in the context of the movement. It is neither equidistant nor symmetrical but constructed of two triads stacked above single tones separated by a perfect fourth.

Figure 4.2. Summary of Voicing Types.

1.	2.	3.	5.	6.	7.	10.	11.	12.	13.
equid.	equid.	Symm.	Synth.	Symm.	Synth. Unique	Symm.	Synth.	equid.	Synth. Unique

Taken in isolation the parameter of chord voicing and construction suggests a loose binary formal interpretation of the movement, A B, with an increased weighting of synthetic chord types in the second half. From a strictly thematic standpoint, the fourth movement is through composed:

Figure 4.3. Thematic/Motivic form.

<u>measure</u>	1	3	7	11
<u>texture</u>	A (sustained)	B (polyphonic web)	C (ostinato)	D (unison/canon)

Registral fluctuations (figure 4.4) reveal a pattern of wide registral spread through measures 1-5, but in which the extremes subsequently move up and down in parallel while remaining confined to a narrower spread through the rest of the movement. Similarly in the parameter of total number of active registral regions there is a pronounced pattern of rising

then falling which first occurs in measure 1-5, and is then duplicated, albeit in a moderate and gradual fashion, in measures 6-12. Movements of register and registral density therefore reinforce a binary AB formal interpretation.

Figure 4.4. Webern SQ Op.5, #4 Registral extremes, Number of registers

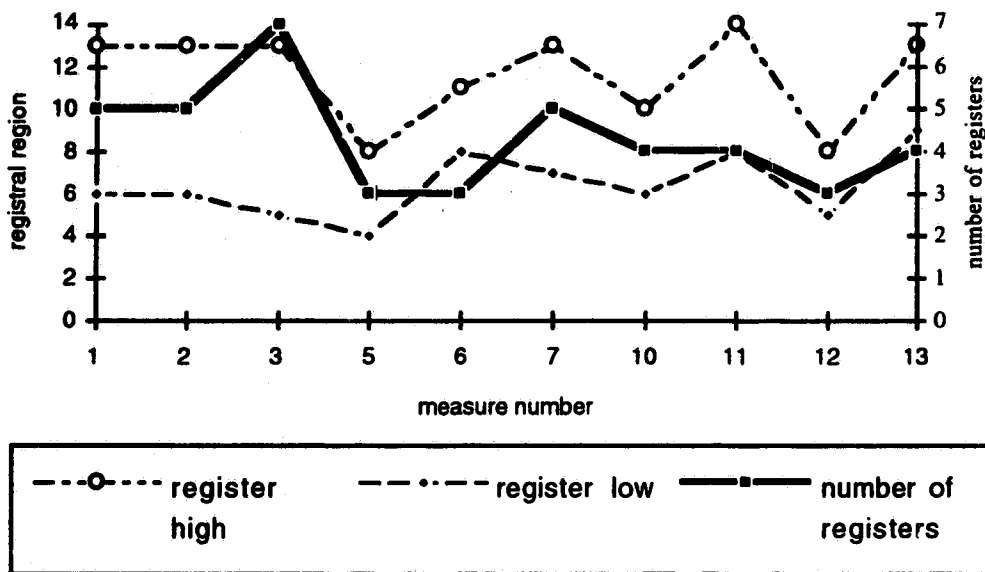
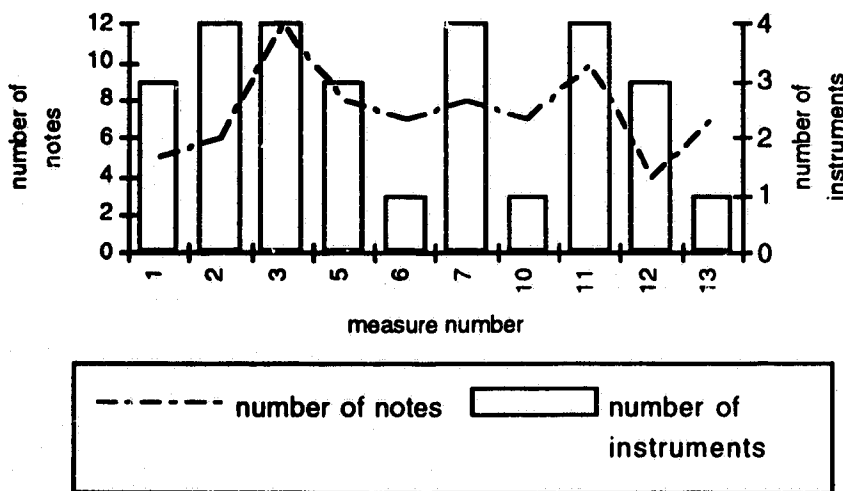


Figure 4.5. Webern SQ Op.5, #4 Number of Notes, Number of Instruments



More than the other movements here examined, the fourth movement makes use of density in terms of the number of instruments playing as a parameter of focus. (figure 4.5) Starting in measure 6 until the end, the piece exhibits a miniature rondo form alternating soloist with tutti figures. When compared with the instrumentation of the first five measures, this parameter also supports an AB interpretation.

Far from providing a definitive interpretation of the work, analysis from the perspective of sonority nonetheless reveals layers of complexity and control beyond a simple motivic/textural interpretation. Register, density, and instrumentation move in parallel with the small thematic cells in shaping the overall form. In later works Webern reduces the rhythmic/motivic element to a minimum, relying almost exclusively upon register and interval. The shift is one of outlook, however. In a manner which perhaps foreshadows the approach of Olivier Messiaen in the 1940's, the fourth movement proceeds as an alternation of gestures defined by register, intervallic makeup, and rhythm. Form is not the result of process.

Footnotes

1. The closest approach to static harmonies occur with the tremolandi chords in measures 1-2, the arpeggiated ostinati of measure 7-9, and the pizzicato chords of measures 2 and 12.
2. Reduction to these three basic voicing types is in many ways an oversimplification. The three may not be mutually exclusive but nonetheless facilitate an overview of the basic polarizations in the movement.

5. Webern, String Quartet Op. 5, Movement V.

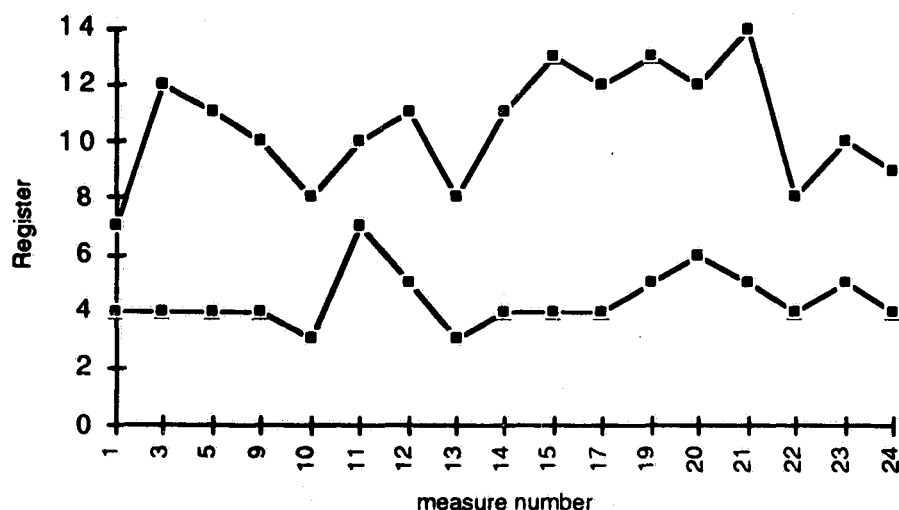
Webern's integration of sonority with the construction and progression of motives and texture is best represented in movement V. Conventional analysis through the discussion of motives and textures alone would certainly be appropriate to movement V. It is a rounded binary form in which the development section, roughly measures 10-23, is comprised of a rapid series of contrasting polyphonic, homophonic, and rhythmically motivated textures. A short recapitulation follows in which a variation of the opening cello solo returns in the first violin. A formal outline based on conventional criteria might read as follows:

Figure 5.1. Thematic Form

Measure.	1-9	10	13	15	17	19	23
Theme/Texture	A	b	c	d	e	f	A'

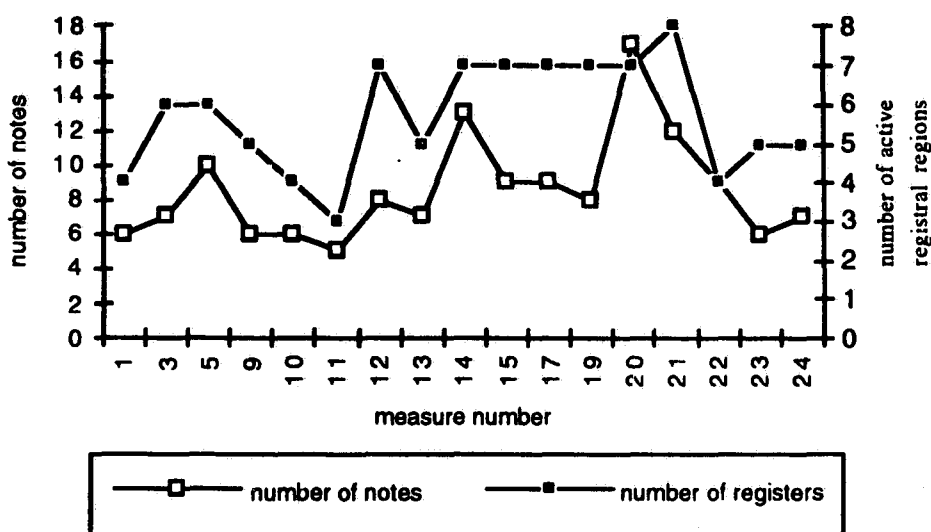
What is not obvious is that approximately the same form may be arrived at through the analysis of sonority alone. Patterns of change in registral extremes, the number of notes, and the number of active registers serve to reinforce the above outline. Sonority expressed as specific voicing types and the rate of alternation in voicing also suggest a rounded binary form. In addition, the rate and type of intervallic change in sonorities participate as an active process closer to the musical surface.

Figure 5.2. Webern OP.5,#5. Registral extremes



The opening section is defined in terms of register by a combination of processes. (Figure 5.2) The strongest feature is the linear descent in the register of the highest pitch in each sonority. Parallel processes are revealed in the parameters comprising density, both in terms of the number of active registers and the total number of tones in each sonority. The number of active registers (figure 5.3) decreases through measures 3-10 while the number of tones remains about the same. The dynamic effect in the passage is not one of obvious growth, but of subtle adjustments in the voicing as the lead line descends.

Figure 5.3. Webern OP. 5, #5. Note density



Webern also utilizes measure to measure voicing change as a characteristic process of the first A section. Upon examination of the musical reduction of the first ten measures (figure 5.4) a process is revealed in which the "large interval" spaces in the voicing move. The gap occurs between second and third pitches (from the bottom) in measure 3, the third and fourth pitches in measure 5, and the first and second pitches in measure 9. At measure 10, the point at which the development section begins, the voicing is adjusted to one with roughly equidistant spacing in contrast to the large "holes" of the voicings in the opening phrase.

The graphic evidence for measures 11-22, the "development" section, reveals a growth process in the parameters of upper registral extreme and the number of notes culminating at extreme values around measure 21. The number of tones in each sonority, while fluctuating up and down to a degree, nonetheless remains on an upward trajectory with local maxima

Figure 5.4. Webern, String Quartet Op. 5, Mvt. V

The image displays a musical score for Webern's String Quartet Op. 5, Mvt. V, covering measures 1 through 24. The score is organized into four systems, each with a treble and bass staff. Measure numbers 1, 3, 5, 9, 10, 11, 12, 13, 14, 15, 17, 19, 20, 21, 22, 23, and 24 are circled. The instruments are labeled as vln1, vln2, vla, vlc, vln2pz, vlap, and ah. The notation includes various musical symbols such as notes, rests, and dynamic markings. The key signature changes from one sharp (F#) to two sharps (F# and C#) between measures 15 and 17. The score concludes with a double bar line at the end of measure 24.

at measures 12, 14, and 20. The number of active registers remains relatively constant throughout, but maintains a level significantly higher than the surrounding A sections.

Even where registral extremes and number of tones remains relatively constant Webern alters chord voicing, a subtle means of development beneath the level of motivic play. In general there is a greater variety of voicing types in the development section and a deliberate avoidance of the same voicing type in consecutive measures. (Figure 5.5) The voicing in measure 12 is relatively evenly spaced, composed predominantly of augmented fourths, with the wide interval on the bottom and clustered tones near the top. In measure 13 the spacing is largely made up of thirds, with the cluster at the bottom and the large interval between the top two notes. At measure 14 the voicing is spread evenly throughout all registers with a regular mixture of minor second clusters, thirds, and augmented fourths. The voicing at measure 15 is composed of two stacked groups; the lower contains a triad, perfect fifth, and major seventh, the upper containing a triad, major seventh, and perfect octave. At measure 17 the voicing is again evenly spread made up of fourths and fifths, while the sonority at measure 19 is comprised of very large spaces between the bottom four notes with a voicing in thirds near the top.

Figure 5.5. Voicings in "development" section

Through a combination of changes in register and voicing, sonority acts simultaneously as an agent of structural distinction and as a subtle process of development. While Debussy is the first to exploit the structural possibilities of sonority, Webern goes further. Musical structure is defined by registral and interval combinations approached through a more abstract, arbitrary vocabulary. But it takes another fifteen years before the attached rhythmic and motivic gestures are stripped away, possibly a negative effect of his association with the more motive oriented Berg and Schoenberg. Nonetheless, in the derived sonorities in the string quartets of Opus five Webern lays the foundation for the permutational methods of his mature period.

6. Arnold Schoenberg. Five Pieces for Orchestra, Op. 16. #3 (1909)

One of the most discussed and influential works of the twentieth century, the third movement of Schoenberg's Op. 16. is often cited as the first and perhaps the best dissertation in "klangfarbenmelodie", literally a melody of tone colors. In that famous passage at the end of Harmonielehre, Schoenberg states :

We go right on boldly connecting sounds with one another, contrasting them with one another, simply by feeling; and it has never yet occurred to anyone to require here of a theory that it should determine laws by which one may do that sort of thing. . . . Now, if it is possible to create patterns out of tone colors that are differentiated according to pitch, patterns we call 'melodies', progression whose coherence evokes an effect analogous to thought processes, then it must also be possible to make such progressions out of the tone colors of the other dimension, out of that which we call simply 'tone color', progressions whose relations with one another work with a kind of logic entirely equivalent to that logic which satisfies us in the melody of pitches.¹

Opus 16 #3 is Schoenberg's most concentrated attempt at tone color melody. The music is constructed through an almost continual sequence of five note sonorities in which the timbral voicing changes on every chord. Reconfigurations in timbre are presumably sufficient to sustain a listener's interest in absence of melodic and rhythmic figurations. Analysis reveals an infrastructure of compositional decisions both in terms of local processes and longer range statistical changes which enables the perceived freshness of the timbral changes above. There is a layer of rigorous logic at work in the voicing and instrumentation which moves in strict parallel with logical processes in the pitch domain.

Looking at the work as a whole one notes a stratification of two distinct types of thematic material. One is the continual transformation of five note sonorities which will be termed the Primary chordal stream.(figure 6.1) Sporadically intersecting the primary stream is a wholly contrasting group of sonorities which will be termed the Embellishing chordal stream (Figure 6.2). Figure 6.3 gives a registral map of the entire movement. While the primary stream is virtually continuous, expect for the interruption in measure 250, and maintains the same registral band, the embellishing stream is spaced by large periods of silence and moves through all registral regions. Registral patterns in the embellishing stream serve as points of structural articulation, particularly when cross referenced with statistical changes taking place in the primary chordal stream. (see figure 6.20)

Figure 6.1. Schoenberg Op. 16,#3. Reduction of Primary chordal stream.

The musical score is organized into five systems of staves. Each system contains several measures, with measure numbers circled above the notes. The instruments used are abbreviated as follows: fl (flute), cor (cornet), tpt (trumpet), cl (clarinet), fg (fagott), hn s (horn), vln (violin), vlc (viola), kfg (cello), bkl (bassoon), and tbn s (trombone). Asterisks (*) are placed above measures 229, 235, 240, and 244, indicating the start of a new pitch process. A triplet of notes is shown above measures 242-244.

* indicates the initiation of a new pitch process, used here as the primary basis of phrase distinction.

247 248

ob vla vlc hn tpt tpt s hn s vlc via
tpt vlc hn s ob tbn s fl fl hn hn s
vln tbn fg tpt s vln vln tpt s fg tbn

cor kl bkl ob cor bkl ob bkl tpt s
tbn cbs tbn s cbs kfg cbs tbn cbs tbn

249

ob cor vla Dkl vln fl vlc h fl vln kl vln
tpt fg tpt ob fg kl vlc h Dkl fl Dkl ob, fl, Dkl
vln fl tbn s hn fl cor vlc h cor vlc h hn s

kl bkl vln fg tpt vln vla vln tbn s fg
kfg cbs tbn s kfg cbs tbn s kfg tbn s tbn

cor, vln, kl vln vla ob ob, cor, vln,
hn, vlc h tpt s tbn s fl ob vla vla, vic ob, vln, vla
fl vlc, fl, ob, hns, kl fg, hn, tpt fg, hns, tpts ob
kl, fg, kl, fg, hn s Dkl kl kl, bkl cor, kl, Dkl, Bkl
tbn tbn s, vln kfg, tbn, cb kfg, tbn, cb hn s, vln

250 251

tpt ob, tbn fl vln Dkl vlc h vln hn s
vln vln kl fl ob vlc h vlc h fg cor
ob, cor hn s vlc fg vlc h via tbn s
cor, Dkl, bkl tbn vlc fg vlc h hn s
kl, vln tbn bkl, kfg, bkl, kfg, hn s, tbn s cbs h hn bkl

253 254 255 256 257 258

fl kl tpt s fl fg cor ob tpt hn s vlc s hn s vla
hn s vic tbn s kl tpt s vlc hn fl cor kl cor vln
vla fg vln hn s vla tbn fg vln tpt s fl tpt s hn s
fg bkl cor cbs hn kl vla tbn s kl vln kl cbs
tbn s vla cbs kfg vlc tuba fg tbn s bkl hn s bkl kfg

259 260 261 262 263 264

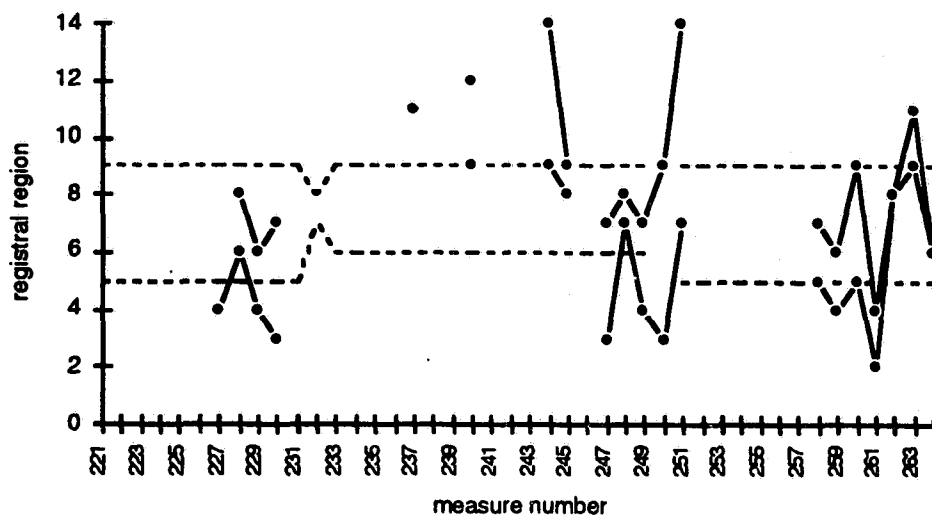
kl hn cor Dkl ob fl fg vln tbn s fl vln fg
fl fg hn s ob hn kl ob fg vlc s vln tpt fl
hn s Dkl fg kl cor vla vlc s vln tpt s fg hn s tpt
fg tbn s tpt s fg tbn bkl Dkl cor kl tbn kl cor
fg tuba bkl hn cbs fg vla hn s bkl kfg hn s kfg, cbs

Figure 6.2 Embellishing stream.

The musical score is divided into four systems, each with a treble and bass clef staff. Measure numbers are circled at the beginning of each system.

- System 1 (Measures 227-240):** Treble clef notes are A, B, E, A, C. Instruments include piccolo, celeste and violin harmonies, harp, and harp and cello harmonies.
- System 2 (Measures 244-245):** Treble clef notes are A, D, C, B, D. Instruments include pic, cor, 15va, harp and celeste, cello harmonies, violin harmonies, viola harmonic, fg, and contrabass harmonics.
- System 3 (Measures 247-249):** Treble clef notes are B, D, B. Instruments include kl, fg, contrabasses, and viola and cello, tremelo, ponticello.
- System 4 (Measures 250-251):** Treble clef notes are B, D. Instruments include harp, pic, 15 va, locc, vin harmonics, vlc h, vlc h, vlc h, cbs, cbs, cbs, fg, kfg, tuba.
- System 5 (Measures 258-264):** Treble clef notes are B, B, A, D, E, A. Instruments include vln trem pont, vln trem pont, harp, celeste, kl, vln harmonics, vlc trem pont, tuba, vlc trem pont, harp, cbs, cbs, cbs, and viola.

Figure 6.3. Schoenberg Op. 16 #3. Registral extremes of Primary and Embellishing Streams.



Primary Chordal Stream.

The fundamental sonority in the work, the chord from which all pitch changes in the primary stream emanate and ultimately return to, is a five-note, mid-range sonority constructed of an augmented fifth, minor third, and two perfect fourths.

Figure 6.4. Fundamental Sonority



The intervallic construction of the fundamental sonority is an important consideration. It must be enough removed from traditional functional harmony so as not to suggest any harmonic function or voice leading tendencies within the pitch structure itself. In theory, the ear must be liberated to follow the changes in timbre alone. Schoenberg is aware of this

fact when he discusses chords of augmented fifths and chords in fourths in his Harmonielehre.² In a sonority of perfect fourths and augmented fifths the component voices are free to be led independently in any direction, which is in fact exactly what occurs.

Throughout most of the primary chordal stream a pitch process is revealed as a voice leading canon in which each pitch of the fundamental sonority moves up by one half step and down a whole step. The sequence of voice leading is S2,S1, T, A, and finally Bass.³

Figure 6.5. Voice Leading Canon



The net result of the process is a series of "common tone" modulations which ultimately transpose the fundamental sonority down one half step. From another perspective the canon is a pitch process in which there will always be three common tones and two new tones in every sonority. This is an important consideration. Too fast a rate of pitch change would likely inhibit the perception of timbral change. To again quote Pierre Boulez :

Compare: 1) a succession of distinct timbres on 1 pitch, and 2) a succession of distinct pitches on one timbre. Case one will give the impression of a kind of analysis of one component by another, of pitch by timbre. In case two the timbre will certainly not appear to be thus analyzed by the succession of different pitches since the homogeneity of timbre will impose itself beyond certain internal fluctuations. The uniqueness of pitch "integrates" the multiplicity of timbres the uniqueness of timbre "coordinates" the multiplicity of pitches.⁴

His point being that in order to hear changes in timbre as the subject for comparison, the pitch material must remain relatively constant, in this case a commontone/new pitch ratio of 3:2.

In spite of the restrictions in pitch change, the various canonic and other pitch processes throughout the work are inexorably linked with more global trends in timbral change.

Every new generation of pitch material is paired with a new timbral process and serves as the basis for structural phrase and sub phrase distinctions. To gain a map of structural changes with respect to sonority each phrase will be examined in order. ⁵

Running parallel to the subtle changes in the pitch domain such as transposition, rate and direction of pitch change, and omission or sustain of certain pitches, are five basic types of timbral variation:

- 1) type of voicing: either interlocking, juxtaposed, enclosed, or some combination.
- 2) relative weighting in terms of wind, string and brass families
- 3) consistent, repeating timbral configurations
- 4) feature or omission of a particular instrument or group of instruments in a given phrase.
- 5) greater timbral weight in terms of number of unison instruments assigned to a particular pitch.

The opening phrase, consisting of one complete cycle through the pitch canon (figure 6.5) ends in measure 230. It is characterized by the regular, half note alternation of two and only two distinct timbral configurations. All but the bottom pitches have a single timbre. The only dynamic process in the phrase is the change to contrabassoon from viola in the bottom pitches in measure 229. Voicings are characterized by a regular alternation of juxtaposed and interlocking voicings only, with two and three families represented respectively. The first phrase is the only one in which the same timbral configurations are systematically repeated.

Figure 6.6. Phrase 1. measures 221-230, voicing.

w	w	w	w	w	w	w	w	w	w	w	w	w	w
w	b	w	b	w	b	w	b	w	b	w	b	w	b
w	w	w	w	w	w	w	w	w	w	w	w	w	w
w	b	w	b	w	b	w	b	w	b	w	b	w	b
s,s	s,s	s,s	s,s	s,s	s,s	s,s	s,s	s,s	s,s	s,s	s,s	w,s	w,s
J	I	J	I	J	I	J	I	J	I	J	I	J	I
2	3	2	3	2	3	2	3	2	3	2	3	2	3

(w=wind, b=brass, s=string, J=juxtaposed, I=interlocking, E=enclosed)

Expressed as a ratio, the relative weighting of the phrase in terms of woodwind, string, and brass families is 3:2:1.⁶

The second phrase, interpreted as measures 231-234, is not articulated by any conventional means such as a caesura. Pitch change of a different type occurs here in that the

fundamental sonority is first built up in increments and then repeated without further pitch change.

Figure 6.7. Phrase two, measures 232-234.



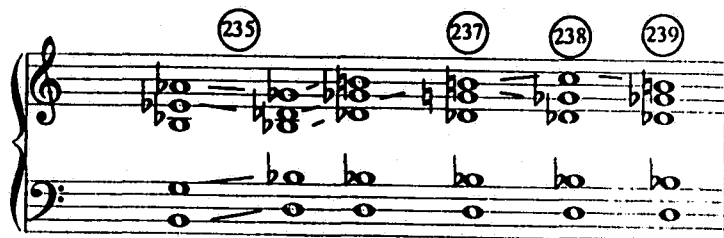
		w	s	b	s
	b	w	w	w	w
s	b	s	b	w	b
	b	b	b	s	b
		b	w	w	b
J	J	J	E	E,I	J
1	1	3	3	3	3

Family class ratio 5:3:6 or 2:1:2

In contrast to the first phrase the second is characterized by juxtaposed and enclosed voicings to the exclusion of clear interlocking voicings. The family class ratio of approximately 2:1:1 is the highest proportion of brass in any phrase of the piece.

Beginning with an abrupt transposition in four voices, a third phrase can be identified from measures 235- 239. The pitch canon does not run its course here but is restricted to a limited ascending and descending half step in the S1 and S2 voices. All other pitches remain the same.

Figure 6.8 Phrase Three. Measures 235-239



				238)		(239)			
b	w,b	w	w	w	s	w	b	w	w
s	w	s	s	w	s	w	w	s	s
s	w	b	w	b	w	w	b	w	w
w	s	w	b	w	b	s	w	w	w
s	s	w	s	s	w	s	s	w	b
I,E	J	E	I	I,E	I,E	J	I	E	I,E
3	3	3	3	3	3	2	3	2	3

Family class ratio about. 3:2:1

Note that the voicing type changes with every occurrence. The frequency of alternation remains in half notes; two per measure. There is an interesting symmetrical organization of voicing types. The voicing types of the first four sonorities are the same as the last four, though in a different order. There appears to be a middle pair of sonorities, coinciding with the half step ascent to C4 in the soprano 1, both of which have a combination of interlocking and enclosed voicings. Note also that while the first and third sub-groupings have similar voicing types they contrast in that the last group alternates two and three family sonorities. There is both symmetry and variation in the timbral voicing parameter. Another subtle feature of the phrase is the weighting toward violin, oboe, trumpet, and D clarinet in the soprano voice. Only these instruments occur more than once in the soprano voice.

In the fourth phrase, from measures 240-244, the descending pitch canon resumes. All voices cycle through except the bass which is instead transposed up a whole step. While the rate timbral change is every half note each sonority is only stated once, in contrast to the canon at the opening.

Figure 6.9 Phrase Four, measures 240-244.



w	s	w	w	b	s	w	w
w	b	s	w	s	w	b	s
b	w	b	w	w	b	b	b
w	w	w	b	w	w	w	w
w	w	s	w	w	s	w	b
E	J	I,E	E	J	I,E	E	I,E
2	3	3	2	3	3	2	3.

Family class ratio 3:1:1

In contrast to the "soprano weighting" which occurred in the last phrase, instruments in the soprano voice are never repeated in the fourth phrase. Another curious timbral feature is the total omission of the viola. There may also be significance in the use of trombone in only the first and last sonorities of the phrase. In addition, it appears that the clarinet and bassoon, frequently used in inner voices, move to the soprano only on the last two sonorities, coincident with the altered transposition of the bass voice.

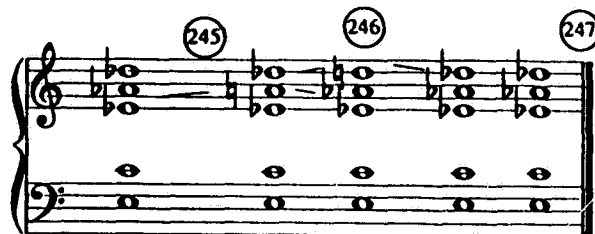
There are no pure interlocking voicings in the phrase. Another interesting feature is a quasi-algorithmic process for the family class distribution in each voicing. The winds cycle from four to three to two while the strings cycle from zero to one to two.

Winds: 4-3-2-4-3-2-3-2
 Strings: 0-1-2-0-1-2-0-1
 Brass: 1-1-1-1-1-2-2

Whether or not the disposition of forces is consistent enough to be convincing of a strict process, it does serve to differentiate this phrase from all others in the work.

The fifth phrase stretches from measure 244 until the end of measure 246, and marks a dramatic shift in the musical texture. The voice leading canon is again absent. The phrase begins with a brief ascending semitone imitation between S2 and S1 voices and is followed by seven repetitions of the same sonority. The rate of timbral change is no longer in half notes, but in a specific accelerating rhythm of triplet eighth notes and sixteenth notes. (Indicated above the staff in figure 6.1)

Figure 6.10. Phrase Five, measures 244-246.



w	w	s	w	b	s	s	w	s	s	b
w	w	w	w	w	b	b	b	s	b	w
w	w	w	b	w	s	w	s	b	w	b
b	s	s	w	w	s	b	s	b	w	b
w	b	w	w	w	b	b	b	s	b	s
E	J	E,I	E	J	E,I	I,E,J	E	E	E	E,I,J
2	2	2	2	2	2	3	3	2	3	3.

Family class ratio 4:2:3

Based on the number of families represented in each sonority, the phrase seems to split into two sub-groups.⁷ Note also the general absence of interlocking voicings.

Over the next three measures, 247 - 249, the pitch canon resumes and completes four cycles. As the rhythmic values are so small and so close together each cycle will be considered a sub-phrase of a larger four-part phrase. As evident in figure 6.1 the rate of timbral change again accelerates from quarter notes, to triplet eighths, to sixteenth notes, and continues as sixteenth notes until the end of measure 249.⁸ Though the rhythmic acceleration is a single process continued through all four sub-phrases, each cycle is characterized by a unique timbral process, and will be examined individually.

The first subphrase, from the downbeat of 247 to beat three of 248, is characterized by a noticeable increase in the percentage of brass instruments. There is also a general tendency away from interlocking voicings in the second half.

Figure 6.11. Phrase Six, subphrase one. Measure 247 downbeat to 248 beat three, second triplet 8th

b	b	b	s	s	w	w
b	w	w	b	b	b	w
s	s	b	w	b	s	w
w	w	w	w	b	w	w
w	s	b	s	b	w	s
J	I	I	E,J	J	E,J	J
3	3	2	3	2	3	2

Family class ratio : 5:3:4

The second subphrase, from beat three of measure 248 to the downbeat of 249, is dominated by juxtaposed voicings. There also appears to be a tendency toward three family voicings in the second half.

Figure 6.12. Phrase Six, subphrase two. Measure 248 beat 3- to downbeat of 249.

w	s	w	s	w	s	w
w	b	w	w	w	s	w
w	b	b	w	w	s	w
w	s	w	b	s	s	s
s	b	w	s	b	w	b
J	I,E	E	I,E,J	J	J	J
2	2	2	3	3	2	3

Family class ratio 3:2:1.

In the third subphrase, condensed between beats one and two of measure 249, there is a pronounced increase in the timbral weight given to the moving voices of each sonority. The effect is one of a melodic duet of reinforced pitches penetrating the texture, perhaps another interpretation of klangfarbenmelodie. Note also that all three family classes are now consistently integrated into each sonority.⁹ Another change from the previous cycle is an increase in the overall weight given to woodwinds.

Figure 6.13 Phrase six, subphrase three. First sixteenth of beat one to third sixteenth of beat two, measure 249.

The image shows two systems of musical notation. The first system consists of two staves (treble and bass clef) with various instrument abbreviations written above and below the notes. The second system is a single grand staff (treble and bass clef) with musical notation.

w	s	w,s,s	w,w,s	s	s	w
w	w,w,s	w,w,w	b,s	b	b	b
w	w	b	w	s,w	w,w,b,s	w
s	b	w	w,w,b	w,w,b,s,	b	w
b		b			w,b,s	w,b,s
3	3	3	3	3	3	3

Family class ratio 2:1:1

The final subphrase, precipitating an arrival back at the initial pitch levels of the fundamental sonority, extends from beat two of measure 249 to the end of the measure. Note that the timbral weight given to changing pitches is increased to five and six pitches. The family class ratio here remains unchanged from the previous cycle. All three family groups are represented in each sonority. Perhaps both of these parameters are frozen to emphasize the growth in the doubling parameter.

Figure 6.14. Phrase Six, subphrase four. Third sixteenth of beat two of measure 249 to the end of the measure.

w	s	w,w,s,s,s	w,s,s	b	w,b,s	w	s	w
b	w,b,b,b	w,b,b,b	w	s		w	w	w
w	b	w	b	s		w,w	w	b
w	w	w,w	w,w,w,w,b,s	w,w,w,w,s			s	w
w,b,s						w,w,b,s	w,w,b,b	
3	3	3	3	3	3	3	3	2

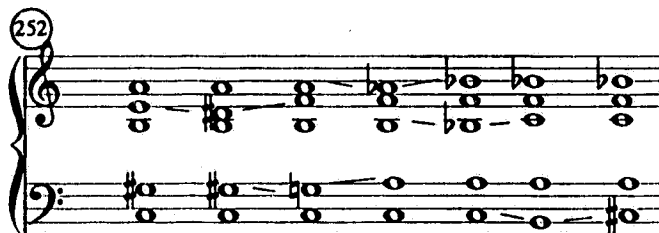
Family class ratio 2:1:1

Evident throughout both the third and fourth subphrases above are "holes" in the voicings. In many cases pitches are not reiterated because of increased duration of sustaining pitches from previous sonorities. Though the durational changes are too many in number to properly codify the net result is a dramatic increase in note density in terms of the total number of sustaining pitches at one time. Beats three and four of measure 249 mark a climatic moment in note density for the entire piece.

Measures 250 and 251 mark an interruption in the extremely fast rate of timbral transformation of the last phrase. Coinciding with a return arrival on the original starting pitches are new voicings of the fundamental sonority for harp and string harmonics. As these instruments have never participated in the primary stream up to that point, their implementation at this juncture marks a major structural event.

Starting in measure 252 the primary stream continues in much the same way as it began. The rate of alternation is again at half notes. As in the opening phrase each sonority is repeated once before the next pitch change. In contrast to the opening phrase, however, the voice leading canon is inverted. The net result is a transposition up by half step. The "top down" order of pitch change stays the same as it was at the opening, beginning with S2.

Figure 6.15. Phrase Seven, measures 252-258



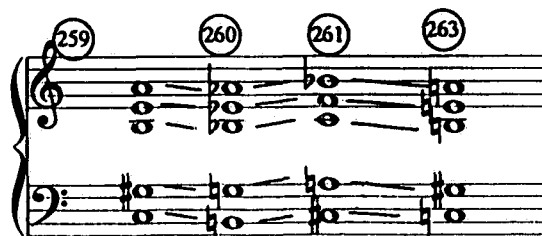
								(256)					
s	b	w	w	b	w	w	w	w	b	b	s	b	s
w	w	b	s	b	w	b	s	b	w	w	w	w	s
w	s	s	w	s	b	s	b	w	s	b	w	b	b
s	b	w	w	w	s	b	w	s	b	w	s	w	s
b	w	b	s	s	w	s	b	w	b	w	b	w	w
E	I	I	E,I	J,E	E	I	I	I	E	I	E	I	J,E
3	3	3	2	3	3	3	3	3	3	2	3	2	3

Family class ratio 3:2:2

Also in contrast to the opening, the timbral configuration changes every measure with no repetitions. Interestingly, there is a pronounced increase in the number of interlocking voicings, avoided through much of the piece thus far. The alternation of two and three note sonorities, together with the prominent use of brass and strings in the soprano 1, may indicate a subphrase division in measure 256.

Throughout the course of the work the pitch material of the primary stream has included 1) complete cycles of the canon in original and inverted form, 2) imitative neighbor type motion between two voices only, 3) transpositions in two or three stages, 4) the gradual building up of the sonority in stages of one, three, and five notes, and 5) unchanging repeated chords. There is a new look to the pitch material in the last phrase, which involves wholesale transpositions of the entire sonority. As a condensed summary of the voice leading canon used throughout, the chord is transposed down a half step in measure 260 and up a whole step in measure 261 before sliding down to the original pitch level in measure 263.¹⁰ As a process the pitch motion it is an inversion of the the original, as in the last phrase.

Figure 6.16. Final (Eighth) phrase, measure 259 to the end, 264.



(259)			(261)				(263)				
w	b	w	w	w	w	w	s	b	w	s	w
w	w	b	w	b	w	w	w	s	s	b	w
b	w	w	w	w	s	s	s	b	w	b	b
w	b	b	w	b	w	w	w	w	b	w	w
w	b	w	b	s	w	s	b	w	w	b	w,s
E	E	I	J	I	E	I	I	E,J	I	E,I	E
2	2	2	2	3	2	2	3	3	3	3	3

Family class ratio 3:1:2

The final phrase is divisible into three sub-phrases of two measures each at measures 259, 261, and 263. The same chord is repeated four times in the last two subphrases, but the distinctions are also apparent in the means of voicing and instrumentation. The first subphrase consists only of winds and brass with both families present in every sonority. The second subphrase marks the first appearance of strings and is weighted toward interlocking voicings. Two and three family voicings are evenly mixed. In the last sub phrase all three families are present in every sonority. A general trend evident in the entire last phrase is the virtual disappearance of juxtaposed voicings, resulting in a more integrated sound.

The same observation holds true for the seventh or second last phrase. A comparison of the voicing types in the first thirteen measures with the last thirteen measures, (corresponding to the first two and last two phrases) reveals a much greater incidence of juxtaposed voicings at the beginning and the more integrated enclosed and interlocking voicings at the end. Just as the classical recapitulation integrates first and second themes in the original key, Schoenberg ends the movement with integrated timbres with the return of the fundamental sonority at its original pitch level.

Embellishing Chordal Stream

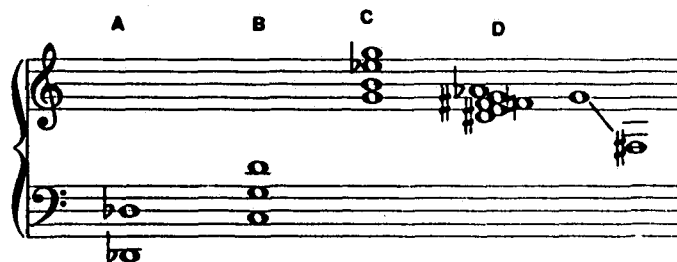
Schoenberg chooses to attach a global, organic process to the embellishing stream. Appearances of embellishing sonorities are not idle points of articulation. (figure 6.2) The embellishing group appears to divide into five units: from measures 227-230, 237-240, 244-245, 247-251, and 260-264. In the second through fifth groupings one notes a gradual increase in the length or continuity of embellishing chords. In sequence, the first

grouping seems to articulate a lower-middle register, the second an upper-middle register. (Figure 6.3) The third grouping moves from high to middle registers while the fourth moves from a low-middle spread to a high-middle spread. The final group maintains a narrow registral spread and moves from the lower-middle register, to the upper-middle register, before settling in the mid register.

So, while the primary chordal stream focuses on subtle and detailed processes of transformation on the local level, the embellishing stream deals with extreme contrasts realized through a global process at a much slower rate. It is nonetheless a dynamic process, a signature of Schoenberg's compositional style.¹¹

There are four chordal types employed in the embellishing stream, each with a distinct intervallic combination and in contrast to the fundamental sonority. They are: **A** ; unison or octave pitches, **B**; triads spaced in perfect fifths, **C** ; four note tertial harmonies , **D**, clusters or glissandi.

Figure 6.17. Sonority types of the embellishing stream.



In terms of instrumentation the embellishing stream is again contrasted with the primary stream. Embellishing chords are characterized by single family and single timbre voicings as opposed to mixed voicings. There are also certain timbres, including the harp and celeste, piccolo, and tutti string harmonics and the use of ponticello, which are restricted to sonorities of the embellishing stream.

A fifth embellishing chord type, **E**, is in fact the fundamental sonority but with instrumentation from the embellishing stream. There are four instances, in measures 230, 250, 260, and 263.

Figure 6.19. Schoenberg Op. 16 #3. Chordal Sonority Type in Embellishing Stream

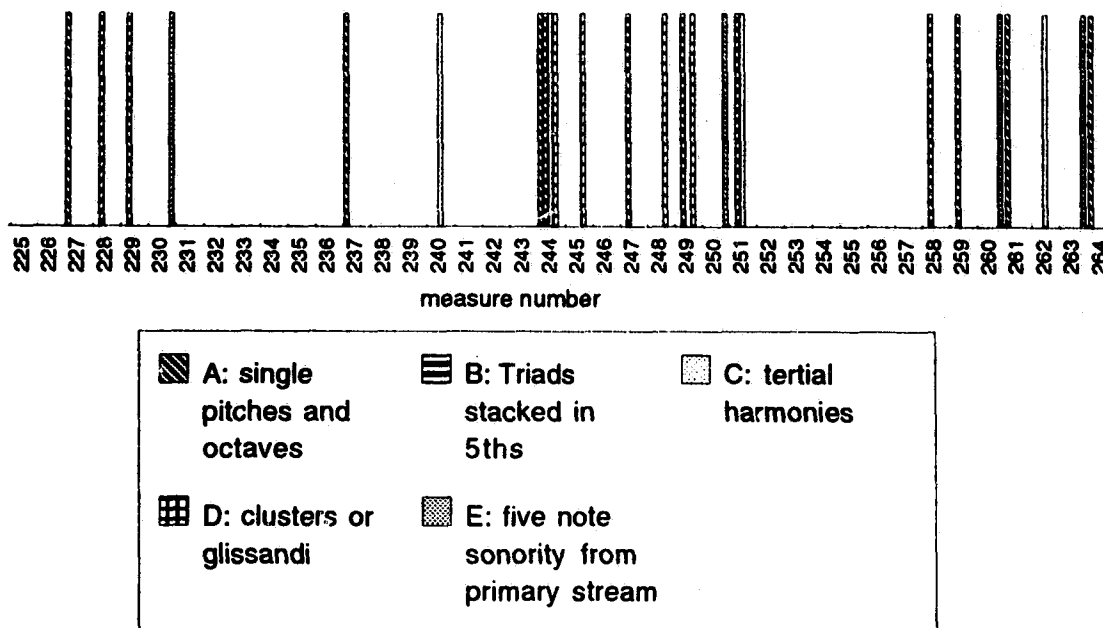


Figure 6.20 is an overview of all features discussed with respect to sonority in Movement III of the five pieces for orchestra. In terms of global trends note movement from half note alternation of sonorities, a rhythmic acceleration in the rate of alternation, and a final return to half note alternation per measure. Types of timbral voicing move from primarily juxtaposed and interlocking voicings, to a mixture of interlocking, enclosed, and juxtaposed in the middle sections, and settling primarily on enclosed and interlocking voicings toward the end. Both of the above trends reflect a bias towards a ternary forms; introduction, development, recapitulation. No global pattern emerges from the family class ratio other than the fact that this value changes with each phrase. The most common family class ratio is three woodwind to two string to one brass, which occurs three times. As for the embellishing stream, A, B, and E type sonorities are concentrated at the beginning and end, while D type sonorities occur only in the middle sections. The above considerations, together with the departure and return to the original pitch level, confirm the structural application of sonority towards the articulation of a rounded binary form.

Figure 6.20. Summary of Schoenberg Op. 16, #3.

measure numbers	221	230 231	234 235	239 240	244	246
Primary Stream						
rate of alternation	half notes two per measure	half notes two per measure	half notes two per measure	half notes two per measure		rhythmic accelerando
Pitch Process	complete cycle but every chord repeated once	built up in increments then repeats	same pitches repeat other than half step motion in soprano voices	canon cycles, except for transposition at the end		same pitches repeat other than half step motion in soprano voices
family class ratio	3 12 11	2 11 12	3 12 11	3 11 11		4 12 13
voicings.	J I	J, E, I, IE	J, E, IE	J, E, IE		E, J, EI, EIJ
Other features	only two sonorities which alternate	high proportion of brass	quasi symmetrical organization of voicing types	quasi-algorithmic process in family distribution		possibly two subgroupings
Embellishing Stream						
events	A B B	E	A	C	ABCD	D
register	mid-low		mid-high		mid	mid

measure numbers	247	248	248 beats 1 and 2	248 beats 3 and 4	250-251	252	256-259	264
Diapason								
rate of alternation	half and quarter	rhythmic accords	alternates	alternates		half notes two per measure	half notes two per measure	
pitch process	complete cycle	complete cycle	complete cycle	complete cycle		complete cycle in inversion every chord repeated once	small interval transposition of entire chord direction inverted same chord repeats twice and four times	
family class note	3 1 2 1 1	3 2 1 1	2 1 1 1	2 1 1 1		3 2 1 2	3 1 1 2	
voice(s)	J, I, E	J, E, E	Overlapping	Overlapping		I, E	E, I	
Other features	movement from inflecting to justness.	possibly two subgroups motion toward three family and justness voicings	note which change highlighted by up to three instruments doubling all three family voicings	note which change highlighted by up to four instruments doubling all three family voicings	Primary stream line at	inflecting voicing featured possibly 3 subgroups division based on instrumentation and number of families no repeating configurations	possibly three subgroups based on pitch, families, and number of families	
Enriching Elements								
events	8 D	8 D	8 D	8 D	E B C	B	B E A C E	A E
registers	mid to low	mid	mid to low	mid to low	low and mid to	lower-mid	mid low to upper-mid	lower-mid

The true significance of the third movement of opus 16 lies in the range of parameters involved and in the coordination between rhythm, pitch, timbral elements. Schoenberg demonstrates a remarkable ear and feel for the quantity and pace of change in sonority. An ongoing dilemma for composers who explore sonority is the degree to which the pitch material dominates the timbral and registral procedures. The canonic pitch process is ultimately responsible for the structure, but proceeds at a rate slow enough to allow for perceived change in sonority. In spite of the detail afforded to timbral and voicing change, he clarifies his bias toward pitch. "In reality, sound colours serve to make the train of thought more apparent, to make the main points stand out better and the secondary ones recede better." ¹² Nonetheless, "Farben" remains one of the most extraordinarily innovative works of the century. The variety and control exercised over sonority, particularly with respect to voicing, are without precedent.

Footnotes

1. Arnold Schoenberg, Harmonielehre Trans. Roy Carter (London: Faber and Faber, 1978) p. 421.
2. Schoenberg, Harmonielehre, p. 389 and 399.
3. The five voice choral standard SSATB is invoked as the easiest way to track sonorities of consistently five notes in traditional choral registers.
4. Pierre Boulez, On Music Today, Trans. Susan Bradshaw and Richard Rodney Bennett, (Cambridge: Harvard University Press, 1973) p. 38.
5. These do not always correspond to Schoenberg's rehearsal marks.
6. The family class ratio is always expressed in terms of winds to brass to strings, and is an indication of the relative weighting of a given family class in a given section.
7. The division corresponds to the fourth beat of 246.
8. The reason for the unusual decision to break the cycle and transpose the bass to E3 in measure 243 is now clarified. Starting on E enables four semitones descents in the duration and rhythmic space allotted in order to arrive back at the starting pitch of the fundamental sonority, C3, in measure 250. For Schoenberg, it is a parallel of the classical ABA departure and return form.
9. Unison doublings make generalizations of voicing difficult.
10. This would be the equivalent of the second theme transposed to the back to the tonic in a classical rounded binary form.

11. In contrast to Webern works such as the piano variations or concerto Op. 24 in which registral changes highlight symmetrical and static structural relationships only.
12. Arnold Schoenberg, Style and Idea, trans. by Leo Black, ed. by Leonard Stein. (New York: St Martins Press, 1975) p. 324.

**7. Olivier Messiaen. Vinct Regard pour L'enfant Jesus. Regard #2.
"Regard de L'etoile." (1944)**

The music of Olivier Messiaen marks a turning point in twentieth century music. He demonstrates completely new criteria for sequence and juxtaposition of gestures and derives a vocabulary of sonorities and rhythms which are quickly devoured into the mainstream. Like Webern, Messiaen considers unique sonority the equivalent of a thematic unit. Typically, the music proceeds as a sequence of alternating and sometimes superimposed gestures, yet each individual gesture remains static through the course of the piece. It is non-developmental music, at least at the motivic level most often associated with development. Within the parameters of sonority Messiaen raises note density, registral spacing, unison doubling, and specific intervallic constructions and processes to a new level of importance.

The piano cycle Vinct Regard pour L'enfant Jesus was composed in 1944. Pierre Boulez, a student of Messiaen, describes his teacher as follows:

The whole German musical tradition is fundamentally alien to him in its need to express evolution and continuity in the handling of musical ideas. His style of writing - juxtaposing and superimposing rather than developing and transforming - may be called eclectic.¹

Messiaen is extremely rigorous in the derivation of his materials, which have included traditional Indian rhythms, melodies and rhythms transcribed from birdsong, and materials derived from mathematical relationships such as non-retrogradeable rhythms and modes of limited transposition.² No one can deny the role of rhythm in the delineation of motivic cells. The new freedom and potential of rhythmic treatment is considered by many to be Messiaen's greatest contribution. Yet each cell may be equally defined by its unique chordal structure and intervallic construction.

Somewhat shorter and more self contained than the others, Regard #2 permits a full disclosure of the various thematic units. For analytical purposes the thematic cells have been divided into five sonority types; A,B,C, D, and E. Figure 7.1 is a reduction of the sequence of sonorities and thematic cells in the piece. A detailed description of the sonorities exposes a huge increase in the range of processes applied to chord structures, and gives a measure of the rigor and subtlety with which Messiaen treats sonority. It must be remembered that sonorities are composed primarily in support of melody and rhythm.

Figure 7.1. Messaien, Vingt Regard #11. Re gard de L'etoile

single line melody
doubled 4 8ves below.
Given here is the total
aggregate of pitches in
this melody.

Single note melody,
chromatic within
this span

Single note melody,
chromatic within
this span

Red.

Red.

Figure 7.2 shows a musical score for piano, measures 29 through 41. The score is divided into three systems. The first system (measures 29-32) features chords labeled E, E1, E, and B2. The second system (measures 33-36) features chords labeled F, A, and B. The third system (measures 37-41) features chords labeled C, B1, and B3. The notation includes treble and bass staves with various musical symbols such as notes, rests, and dynamic markings.

Sonority type A, the first gesture in the piece, is an ascending arpeggiation with the damper depressed resulting in a large fifteen note sonority.³ Sonority A returns in measures 18, and 35.

Figure 7.2 Sonority type A.

Figure 7.2 shows a musical score for piano, measures 18 and 35. The score shows two instances of Sonority type A, which is an ascending arpeggiation. The notation includes treble and bass staves with various musical symbols such as notes, rests, and dynamic markings.

A second sonority type, B, consists of triads in one or both of the right and left hand parts. Broken and solid triads are here placed in the same category. There are four subgroups within this category. Subgroups are distinguished by intervallic makeup, intervallic process, and registral movement in terms of trajectory and contrary or similar motion. The first example, B, occurs in measure 2 and returns in measures 19 and 36. Two parallel processes are attached to the sonorities. First, the upper and lower parts move in contrary motion until they are separated only by a tritone. Secondly, the intervals separating pitches of each chord are gradually reduced. The perfect fifths of the right hand voice are reduced to an augmented triad, while the perfect fourth/augmented fifth structure of the first left hand sonority is reduced to a major triad.

Figure 7.3. Sonority type B

The musical score for Figure 7.3 shows two instances of sonority B. The first instance is in measure 2, and the second is in measure 36. The sonority B is a triad with a perfect fifth in the right hand and a perfect fourth/augmented fifth in the left hand. The score is marked with 'ppp' and 'Red.' (Reduction).

A second triad-based sonority, B1, first appears in measure 16 and is repeated only once in measure 40. B1 differs from B in several respects. First, there is no movement in register. The two parts remain separated by three octaves. Secondly, the lower triads double the pitches of the higher giving the effect of increased weight to a three voice sonority as opposed to a six voice chord. From the standpoint of intervallic construction, B1 contains the same range of intervals as B but in free alternation. There is no directed process.

Figure 7.4. Sonority type B1

The musical score for Figure 7.4 shows two instances of sonority B1. The first instance is in measure 16, and the second is in measure 40. The sonority B1 is a triad with a perfect fifth in the right hand and a perfect fourth/augmented fifth in the left hand. The score is marked with 'p' and '8va' (Octave).

Note, there is one variation of B1, at measure 33. The same chords are transposed by octave into the mid register, with no doubling.

A third triad-based thematic cell, B2, enters at measure 24 and is repeated in measures 28, and 32. The sonorities ascend into the high register before falling off sharply at the end, in contrast to the static and contrary motions of B1 and B. As B2 contains only a right hand part, there is a progression from six voice sonorities to a doubled three voice sonority, to three voices alone from B through B1 and B2. In the domain of intervallic construction the sonorities of B2 are of three types only. The first five chords are constructed of an augmented fifth/perfect fifth combination. The sixth chord moves to a perfect fourth/augmented fifth combination, while the seventh and last sonority increases to a four note, minor seventh/tritone/perfect fifth combination.

Figure 7.5. Sonority type B2

The final triad-based thematic cell, B3, serves as the closing gesture of the piece in measure 41. Only occurring once, it is characterized by contrary registral motion between upper and lower voices. Note that the interval of separation is reduced to a semitone in contrast to the tritone separation of B. Also, similar to B each sonority contains six distinct pitches. In terms of intervallic construction all of the sonorities remain the same. The right hand chords are constructed of a perfect fifth and tritone while the lower triads are composed of a perfect fourth and tritone.

Figure 7.6. Sonority type B3

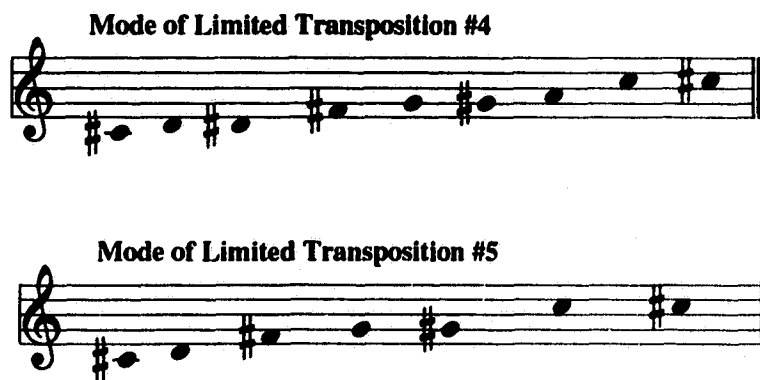
Differences in the four triad-based sonorities are summarized in figure 7.7 below. Note that B3 returns to the same number of notes and registral process as B. The difference is that the intervallic structures of B3 remains static, and moreover the arrival at a static process comes via gradual change through B1 and B2. A thematic recapitulation which also serves as an arrival is then appropriate for cadential function.

Figure 7.7. Summary of "B" or triad type sonorities.

	B	B1	B2	B3
Register	contrary motion	static	ascending	contrary motion
N. Notes	six notes	three notes doubled	three notes	six notes
Intervals	Linear Process Aug. 5th through mi3rd	alternation Aug.5th through mi3rd	static, then moves Aug. 5th to mi7/P5th	Static.

Just as some of Debussy's chordal sonorities come about as diatonic chords of varying scale types such as the major and minor pentatonics or liturgical modes, Messiaen derives his own chordal vocabulary in part as a product of diatonic chords of his "modes of limited transposition." The origins of chordal sonorities are not always easy to trace as he often combines modes, but there are at least two traceable examples in Regard #2. The sonorities of B2 at measure 24, characterized by augmented fifths, are likely derived from mode #4. Similarly, the sonorities of B4 at measure 41 appear to be derived from mode #5. To a degree, then, different components of the form acquire a characteristic sound due to the mode of derivation.

Figure 7.8. Sonorities derived from Modes of Limited Transposition.



Mode of Limited Transposition #4

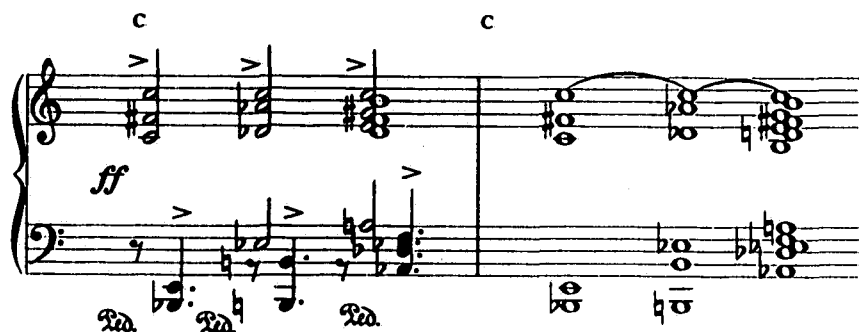


Mode of Limited Transposition #5



Thematic group C is a three chord progression in which the soprano pitch is held in common while the number of inner voices increases. Occurring without variation in measures 3-6 and 20-22, and 37-39, the gesture may also be described as a gradual filling of the mid and lower-mid registers with decreasing intervallic spaces between each chord tone.

Figure 7.9. Sonority type C.



All gestures involving a single note melodic line are lumped in the D thematic group, and for obvious reasons they will be distinguished more by rhythm than by sonority.⁴ However, the relative clarity and simplicity of single note gestures are perhaps best suited for another level of compositional treatment. Measures 25-26, and 29-31 mark the only moments in the work where Messiaen employs a polyphony of thematic units, in each case involving a single note sonority simultaneously with a chordal sonority. As all other moments in the work involve alternations of single thematic cells only, this textural broadening must be considered an extreme development.

The only remaining sonorities in the work are those which run opposite the single lines in the measures 25-31. The six note sonorities, classified as E, occur first at measure 25 are characterized by specific intervallic spacing. Both chords are composed of a perfect fifth, a perfect fourth and at least two major thirds. In the second chord the placement of the perfect fourth has been moved to the top of the voicing.⁵

Figure 7.10. Sonority type E.



E1, first occurring in measure 26, involves three consecutive four-note sonorities, each with the same intervallic content of tritones and perfect fourths. However, as was the case in E, there is some motion in the voicing position between the first and second chord.

Figure 7.11. Sonority type E1.



Figure 7.14. Messiaen. Regard de L'etoile. Number of Notes

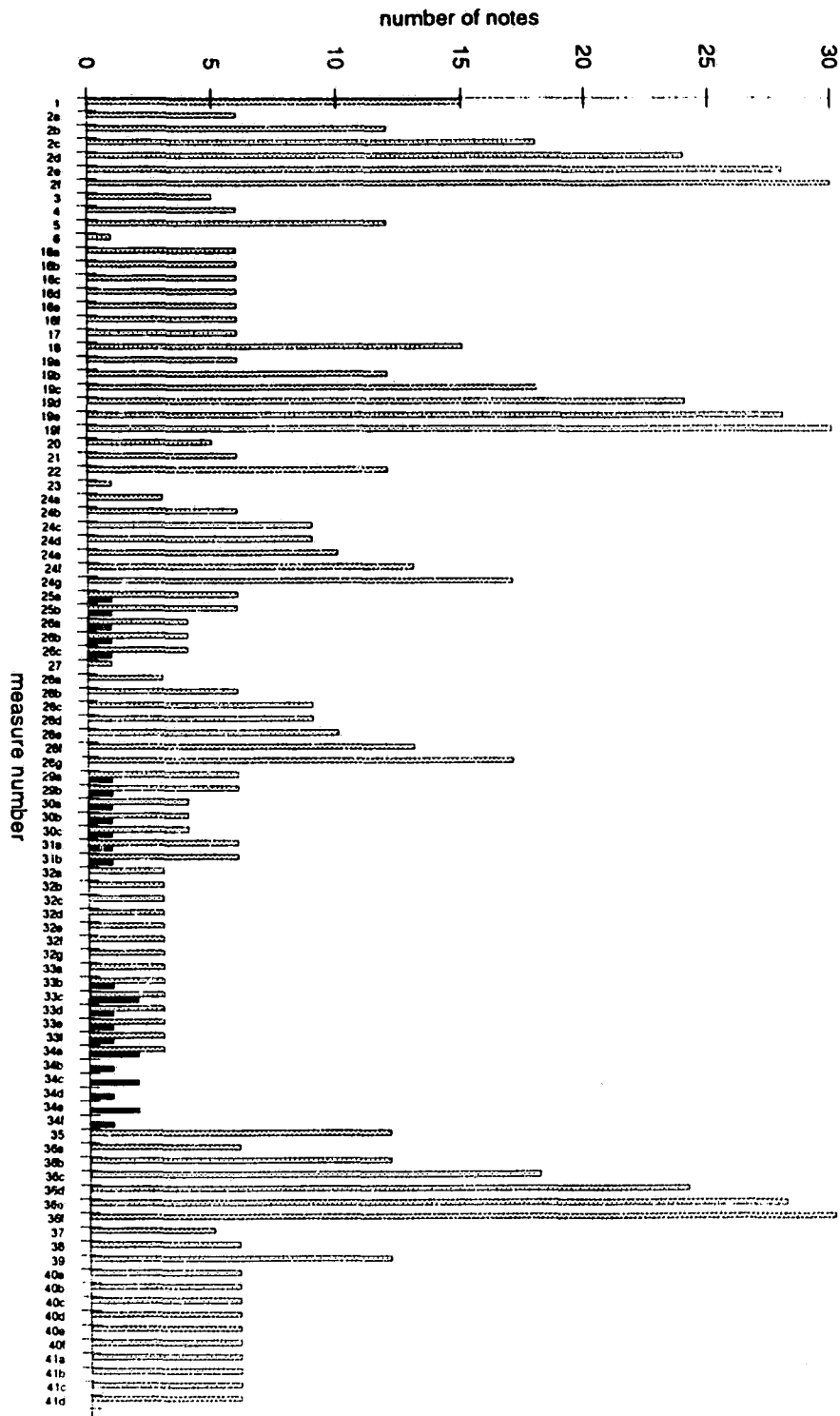
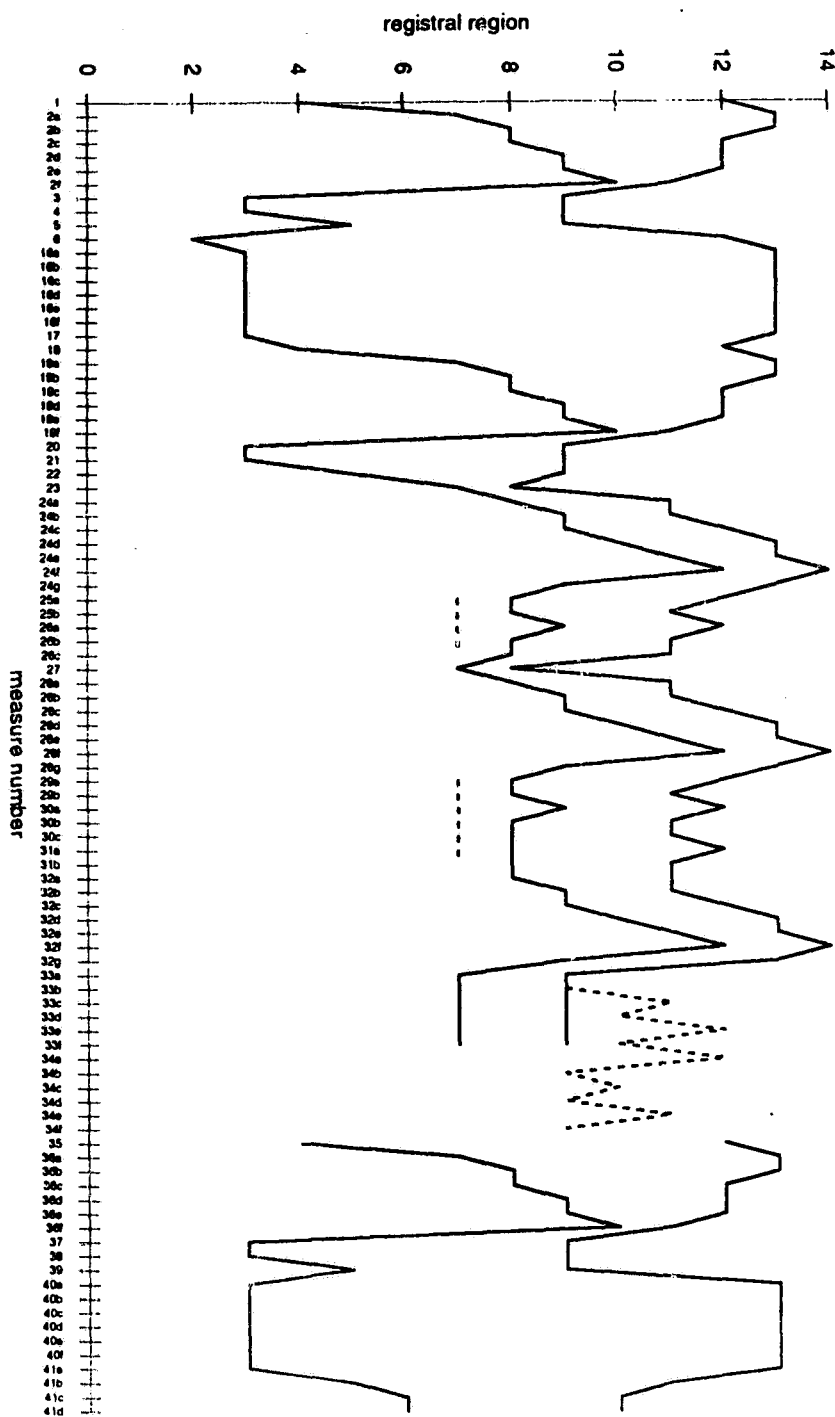


Figure 7.15. Messiaen. Regard de L'etoile. Registral Extremes



and these thematic cells are made distinct by the properties of the sonorities contained within them.

As a result of the placement of thematic units, global properties of the form emerge in terms of the movement of registral extremes and note densities. There are two interesting properties with respect to note density (figure 7.14). First, the relative weight of the middle section is lower than for the outer sections. There is a curious self replicating pattern in the rapid increase followed by steady state number of notes in both the first and middle sections, with the larger specimen occurring in the former. Secondly, rapid increases in the number of notes occurring in the middle section at measures 24 and 28 are linked to a rapid and parallel ascent in registral extremes. By contrast, in the outer sections the ascent in the number of tones at measures 2, 19, and 36 are linked with first obtuse and then contrary motion in registral extremes. Upon examination of the registral extremes (figure 7.15) one notes that the large middle section, from measures 23 through 34, is limited to the middle and upper registers. By contrast, the registral extremes in the outer sections span all registers. Further, changes in register in middle section tend to move in parallel, while in the outer sections the registral extremes tend to move in contrary motion. Clearly, the large ABA form evident in the distribution of thematic cells is resoundingly reinforced through global change in register and note density.

A non-developmental form such as occurs in Regard #2, which considers unique sonorities the equivalent of a thematic unit, places Messiaen in direct lineage from Debussy. Yet in some respects, in particular the attention paid to the intervallic construction of chords, his use of sonority retains a connection with traditional harmonies. He still believes in what he terms Natural harmony, "true, unique, pretty by essence, willed by the melody, pre-existent in it . . . awaiting manifestation."⁷ Messiaen works with a system which is both strict and free. The compositional application of sonority is rigorous and essential, but still remains a descriptive rather than an active parameter of the music. The listener's first focus of attention is to melody, secondly to rhythm, and lastly to sonority.

Footnotes

1. Pierre Boulez, *Orientations*, trans. by Martin Cooper, ed. by Jean Jacques Nattiez (Cambridge: Harvard University Press, 1985) p. 407.

2. Olivier Messiaen, The Technique of my Musical Language, trans. by John Satterfield (Paris: Alphonse Leduc, 1961)
3. While far from conclusive, this sonority may be related to Messiaen's "chord of resonance" discussed in The Technique of My Musical Language. A similar pattern of what are conventionally termed dominant seventh and diminished triad sonorities are common to both.
4. The only distinguishing feature of the solo lines with respect to sonority would be the overall registral spans of the melody, which is an octave in D, a perfect fifth in D1, a major third in D2, and a major second in D1. In a subtle way, the registral "narrowing" process in the single note lines parallels the intervallic processes in the triad based sonorities, B-B3.
5. The intervallic contents are not identical. In the first of the two chords the intervals grow increasingly narrower for the higher pitches. However, the collections are certainly deliberate , with the discrepancy likely the result of a melodic concern.
6. The use of diads also resembles the first gesture, A , but the use of the sustain pedal in the latter results in a completely different sound.
7. Messiaen, p. 52.

**8. Messiaen. "Chant D'Amour #1 " from the
Turangalila Symphony. (1948)**

Compositional techniques of juxtaposition as opposed to development are again characteristic of Messiaen's first great orchestral work, the Turangalila Symphony. In the movement entitled "Chant D'Amour #1", three independent timbral streams are superimposed without any direct relationship between them. As was the case in Regard #11, rhythm and sonority are inexorably linked. One of the many rhythmic techniques Messiaen discusses in Techniques of my Musical Language is the use of "irregular" or additive augmentations of note values. The only conspicuous active compositional process in the movement involves incremental additions to the durations of the homophonic chords which comprise each of the three independent streams. As in Regard #11, change in sonority is not the subject of the process, yet forms the essential infrastructure of the process. Sonorities of each of the three streams are distinguished by intervallic construction and timbre. Chordal sonorities are not intuitive constructs but are the result of the superimposition of specific interval collections and intervallic processes. Again, it is characteristic of Messiaen to apply extreme rigor and subtlety toward what is essentially a background function. The main source of musical interest in the movement lies in the unexpected combinations both of pitch sonorities and associated timbres resulting from the algorithmic durational process. This is an extremely innovative idea for the time of composition, considerably more daring than the concept of "polytonality" employed by Bartok, Stravinsky, and Milhaud. With the aid of a system, Messiaen sets in motion a process which must result in serendipitous chordal superimpositions and the creation of what might be termed "polysonorities", completely divorced from any tonal/harmonic reference.

Details of construction of the three timbral streams are given in figures 8.2, 8.3 , and 8.4. Note the differences in the periodic cycle of sonorities. Stream 1 cycles through six sonorities before repeating the first three. Stream two cycles through only three sonorities before repeating while stream three contains five separate sonorities. Each of the three streams is characterized by a unique instrumentation which remains the same throughout the movement. The first stream contains only two timbres; trumpet and violin section. The second stream contains five woodwinds, piccolo, flute, oboe, english horn, and clarinet, and one trumpet. Naturally, the registral range of the second stream is also limited to the mid range and above. The third timbral stream occupies lower registers and utilizes

instruments from all three families; bass clarinet, bassoon, trumpet, horn, trombone, tuba, viola, cello, and contrabass.

Timbral stream 1

two families: brass and woodwind
1 trumpet, 5 woodwind

Timbral stream 2

two families: brass and strings
1 trumpet, 5 violins

Timbral stream 3

three families.
2 woodwind, 4 brass, 3 strings

Figure 8.1. Messiaen: Chant D'Amour 1 from Turangalila Symphony

Registral Reduction of the resulting progression of sonorities

The musical score consists of three systems, each with a grand staff (treble and bass clefs). The first system contains measures 1-4, the second system contains measures 5-10, and the third system contains measures 11-12. Above the notes, sonority labels are placed: 1A, 2A, 3A; 1B; 2B; 3B; 1C; 2C; 3C; 1D; 2D; 1E; 3D in the first system; 2B; 1F; 3E; 1A; 2C; 1B; 3A; 2A in the second system; 1C; 3B; 2B, 3C in the third system. Circled numbers 1 through 12 are placed above the notes in each measure to indicate the progression of sonorities.

Figure 8.2. 1st Timbral Stream
Violins , with trumpet attacks

The musical score consists of two systems of staves. The first system contains measures 1 through 4, and the second system contains measures 5 through 11. Each measure is numbered in a circle above the staff. The notation includes notes for trumpets (tpt) and violins (vln) with stems and beams. Measure 1 is labeled (A), measure 2 (B), measure 3 (C), measure 4 (D), measure 5 (F), measure 7 (A), measure 9 (B), and measure 11 (C). The bottom staff of each system is empty.

Figure 8.3. Second Timbral Stream

piccolo, flute, oboe, english horn, clarinet, with trumpet attacks

Musical score for measures 1-4. The score is written on two staves (treble and bass clef). Above the staves are four circled measure numbers: 1, 2, 4, and 4. The instrument parts are labeled: piccolo (pic.), flute (fl.), oboe (ob.), english horn (tpt.), and clarinet (kl.). The woodwinds are grouped into three sections: (A) piccolo, flute, and clarinet; (B) oboe and english horn; and (C) piccolo, flute, and clarinet. The trumpet part is labeled 'tpt.' and includes attack markings. The bass clef staff shows parts for cor and kl.

Musical score for measures 5-12. The score is written on two staves (treble and bass clef). Above the staves are four circled measure numbers: 5, 7, 10, and 12. The instrument parts are labeled: piccolo (pic.), flute (fl.), oboe (ob.), english horn (tpt.), and clarinet (kl.). The woodwinds are grouped into three sections: (B) oboe and english horn; (C) piccolo, flute, and clarinet; and (A) piccolo, flute, and clarinet. The trumpet part is labeled 'tpt.' and includes attack markings. The bass clef staff shows parts for cor and kl.

Figure 8.4. Third Timbral Stream

violas and cellos sustain; with trumpet, trombone, horn,
bassoon, bass clarinet, and bass attacks

The musical score consists of two systems of staves. The first system includes measures 1, 3, and 4, with circled measure numbers 1, 3, and 4 above the staff. The second system includes measures 6, 9, and 12, with circled measure numbers 6, 9, and 12 above the staff. The score is written for a large ensemble, with instruments grouped into sections (A), (B), and (D). The instruments listed are: horn (hn), trumpet (tpt), trombone (tbn), horn (hn), viola (vla), horn (hn), tuba, fg. (tuba, fg.), bassoon (bkl), bass clarinet (cb), and bass (cb). The score shows various musical notations, including notes, rests, and dynamic markings, indicating the entry and sustain of different instruments across the measures.

The actual five and six note sonorities are not tonal or triad based sonorities with extensions added but are artificial constructs based upon specific interval collections. This development has significance for two reasons. First, in absence of the forward pull provided functional harmonies, new, artificial means of sequential relationship between chords are necessary. Secondly, the interval itself, not the root, has been elevated to a functional level. The intervallic content of the sonorities which comprise each stream are broken down in the figures below.

The sonorities of the first stream break down into a two-part variation, with close correspondence between the first and fourth, second and fifth, and third and sixth sonorities.

Figure 8.5. Intervallic breakdown of first stream sonorities.



A	B	C	D	E	F
TT	TT	P4	m3	m3	P4
P4	P4	P5	P4	P4	P5
m3	m2	m2	m3	M2	m2
TT	m3	TT	TT	m3	TT
m2	M7		M2	M7	

Sonorities A and D are both constructed, from the bottom up, with a major or minor second, a tritone, a minor third, and a perfect fourth. Sonorities B and E both comprised of a major seventh, a minor third, a major or minor second, and a perfect fourth. Sonorities C and F have identical intervallic content. The first interval stream, then, is not an arbitrary or static sequence of chords, but a deliberate process of variation.

The sonorities of the shorter second stream are characterized by their unique qualities. One possible interpretation involves the sequential transfer of certain intervals to the next sonority. Sonority A is characterized both by its symmetrical structure and the absence of

fourths or tritones. In Sonority B the minor sixth and major second from sonority A are transferred to sonority B, which also introduces the tritone and perfect fourth. The tritone and perfect fourth are then preserved in sonority C, which also introduces the perfect octave and minor third for the first time. In other words, one could conceive of the second stream as a linear sequence of interval transfers.¹

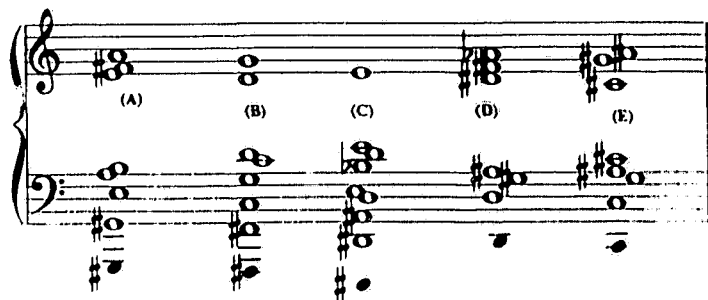
Figure 8.6. Intervallic content of second stream sonorities.



A	B	C
M7	m6	TT
m2	P11 (4)	P4
m6	M2	P8
M2	TT	m3
M7	P4	m3

Whereas the sonorities of the first and second stream involve variation and through composed structures, the sonorities of the third stream suggest a quasi-symmetrical arrangement.

Figure 8.7. Intervallic content of third stream sonorities.



A	B	C	D	E
m3	P4	M2	M2	M2
M2	M2	M3	m3	P5
P4	P4	TT	P4	m3
M2	P5	M2	M2	m3
P4	TT	M3	TT	P5
m6		P5		

The third sonority, C, exhibits a quasi-symmetrical interval arrangement with a major second and major third on both sides of a middle tritone. The outer two sonorities each contain two sets of intervals. There are two major seconds and perfect fourths in sonority A and two minor thirds and perfect fifths in sonority E. Sonorities D and E each contain a tritone, perfect fourth, and major second, a combination of intervals not found in A, C, or E. On a more general level, there are no intervals larger than a minor sixth (aside from octave doubling in the bass) in the third stream, resulting in more evenly distributed voicings than in the other two streams.

The sonorities of each chordal stream are distinguished both by unique intervallic construction by the pattern of arrangement for sonorities of similar intervallic content. Even though these distinctions are likely too subtle to be perceived by the listener, for Messiaen the rational composition of sonority is a vital means of control and identity for thematic material. But the most original and lasting influence of the movement is not the construction of sonorities but the cumulative effect of superimposed sonorities from different streams. Because of the rhythmic augmentation process and the fact that each stream has a different cycle of sonorities, new and unpredictable large sonorities are created. Even if individual distinctions between sonorities are too subtle to perceive directly, these composite sonorities may be arrived at by no other means. The composite sonorities of measures 6-12 are given in figure 8.8 below. The difference between this and figure 8.1 is that here allowances are made for duration and the accumulation of sustained tones while the latter gives only the sequence of entries. Aside from the fact that there are no duplicate sonorities, one gains an appreciation of the true nature of the chordal material. Messiaen is ultimately working with densities rather than with recognizable chords.

Figure 8.8. Cumulative sonorities.

It is also interesting to consider transitory stages in the manner of common tones between composite sonorities. Figure 8.9 presents the number of tones and movement in registral extremes from measures 6-12. The two parameters are in a constant state of flux, with somewhat more motion in the number of notes parameter. No identifiable global shape is revealed, but the importance lies in the fact that there is constant change. Density change on every beat or every measure as a main subject of focus is a major innovation for the time of composition, and sets the stage for more systematic approaches to sonority pursued by Boulez and others.

It is curious that a comparison of the number of notes and the number of registral regions in the passage (figure 8.10) produces an almost identical shape. Generalizing, this correspondence confirms a general consistency in his voicings. This is not evidence of an innovation, but of a personal bias. Messiaen still feels, like Schoenberg, that a five or six voice sonority should be spread over a certain range, no doubt influenced by the conventional disposition of parts in traditional choral music and triad based harmonies in general. Although changes in density is manifest in the system, unusual densities such as the clusters used by Henry Cowell, are not part of Messiaen's basic vocabulary of sonorities.²

Figure 8.9. Registral extremes and number of notes.

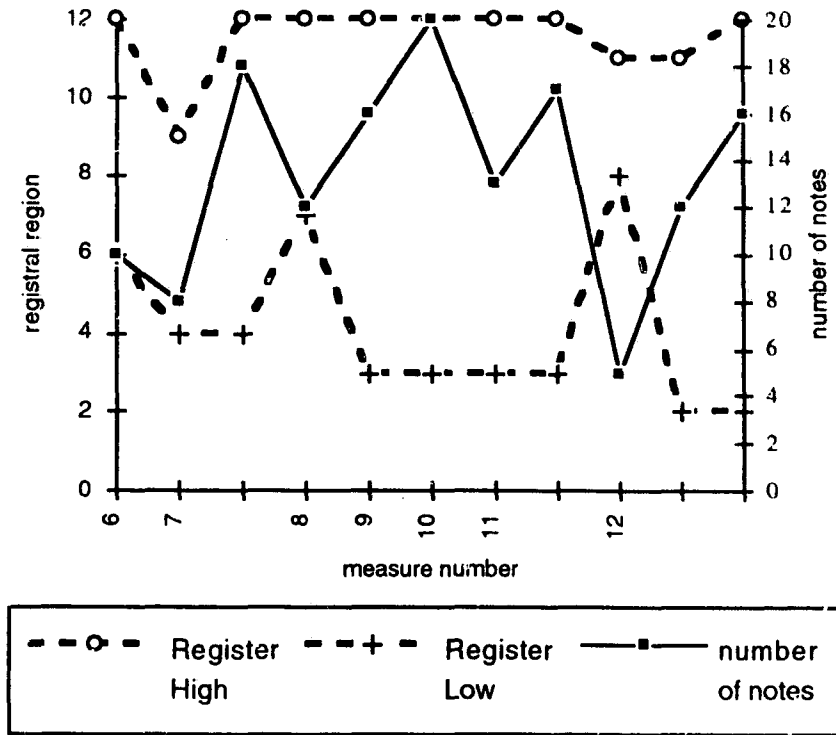
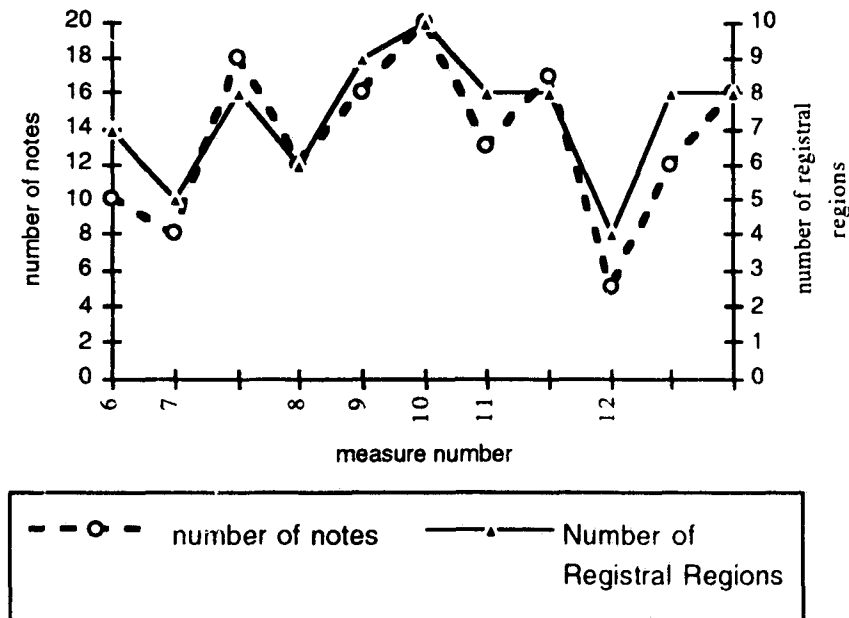


Figure 8.10. Number of notes and number of registral regions.



In the *Chant d'Amour* Messiaen manipulates both the intervallic structure and registral spacing of chordal sonorities. He separates the ensemble into three streams of sonority based on instrumental grouping and on the number of chords which cycle periodically. As the result of systematic additive rhythmic augmentation to the chords of each stream he generates a kaleidoscope of compound sonorities and dramatic fluctuations note density. Arguably, as the durations increase more attention is paid to the sound of sonorities as opposed to the rate of attack. It is a movement from rhythm to sound. Most significantly, it is possibly the first instance of a "large form" or statistical approach to composition exploited ten years later by Xenakis, Stockhausen, and Ligeti.

Footnotes

1. From another perspective, the sequence may be heard as an opening and closing the large intervals in the middle registral band.
2. Henry Cowell, New Musical Resources (New York: Something Else Press, 1969)

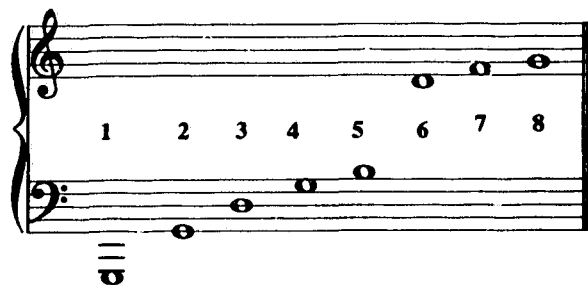
9. Morton Feldman. Piano Piece, Three Hands. (1951)

Morton Feldman once said, "One of the problems of functional harmony is that it hears for us, we no longer have to hear."¹ Early in the century Debussy succeeded in divorcing common sonorities of tonal music from the harmonic function usually associated with them. Forty years later Morton Feldman takes the same concept to its logical extreme. Not only are sonorities divorced from any harmonic function, but the very notion of function, of directed motion and expectation, are challenged. Sonorities are first to be vertically integrated in real time, and secondly to be referred back to the pitch and spectral content of the immediately preceding measures. It is music of observation and not of speculation. Often loosely referred to as a "minimalist" style, much of Feldman's music is featureless in terms of conventional musical parameters such as tempo changes, dynamics, articulations, rhythms. All that remain to motivate the musical progression in time are changes in sonority through registral shifts, increasing and decreasing note density, and timbre change. A listener's interest is engaged, not through expectation of what is to come, but through various modes of association between proximate sonorities.

There are principally two concepts in effect at the musical surface of the Piano Piece Three Hands; short term pitch recall, and the harmonic series. Feldman selects specific pitches which either refer back to the same pitch class within the last two or three events², or in which the harmonic spectra above a given fundamental reinforces another pitch in the same or previous measure. A listener's attention is therefore divided simultaneously between the linear pitch and pitch class sequence, and the vertical composite of pitches and resultant spectrum. The traditional conception of musical function as process is replaced by functions of association. There arise two principle questions, however. First, is the specific choice of pitches and intervals left to an intuitive, arbitrary choice or is there a more systematic strategy in effect? And secondly, is the music a continuous, through composed sequence or is it possible to subdivide larger sections of the music into structural units?

By way of review, the harmonics of any vibrating pitch, the fundamental, are bands of spectral energy corresponding to frequencies which are whole number multiples of the fundamental frequency. Harmonics contribute to the perception of "brightness" of a given sound, but with practice can be isolated and heard as specific pitches. For purposes of the analysis of the Piano Piece, harmonics will be taken up to the eighth harmonic, which lies two octaves above the fundamental.³

Figure 9.1. Harmonic Series to the eighth harmonic.



It is possible to identify eight modes of pitch association functioning at the local level in the Piano Piece:

- A. Pitch class association within the same measure. Typically this involves duplication of the same pitch at distances greater than three octaves.
- B. Pitch class association in previous measures, usually within three previous events.
- C. Introduction of a new “fundamental” pitch in which some component of the spectrum reinforces an actual pitch higher in the chord.
- D. Introduction of a new fundamental pitch in which some component of the spectrum reinforces the same pitch as a harmonic of a different true pitch in the chord.
- E. Introduction of a new fundamental pitch in which some component of the spectrum restates an actual pitch or prominent harmonic from the previous measure.

While all of the above associations have to do with varying degrees of blend and consonant pitch association, it is possible to identify three additional procedures which add contrast, or dissonance if you will, to the sonority.

- F. Introduction of a new fundamental and associated spectra which will mask or interfere with other true pitches in the chord. In other words, prominent harmonics of the lowest fundamental will lie a major or minor second away from the next highest fundamental, and will be heard as dissonance. ⁴
- G. Introduction of a new fundamental in which the spectra simply fills out a vacant registral region of the sonority. The effect in musical context will be of a rich, full sonority but without blend.
- H. Introduction of a new single pitch sonority in which there is no association with the previous two or three events. As such these pitches will be perceived as an introduction of new material and the beginning of a new stream of associations.

Figure 9.2 presents the pitches of the first twenty two measures together with lower harmonics (usually to the seventh harmonic) above each fundamental. It is followed by a measure by measure description of the field of possible associations between each sonority. These associations are catalogued by the letter description above and written under each measure. Analysis from the perspective of modes of association reveals a sequence of specific events which both involve and refresh the listener. When one adopts this level of focus the piano piece is far from the static, featureless music with which Feldman is so often labelled.

Figure 9.2. True Pitches and Harmonics present in first 15 measures

The figure displays a musical score for the first 15 measures of a piano piece. The score is presented in two systems, each containing seven measures. Each measure is numbered in a circle (1 through 15). Above each measure, a series of vertical lines represent the true pitches and harmonics present. Below each measure, a list of letters indicates the field of possible associations between the sonority and the previous one.

Measure 1: h

Measure 2: e

Measure 3: a, c, g

Measure 4: b, e, f

Measure 5: b, e

Measure 6: a, b, c

Measure 7: d, f

Measure 8: b, e

Measure 9: c

Measure 10: b, g

Measure 11: c, e

Measure 12: b, e, f, g

Measure 13: d, f, g

Measure 14: h

Measure 15: h

Figure 9.3. Modes of Association.

- a) same pitch class, same measure
- b) same pitch class, previous measure
- c) harmonic reinforces actual pitch in chord
- d) harmonic reinforces another harmonic within chord
- e) harmonic reinforces actual pitch or harmonic from previous measure
- f) harmonics mask true pitch
- g) fills out register, increased spectral content
- h) new pitch material only

In measure 2 the fifth harmonic of the A, C#7 reinforces the same pitch as a fourth harmonic of the true pitch C#5 in measure 1(e). Measure 3 is characterized by the pitch class G separated by two octaves in which the fourth harmonic of the lower G3 reinforces the higher octave. Harmonics of the low Bb in the sonority do not agree with those of G, and therefore simply function by filling out a vacant registral region (a,c,g). The true pitches A4 and C#7 of measure 4 refer back to the A-C# connections of measure 1 and 2. The low G#2 produces harmonics, notably the fourth harmonic G#4 which will interfere with the true pitch A4 (b,e,f). Three different associations are evident between measures 4 and 5. The pitch class G# is common to both measures. The other associations are weaker and correspond to the harmonics common to both measures. In measure 5 the fifth harmonic G#4 of the low E continues the "dissonant" fourth harmonic G#4 as a fourth harmonic of the low G# in measure 4, while the third harmonic C#6 of the F# in measure 5 relates, though with less certainty, to the C#7 of measure 4 (b,e).

In the flow of sonorities thus far, measure 6 would be perceived as highly "consonant". The same pitch class, Eb, occurs in the top and bottom voices, while the middle voice Ab5 will produce a third harmonic Eb7, reinforcing the top true pitch. Further, the Ab5 is continued from measure 5 (a,b,c). There is less agreement among the elements of measure 7. Bb appears to be a prominent pitch class, occurring as a seventh harmonic of the low C3, and as the true pitch Bb4. The high true pitch B6 has no connection with the previous measure and will clash with the fourth harmonic Bb6 (d,f).

Before examining the next seven measures, note in the first seven a continual sequence of associations measure by measure, and no complete duplication. A subtle structural division is implied at measure 8. The succession of true pitches present in the sonorities of measure 8 to 14 bears a striking resemblance to those of the first seven measures and might be thought of as a variation in voicing, and therefore harmonic content also. If this is the case, it is among the first evidence of a systematic approach in Feldman's music. The pitch class

succession in measures 1 through 7 is C#, A, G, A, F#-G, and G#. With slight variation, (the A4 in measure 9 seems to be an added measure) the same pitch class sequence is repeated in measures 8 through 14, subject to octave transposition in measures 10, 12, and 13.

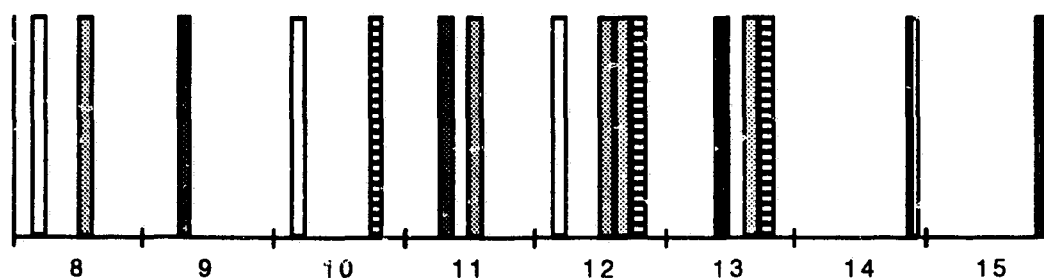
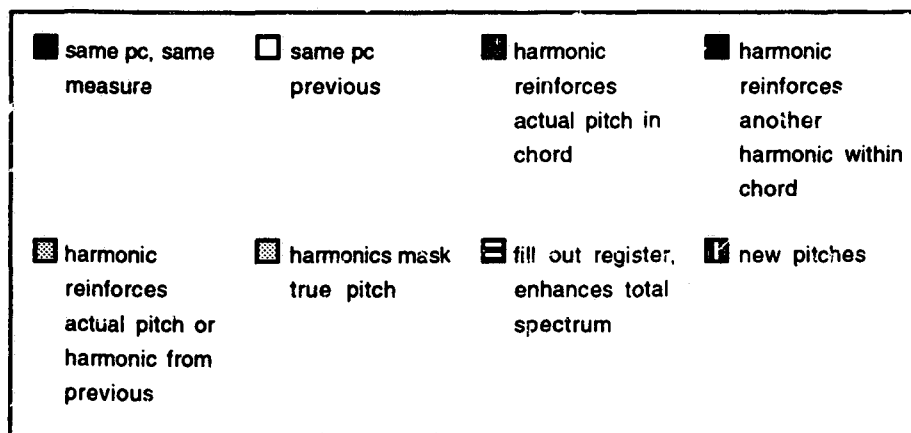
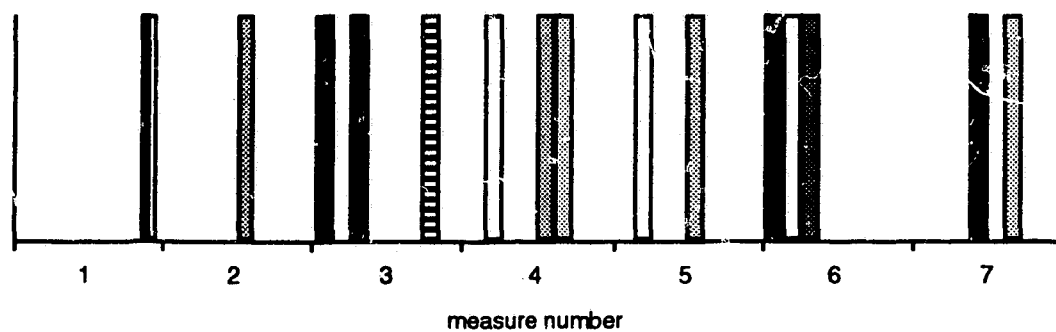
The consecutive chain of associations for measures 8-14 has both common and distinct features compared to the first seven, now referred to as the first phrase. Measure 8 contains associations on three different levels. The true pitch Db 5 refers back to the C#5 of measure one, as discussed above. The true pitch Eb7 connects with the Eb7 of measure 6. The low C2 will produce a seventh harmonic Bb4 which echoes the Bb4 of the previous measure (b,e). The sonority of measure 9 has no relationship with the previous measure, excepting the restatement of the initial pitch series discussed above. However, it contains a self reinforcing sonority, in which the third harmonic of the low D3 reinforces the true pitch A4 (c). Measure 10 is clearly a re-voicing of the pitch material of measure 9 (b,g). Measure 11 contains one relatively weak association in which the fourth harmonic E7 of the E5 is restated as a third harmonic of the A5 in measure 10 (c,e).

Associations in measure 12 have mostly to do with true pitches, as the A5 and G3 are repeated from measure 10 and 11 respectively. In addition, the second and third harmonics of the true pitch A5 also reflect the true pitch A6 and harmonic E7 respectively of measure 11 (b,e,f,g). Measure 13 emphasizes the harmonic Bb5 both as a second harmonic of the Bb4 and a fifth harmonic of the F#3. The low pitches of measures 12 and 13 may have been selected to mask the middle pitch of each sonority through the fourth and fifth harmonics, although this situation arises too frequently to make the claim with certainty (d,f,g). The G#5 in measure 14 has no perceivable relationship with the immediately preceding measures, referring only back to Ab5 of the initial pitch series in measure 6 (h).

Further, it is of interest that the single pitch D#6 of measure 15 also bears no immediate association with previous measures. It may be that Feldman utilizes single pitch sonorities with no spectral or pitch class association to deliberately break the linear flow of connections and therefore create the impression of a structural or phrase subdivision. Based on the spectral and pitch class evidence of the first 15 measures it is even possible to describe the form in conventional language as a "period" consisting of an antecedent and consequent phrase of approximately equal length, seven sonorities. Figures 9.4 graphically illustrates the chord-by-chord stream of associations and provides a "visual" basis for the phrase divisions discussed above. Note that larger concentrations of three and four

associations tend to occur in the middle, sonorities of a phrase suggest an arch form to and from associations of greater complexity.

Figure 9.4. Feldman Piano Piece Three Hands. Local Associations



The graphs of figures 9.5 and 9.6 represent the register and density of the piece over a larger span. At measure 88 a rest occurs for the first time. The absence of sound must be considered the strongest means of structural articulation in the piece. Harmonic structure and specific pitch recall may provide the key for relationships at the local level, yet larger

sections of the music may be heard in terms of statistical changes in register and note density at the middle ground level.

Figure 9.5. Feldman. Piano Piece Three Hands. Register

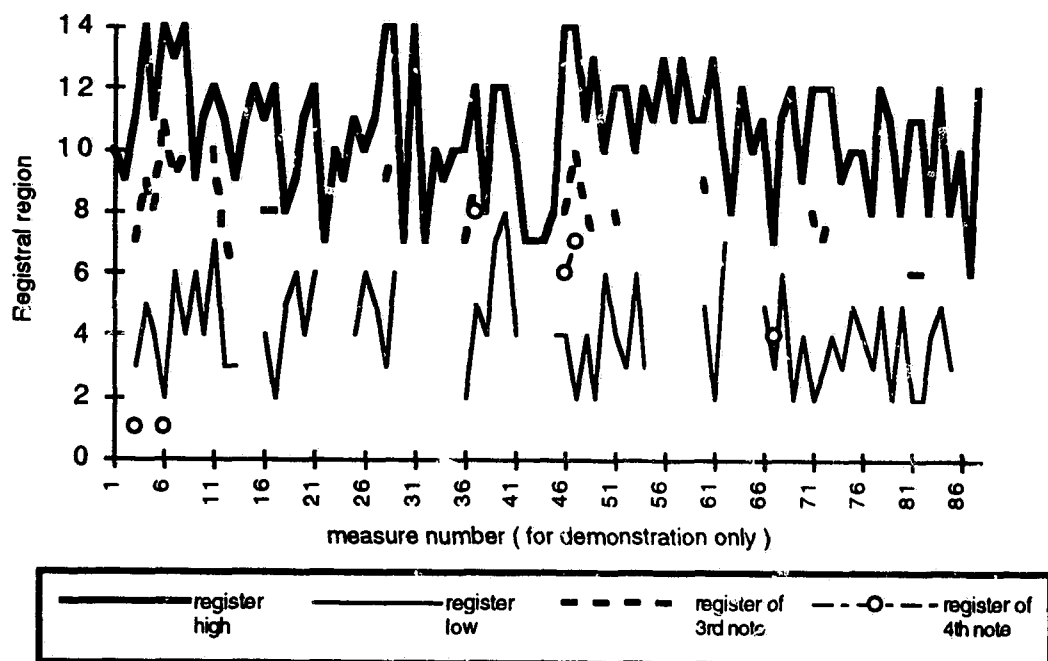
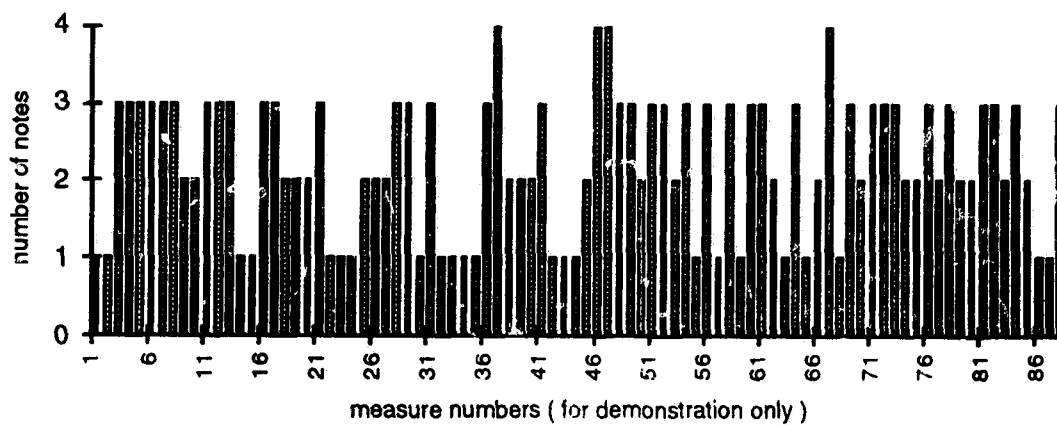


Figure 9.6. Number of Notes



Purely from a visual interpretation of the two graphs the first eighty-eight measures subdivide into four groups, roughly at measures 21, 47, and 66. The beginning until

measure 21 reveals a process in which the number of consecutive three note chords gradually decreases from five, to three, to two, to one. On the registral side, the process is not gradual but in two parts articulated by the two plateaus of extreme high register in measure 1-10 and 11 through 21 respectively. The second large section, from measures 22-47, is characterized in terms of note density by small groups of three and four reiterations of chords with the same number of notes. The registral aspect of this section is characterized more by the lack of process than of a specific pattern. When compared to the other three sections the second has the most variety. A third section from measures 47-66, is framed by four-note chords. Within these limits a pattern of alternation with sonorities of three notes is evident. In register one notes relatively static upper extreme. The fourth section is clearly weighted toward two and three note sonorities in semi-regular alternation. There is a consistent pattern of registral change in which there are no spikes into the extreme high range, and in which the lower voice is consistently weighted more toward lower registral regions than previous sections.

With Feldman one must adapt an entirely new attitude towards listening to music. He expressed a desire for a "sound world more direct, more immediate, more physical than anything that had existed before."⁵ The "physical" aspects of piano music would include pitch, register, dynamic, duration, density, and spectrum. But within these parameters dynamic and duration are eliminated. Spectrum or harmonic content, however, emerge as a vital parameters. One is obliged to entertain notions of sonority in perhaps the purest form. While the modes of association suggested are far from conclusive and do not begin to address the many perceptual contingencies, they do suggest a possible strategy for Feldman's application of sonority. That Feldman may have in fact been attempting to fill older models of periodic structure is at the very least an intriguing possibility.

Footnotes.

- 1 Morton Feldman, Essays, ed. Walter Zimmerman (Kerpen, Germany: Beginner Press, 1985) p. 159.
2. The term "Pitch-class" is used to indicate same pitch associations not restricted to the same register.
3. The term "first harmonic" actually refers to the fundamental.
4. Masking will be discussed in the last chapter, "future research". It refers to the placement of one pitch very close to another, rendering it more difficult to identify both of them. Masking occurs within a "critical bandwidth", which in the middle register is about a minor third.

5. Feldman, Essays, p. 38. Note, in many ways his music is a return to primitive or ritual music making in which the sound has an immediate incantational effect and is completely devoid of metaphor. The idea is discussed in the Theatre and its Double by Antonin Artaud.

10. Feldman. Durations III, Movement II (1961)

Like so many of Feldman's works, Durations III for violin, tuba, and piano, proceeds as a series of featureless, sustained sonorities of indefinite duration. Yet when conventional musical parameters such as melody, rhythm, and dynamic are frozen, this seems to permit an even finer degree of distinction in the parameters which remain; register, number of notes, and timbre change. In total contrast to modes of association which may link successive sonorities in the Piano Piece, the sonorities of Durations III are specifically constructed to avoid continuity. The purpose of analysis is then to first identify the rate, degree, and range of the parameters which are considered in the construction of sonorities, and secondly whether statistical patterns in the placement of sonorities suggest an overall formal/structural plan. Feldman's music is usually interpreted as an intuitive stream of events but in this movement the distribution of sonorities still permits a formal interpretation. At the surface the chord-by-chord stream of events is governed by contrast, but parallel movements in the distribution of timbral groups, note densities, general voicing types, and tertial and large interval voicings suggest a structural division around measure 16, dividing the 30 measure piece roughly into two symmetrical units. ¹

The total field with respect to sonority of active parameters in the second movements include:

- a) register in terms of extremes
- b) total number of notes in each chord
- c) spacing or relative density of chord tones
- d) choice and combination of timbres
- e) voicing in terms of the vertical disposition of timbres
- f) timbral variety through the use of harmonic fingerings.

In addition to these, Feldman utilizes what might be termed "rare events," indirectly related to sonority. These include:

- g) the pronounced sustain of one sonority into the next, such as occurs in measures 5 and 24.
- h) change of modes of attack, the only example being the pizzicato in measure 26.
- i) pitch motion as occurs in measure 23 in the violin.
- j) short "grace note" attacks, which conclude the movement.

In a featureless musical context rare events are striking and the frequency of their occurrence is responsible for any sense of climax in the piece. With the exception of the sustained chord in measures 4-7, all the rare events are concentrated within the last 10 measures of the piece. (refer to figure 10.1)

Figure 10.1. Feldman. Durations III. Part II

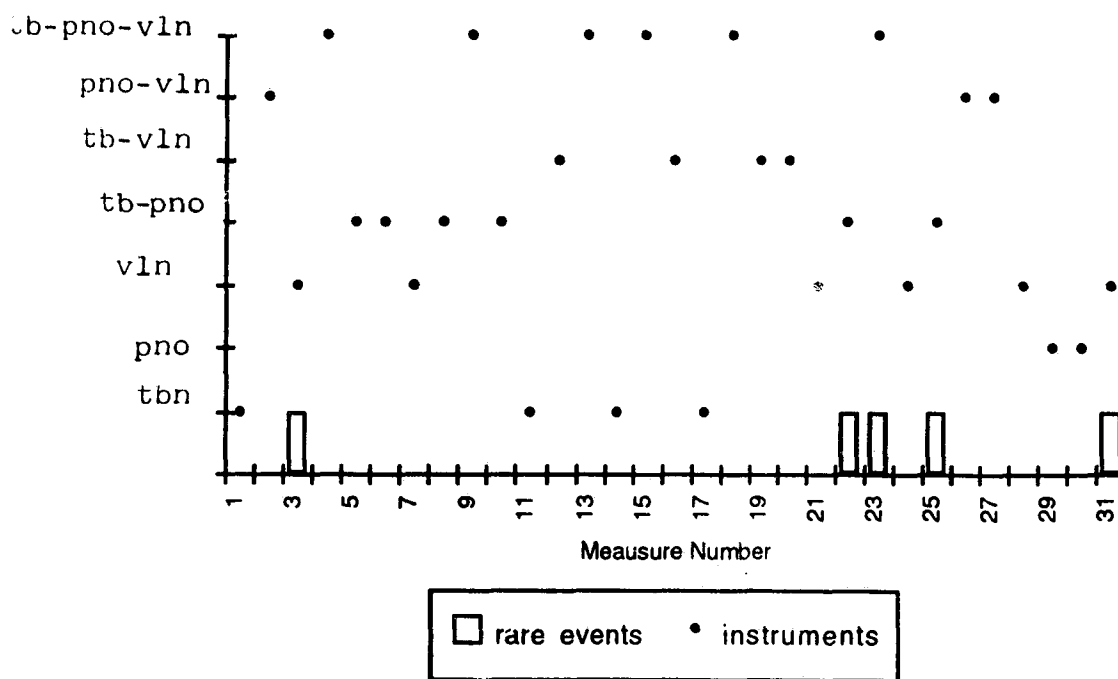
The musical score is divided into four systems, each with a grand staff (treble and bass clefs). The instruments are piano (pno), violin (vln), violin harmonica (vln h), and tuba. Measure numbers 5, 10, 15, 20, 25, and 30 are circled. Annotations include dynamic markings (p, mp, mf, f, sfz), articulation (accents), and performance instructions like '8va' (8va) and 'pno' (pno). The score shows a complex interplay of sustained notes and rests across the instruments.

The most revealing parameter is the distribution of timbres. A statistical comparison of the instrumental combinations throughout the movement reveals four levels of activity. All three instruments sound together six times. The tuba/piano combination and violin alone also occur six times. At the next lower level, both solo tuba and the tuba/violin combination occur four times. The piano/violin combination occurs three times. The least frequent timbre is the solo piano, occurring only once.

1. Six times: tba/pno/vln, tuba/pno, solo violin
2. Four times: tuba/violin, solo tuba
3. Three times: pno, violin
4. Two times: solo piano

It is interesting that the rarest combination, solo piano, occurs near the end of the movement along with the majority of other "rare events" discussed above. This might contribute to a feeling of heightened tension, though in a subtle, muted realization. But it is of particular interest to observe a quasi-symmetrical disposition of the different instrumental combinations (figure 10.2), most evident in the solo violin, tuba/piano, tuba/violin, and tuba/piano/violin groups.

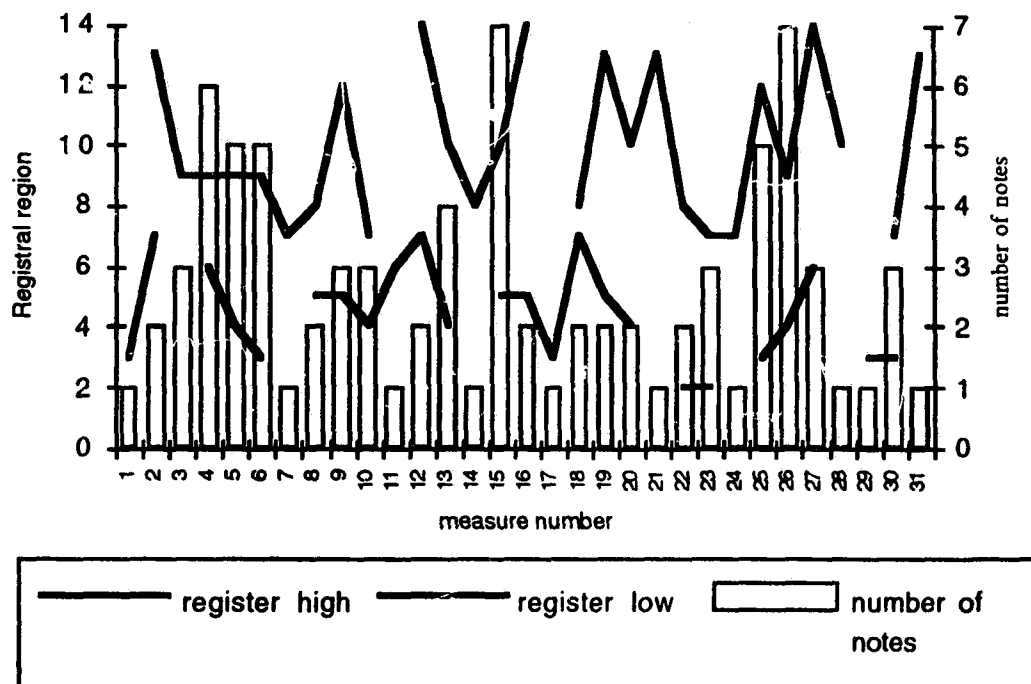
Figure 10.2. Feldman Durations III, Mvt. II.
Instruments and Rare Events



Three-timbre events are spread relatively evenly throughout the movement. The four events of the tuba-violin combination are clustered in the middle of the movement with two events on each side of an approximate mid point at measure 16. The tuba-piano and solo violin groups are both weighted toward the beginning and end of the movement. Each have six events occurring 4, 2, and 2,4 in the first and second half respectively. Even in a minimalist environment consisting of only sustained, even sonorities, Feldman is aware both of a balanced, symmetrical structure through instrumental combinations, and simultaneously of a growth process through the use of rare events.

In terms of the parameters affecting density, being register and number of notes, only the number of notes appear to have a recognizable pattern. (Figure 10.3)

Figure 10.3. Feldman Durations III, Mvt. II. Register and Number of Notes



The most obvious features are the spikes of six and seven notes occurring in measures 4, 16, and 26. As measure 16 is the approximate half way point, and measure 4 and 26 fall adjacent rare events, the significance of which was suggested earlier, it is conceivable that maximum values for the number of notes are employed to further articulate the quasi-symmetrical form visible in the timbral domain.

In terms of frequency of note densities, given in figure 10.4 below, there is a pronounced weighting toward sonorities with fewer tones.

Figure 10.4. Frequency of note densities.

one note:	ten times
two notes:	eight times
three notes:	five times
four notes:	once
five notes:	three times
six notes:	once
seven notes:	two times.

The restricted use of sonorities with five or more tones enhances their value as structural articulators. Sonorities with three or less tones are interpreted as local contrast while sonorities with five or more tones are perceived at a deeper level.

In addition to timbre change and note density Feldman pays careful attention to the type and variety of voicing for chords of three or more pitches. Figure 10.5 identifies the type of voicing and rough intervallic spacing of each sonority. The distribution of voicings again reinforces a binary division suggested around measure 16.²

Figure 10.5. Voicing and intervallic spacing.

<u>Measure Number</u>	<u>Type</u>	<u>Voicing- top down</u>	<u>General Intervallic Spacing</u> (also top down)
4.	enclosed	v, p,p,p,p, t	m3,a4,p4,m6,m2
9.	juxtaposed	vh, p, t	a5, m24
10.	enclosed	p,t,p	p4, M9
13.	enclosed/ovlap	p, p, v-p, t	p5,M7,P11
15.	encl/juxt.	v, p, p, p, t, p, p	M3,m3,M3,m3,M10,p4
18.	juxt/ovlap	v,t-p	p5
23.	juxtaposed	t,v,p	p4, M17,
25.	juxtaposed	p,p,p,p,t	M9,m6,M3,M17
26.	enclosed	p,p,p,vpz,p,p,p	M3,m2,m6,M3,m2,M6
27.	juxtaposed	p,p,v	p15, m16
30.	NA	p,p,p	m14, M3

First, note that enclosed voicings are more prominent in the first half of the piece than the last, occurring four times in the first 15 measures and only once in the last 16, again reinforcing a structural division around the mid point. There may also be significance in comparing the intervallic spacings of measures 4, 15, and 26, which contain the majority of thirds, sixths, and tenths in the piece. In context these will be heard as the most "familiar" or "tertial-sounding" voicings in the piece. These are approximately the same measures

around which the structural symmetries discussed earlier with respect density occur. Intervals of approximately two octaves separation such as the fourteenth, fifteenth, sixteenth, and seventeenth, are weighted toward the second half of the piece while the first half contains primarily smaller intervals³. This too supports a structural division around the midpoint of measure 15-16.

There is no duplication, even partial, of specific intervallic spacings. Specific timbral voicing also appears to be completely through composed. Even for chords of the same number of tones there are no duplications of instrumental voicing. This is most evident for chords of three tones occurring in measures 9,10,19, 23,27, and 30. In addition, fluctuations in register (figure 10.3) do not group into any recognizable pattern and therefore function, together with specific intervallic spacing and specific timbral voicing, as an agent of local contrast between consecutive sonorities only.⁴

Eric Salzman has said of Feldman's music, "Instead of organizing sounds in relation to one another, the elements are carefully disassociated. . . In Feldman, it is the isolated sounds themselves that are the essential experience, intentionally unrelated and disassociated from one another."⁵ Analysis of Durations III suggest this statement is not entirely true. In this specific piece consecutive sonorities do indeed appear to be deliberately disassociated, but are carefully integrated at a deeper hierarchical level. At the surface register change, specific timbral voicing and specific intervallic spacing ensure lack of continuity and association while the parameters of note density, general voicings type, and distribution of timbres suggest a two part binary structure. Is this any different than traditional forms such as the sonata, in which the real time experience of the music is governed by harmonic motion, while structural features evident in retrospect are governed by balance and symmetry?

Footnotes

1. Again, measure numbers are not actually indicated in the score and durations are of indefinite duration. Even if one accepts the validity of the structural design the slow pace will likely prevent actually hearing structural change on first or second listening.
2. As the overall discussion tends to involve static chords it was felt the use of terminology such as "thirds" and "fourths" more appropriate to a discussion of sonority than using interval class numbers, even though there is no tonal/scalar reference for these intervals.
3. The extreme twenty-fourths in measure 9 are an exception.

4. The terms "general" and "specific" are used to qualify voicing and intervallic spacing. Even though a general voicing type such as 'enclosed' is repeated several times there is no duplication of the specific timbres involved. Likewise, in the general sense a sonority with tertial or large interval spacings may be repeated, but there is no duplication of specific chords.
5. Eric, Salzman. Twentieth Century Music. An Introduction, Second edition (Englewood Cliffs, New Jersey : Prentice Hall, 1974) p. 156.

Figure 11.1. Feldman. Numbers. (1964)

vln h
 vln h
 vln h
 vln h
 fl
 chimes
 chimes
 chimes
 hn
 tbn
 tbn
 tbn
 tuba
 vlc
 vlc
 tuba
 tuba
 tuba
 vln h
 celeste
 fl
 hn
 tbn

fl
 chimes
 tbn
 hn
 pno
 tbn
 vlc h
 celeste
 pno
 tuba
 timp
 timp
 tuba
 tuba
 cbs
 pz
 vln h
 vln h
 vln h
 vln h

vln h
 vln h
 vln h
 vln h
 celeste
 celeste
 vln h
 celeste
 vlc h
 fl
 chimes
 chimes
 hn
 tbn
 tbn
 tbn
 tuba
 pno
 tuba
 tuba
 tbn
 vlc
 cbs
 hn
 hn
 tuba
 chimes
 hn
 tbn
 hn

11. Feldman, Numbers. (1964)

In Numbers Feldman applies several of the ideas occurring in the Piano Piece to a larger chamber ensemble. While the expansion to more available instruments gives opportunity for increased variety and contrast Feldman proceeds in an opposite fashion. Increased availability of timbral variety necessitates even greater restrictions on other parameters associated with each instrumental entry. Feldman places great confidence in the short-term memory of the listener and composes similarity relationships in the parameters of pitch, timbre, and register over periods of up to four measures in retrospect. Instrumental entries are tied to a specific pitch class in a specific register, and a specific group of surrounding, consecutive sounding instruments. As in the piano piece, Feldman exploits a kind of resonant continuity between consecutive and proximate entries. The term "modes of association" is again applicable. The purpose of analysis is twofold. First, it is to test the use of modes of association as a descriptive and convincing analytical language for the work, and secondly to provide insight into his compositional strategy, especially with respect to form and structural division.¹

Feldman directs the ear to pitch and timbral connection from one measure to the next, to a lesser extent to relationships two measures apart, and least often to quasi-structural relationships of reaching back four or five measures. The perception of complexity in the piece lies in the fact that parameters of a given sonority may refer to the same parameters in two or three of the preceding sonorities simultaneously. Generally speaking, the more parameters relate to the immediately preceding sonority only, the more the music will seem to flow. A sequence of sonorities relating one to the next sets up an expectation for continuation, and may thus be regarded as a functional device.² For purposes of an initial attempt at analysis of the first 26 measures, possible modes of association are given in figure 11.2 below.

Figure 11.2. Modes of Association (similarity relationships) in Numbers

Relationships of common tones and/or Timbral Transfer

- a) - same pitch, same timbre, same register
- b) - same pitch-class- transposed by octave to a new register, same timbre
- c) -same pitch, same register, new timbre
- d) - new pitch, same register, same timbre.
- e) -addition of a tone and timbre
- f) -same pitch-class, transposed by octave, new timbre.

Relationships specifically focussed toward density.

- g) - movement of cluster of tones. (vertical density)
- h) - deliberate masking
- i) - relationships in terms of number of tones
- j) - approximate intervallic spacing remains the same
- k) - use of symmetrical intervallic voicings.

Other Devices

- l) - superimposition of consistent or "established" sonorities.
- m) - larger sonority which restates pitch-class material of the preceding measures.
- n) - the use of rare events, such as timbres which only occur at points of articulation.
- o) - addition of a tone and timbre.

In spite of the continuous flow of associations between sonorities, it is possible to suggest three distinct phrases within the first twenty-six measures. The two strongest criteria for phrase division are high values in the number of tones coupled with a lack of common tone relationships between sonorities. Phrase divisions are suggested between measures 8 and 9, 16 and 17, and at measure 26.³ A verbal description of analytical distinctions in the first 26 measures is undertaken below .

The piece begins with the high pitch G6 held in common as a violin harmonic through the sonorities of the first four measures (a).⁴ A glance ahead concerning the flute and chimes pitches added in measure 3 suggests a superimposition of distinct sonorities rather than a common tone or common timbre relationship with the sonority in measure 1 (1) . In measure 4 this new "compound" sonority is increased by the addition of the low D3 in the trombone (e). Over the first four measures there is a gradual increase in the number of notes. (refer also to figure 11.3)

The low tuba B1 in measure 5 refers to the low tuba F# in measure 1(d). As the reference is one of timbre and register only it is a weaker event in context.

Starting in measure 6 associations begin to stretch beyond the immediately preceding sonority. The flute and chimes pitches are common to measure 4 (a), while the low Tuba B1 continues from measure 5 (a). The solo trombone in measure 7 may be interpreted either as a continuation of the trombone timbre from measure 6 (d) , or as a literal repetition from measure 4 (a). In addition, it may be understood in terms of density as a repetition of the solo sonority, albeit in the tuba, in measure 5 (i). The sonority in measure 8 is unusual for two reasons. First, the intervallic spacings bottom to top of minor ninth, minor ninth ,

perfect fourth, major ninth, and minor seventh are positioned in quasi-symmetrical fashion (k).⁵ Secondly, five of the six pitch-classes in the chord, the Ab, G, C, C#, and D, recur from the previous eight measures. A simultaneous restatement of pitch material might contribute to a feeling of closure and articulation (m).⁶ New information in this sonority includes the introduction of the pitch A5 assigned to a new instrumental timbre, the celeste (n). A combination of the three parameters above; a quasi-symmetrical voicing, pitch class restatement, and a new timbre, in addition to the largest total number of tones thus far, six, suggest that measure 8 be heard as a point of articulation.⁷

Measure 9 marks the beginning of a second phrase. There is a tendency towards octave transposition with timbral change, not found in the first eight measures. In measure 9 the tuba C2 is held in common from measure 8 (a), while the flute-chimes sonority refers back to measures 6 and beyond (d). However, the pitch change to F# in the flute, together with the decrease in number of notes, reinforces measure 9 as the beginning of the second phrase. In measure 10 one encounters for the first time a direct timbral substitution on the same pitch (c). The trombone C# in measure 10 is then given to the horn in measure 11(c). At the same time the outer voices reflect octave registral shifts of specific pitch-classes from measure 10, in addition to timbral change (f). The timpani G2 is new. While the timpani G2 is held in common in measure 12 (a), there is also a new device involving note density. The C#4 reiterated in the previous three measures is masked by a cluster of adjacent pitches (h).

Common tone pitch associations are weaker in measure 13, as only the Db 5 in the flute is connected to previous measures (f). There are stronger connections in terms of intervallic spacing. In general terms, a four-note voicing characterized by large leaps will refer to measure 11 (j). Measures 14 (f) and 15 (c) are again characterized by direct timbral transfer on the pitch Ab4, a continuation from the high Ab6 of measure 13. The voicing in measure 16 is characterized by a dense collection of six tones within a major ninth span in the middle register, which refers back to the cluster voicing of measure 12 (g). This voicing may possibly be interpreted as a "filling in" of the minor tenth space in the middle of the likewise widely spaced four-note voicing of measure 13 (j). Another distinguishing feature is the entrance of a new timbre, the contrabass pizzicato, perhaps marking measure 16 as a point of closure (m).

For three reasons, the sonority of measure 17 may be regarded as the beginning of the third phrase. First, there are no obvious pitch connections with the immediately preceding

measures (o). Secondly, both the instrumentation and registration are very similar to the sonorities of measures 1 and 9, the beginnings of the first and second phrases (j) (n). Sonorities involving any combination of tuba with chimes and/or string harmonic, and no other timbres, seem to be used as initial sonorities of phrases. Thirdly and perhaps most convincingly, the succession of sonorities from measure 17-26 are linked through specific pitch and timbral transformations, with introduction of new pitch material kept to an absolute minimum.

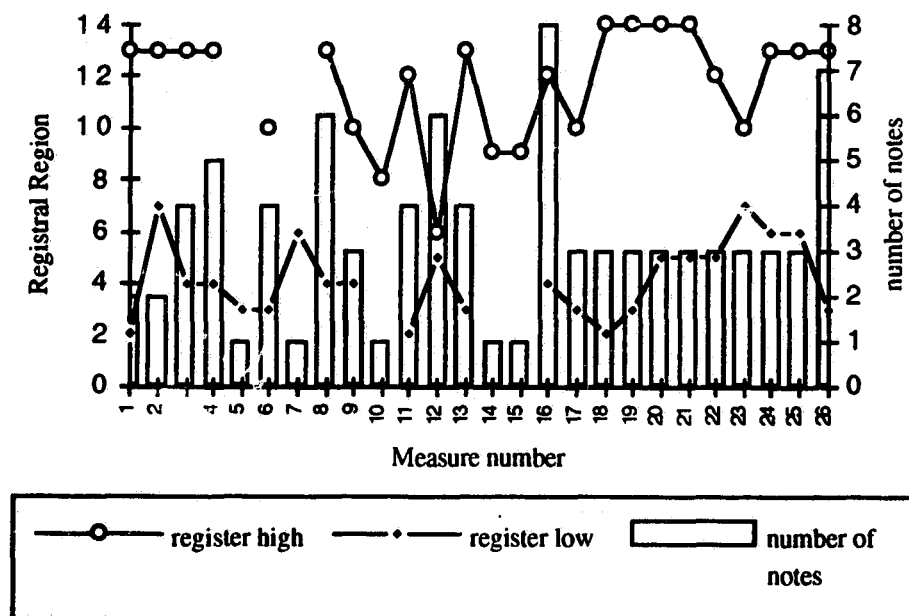
In measure 18 the high violin harmonic C# 7 replaces the cello harmonic of measure 17, while the chimes C4 is transferred to the low piano C1(f). Measure 19 keeps the violin harmonic in common (a) while the chimes G#4 derives from the horn G#3 of measure 18 (f). Likewise in measure 20 the high violin harmonic is held in common (a) while the celeste G#4 replaces the chimes (c), and the low tuba A1 of measure 19 is transferred to the trombone A2 (f). Measure 21 holds all pitches in common, with timbral transfer of the celeste and trombone to the flute and cello (c).

The pitch classes of measure 22 remain the same as measure 21 but are subject to octave transposition down for the celeste C#6, and up for the horn A3 (f). The flute G#4 is held in common (a). In measure 23 the flute G#4 is transferred to the chimes G#4 (c), while the pitch C# moves from the celeste C#6 to the cbs C#2(f). All three pitches in measure 24 are octave transpositions with timbral change from measure 23 (f); G#6 to celeste from chimes, E 5 to cello harmonic from the trombone of measure 23, and C#3 to the horn from the contrabass. Measure 25 preserves two of three pitches in the same register. The violin harmonic G#6 replaces the celeste and the horn C#3 is held in common (c). The flute E4 of measure 25 is transposed from the cello harmonic E5 of measure 24(f).

The third phrase concludes in measure 26, largely articulated by the increased density to a seven note sonority (i). The use of increased number of tones to cadence a phrase would seem to concur with the six and eight note sonorities of measures 8 and 16 which conclude the first and second phrases respectively. All three pitches of measure 25 are preserved in the same register in measure 26 (c). Timbres for the lower two common tones also remain in tact (a), with only the high G#6 being transferred from the violin harmonic to the celeste. It is also of interest to note the quasi-symmetrical intervallic spacing of the outer voices in measure 26 (k), perhaps a reference to the quasi-symmetrical voicing of measure 8. From bottom to top; augmented eleventh, minor seventh, minor second, major third, major seventh, perfect eleventh.

Far from being a random collection of contrasting sonorities, Numbers clearly proceeds as a sequence of carefully constructed audible relationships between adjacent sonorities. Accepting the articulation of structural divisions at measures 8, 17, and 26, there are observable trends in the statistical frequencies of types of associations within these spans. In measure 1-8 one observes a predominance of "a" common tone/ common timbre relationships, as well as "d" new pitch/same timbre relationships. There appears to be deliberate "non-repetition" of types of association in measures 9-16. In addition, the second phrase includes associations focussed toward density which are not found in the surrounding phrases. Sonorities belonging to measures 18-26 utilize only "a", "c" and "f" relationships. All involve common tones and octave transpositions.⁸ Phrase divisions at approximately measures 8, and 17 based upon the frequency of modes of association between sonorities is supported by the use of rare timbres and/or quasi symmetrical voicings in measures 8, 17 and 26.

Figure 11.3. Feldman, Numbers. Register and Number of Notes



Phrase divisions based on the frequency of modes of association are strengthened when cross referenced with tendencies evident in the overall variation of register and density (figure 11.4). From measures 1-8 the registral spread remains relatively consistent while the number of tones ranges between one and five. By contrast, sonorities of the second

phrase are characterized by rapid fluctuations in registral extreme together with extreme alternations and larger values for the number of tones. Measures 17-26 are striking in that the number of tones remains consistently at three. The registral extremes behave much like those of the first phrase, with perhaps a more pronounced narrowing in measure 22. To stretch the point further, the similarities between the first and third phrases in register and in the frequency of common tone associations suggested the entire passage could be interpreted as a rounded binary ABA form.⁹

Feldman once said, "You can do two things with music; you could be involved with variation, or you could be in repetition. My work is synthesis between variation and repetition."¹⁰ Perhaps such a synthesis could be termed a "developing variation." But in contrast to the developing variations in early Schoenberg involving transformation of select motives, in Numbers it is specific sonorities which are transformed. Common tone and common intervallic relationships are the predominant parameters of variation at the musical surface, with the number of tones and new timbres employed only at key moments. Collective trends in register and the types of association also suggest structural groupings of eight to ten events in length. Whether or not there is enough evidence to suggest a binary form is debatable, but not unthinkable. In his own words, "Music is still based on just a few technical models. As soon as you leave them you are in an area of music not recognizable as such."¹¹

Footnotes

1. While there is obviously no directed motion to a point of climax and rest certain statistical trends in the type and degree of manipulation of specific parameters do suggest structural applications of sonority.
2. Note the distinction (e), addition of a tone and timbre, is a convenient label for sonorities in which most tones and timbres are held in common with the only change being the addition of a tone.
3. Again, measure numbers are added as an analytical tool and are not present in the score. Durations are indefinite.
4. It may be that the pitches in the first two measures, F#1 and Ab, are deliberately chosen for their remoteness to the G. The high G will not be encountered as a reinforced harmonic above either tone, and therefore the emphasis will be on pitch identification and the register change. This is in contrast to the repeated violin harmonics of the third phrase.
5. While not exactly equal the ear is nonetheless tuned to large and small spacings of approximately equal value in a piece of this nature.
6. The suggestion of total pitch class content as a rigorous compositional parameter is difficult to prove, and in many ways runs contrary to

Feldman's negative feelings expressed about pitch-class set composition in general. Nonetheless, the device is repeated. In measure 26, five of seven pitch classes are restated.

7. Due to the relatively weak association between measures 4 and 5, together with the large values in the number of notes parameter, the first phrase might itself divide into two sub phrases of four measures each.
8. In the traditional sense the third phrase would be a return to harmonic stability after a more turbulent middle section.
9. The other two pieces discussed also suggest a preference for quasi symmetrical organization and binary phrase structure. Of course, the analysis must be continued before concluding it is ABA. It might be part of a larger rondo form or some higher hierarchical organization.
10. Morton Feldman, Essays, ed. Walter Zimmerman (Kerpen, Germany: Beginner Press, 1985) p. 169.
11. Feldman, Essays, p. 91.

12. Włodzimierz Kotonski. *Musica per Fiati e Timpani*. (1963)

Kotonski is perhaps not as widely known as his Polish contemporaries. He began his career in a neo-baroque idiom and later turned to serial and textural techniques after attending the Darmstadt summer composition courses. ¹ *Musica per Fiati e timpani* is selected because of the variety and freedom afforded the parameters of sonority and the restrictions and the consistency applied to the rhythmic/temporal element. The music proceeds as a series of pitch clusters in various registers which are passed from one instrumental collection to another. Due to both the indeterminacy of the notation and the restrictions of available pitch material, musical gesture and motive are removed from the musical dialectic.² It is composed of sonorities; steady state in that a static group of registral bandwidths are articulated with each entry. The main parameters of focus are register change, the number of registral regions articulated by each sonority, intervals of separation within each sonority, timbre change, and fluctuations in density in terms of the number of notes in each sonority. From an analytical perspective it is interesting to observe at which times certain parameters are more prominent than others and whether fluctuations in sonority suggest structural units. In this particular work significant moments in different parameters generally do not occur at the same time but rather alternate and overlap. Aside from a single major structural division the music is not segmented but proceeds in continuous flow as different aspects of sonority come into greater focus.

Perhaps the most characteristic surface feature are the pitch materials, which typically involve one to four concentrations of clustered pitches with varying degrees of intervallic separation. (See figure 12.1) Variation in the interval of separation between clusters is the dominant compositional process through the first large section of the work. Sonorities in which there is no clear separation such as in measures 1,13-14, 20-21,31,36-37, and 43, are significant events, perhaps a kind of sub-phrase caesura. Figure 12.2 lists the intervallic separation between clusters. Arbitrarily, a separation of a minor third is chosen as the smallest value.³ Intervals less than a minor third are simply labeled as "0", or no separation.

Figure 12.1 Kotonski, Musica per Fiati e timpani. (1963)

The musical score is presented in four systems, each with a grand staff (treble and bass clefs). Measure numbers 1 through 33 are circled at the beginning of each measure. The instruments and parts are indicated by abbreviations: kl (clarinet), hn s (horn section), tpt s (trumpet section), tbn s (trombone section), fl (flute), fg (fagotto), tbn (trombone), tuba, kfg (kornett), and timp (timpani). A specific annotation in measure 13 reads "(verticalization of pitches m.3-12)". The score shows a complex interplay of melodic lines and rhythmic patterns across the different instruments.

The minor sixteenth of measure 22 stands out as by far the largest interval of separation in the work. Another curious event occurs in measure 32. The sonority contains only five tones but is spaced to articulate five separate registral regions. In other words, it is the only sonority of two or more tones which does not contain a cluster of any kind. Unique events based on the interval of separation may also serve as points of articulation.

With the exception of the 0 values, the interval of separation does not repeat in consecutive measures. There are, however, certain patterns which emerge. From the beginning until measure 22 intervals of separation are less than one octave. Sonorities from measures 22 to 28 contain a relatively large percentage of intervals in the seventh to tenth range. Measures 32-35 are similar in that they all contain either a fourth or fifth on the top, thirds in the inner voices, and relatively large intervals of a seventh and beyond in the lower voices. By contrast, sonorities from measures 38-42 are separated primarily by major and minor thirds. There are larger intervals at the bottom of these voicings but they are restricted to a minor seventh or less. In other words, there appears to be a kind of consistency evident in the intervallic spacing between small groups of consecutive voicings which may suggest a kind of sub-phrase partitioning.

Figure 12.3. Kotonski. Registral extremes

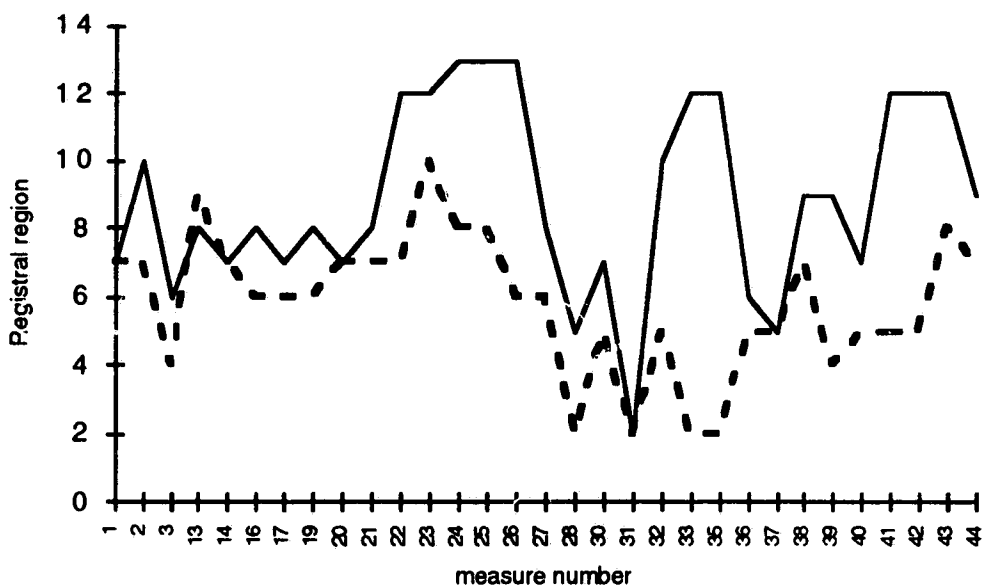
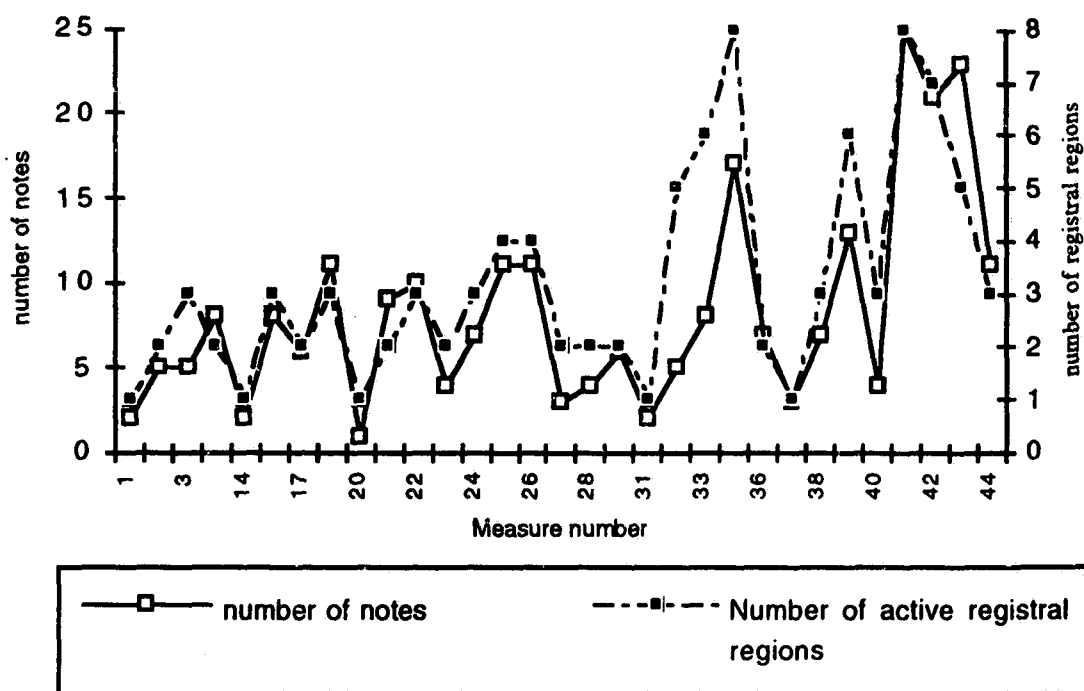


Figure 12.3 plots the movement of registral extremes over the first forty-four measures. Taken in isolation the movement of register clearly separates in phrase units. The most

obvious global feature is the extreme low point reached in measure 31, the tuba and contrabassoon sonority, which divides this section in half. At a lower structural level the passage divides into five phrases. The first phrase, from measures 1-21 maintains a very narrow bandwidth in the mid register. A second phrase from measures 21-26 remains in the higher regions with approximately a two to two and a half octave spread between lowest and highest pitches. The third phrase, from measures 27-31, is characterized by a movement toward the low register and is limited to a narrower separation, within one octave. As mentioned above, the arrival in measure 31 of the low cluster serves as a point of major structural division, perhaps the only conclusive structural event in the section. Following this the fourth phrase extends from measures 31-36 and features extreme separation, approximately five octaves. The last phrase from measures 37-44 is characterized by roughly parallel movement of extremes ranging from one and a half to three octaves, and narrowing to one octave in the mid range at measure 44.

Figure 12.4. Kotonski. Number of Notes and Registral Regions

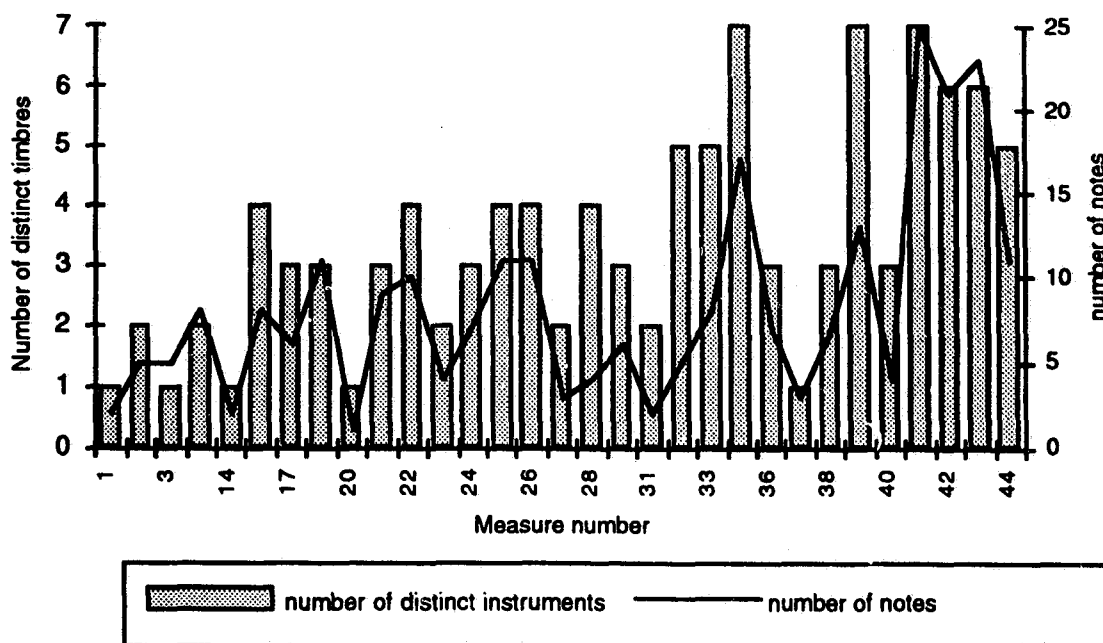


As was the case with registral extremes, measure 31 is clearly evident as a point of major structural division in the parameters of number of notes and number of registral regions. (Figure 12.4) In measures 1-31 both the number of notes and registral regions remain in

the low-mid region. After measure 31 there are extreme variations in both parameters which reach maximum values. On a more detailed level there are several smaller valleys in the graph, occurring at measures 14, 20, 23, 31, 37, 40, and 44. These are all points of smallest numbers of notes and least number of registral regions, and may correspond to phrase units.⁴

Trajectories for the number of notes and the number of registers move almost in exact parallel and with approximately the same amplitude.⁵ Given there are twenty-three distinct semitones in any two octave span, a twenty-three note sonority could be restricted to this intervallic span, or four registral regions on our scale. Kotonski consistently divides the sonority over seven or eight registral regions. In other words he specifically limits the degree of fluctuation in note density, perhaps pacing for a later part of the piece. Another curious feature of the pitch material is the sporadic tendency for Kotonski to "overbalance" either the lower or higher component of the sonority. In measure 16 four notes are given to the highest pitch band while the lower two clusters have only two tones each. This is reversed in measure 17 as the lower band has four tones compare to two for the upper. (refer to figure 12.1) Another example occurs between measures 28 and 30 with a lower concentration followed by a higher. In traditional terms this might be analogous to giving either the soprano or bass melody a higher dynamic marking or prominent doubling from another instrument. Perhaps Kotonski employs this type of density as an agent of expression.⁶

Figure 12.5. Kotonski. Distinct timbres vs. Number of notes

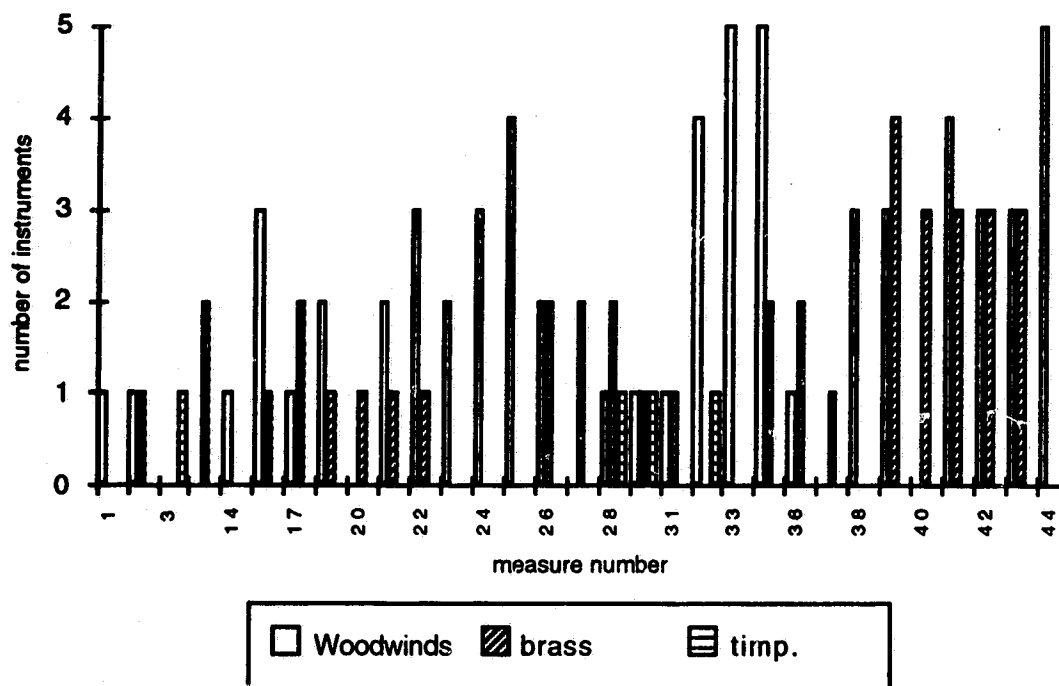


Given that there are five woodwinds, four brass, and one timpani in the ensemble, or a possibility of ten distinct timbres it is interesting to note that the total number of distinct timbres is limited to seven, perhaps to save certain maximum values for later in the work. A comparison of the number of distinct timbres per sonority as compared with the total number of notes (Figure 12.4) is an expression of density of a different kind. Simply, when the number of distinct timbres exceeds the number of tones then it necessitates instrumental doubling of some tones. Here the number of timbres is always less than the number of tones. Curiously, orchestral doubling is excluded as an operative parameter in this passage.

On the whole, consecutive sonorities vary in the number of distinct timbres. There are only four instances where the same number of timbres occurs in consecutive measures; measures 17, 25, 32, and 42. Consistent variation in the number of distinct timbres is considered a means of sustaining interest at the musical surface. The timbral parameter, however, still exhibits statistical tendencies which suggests phrase groupings. Measure 31 again figures prominently. Figure 12.5 plots the number of distinct timbres and the total

number of notes. Up to measure 31 the number of timbres varies between one and four and thereafter between one and seven.

Figure 12.6. Number of instruments per family



The number of distinct timbres oscillates in a similar pattern to the number on notes. Based on the relationship between the two parameters it is possible to subdivide the last sixteen measures into three groups; from measures 26-33, 35-39, and 40-44. Taken as a percentage of the maximum measures 27-33 are weighted more towards distinct timbres than number of tones. In measures 35-39 the two parameters move in parallel, which is the norm, but the maximum values of seven distinct timbres in measures 35 and 39 seem to frame this section. From 39 to 44 both parameters inhabit a region at the top of their range creating more diversity relative to previous sections.

Figure 12.6 is a more detailed examination of the timbral makeup of each sonority. It specifies the number of instruments within each family as opposed to the number of distinct timbres of figure 12.5. Kotonski's control of this parameter permits continuity between small groups of sonorities and thus provides a basis for grouping at a higher hierarchical level. Patterns of similar timbral configurations emerge in groups of three and four

consecutive sonorities. From measures 1-13 each sonority has a unique configuration and may be considered "expository" material. From measures 14 -23 a solo woodwind orchestration is repeated from measure 1 and followed by six sonorities involving both woodwind and brass, with a return to woodwinds alone in measure 23. Measures 39-44 cohere as all involving combinations of three or four woodwinds and brass. Measures 28 - 33 are noteworthy as the only region beyond measure 3 to utilize the timpani. There is a pattern of timbral grouping from measures 23-37 which operates in units of three like sonorities, but with some overlap. Measures 23-25 involve increasing numbers of woodwinds alone. Measures 26-28 all contain an even two brass instruments. Measures 28,30, and 32 all contain the timpani. Sonorities in measures 32-35 all contain large values for woodwinds, and those of measures 35-37 contain one or two brass instruments only. Globally the same configuration never occurs in consecutive measures until near the end, measures 32-33, indicative of a cadential function.⁷

Figure 12.7 is a summary of all the suggested points of articulation in the various parameters active in this section of the work. It was hoped initially that agreement of points of articulation would be found between different parameters to strengthen these events as moments of major structural articulation. This, however, was not the case. Measure 31 emerges as the only point of clear division. There are several instances where three parameters have significant divisions in the same measure but they happen so frequently and with such variety that it is difficult to draw firm conclusions. What does emerge, however, is a dynamic pattern of the flow of sonorities over the entire section. Kotonski's strategy does not involve segmenting the musical flow into clear structural units but rather a continuous weave of sonority in which different parameters come to the fore at different times. Furthermore there is a gradual increase in both the number and variety of points of articulation through to measure 40, then tapering off. In effect, the compositional process emerges as one of increasing complexity terminating in measure 40.⁸

Figure 12.7. Summary of possible points of articulation in all parameters of sonority.

Measure number	1	2	3	13	14	16	17	19	20	21	22	23	24	25	26	27
Registral Extremes										X						X
Number of Notes					X				X			X				
Number of Distinct Timbres																
Number of Instruments per Family				X								X		X	X	
<i>Woodwinds alone</i>				X								X	X	X		
Intervals of Separation											X					
<i>O Values</i>			X	X					X	X						
Measure number	28	30	31	32	33	35	36	37	38	39	40	41	42	43	44	
Registral Extremes			XX				X									X
Number of Notes			XX				X				X					
Number of Distinct Timbres	X		XX	X	X				X	X						
Number of Instruments per Family	X		X	X	X		X		X							
<i>Woodwinds alone</i>								X								
Intervals of Separation	X		X	X				X					X			
<i>O Values</i>			X				X	X							X	

In Music per Fiati e timpani Kotonski treats sonority as a gesture unto itself, not as a descriptive quality of a rhythmic or melodic motive. By employing limited aleatoric notation with respect to rhythm and through the consistent isolation and movement of narrow clusters of intervals these narrow pitch bands, not individual pitches, become the equivalent of steps of the diatonic scale. Pitch clusters, however, are qualified by other parameters of sonority, including the interval separating pitch bands, the number of active registral regions, the number of notes, the number of distinct timbres, and the specific number of instruments sounding within each instrumental family. What is almost lost in the exposition of parameters is Kotonski's remarkable approach to phrasing and structure. There are no periodic structures. Instead it is a continuous flow of small textures which are constantly revitalized as the various parameters affecting sonority in turn rise and fall in prominence.

Footnotes

1. Boguslaw Schaffer , " Wlodzimeirez Kotoski," in The New Grove Dictionary of Music, Stanley Sadie, ed. Volume 10. (London: McMillan, 1980) p. 216-217.
2. Curiously the same idea, removal of gesture, occurs in Feldman's music also but through the opposite approach.
3. The analysis concerns the intervallic space between clusters. A major or minor second would be interpreted as part of the same cluster. The minor third, approximately the critical bandwidth in the mid register, is the smallest separation ensuring the perception of separate clusters. The critical band concept is discussed in the Further Research chapter.
4. The placement of these nodes does not, by and large, correspond to the phrase divisions suggested by registral extremes. Kotoski is not working with carefully punctuated syntactic units, but rather a continuously overlapping cycle in which different parameters come to the fore at different times. The concept is discussed further at the end of the chapter.
5. Amplitude refers to the same percentage compared to the maximum possible. Number of notes and number of registers are not only similar, but equal.
6. The same device, stronger weighting of instruments to particular pitches within a chordal sonority, is evident in measure 249 of Schoenberg's Op. 16 #3 as a kind of Klangfarbenmelodie.
7. Note also that woodwinds alone occur in measures 1,14, 23-25, and 38, which may serve as a kind of phrase subdivision.
8. Note: while measures 40-44 all contain the largest values in terms of the number of tones, this does not correspond to a point of maximum complexity. Quite the opposite, these measure emerge as a kind of denouement or coda for the section as a whole.

13. Gyorgi Ligeti. Chamber Concerto, Movement III (1970)

Ligeti once said, " In working out a notational compositional structure the decisive factor is the extent to which it can make its effect directly on the sensory level of musical perception." ¹ Sonority is a key consideration at both the surface and background levels of Movement III of the Chamber Concerto. The piece is an example of a textural approach to composition in which register and registral density, timbre change, and temporal density are adjusted in small increments as the texture evolves between clear reference points. These large structural divisions are easily audible due to collective reconfigurations of timbral and registral processes. Ligeti's approach to textural composition is in some respects a simplification of the textural approaches of Xenakis, Boulez, and Stockhausen in that the intellectual or academic justifications behind the music are less important, less obvious. This is not to suggest a lack of intellectual strategy, but conceptually his devices tend to be very basic. He demonstrates a preference for contrapuntal procedures such as canons,² and compositional processes which move to and from moments of extreme contrast. Processes tend to move from high to low, from fast to slow, and from dense to sparse. Many of Ligeti's textural works employ a technique of "micropolyphony", roughly defined as a mass texture resulting from the superimposition of a large number of small melodic fragments. Most of the Chamber Concerto is in fact composed of these micropolyphonies. In third movement, however, the pitch material is frozen. Melody has been replaced by single notes or single chords which are repeated. At any given time the precise pitch content of the texture may be identified, rendering it suitable for analysis of sonority. The question becomes whether or not the changes in sonority alone are sufficient to motivate the music forward, or whether it is ultimately the rhythmic texture which controls.

Like many of Ligeti's works the dominant pitch process in the third movement is gradual ascending and descending step-wise motion, starting either from a unison or clustered pitch texture. Points of initiation and termination of the local pitch processes coincide with abrupt or wholesale changes in register. The movement appears to divide into four clearly defined large sections, evident from figure 13.2. Divisions occur roughly at measures 12, 36, and 41.

As each phrase is examined in more detail it becomes evident that a variety of processes taking into account interval spread, relative recognizability of sonorities, timbral configuration, number of notes, and the isolation of distinct registral regions, are evolving

Figure 13.1. Ligeti Chamber Concerto, Mvt. III

The musical score is presented in four systems, each with a treble and bass clef staff. Circled measure numbers indicate key points in the score. Instrument entries and changes are indicated by text labels above or below the notes.

System 1 (Measures 3-8):

- Measure 3: fl, ob, kl, hn s, tbn s
- Measure 5: pno, tbn s, fl, kl, ob, hn s
- Measure 7: cemb, pno, hn s, tbn s, vln pz, vlapz, vlc pz
- Measure 8: vlnpz, vlapz, vlc pz, pno, vlnpz, vlapz, vlc pz, kl, cb s h (sord, harmonic)

System 2 (Measures 10-22):

- Measure 10: kl, cbsh
- Measure 11: kl, fl
- Measure 12: fl, kl, vlnpz, pno, cemb, vlnpz
- Measure 17: fl, kl, pno, vlnpz, ob, cemb, vlnpz
- Measure 22: fl, pno, kl, vln pz, ob, cemb, vlnpz, vlapz, hns, kl, tbn s

System 3 (Measures 27-36):

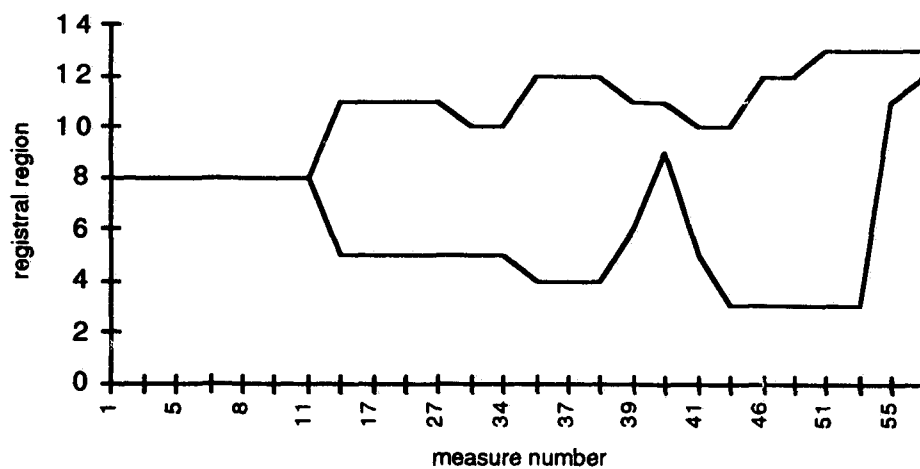
- Measure 27: fl, pno, kl, vln, ob, pz, vlnpz, cemb, hns, tbn s, kl, vlc pz, pno, cemb
- Measure 31: fl, pno, kl, vlnpz, cemb, hns, vlnpz, vlapz, vlnpz, tbn s, kl, vlc pz, pno, cemb
- Measure 34: fl, kl, pno, vlnpz, vlapz, vlnpz, vlapz, hns, vlc pz, pno, cemb
- Measure 36: vlnpz, fl, kl, pno, vlnpz, vlapz, ob, hn s, tbn s, vlnpz, kl, pno, cemb, cbpz

System 4 (Measures 37-40):

- Measure 37: fl, pno, ob, hn s, vlnpz, kl, vlapz, tbn s
- Measure 38: fl, vlnpz, kl, cemb, pno, hn s, vlapz, vlc pz, kl, cbpz
- Measure 39: vln, kl, pz, cemb, pno
- Measure 40: cemb, pno

at different rates in each phrase. The movement begins on the unison E4, gradually expanding outward in both directions to an intervallic spread of a tritone. (Refer to figure 13.1) Note that the process is one of gradually filling out a single registral region rather than outward expansion to more than one region. A new phrase begins in measure 12 with four unison Abs spread in octaves from Ab2 to Ab5. While maintaining the outermost Abs the pitch aggregate gradually expands inward by semitone, passing through various intervallic configurations en route. The arrival in measure 31 at a more recognizable sonority consisting of entirely of thirds and sevenths is an interesting by-product of the process. The process continues to measure 34 with slight inward movement of the outermost voices to arrive at a sonority with four distinct clusters of pitches in four registral regions, likely in reference to the four unison pitches which initiated the phrase.

Figure 13.2. Ligeti Chamber Concerto. Registral Extremes



To clarify the reference, the first phrase starts on a single unison pitch and terminates with a cluster of tones within a single registral region. Likewise, the second phrase begins with four unison pitches and terminates with clusters of tones in four registral regions. This is but one example of the rigorous logic and symmetry Ligeti demonstrates throughout the work.

Figure 13.3. Ligeti Chamber Concerto. Number of notes

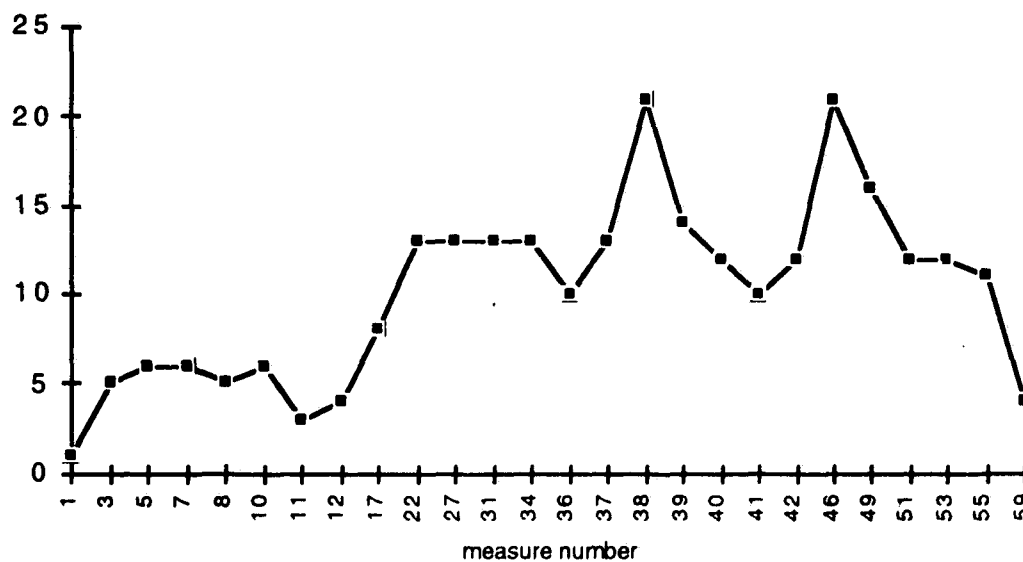
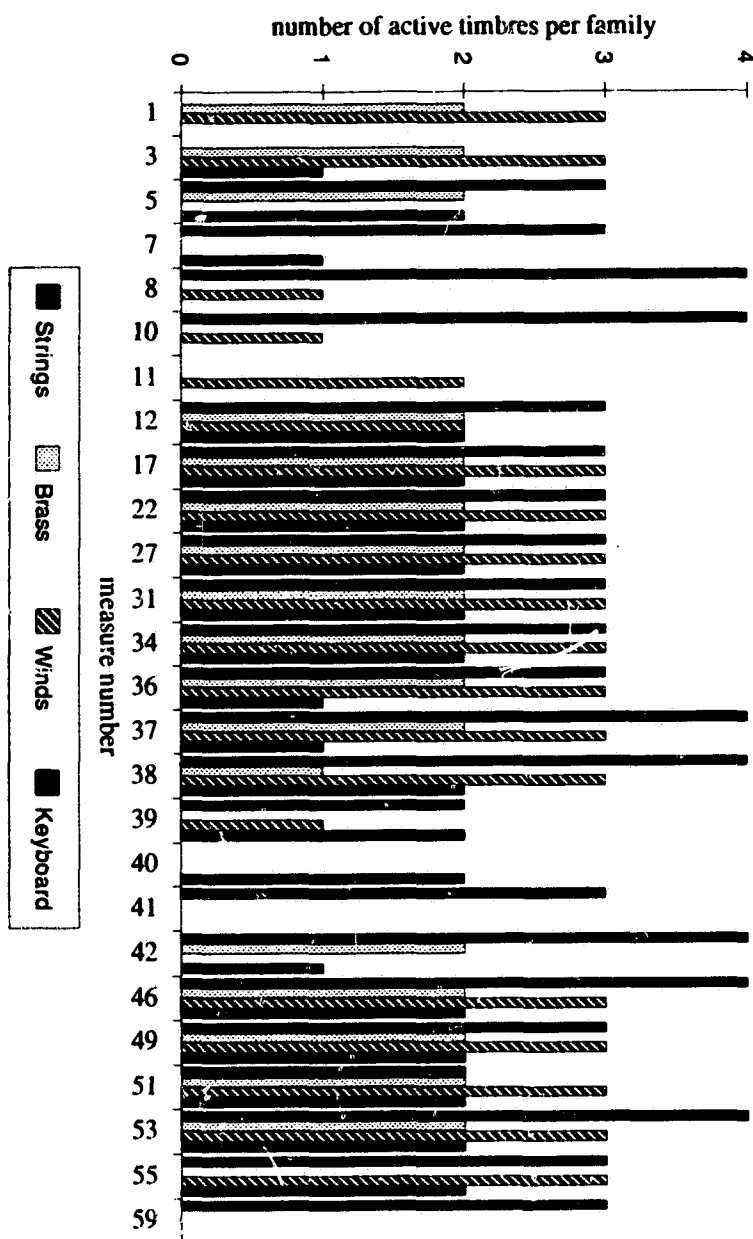


Figure 13.4. Ligeti Chamber Concerto, Mvt. III. Number of active timbres per instrumental family.



In both of the first two phrases the total number of tones remains relatively constant, particularly from measures 22-34. (figure. 13.3) A large number of tones in common permits clearer focus upon changes in other parameters. The emphasis from measures 1 to 12 is on timbral change. (Figure 13.4) The pitch complex within the tritone spread also remains the same through the first phrase. As a kind of complementary gesture it is the pitch complexes which are the focus of attention in the second phrase while the timbres are held constant. Figure 13.4 illustrates the number of active timbres within each of the four families used in the work. The values remain virtually unchanged from measures 12 through 34.

Starting in measure 36 is an abrupt change in the total registral spread of the sonority. The pitch process here is not so much one of pitch and registral change but the creation of new, dense sonorities through the addition of tones. The process reaches a maxima in measure 38 with the addition of the chromatically filled-in major ninth span in the keyboard instruments. This maxima is followed by a rapid decrease in the number of tones taken equally from soprano and bass registers until only the chromatic span remains.

The final phrase begins in measure 41 with a new voicing and registration consisting of intervallic gaps of fourths, fifths and tritones.³ As was the case in the third phrase, registral expansion occurs not as a gradual process of pitch change but through the addition of tones, such as the low Bb1 in measure 42 and the high, chromatically filled in span from B5-G6 in measure 46. Register and the number of tones figure prominently in the remainder of the phrase. From measure 46 to the end more and more tones are withdrawn from the texture until only four pitches in the extreme high register remain. Both the third and fourth phrases are similar in that they involve rapid increase and decrease in the number of tones as well as an expansion and later a narrowing in registral span. A subtle difference between them is that while number of tones and register move in an almost symmetrical fashion between upper and lower regions in the third phrase the process is more unbalanced in the fourth phrase.

Another significant difference between the otherwise similar third and fourth phrases lies in the distribution of timbres. Figure 13.4 gives the timbral configuration in terms of number of instruments active per family. This parameter changes with each new sonority from measures 36-42 but remains virtually unchanged from measure 46 to 59. This opposite or complementary relationship in terms of timbral forces parallels the same complementary relationship evident between the first and second phrases.

Figure 13.5. Ligeti Chamber Concerto, Mvt III. Polyrhythms

The figure displays musical notation for polyrhythmic patterns, organized into two rows of measures. The measures are numbered 1, 5, 8, 12, 34, 37, 39, and 40. Each measure contains multiple rhythmic lines with various note values and rests, often accompanied by numerical labels (5, 6, 7, 3, 7, 5, 3, 6, 3, 7, 3, 6, 6) indicating specific rhythmic groupings or patterns.

Measure 1: A single line of eight eighth notes.

Measure 5: Three lines of eighth notes. The top line has a '5' above it, the middle line has a '6' below it, and the bottom line has a '7' below it.

Measure 8: Two lines of eighth notes. The top line has a '5' above it, and the bottom line has a '3' below it.

Measure 12: A single line of eight eighth notes.

Measure 34: Four lines of eighth notes. The top line has a '7' below it, the second line has a '5' below it, the third line has a '3' below it, and the bottom line has a '6' below it.

Measure 37: Two lines of eighth notes. The top line has a '3' below it.

Measure 39: Two lines of eighth notes. The top line has a '6' below it.

Measure 40: A single line of eight eighth notes with a '6' above it.

55

57

59

41

42

46

51

53

There are clear processes and structural divisions defined through sonority but the driving force through the movement is rhythm. Not surprisingly, the compositional strategies guiding rhythmic complexity moves in a parallel, supporting relationship with changes in sonority. Figure 13.5 is a rough approximation of the rhythmic textures in the third movement. As was evident in the movement of registral extremes, (figure 13.2) it is again possible to subdivide the movement into four sections; from measures 1-11, from measures 12 -33, from 34- 40, and from 41 - 59. ⁴ The rhythmic configuration of the first phrase changes measure to measure, but remains relatively simple in context of the movement as a whole. By contrast the rhythmic pattern in the second phrase remains constant throughout. The rhythmic texture of the third phrase begins with a complex stratification of patterns which is simplified and reduced throughout the course of the phrase. The last phrase, again in contrast, exhibits an internal arch form. It begins with one simple strata of rhythm, increasing to a maximum of eight superimposed rhythmic ostinato in measure 53, and decreasing to a simplified texture of three different subdivisions in measure 59.

Figure 13.6 compares the phrase structures and processes of sonority and rhythm. Note that structural distinctions may be expressed in terms of whether certain parameters of sonority are active and static. Measures 1-34 are weighted toward static parameters while measures 36-39 are clearly weighted toward active parameters. It is also interesting to note that while structural divisions based on rhythmic texture closely correspond to those suggested by sonority the internal relationships between each rhythmically defined section are not the same. Structural divisions by sonority suggest two groups of two complementary phrases. In contrast the rhythmic structure suggests a through composed format of four unique patterns: 1. alternating 2. static 3. Linear decay , 4. Arch form with growth and decay.

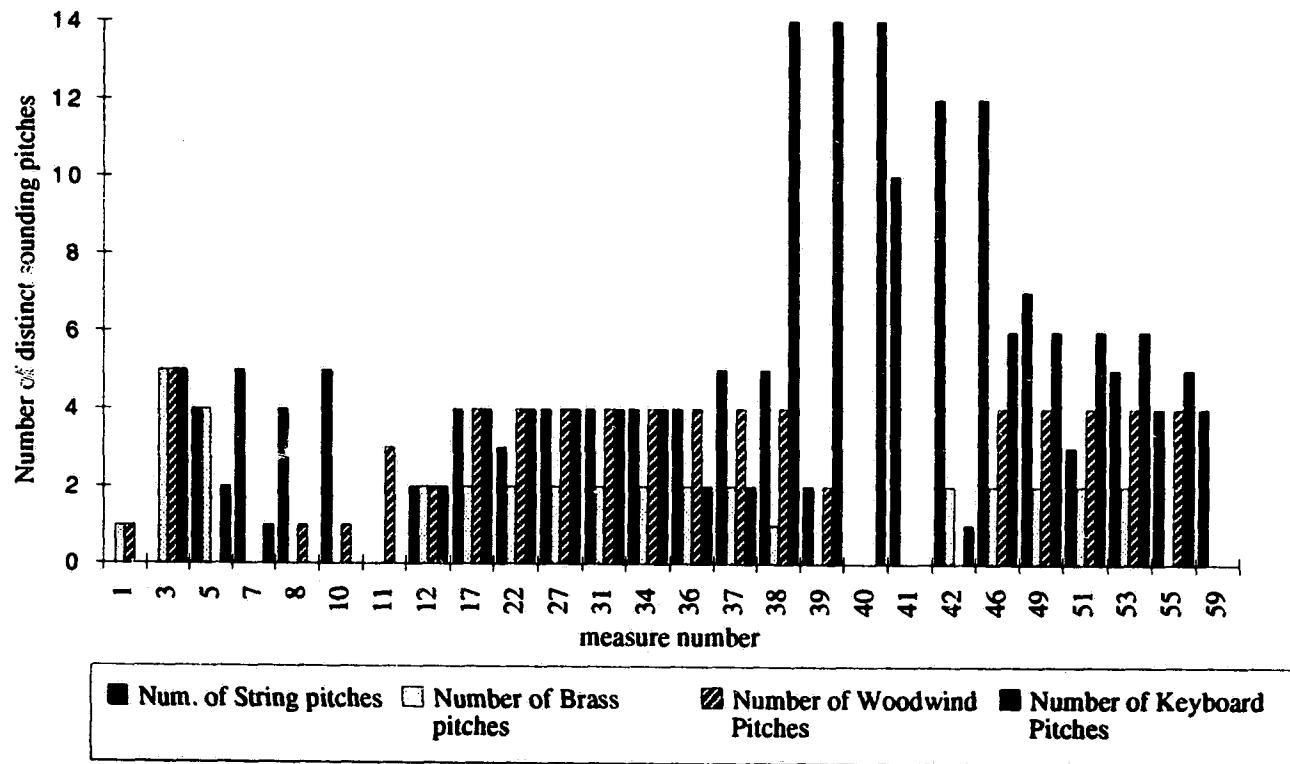
Figure 13.6 Overall summary of general trends in rhythm and sonority.

<u>Measure Number.</u>	<u>Rhythmic texture</u>	<u>Active Sonority Parameters</u>	<u>Static</u>
1 - 11	Alternating each measure	changes in timbre gradual pitch change to cluster	Number of notes Registral Region
12- 34	Static	gradual pitch change to 4 clusters	Timbre Number of notes Registral extremes
36 - 40	Linear Decay from complex to simple	changes in timbre number of notes registral extremes pitch change in increments	none
41 - 59	Arch form. simple/complex/simple	number of notes registral extremes pitch change in increments	timbre

While figure 13.5 displayed the number and family of instrumental timbres active at a given time figure 13.7 gives the relative weighting by family class in terms of actual number of sounding pitches. In short, analysis by the actual number of sounding pitches permits a distinction between polyphonic and monophonic instruments. Among the distinctions enabled by this comparison is the clear isolation of the third phrase. The actual number of tones increases only slightly from the second phrase but are distributed almost exclusively to one family class only. The third phrase is a movement away from timbral homogeneity toward timbral isolation. Four distinct sections are again evident, corresponding to the same divisions around measures 12, 38, and 42. The first and third phrase are related in that both involve new timbral configurations every measure. The second and fourth phrases are also related in that both keep approximately the same configuration every measure, even though there are pronounced differences in the actual number of pitches per instrumental family. From the perspective of timbre the phrase structure might be summed up as A B A'B'. Curiously, movement in the actual number of tones (figure 13.3) is in the same shape and magnitude for both the third and fourth phrases. Phrase four is a timbral variation of the same note densities presented in phrase three. If the number of tones are considered, an alternative phrase structure of A A' BB' is feasible.

Ligeti's application of sonority is with depth and calculation. He is perhaps the first composer to successfully gauge an effective rate of change in the parameters of sonority while maintaining the interdependence of parameters. Some remain frozen while others are

Figure 13.7. Ligeti Chamber Concerto, Mvt. III. Actual number of sounding pitches per instrumental family.



subject to a continuous process of evolution, and it is the degree of stasis or movement in specific in the parameters affecting both sonority and rhythm which, together with movement in extremes, define the formal regions. Whereas with Messiaen each motivic cell is defined by a combination of sonority and rhythm, with Ligeti both are calculated to move in parallel toward common structural goals. The point cannot be overemphasized. After the experience both of the serial and experimental movements of the 50s and 60s Ligeti's interest in directed motion clearly marks him as a traditionalist. The most telling feature of Movement III of the Chamber Concerto is the advance in rhythmic complexity of texture in the last phrase. In spite of the subtleties of the changes in timbre and note density throughout the movement the rhythmic climax is delayed until measure 53. It is at precisely this moment that register is confined to the extreme high range. Rhythm and register alone are for Ligeti the only parameters capable of long range evolution.

Footnotes

1. Gyorgi Ligeti, Ligeti in Conversation, (Fragen un Antworten mit mir Selbst) trans. Geoffrey Skelton (London: Eulenberg, 1983) cited in Jonathan Bernard, "Inaudible Structures, Audible Music. Ligeti's Problem and his Solution." (Music Analysis 6:3, 1987) p. 209.
2. Jonathan Bernard, "Inaudible Structures, Audible Music. Ligeti's Problem and his Solution." (Music Analysis 6:3, 1987, p. 207 - 237) Ligeti's use of canon is discussed at length, mostly with respect to specific interval spans.
3. This voicing and registration is suspiciously reminiscent of the sonority in measure 27, perhaps a subtle reminiscence to theme statement and recapitulation
4. With the exception of measure 12, transformations in the rhythmic texture are not sudden but result from dovetailing. As such, identification of a specific measure number as a point of division is somewhat arbitrary and may be stretched one or two measures in either direction.

14. Ligeti. *Continuum for Harpsichord* (1968)

Continuum is one of the most balanced and self contained works in the twentieth century repertory. All of the parameters of sonority with which Ligeti has been occupied in the late 60s and early 70s, with the obvious exception of timbre change, are put to most efficient use in *Continuum*. An overall arch form is clearly evident in the movement of registral extremes. Within the global form smaller sections are defined by the rise and fall of note density and local pitch trajectories. The most intriguing aspect of the form is the presence of mirror image symmetries defined by sonority at up to three hierarchical levels. It is of particular interest that Ligeti employs quasi-recognizable sonorities from the extended tonal vocabulary as a passing function of register and note density change. In order to connect large sections of the form Ligeti carefully seeds voice leading and commontone relationships from the last sonority of one section to the first sonority of the next. While processes within all parameters work together within each section, it is change in register which exerts the strongest influence. Note density, recognizable harmonies, and voice leading and commontone relationships are all calculated to synchronize with large movements in register.

Because it has two separate manuals the harpsichord offers the advantage of both hands playing in the same register, or even all the same pitches. In Continuum Ligeti exploits the harpsichord through a process of gradual registral expansion of pitch clusters achieved through rapid and simultaneous arpeggiation of up to five note patterns in both hands simultaneously.¹ As in the third movement of the chamber concerto, *Continuum* is a process set in motion and easily perceivable at the musical surface. It involves the gradual registral expansion of a sonority, usually by increments of semi-tones, until a single registral band or specific group of registral regions are either saturated or emptied. In other words, the piece is about register and density.

The global shape of the work, typical of Ligeti's textural compositions, is clearly evident from the movement of registral extremes. (Figure 14.2) The piece begins at a narrow concentration in the mid range and gradually expands both higher and lower until approximately the 3/4 point in the piece, with a slight weighting toward the bass register. The final section of the work returns to a narrow registral band in an extreme high register. It is an arch form defined by register.

Figure 14.1. Ligeti. Continuum for Harpsichord

System 1: Measures 10, 15, 18, 20, 27, 36, 43, 44. This system contains the first eight measures of the score. The music is written for harpsichord with a grand staff. It features complex, multi-measure chords and textures, with various accidentals and rhythmic values. The key signature changes from one flat to two flats, and then to two sharps.

System 2: Measures 56, 62, 68, 76, 78, 80, 86. This system contains measures 56 through 86. The texture continues with dense, multi-measure chords and complex rhythmic patterns. The key signature remains two sharps.

System 3: Measures 87, 92, 96, 98, 104, 106, 107, 108. This system contains measures 87 through 108. The music continues with complex textures and multi-measure chords. The key signature changes from two sharps to one flat.

System 4: Measures 109, 110, 111, 112, 113, 114, 115, 116. This system contains measures 109 through 116. The texture remains complex with multi-measure chords and intricate rhythmic patterns. The key signature changes from one flat to two flats.

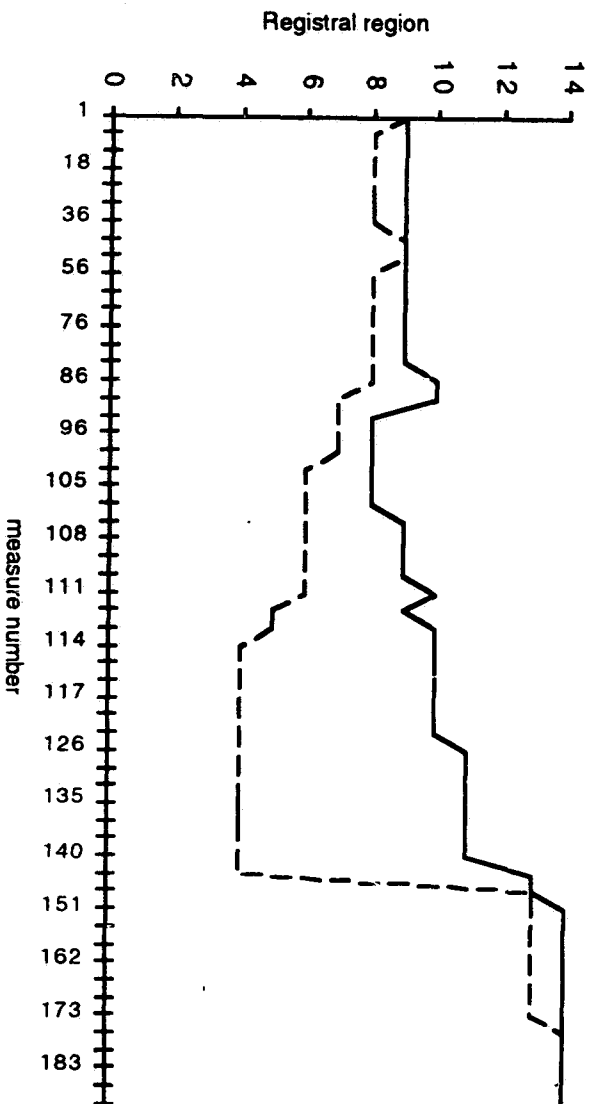
System 5: Measures 117, 118, 119, 126, 131, 134, 135. This system contains measures 117 through 135. The music concludes with complex textures and multi-measure chords. The key signature changes from two flats to one flat.

Musical score for measures 136-155. The score is written on two staves (treble and bass clefs). Measure numbers 136, 137, 140, 143, 150, 151, 155 are circled. A dotted line labeled "Gus" is at the end of the system.

Musical score for measures 161-174. The score is written on two staves (treble and bass clefs). Measure numbers 161, 162, 163, 170, 173, 174 are circled. A dotted line labeled "Gus" is at the end of the system.

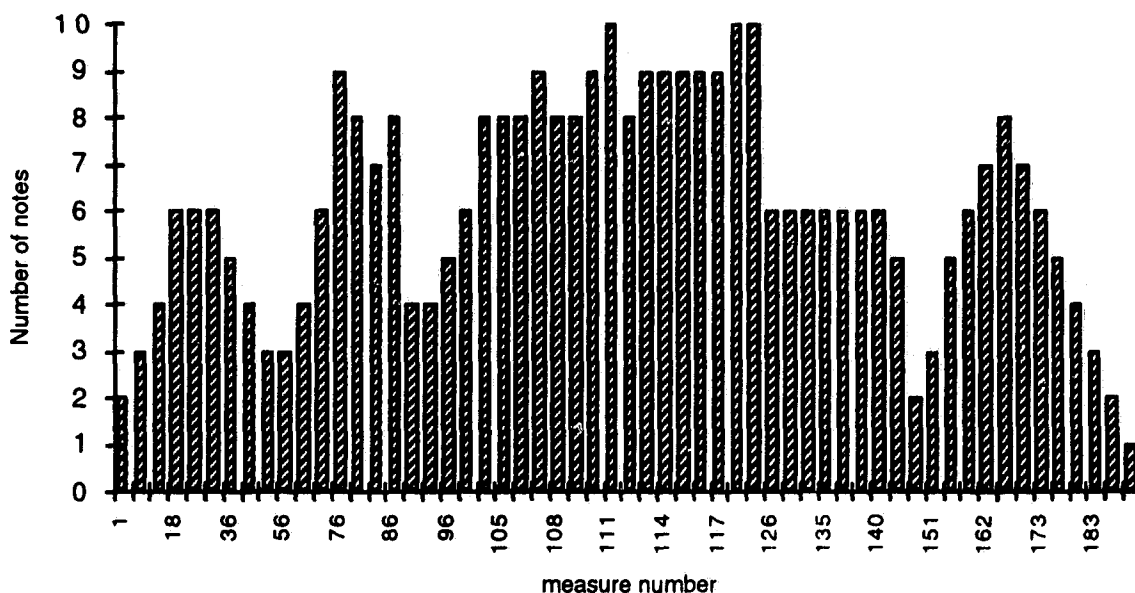
Musical score for measures 176-193. The score is written on two staves (treble and bass clefs). Measure numbers 176, 183, 186, 193 are circled. A dotted line labeled "Gus" is at the end of the system.

Figure 14.2. Continuum. Registral Extremes



Taken as a general term, "density" is roughly the ratio of registral extremes to the total number of tones. The strongest structural divisions based on density occur when there is agreement between the two parameters. In terms of the global disposition of the number of tones in Continuum,² (figure 14.3) an arch form is again indicated. There is only a slight departure from the registral shape. The first section, roughly from measures 1-96, divides into two smaller groups at measure 56. The large middle section of registral expansion, roughly from measures 96-150, is likewise defined by larger and more consistent values for the number of notes. The final section from measure 150 to the end, defined by an extreme high and narrow registral band, is characterized by in note density with a uniform rising and falling shape. This rapid growth and decay pattern reflects the same shapes in the opening phrase, reinforcing the arch form. Note, however, that aside from obvious congruencies such as the rising and falling shapes there is little in the way of extreme change in the number of notes throughout the main body of the piece. Note density can be considered a background function, with interest at the musical surface achieved through other means.³

Figure 14.3. Continuum. Number of Notes



Saturation of a given interval span, by either diatonic or chromatic steps, can be considered a middle ground structural goal in Continuum. In general, where the number of notes are increasing Ligeti attempts to saturate a given intervallic span with chromatic or diatonic

Ligeti's concern for symmetrical arrangement at more than one structural level become apparent upon further consideration of the smaller phrases defined above by pitch trajectories. Ligeti achieves a long range symmetrical balance both in terms of the "angle" of the pitch contours, and possibly the relative width or envelope of the intervals of separation outlined by registral movement within each phrase. Analysis by register and contour alone group the six phrases into a four part symmetrical form, A bb cc A, while analysis by specific intervals of separation suggest a six part symmetrical arrangement a b c c' b' a'. Justification for these distinctions will be evident after a more detailed exposition.

The long first section, from measures 1 -55 begins with a minor third, expands outward slightly in both directions to a tritone, and returns to a major third. As pitch contour it assumes a mild arch form. The second phrase, from measures 56-91 begins at a perfect fourth separation and terminates at a major tenth (major third) separation. The pitch contour involves a steep incline in the soprano voice with a mild descent in the bass voice. The third phrase begins with a major sixth separation, expands outward at approximately the same rate in both bass and soprano voices, reaching an augmented eleventh (tritone) separation. There is a noticeable reversal in the soprano pitch contour at measure 108, the function of which is not immediately evident.⁵ The pitch expansion up to measure 107 results in a virtually unbroken diatonic saturation of the augmented eleventh span. Starting in measure 108 the inner voices, alto and tenor if you will, also begin to separate in contrary motion.⁶ The net result is a reversal and polarization of articulated registers into two extremes. Prominent minor sixth and tritone intervals at the beginning and end of the phrase may also be of some significance. Starting in measure 126 the number of active pitch contours is multiplied to six. A strict inversion process begins in which the upper and lower voices move in a mirror image. Beginning at the tritone, the extreme outer voices moves in contrary motion by a major third. The middle voices remain at the same pitch level, while the extreme inner voices again move in contrary motion by a major third. The final phrase, in specific reference to the first phrase begins at a narrow major third span, expands outward in both directions to a perfect fifth, and finally returns to a unison. Like the first phrase it is a mild arch form.

Giving consideration first to the relative size of the intervals outlined at initial and terminal points in each phrase it is possible to abstract a symmetrical form with close correspondences between phrases one and six, two and five, and three and four respectively. Even though there are no exact intervallic matches, the shape or envelope of the interval sizes are related.

steps.⁴ When, however, the number of tones remains relatively constant, Ligeti begins to separate the texture into discrete registral regions. From measure 1- 55, the first phrase, the number of notes increases to six, saturating a single registral band before returning to a three note texture. In the second phrase, measures 56- 91 the number of notes again rises and falls, but not before filling up an octave span with largely chromatic steps. The third phrase, from approximately measure 92- 111 is unidirectional, involving ever increasing numbers of notes to the maximum of ten in measure 111, the largest registral span in the piece with no more than a major third separation between pitches. Jumping ahead to final phrase, measure 143 to the end, note again the familiar rising and falling pattern in the number of notes as a single registral region is filled and then emptied. By contrast, in the fourth and fifth phrases, roughly from measures 112-125 and 126-140 respectively, the number of notes generally remains fixed. The focus of these phrases is the transformation and condensation of a dense mass of tones into separate bands rather than growth.

A finer level of focus for register suggests formal divisions at a different structural level than the overall movement in registral extremes. Determined by initial, maximum, and terminal points for processes of stepwise pitch change, interruptions at moments of arrival and sustain subdivide the form into five and possibly six sections. Divisions occur at measures 56, 92, 108, 126, and 150. Figure 14.4 presents the actual pitches for the registral extremes around these divisions. Points of articulation are not arbitrary. Ligeti is extremely deliberate and binary in his logic here. A pitch level will either move up or down, and any change in the trajectory of the highest or lowest pitch indicates a phrase end.

Figure 14.4. Specific initial and arrival pitches within each phrase of Continuum

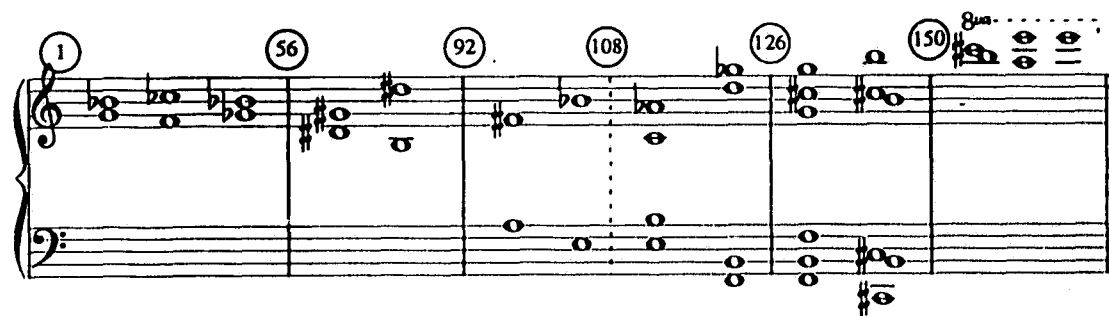


Figure 14.5 Intervallic outline of each phrase.

Measure:	1 - 55	56 - 91	92 - 107	108 - 125	126 - 149	150 - 193
Intervals:	m3 TT M3	P4 m3	M6 TT	m6 TT	TT m2	M2 P5 Un.

In terms of the overall organization of register and pitch contour an arch form emerges expressed roughly as A bb cc A. The decision to group the second and third, as well as the fourth and fifth phrases together is based on the presence of contrary motion in the inner voices at measure 108 and 126. But as the number of pitch trajectories increases throughout the piece from two to four to six before returning to two in the final phrase, Ligeti simultaneously achieves organic growth within the arch form. Significantly, organic growth in the number of pitch trajectories until approximately the beginning of the last phrase moves in parallel with the global shape of registral extremes.⁷

The number of discreet leaps within a voicing is partly determined by registral spread and the number of tones. Still, within these constraints Ligeti works with the number of separate bands of sound as a structural device. Figure 14.6 gives the intervals of separation between the inner voices of each sonority throughout the piece. It is not a specific account of the pitches and intervals which make up each sonority, but rather the number of separate intervallic units. For practical purposes, whenever the interval is less than a minor third and indication of "0" or no separation is given. Inner voice separations of less than a minor third are simply omitted. At measure 111, one of only three points in the piece with ten different notes, the intervallic spacing consists entirely of major and minor thirds with seven different gaps. This is the maximum number of discreet leaps of any sonority of the piece. It is after this point that the innermost interval spreads to ultimately generate polarized registral extremes. From the perspective of the number of individual registral units measure 111 must be considered a structural event.

Figure 14.6. Intervals separating clusters within each sonority.

Measure Number	1	10	15	16	20	27	36	43	44	58	62	78	80	88	97	97	98	99	104	105	106	107	108	109	110	111			
Interval of Separation																													
top of voicing	m3	m3	0	0	0	0	0	0	0	0	M3	0	m3	M3	M6	M3	M3	M3	M3	M3	0	0	0	0	0	0	0		
middle of voicing																M3	m3	m3											
bottom of voicing	0	0								m3	0	0	m3	m3	m3	0	0	0	0	M3	m3	m3	0	m3	0	M3			
Measure Number	112	113	114	115	116	117	118	119	126	131	134	135	136	137	140	143	150	151	155	161	162	163	170	173	174	176	183	186	187
Interval of Separation																													
top of voicing	0	0	m3	M3	0	0	0	0	d5	P5	m6	d5	m6	M6	m7	M2(0)	0	0	0	0	0	0	0	0	0	0	0	0	
middle of voicing																													
bottom of voicing	m3	0	0	0	0	0	0	0	d5	d5	m6	m6	M6	m7	m7														

Another interesting feature, though a source of passing or surface interest only, is the voicing decision whether or not to isolate the bass or soprano pitch by an interval of a minor third or more. (Figure 14.6) In the fourth phrase, roughly from measures 108-125, Ligeti tends to keep the outermost intervals closed. Measure 108 marks a change to contrary motion and separation in the inner voices. Placing a cluster of tones in the outer voices may have the perceptual effect of drawing the listener's attention toward the contrary motion the inner voices and away from the overall changes in registral extreme. As a more liberal interpretation perhaps directing attention toward the inner voices of a sonority is a kind of development, while focus upon the movement of higher and lower extremes is considered expository.

The term sonority is often mentioned with reference to specific types of chords and scales. It is a subjective use of the term which assumes an ear educated in the Western musical tradition. One of the unique facets of Ligeti's style is that he is not afraid of passing through familiar or quasi-diatonic harmonies from the tonal vocabulary as part of an otherwise algorithmic pitch/registral process. Rather than denying his heritage Ligeti rejuvenates attractive tonal sonorities considered taboo by the serialists. The relative familiarity of sonorities certainly enables bar to bar contrast but moreover becomes an additional agent in the delineation of form. Figure 14.7 is a subjective tabulation of incidental sonorities in Continuum expressed in the traditional harmonic/modal vocabulary.

Figure 14.7. Conventional Tonal "labels" for the Sonorities of Continuum

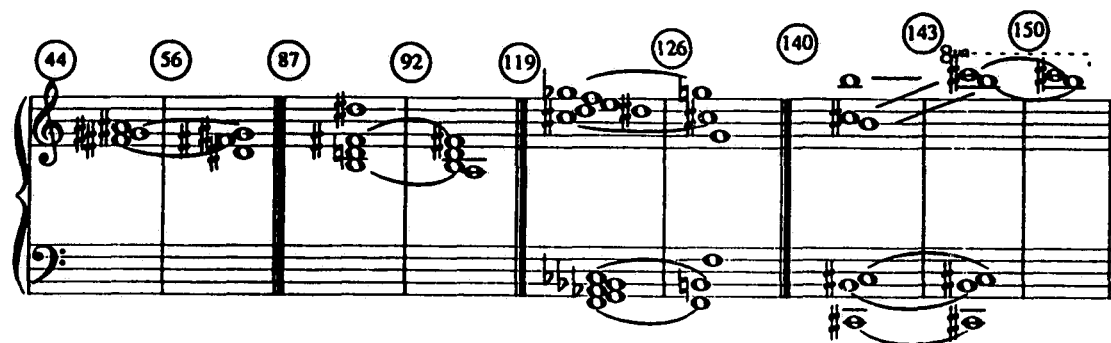
<u>Measure number</u>	<u>Chord, Scale, or Mode</u>	<u>Measure Number</u>	<u>Chord, Scale, or Mode</u>
1	Gmi	113	D7/ Cmi7
10	Gmi7	114	Gmi7/F#
15	Fmi diatonic	115	Ebmi7/F#7
20	chromatic	116	Bb aug/ G aug
27	chromatic	117	chromatic
36	chromatic	118	chromatic
43	chromatic	119	chromatic
44	F# diatonic	126	tritones
56	Ebmi11	131	C# / tritones
62	Ebmi diatonic	134	A/ Eb aug.
68	C# diatonic	135	A7 / Eb + (maj7)
76.	chromatic	136	A / Bmi
78	chromatic	137.	Bb mi/ C#7
80	C# quasi diminished scale	140	C#7
86	C# quasi diminished scale	143	C#7
87	Bmi (ma7)	150	C#7
92	Bmi7	151	Bmi diatonic
96	Gmaj9	155	chromatic
98	G lydian	161	chromatic
104	F quasi whole tone	162	chromatic
105	E7/Edim	163	chromatic
106	E aug 7	170	chromatic
107	Db/C7	173	chromatic
108	Eb mi /F lydian	174	chromatic
109	Fmi11/ G7	176	chromatic
110	Dbmaj7/ Db dim	183	chromatic
111	Bbmi7/C7	186	chromatic
112	Ebmi11 / G	193	unison.

There are certain regions of the piece which appear to utilize more recognizable sonorities. The section from measure 87 to 106, corresponding roughly to the third large section of the piece, is characterized by more diatonic and simple modal sonorities than any other section. The sonorities from approximately measures 107- 116, the body of the fourth section, seem to cohere as polyharmonies or superimposed triadic harmonies.⁸ While there appears to be no functional harmonic connection between any sonorities the familiarity factor does serve to distinguish these sections from the largely chromatic outer sections, in addition to the local contrasts.

There is one final feature of continuum, insignificant at first, which may ultimately hold a controlling influence over all the sonorities in the work. Continuity between large sections of the work is achieved through common tone pitch associations. Figure 14.8 gives common pitches between the sonorities at the end of the first, second, fourth, and fifth phrases.⁹ Most striking are the two extreme pitch clusters arrived at in measure 119. The outermost pitches of the two clusters, F, B, D and Gflat, prepare the arrival at F, B C# and

G in measure 126. Similarly, systematic contrary pitch motion throughout measures 126-140 is calculated to arrive at a uniform B and C#, the same pitches which start the final phrase. The rate and degree of pitch change throughout all transitional sonorities in the work are be calculated to arrive simultaneously at these common tones bridging large sections.

Figure 14.8 Common tone connections between phrases in Continuum.



In conclusion, while it is clear that registral and note density shape the large formal regions of the piece, and while the internal symmetries may be exerting a deeper cohesive hold over the entire work, the primary motivating forces of the work are much more fundamental and brutally simple. The pitches simply move up or down creating an expectation of continuing in the same direction- a kind of kinetic energy. As a stylistic feature it is evident that large scale changes are very infrequent. "Step" motion is the norm. Complexity arises through the simultaneity of linear processes at different levels for different parameters. One still doubts, however, whether the piece would enjoy the same success were it not for the continual influx of excitement and drive through the virtuosity and speed of the harpsichord arpeggiations. It is rhythmic tenacity which keeps the piece alive, not sonority. Nonetheless, Ligeti demonstrates a gifted ear for the pace and proportion of change in the parameters of sonority, and more importantly imposes logical transitions of sonority based upon movement between opposite poles. The question remains, is the logic evident in Ligeti's transformations intrinsic to the raw materials of sound, or is it as arbitrary and external as the serial rationalizations he was reacting against?

Footnotes

1. Though there is no real sustain on either the piano or the harpsichord, playing the same sonority in both hands simultaneously and at a very fast rate gives the impression of a sustaining sonority.
2. To a maximum of ten naturally.
3. As was the case the Chamber Concerto, the main source of interest at the surface is actually the rhythmic texture created by the periodicity and speed of the arpeggiated patterns. Nonetheless, other parameters of sonority are integrated into the surface tension.
4. In one exceptional case, measure 111, registral saturation is achieved or attempted through minor third steps. Separation into registral bands separated by a minor third can be considered a progression and evolution from previous chromatic and diatonic saturations, reinforcing the structural significance of this sonority.
5. A reversal in the registral descent in the outer extremes signals the beginning of inner voice contrary motion.
6. However, as more notes are added up to the maximum ten in measure 111, the separation does not actually begin until 112.
7. There are virtually no direct stylistic or idiomatic similarities between Ligeti's music and his early idol, Bela Bartok. However, Ligeti's preference and finesse in constructing forms which simultaneously exhibit symmetrical and growth properties shows the subtle but powerful influence of Bartok.
8. The use of conventional polychords may be a more literal reference to Bartok.
9. The phrase division at measure 108 is more of an interruption than a clear terminal point. There are common tones, but the pitch trajectory is aimed toward the termination in measure 125.

15. Toru Takemitsu. November Steps. Phrase Seven.(Measures.36-48)

Takemitsu has described composition as "creating an environment where sounds may meet dramatically." ¹ Indeed, the sense of urgency felt at times is the result of dramatic rising and falling shapes in the parameters of sonority. In contrast to Feldman's pulseless music, which may generally be described as a sequence of comparisons between static sonorities, November Steps comes alive through dynamic changes in timbre, register, and density. The complexity of Takemitsu's technique lies in the superimposition of different envelope shapes in different parameters, and often with contradictory tendencies. In November Steps Takemitsu demonstrates a refined, highly personal approach to musical pacing and structure which on the whole proceeds as a through composed sequence of short phrases. Long range relationships between phrases are not immediately apparent, but are to a degree clarified from the perspective of sonority.

It is not easy to isolate steady state sonorities in November Steps. The music proceeds as a dovetailing of chordal and textural events in different registers in continuous evolution. Sonorities reduced for purposes of analysis (figure 15.1) are abstracted from moments within a gesture when the most pitches have the greatest duration. As there is no accounting for all surface melodic events the present analysis enters at the middle and background levels only. There are often up to four transformations in sonority within a given measure, and some measures are arbitrarily subdivided into a,b,c, and d. A second challenge lies in the area of phrase and subphrase division. Clearly, in music which under almost constant evolution and overlap of sonorities, phrase divisions will be felt wherever there is silence or a caesura. In the passage in question, the seventh large section of the music which extends from measure 36-48, the form divides into six clear phrases with divisions at measures 37,38,40, 44 and 46.

Phrase divisions articulated by duration prompt two questions with respect to sonority. First, how might global changes in sonority reflect or depart from the quasi-symmetrical form outlined by duration? Secondly, is there a change in the treatment of sonority which enables a continuous musical flow through the longer fourth phrase?

Figure 15.1 Takemitsu, November Steps

Phrase 7. m 36-48.

36 vln s tpt tpt vln ah vln ah vln ah vln ah
 harp vla vlc harp harp harp
 harp tbn cb tbn cb cb cb

37 cb h vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

38 vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

39 vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

40 vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

41 vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

42 vln ah vln ah vln ah vln ah
 harp harp harp harp harp harp
 harp tbn cb tbn cb cb cb

Figure 15.2. Phrase divisions based on silence.

I	II	III	IV	V	VI	
36	37	38	40	44	46	48.
	(A)		(B)		(A)	

Upon consideration of movement in registral extremes (figure 15.3), the number of active timbres (figure 15.4), and the number of active registers (figure 15.5), the seventh section of November steps indeed appears to divide into a three-part ABA form with divisions at measure 40 and 44. There are only two moments with extreme registral spreads, occurring at measures 37 and 47, and both events are approached by a rapid expansion from a narrow registral band. Measures 37 and 47 also both contain the highest values for the number of registral regions articulated by the sonority. In addition, extreme fluctuations in the number of active timbres are noticeable at the beginning and end of the section, though with somewhat less variety in the latter.

Figure 15.3. November Steps. Registrational Extremes

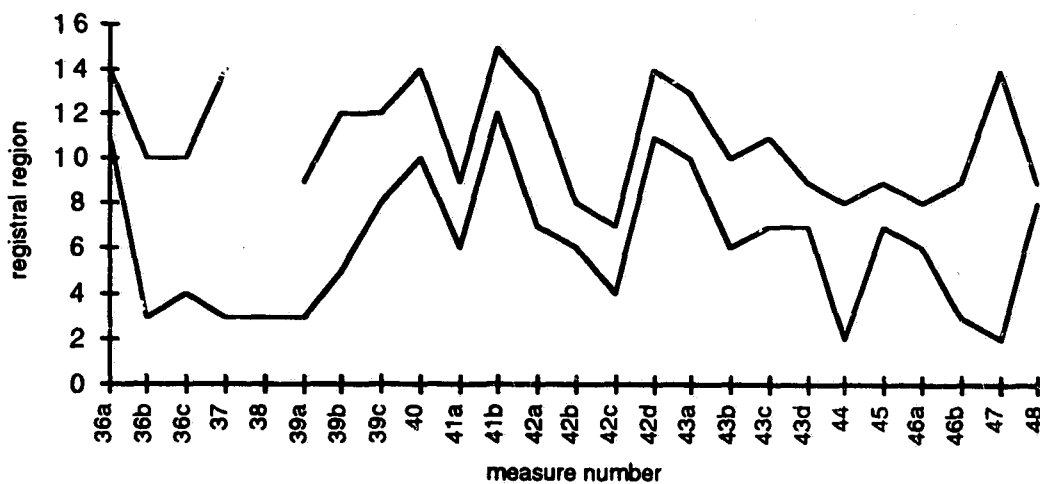
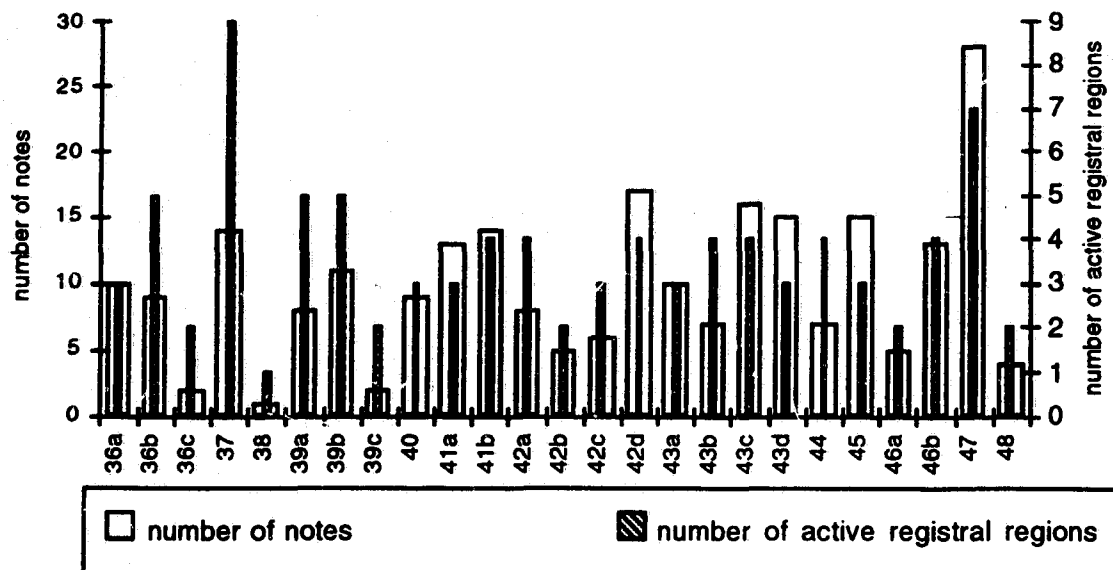


Figure 15.4. November Steps. Number of Timbres



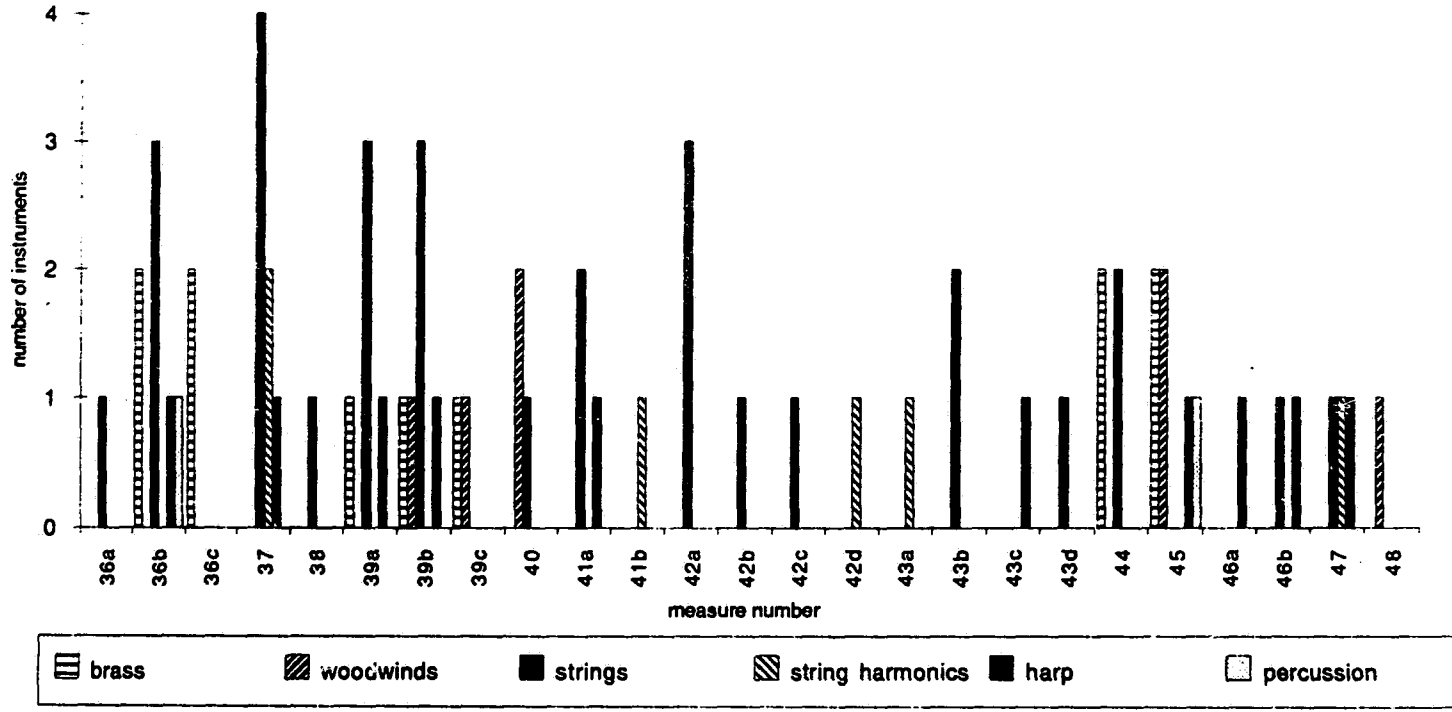
Figure 15.5. November Steps. Number of notes vs. number of active registral regions



There are specific timbres which tend to be concentrated in the early and late stages of the movement, giving further support to a quasi-symmetrical structural interpretation. Harp occurs on four occasions in the first three and last three measures. (figure 15.6) The gongs are employed on only two occasions, in measures 36 and 45.² Woodwind figures occur on each side of the middle phrase, in measures 39-40 and measure 45, framing the contrasting middle section.

There are two additional trends revealed in the use of timbre which are too subtle to act at the level of structure, but nonetheless help maintain freshness and buoyancy throughout and reflect conscious decisions by the composer. Both of these trends involve the string instruments. One is the gradual elimination of string sonorities of more than one instrument type. Evident in figure 15.6, there is a high proportion of three and four timbre string sonorities at the beginning of the movement but exclusively two and single timbre string sonorities at the end. From this perspective the entire movement might be heard as a process toward timbral homogeneity within the string family. A second trend is the gradual decrease in the frequency of string sonorities, which occur almost in every consecutive sonority until measure 43, and tend to alternate sonorities after this point. Though the

Figure 15.6. Number of instruments per family class



opening and closing phrases are the same in many respects, the net timbral effect will be noticeably different.

The most compelling registral feature of the movement is the consistently narrow registral movement between measures 40-44, corresponding to the fourth phrase or "B" section above. During the same time period figure 15.4 reveals a pronounced flattening in the variety of timbres. Measures 41b - 43b are exclusive to the strings, unlike the mixed brass and percussion sonorities of the outer sections.

As is often the case, freezing one or more parameters seems to permit more subtle manipulations of other parameters. Parallel registral movement for sonorities maintaining approximately the same registral spread, together with relative homogeneity of timbre, enables an entirely different level of perceptual focus. Certainly one is more acutely aware of the pitch, and Takemitsu seems to take advantage of this with more rapid and extreme fluctuations in pitch level. But it is the number of notes and the number of registers which emerge as functional parameters in the passage. Figure 15.5 reveals an oscillating pattern of change in the two parameters starting at the end of measure 39, which corresponds to a relatively static period in the number of timbres. (figure 15.4)

The pitch structure of chordal sonorities employed in November Steps suggest an integration of vocabulary based on register and density alone with somewhat more recognizable sonorities left over from tonal music. There are four basic type of vertical pitch structures in the movement: 1) chromatic clusters, 2) diatonic clusters, 3) quasi-triadic harmonies, and 4) simple, exposed two-note intervals. Notably, there appear to be no examples of "artificial intervallic constructs" of say, consecutive fourths, fifths and tritones, such as occur with Ligeti and Messaien, anywhere in the movement.³ Takemitsu, informed by the experience of textural compositions in the late 1950s and early 1960s, manages to synthesize movement in register and note density with movement between recognizable sonorities and modes. While there are certainly no harmonic functions in the traditional sense in the music, the listener may still perceive motion from, for example, triad based harmony to chromatic clusters, to diatonic. It is an elaboration of a concept first suggested in the piano preludes of Debussy sixty years earlier.

Takemitsu's approach to pitch structure may be approached through analysis of the longer middle phrase.(figure 15.7) The construction and sequence of sonorities suggests a division into two subphrases, from measure 40-42 and 43 through 44. Each of the two

subphrases illustrates opening and closing envelopes in terms of registral density, moving from chromatic sonorities to more spacious triadic sonorities, then returning to a chromatic sonority by way of an intervening diatonic spread. The second subphrase, perhaps an organic extension of the first, demonstrates two such opening and closing envelopes. ⁴ As the outer sections of the movement seem to focus upon outward expansion of registral extremes, the middle section works with the relative intervallic space between the inner voices. The main difference between Takemitsu's approach to composition with registral space and textural composers such as Ligeti, Kotonski, and Penderecki is that Takemitsu finds a qualified, near tonal sonority to serve the same purpose. True, there are instances of this in Ligeti, but there it is an affectation. Here the technique is used consistently as part of the main stream.

Figure 15.7. Pitch structure of sonorities in the fourth (middle) phrase.

The figure displays two systems of musical notation, each consisting of a treble and bass staff. The first system begins at measure 40. Above the treble staff, the labels 'chromatic', 'chromatic', 'chromatic', and 'triadic' are positioned over measures 40, 41, 41, and 42 respectively. A dashed line labeled '8va' spans from the first 'chromatic' label to the second. Above the bass staff, the labels 'diatonic' and 'diatonic' are positioned over measures 41 and 42. The second system begins at measure 43. Above the treble staff, the labels 'chromatic', 'triadic', 'diatonic', 'chromatic', 'triadic', and 'chromatic' are positioned over measures 43, 44, 44, 45, 45, and 45 respectively. A dashed line labeled '8va' spans from the first 'chromatic' label to the second. The bass staff of the second system shows additional notes below the staff line.

As mentioned at the outset, in November steps one often observes simultaneous layers of measurable change in several parameters at the local level. A large quantity of information is condensed into a short time span. The number of parameters, the rate of change, and a tendency towards linear growth and decay as opposed to sudden shifts is a signature of the Takemitsu sound. Superimposition of contrasting envelopes of sonority are demonstrated in the short phrase first phrase starting in measure 36. It is divisible into a three stage envelope labelled 36a, 36b, and 36c, comprised of three different dynamic shapes in four parameters of sonority. The movement in registral extremes (figure 15.3) places the top and bottom voices in contrary motion, flaring open from high to upper-mid and low registers. In contrast, a rising and falling "spike" pattern occurs in both the parameters of number of active registral regions (15.5), and the number of individual timbres (figure 15.4). The number of registers moves from three to five to two, while the number of timbres moves from one to six to two. As a third tendency, the total number of tones decreases from ten to nine to two.

Figure 15.8 Contrasting dynamic shapes in the first phrase.

Contrary Motion
- registral extremes

Rising and Falling
- number of active
registral regions
- number of timbres

Decreasing Only
- number of notes.

The rapid transformation in the number of timbres bears closer inspection. From a timbral perspective the phrase undergoes a transition from strings to brass, passing through a transitional mixed-family state where string, brass, and harp and percussion are present. (Figure 15.6) It is a three stage timbral envelope which moves in parallel to the three stage transitions in registral extremes and number of notes.

The discussion thus far has focussed upon statistical differences and transitional states between phrases through analysis of sonority. The ultimate controlling variable in the passage, however, has nothing to do with sonority. The listener's ear is ultimately tuned to the slow passage of melody. More accurately, direction and continuity are achieved through counterpoint between the highest and lowest notes of each sonority. Figure 15.9 is a reduction of the pitch extremes throughout the phrase while in figure 15.10 each pitch is transposed within a single octave span in the mid register. The predominance in tied notes occurring in an almost unbroken chain in figure 15.10 illustrates the degree to which Takemitsu is dependent on registral transfer of specific pitch classes to achieve continuity

through the movement.⁵ Secondly, the most common absolute intervals between soprano and bass are thirds, sixths, and fifths, which are familiar as the basic consonant intervals employed in first species counterpoint. Though thoroughly disguised by registral transfer and all the other manipulations in sonority, this middle ground counterpoint gives the music a familiar quality and a very deep sense of logic and control.

Figure 15.9. Highest and lowest notes of sonorities.

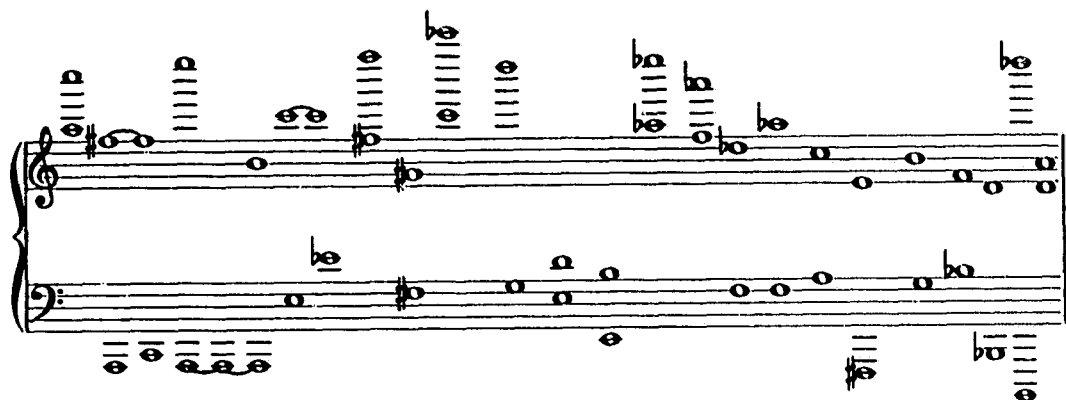
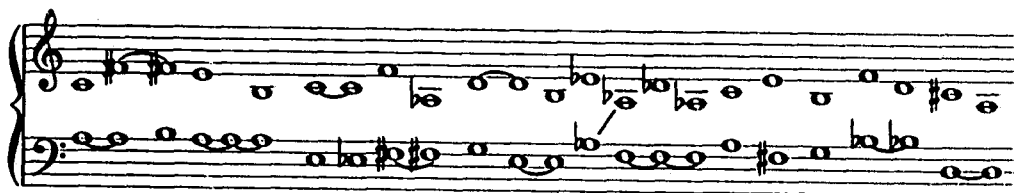


Figure 15.10. Highest and lowest notes transposed as first species counterpoint.



A final comment concerns specific pitch structures of some of the basically triadic harmonies which occur in the passage. Figure 15.11 presents the sonorities occurring at measures 36b, 37, 42a, and 43b. As discussed earlier, Takemitsu moves through triadic sonorities as part of a process of registral spacing, permitting clearer perception of inner voices. But it is in these triadic sonorities that his lingering affiliation with remnants of functional harmony are exposed. Allowing for a certain degree of arbitrariness, some chords may be associated as highly embellished functional harmonies. The chord in measure 36b may be thought of as a C altered dominant seventh. The sonority in measure

37 might be interpreted as a D7 chord in second inversion, as in a dominant pedal. The sonority in measure 42 is highly reminiscent of a G half diminished seventh, while the harmony of 43b could easily be interpreted as an F altered dominant seventh. What they all seem to have in common is that they are traditional "penultimate" harmonies containing at least one tritone. For ears educated in the western tradition such sonorities have strong connotations of unresolved tension. This may assist in generating forward momentum in music with an absence of rhythm.

Figure 15.11. Triad-based sonorities in measures 36b, 37, 42a, and 43b.

The figure displays four measures of music on a grand staff. Above each measure is a circled label: 36b, 37, 42a, and 43b. Below each measure is a chord symbol: C7alt, D7/A, Gm17(b5), and F7alt. The notes are as follows:

- Measure 36b: Treble clef has notes G4, B4, D5; Bass clef has notes C3, E3, G3.
- Measure 37: Treble clef has notes D4, F#4, A4; Bass clef has notes D3, F#3, A3.
- Measure 42a: Treble clef has notes G4, Bb4, D5; Bass clef has notes G3, Bb3, D4.
- Measure 43b: Treble clef has notes F4, Ab4, C5; Bass clef has notes F3, Ab3, C4.

Takemitsu's music is often characterized as a blend of Eastern and Western European aesthetics. The strongest Eastern adaptation, besides the use of traditional instruments, is the suppression or absence of "purpose". It is not goal oriented music in which some conflict must be resolved. Certainly the changes in sonority and melody create a naturally dynamic music, with a tempo perhaps rooted in the ebb and flow of breath. But the ultimate effect is simply of sustained mood, a meditation. Takemitsu once said, " Sound may be beautiful without making sense. The quality of the music is thus elusive. One must absorb and accept, but not necessarily understand." ⁶ Curiously, this type of statement could easily have come from Morton Feldman. Both use sonority as a means to a slower, deeper mode of listening. The single element which separates Takemitsu from all others in the post

serial era is a return to and wholesale exploitation of melody. In this respect Takemitsu is solidly in a Western mode of thought. Specifically, melody which dominates chordal sonorities largely emanating from the Western tradition shows the direct influence of Messiaen. The difference is a much slower, suppressed approach to rhythm, and the incorporation of dynamic change in timbre during the course of a melodic span, rather than in sequential or alternating gestures. The most remarkable feature of *November Steps* is that it achieves a subtle sense of tension and relaxation, a gentle flow to and from points of articulation and phrasing even though pulse and rhythm are all but eliminated.

Footnotes

1. Thirteen Steps Around Toru Takemitsu , (Video)Vol. 4 of series " From East to West". (London: British Broadcasting Corporation, 1986)
2. As an interesting twist, it is the inharmonic spectra which seems to be functioning as a "tonic" sonority, if one allows a traditional interpretation of a rounded binary form.
3. In an indirect way this reveals the continuing influence of traditional functional harmonies on Takemitsu, however watered down or disguised they may be
4. If one were further to apply the concept of critical bandwidth to the section, movement from chromatic to quasi triadic sonorities results in the perception of independent inner voices instead of a totality, a movement from monophony to polyphony. One is likely also to perceive the triadic sonorities as Louder than the cluster sonorities.
5. From this point of view Takemitsu is perhaps not as far removed from Feldman as originally thought
6. Thirteen Steps Around Toru Takemitsu , (Video)Vol. 4 of series " From East to West". (London: British Broadcasting Corporation, 1986)

16. Pierre Boulez. *Pli Selon Pli*, Movement I, "Don" (1967)

"Don" is the first movement of Boulez' monumental work *Pli Selon Pli*, subtitled *Improvisations on Mallarme*. It difficult to discuss sonority in much of Boulez' music. His boldest innovations lie in the area of rhythm and pieces are typically saturated with rhythms of almost unperformable complexity. Most of the first movement of *Pli Selon Pli*, however, is composed of homophonic, sustained chords enabling a clearer perception of changes in timbre, density, and interval content. Boulez controls finer aspects of sonority such as the number of instruments of a given family, the total number of tones, and timbral voicing, and in so doing defines cohesive units corresponding to the phrase level. Repetitions or clear variations of these processes and timbral configurations then define the overall structural form. A formal approach based upon the sequence and repetition of contrasting small units clearly shows the influence of Messiaen. However, Boulez is also motivated by the notion of total symmetry and the rational justification of the smaller parts to the whole found in Webern's twelve tone period. *Pli Selon Pli* stands as a synthesis of these two primary influences, a byproduct of which is the heightened role and controlled application of sonority.

Boulez is the quintessential serialist, which generally refers to a mathematically inspired compositional approach of permutation extended to parameters other than in the pitch domain. He divulges many of his preferred techniques in *On Music Today*. With respect to sonority he states:

It is important to choose a certain number of basic concepts having a direct relationship with the phenomenon of sound, and with that alone, and then to state postulates which must appear as simple logical relationships between these concepts, independent of the meaning attributed to them.¹

In spite of Boulez' renowned verbosity his permutational approach may basically be reduced to two conditions: Values in a given parameter will either remain static or will undergo change. As for parameters having a direct relationship with sound, this would include timbre, register and the number of notes. Boulez separates timbre into two families, Non evolutionary (or of limited and homogeneous evolution) and Evolutionary. He further divides the evolutionary group into two sub categories:

①E7 ①E8 ①E9 ①E10

Musical score for measures E7-E10. The score is written for two systems of staves. The first system consists of a grand staff (treble and bass clefs) with various instrument parts. The second system consists of two staves, likely for woodwinds and percussion. Measure E7: Treble clef has notes for fl, ob, and fl. Bass clef has notes for kl, Afl, Bkl, fg, and pz. Measure E8: Treble clef has notes for vlnpz. Bass clef has notes for via and pz. Measure E9: Treble clef has notes for vlapz and vlc pz. Bass clef has notes for vln, via, ob, Bkl, fl, kl, fg, and hn. Measure E10: Treble clef has notes for fl, hn, fg, hn, Afl, hn, and Bkl, hn. Bass clef has notes for Chimes.

①E11 ①E12 ①E13

Musical score for measures E11-E13. The score is written for two systems of staves. The first system consists of a grand staff (treble and bass clefs) with various instrument parts. The second system consists of two staves, likely for woodwinds and percussion. Measure E11: Treble clef has notes for kl, vlnpz, and vlapz. Bass clef has notes for via, vln, fg, and via. Measure E12: Treble clef has notes for ob, vln, via, ob, Bkl, fl, kl, fg, and hn. Bass clef has notes for harp, vln, pno, vln, pno, vb, and vln. Measure E13: Treble clef has notes for fl, ob, kl, and via. Bass clef has notes for harp, vln, pno, vln, pno, vb, and vln.

The image displays musical notation for Boulez's 'Step' in the domain of timbral change. It consists of two systems of staves. The first system covers measures E14, E15, E16, and E17. The second system covers measure E11. The notation includes various instruments and their parts, with dynamic markings and articulation symbols.

Measure E14: Flute (fl), Alto Flute (Afl), Violin parts (vln pz), Horn (hn), and Trombone (tbn).

Measure E15: Violin parts (vln pz), Viola parts (vln pz), and Trombone (tbn).

Measure E16: Trumpet (tpt), Violin parts (vln), Violin parts (vln pz), Viola parts (vln pz), and Trombone (tbn).

Measure E17: Violin parts (vln), Violin parts (vln pz), Viola parts (vln pz), and Trombone (tbn).

Measure E11: Harp, Violin parts (vln), Piano (pno), Violoncello (vb), and Xylophone (Xyl).

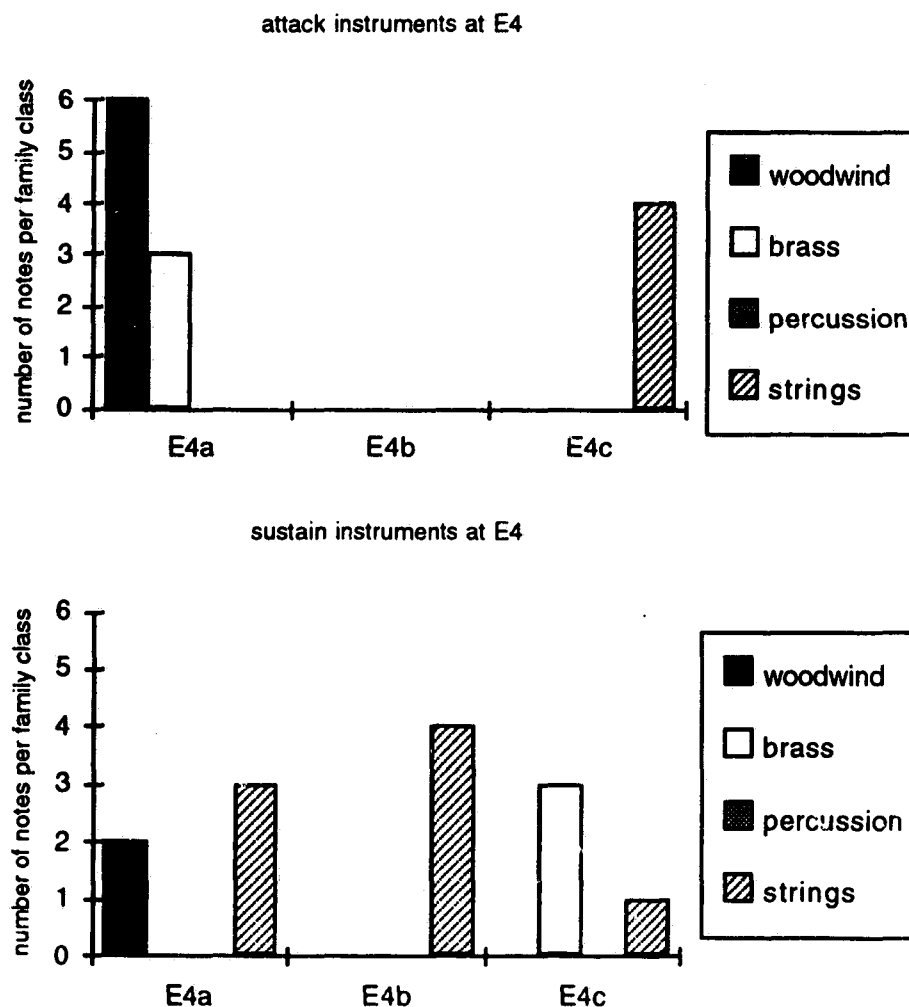
In effect Boulez is attempting to clarify the notion of "step" in the domain of timbral change, a concept first suggested by Schoenberg and which continues to elude composers.³

A discussion of the short phrase at measure E4 serves to clarify some of Boulez' strategies with respect to sonority and descriptive terminology. The number of sustaining tones remains at four in each of the three parts of the phrase. It is a non-evolutionary parameter. If one combines attack and sustain timbres one observes that the number of tones belonging to instruments of the string family moves from three, to four, and to five. In other words, the parameter of "number of string tones", proceeds by limited and homogeneous evolution, and would also be termed non-evolutionary.

The number of tones per instrumental family in the phrase (only one measure in total) are given in figure 16.2 . There is movement throughout the measure from three strings, three brass, and six woodwinds, to four strings alone, and finally to three brass and five strings. In each case the number of tones played by new timbres remains less than the number in common between the two. Changes in timbre by family class may therefore be said to proceed by conjunct motion. There are also interesting symmetries within the measure. E4a contains three sustaining pitches on one timbre, in this case belonging to the string family, which are masked by the entries of brass instruments. In E4c the situation is reversed. Three tones are sustained by brass instruments, which are masked by attack pitches from the string family.

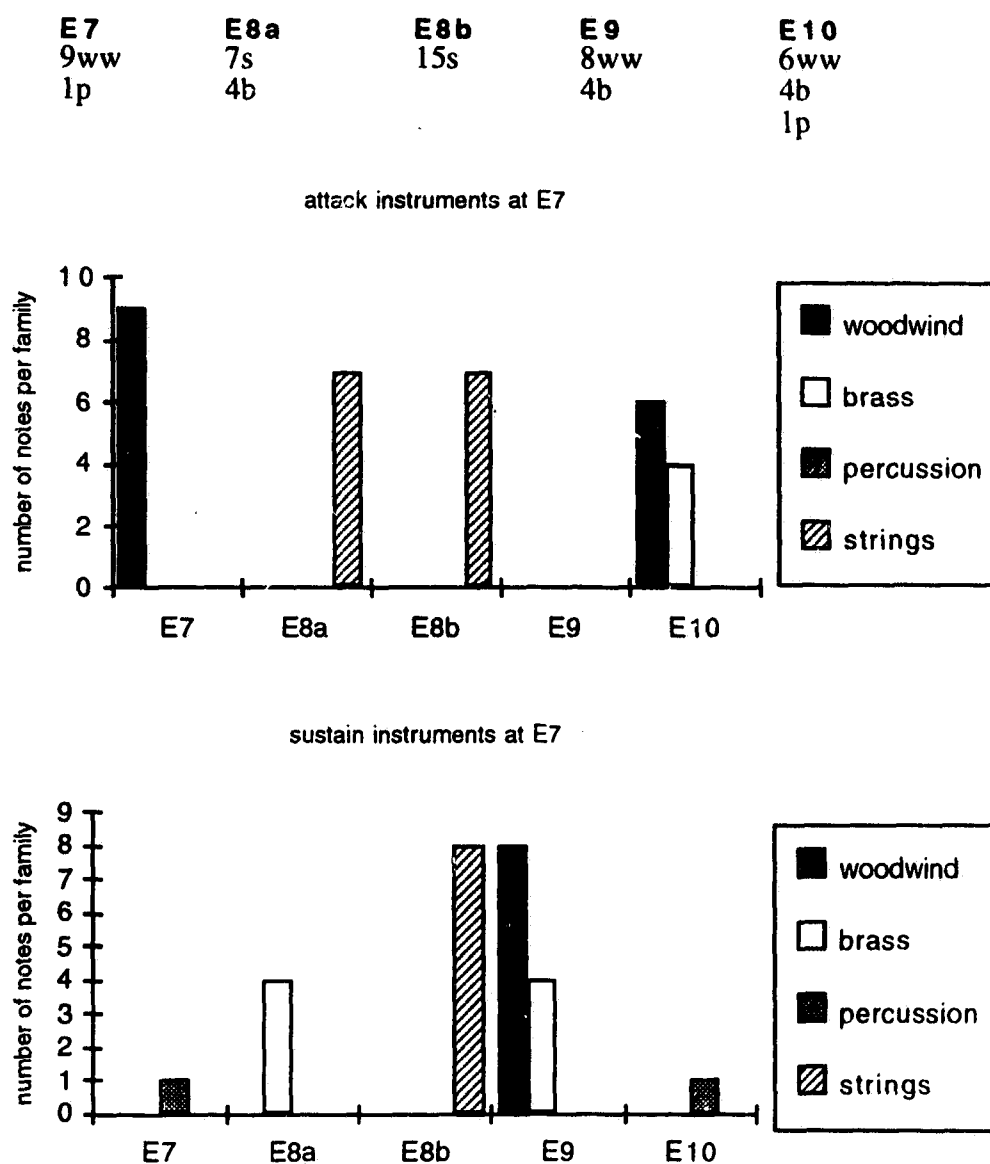
Figure 16.2. Number of tones per family in measures E4a - E4c.

	E4a	E4c
attack:	brass, two timbres	single string timbre(vlc pizz)
sustain:	3 pitches in one string timbre	3 pitches in brass, two timbres



Boulez tends to employ quasi-symmetrical relationships such as that above to define subphrase boundaries. Measures E7 and E10, like E4a and E4c, suggest a symmetrical relationship in that both measures contain a sustained chimes pitch masked by a large mixed ensemble sonority.⁴ By their commonalties, one could characterize the progression from E7 through E10 as having limited and homogeneous evolution. Through the phrase the number of sustaining tones moves from one to four, to eight, and back to one. While there is growth and decay in the number of notes timbral changes are not as obvious. The number of notes per family are summarized in figure 16.3 below.

Figure 16.3. Number of Tones per family in measures E7-E10.



Curiously, this phrase also contains a homogeneous string sonority in the center, as was the case with measure E4. The timbral motion clearly appears to be disjunct, but may in fact be "displaced" conjunct motion. If the string sonorities are removed, and measure E8a combined with E7, there is little change. Boulez has inserted a string "tangent" in what would otherwise be virtually static sonorities.

Figure 16.4 Modification of E7- E10.

E7	E9	E10
9ww	8ww	6ww
4b	4b	4b
1p		1p.

In any event, the passage demonstrates a consistency in the treatment of timbral resources measured in concrete quantitative terms. Local processes and later variations are based on counting the number of things rather than on subjective quality.

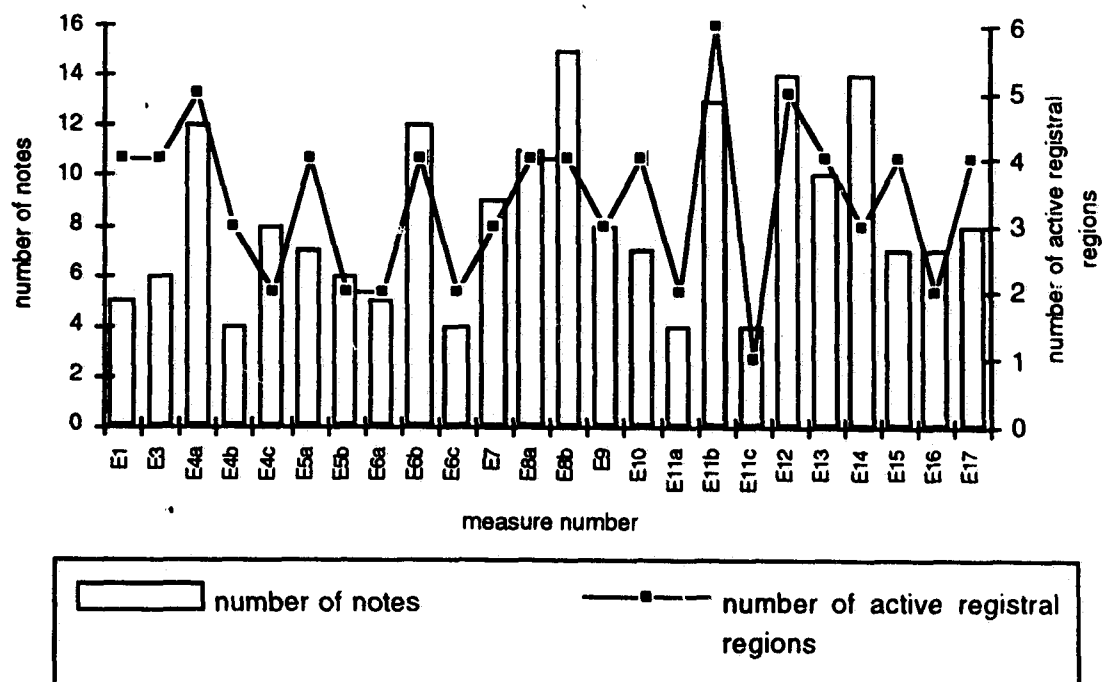
In contrast to phrases involving conjunct evolution in timbre, wholly homogeneous phrases focus more deliberately upon other aspects of sonority such as register and spacing, and the number of tones. In measure E6 the timbres are taken only from the percussion group.⁵ In terms of the number of notes the gesture moves from five to twelve and back to four, or an irregular arch form. The number of active registers, indicative of the spacing and registral span of the sonorities, moves from three to four to two, again an irregular arch form. (figure 16.5)

The notion of disjunct and conjunct motion is also extended to the intervallic makeup of sonorities. The characteristic intervals of the sonorities in phrase at E6 are summarized in figure 16.6 below.

Figure 16.6 Specific intervals in measure E6.

P4	m2	m2
P4	m2	m2
m2	m2	TT
M2	m3	
	M2	
	m2	
	m2	
	m3	
	P5	
	M2	

Figure 16.5. Number of notes and number of registral regions.

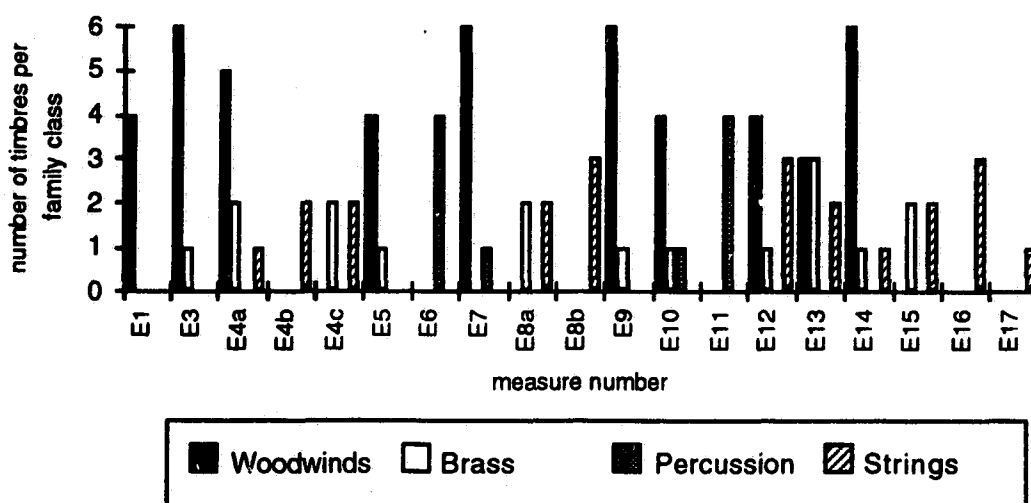


Again, an irregular arch form is apparent. Moreover, there is a kind of inversion between the first and last sonorities in terms of the placement of the larger interval, not unlike the inversion occurring between the first and last sonorities of E7 and E10. The movement of intervals to and from the middle sonority is conjunct. There are two new intervals, the minor third and perfect fifth, but also two intervals in common, the major and minor second. Boulez' quantitative approach in all parameters of sonority, including the interval collection, permits complete and rational control of change in sonority for the first time. From a listener's perspective, however, it is difficult to establish a focal point for one's attention. Whereas Takemitsu tends to rely on melody, and Ligeti on linear change in register, Boulez does not appear, initially at least, to employ any longer range or continuous processes to engage the listener.

It is clear that the entire passage from letter E to the end is made up of short sub-phrases of one to three measures in length, each which display some level of timbral homogeneity. What is unexpected, however, is the thread of timbral continuity which runs almost throughout the entire section. It is timbre, not register or note density, which is intended as

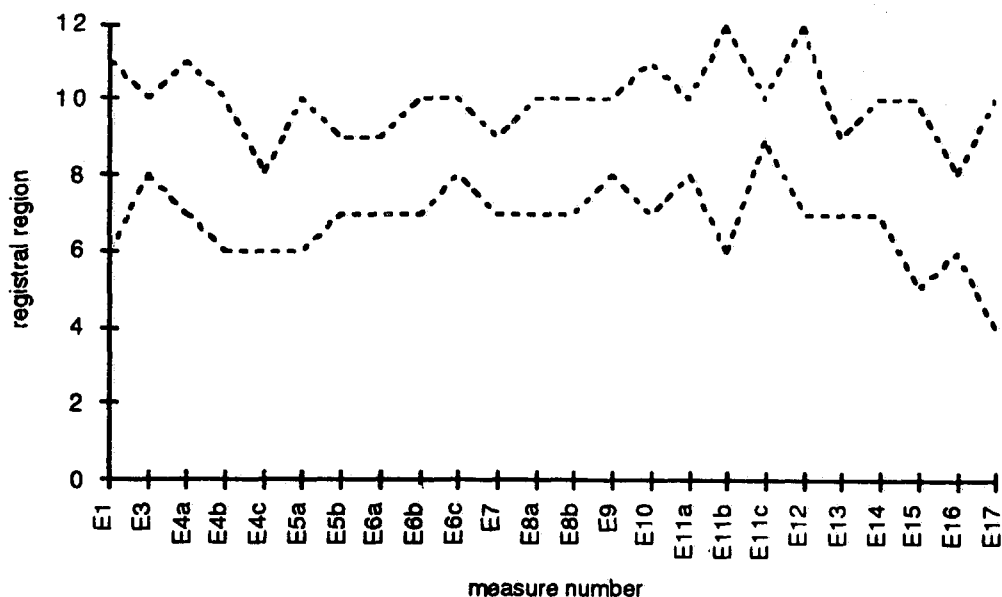
the primary focus and which emerges as a long range, continuous process. With the exception of the percussion figures in measures E6 and E11, figure 16.7 reveals how sonorities in every measure retain some degree of timbral homogeneity with the previous measure. The appearances of percussion instruments serve as points of structural division. Measures E6 and E11 clearly serve to divide the section into a three part ABA form. In terms of the family class distribution within the above dimensions there is a quasi symmetrical relationship between the first and last phrases. Both are weighted first to the woodwinds and then to the strings.

Figure 16.7. Timbral flow of entire section, letter E to the end.



Boulez' priority with respect to sonority in this last section of Don is to timbre, with register and number of notes being secondary considerations. The overall movement in registral extremes, figure 16.8, is striking in its lack of variety. The registral spans are consistently between two and three registral regions. Where there is motion, be it contrary or parallel, the "step" is consistently one or two registral regions only. There are no abrupt changes in register. Register would then be described as "non-evolutionary", and imparts an even greater significance to the timbre changes.

Figure 16.8. Movement in Registral Extremes



The number of notes per sonority ranges from four to fifteen, and seems to oscillate in a consistent fashion. (figure 16.5) It is interesting, however, that with the exception of measures E6b and E11b, each increase in the number of tones never exceeds twice that of the previous measure. This would be consistent with Boulez' postulate that for conjunct motion new values in a sonority must be less than or equal to the number of values in common. For example, movement from six to twelve notes is still conjunct motion but moving from six to thirteen notes would be disjunct. Disjunct steps in number of tones at measures E6b and E11 occur, significantly, in the middle of the percussion subphrases, which are timbrally homogeneous.

Registral density in terms of the spacing or the number of registers articulated by a given sonority also changes at the chord-to-chord level. (figure 16.5) But the pattern that emerges is not some overall progression from lower to higher, but rather a consistent (or limited evolutionary) alternation between sonorities articulating two or four registral regions. The number of registral regions is a parameter of foreground interest only. By repetition, Boulez establishes this alternation as a consistent "step" in the domain of registral density. Again, these measures are likely taken to ensure that linked progressions in the area of timbre, the only long-range continuous process, are more clearly perceived.

In *Pli Selon Pli*, Boulez succeeds in defining and controlling the properties of sonority for the first time in a post-tonal language. It is the first serious attempt at a logic of progression in timbre change and other parameters of sonority. In *Harmonielehre* Schoenberg speculated on a logic of Klangfarbenmelodie similar to the logic of pitch melody. The key to unlocking this riddle is to find an appropriate measure of "step" and "leap" in the timbral domain. Boulez' postulate concerning evolutionary and non-evolutionary disjunct and conjunct motion is a noble attempt at a solution. The problem, obviously, is that quantitatively equal measurements in the number of tones by timbre are not necessarily perceptually equal in the ears of the listener. In spite of linear timbral connections between most sonorities in the section, one cannot follow the line. Perhaps in time, with ears more attuned to timbrally motivated composition, the line will emerge with absolute clarity. The piece nonetheless remains of huge importance in that the parameters of sonority are fully integrated and emancipated as musical subject, not as an adjective for a rhythmic or melodic gesture.

Footnotes

1. Pierre Boulez, *On Music Today*, trans. Susan Bradshaw and Richard Rodney Bennet, (Cambridge: Harvard University Press, 1973) p. 31.
2. Pierre Boulez, *On Music Today*, p. 62.
3. There is an additional technique prevalent in the movement which involves a division of orchestral forces for the attack and sustaining portions of the sonority. Specifically, the attack instruments will "mask" the entrance of the sustaining instruments, resulting in a complex, dynamic timbral shape. In psychoacoustics, the ability of one sound to mask another is due to the presence of the masking tone in the same critical band as the original tone. For the middle range the critical band interval is believed to be in the neighborhood of a minor third. Masking and the critical band are discussed in the last chapter.
4. In E7 all attack pitches are situated lower than the chimes, while in E10 they are ordered above, perhaps suggestive of a reinforced chimes spectrum. It is still the same timbres, however. It is also the only use of chimes in the last section, perhaps suggestive of a kind of structural midpoint.
5. Arguably, there may be limited timbral motion with the addition of the harp for the middle sonority.

**17. Steve Reich. Variations for Winds, Strings, and Keyboards. (1970)
First Variation.**

Reich's music belongs to the so called minimalist school of American contemporary music in the 1970s. With the intent that the listener perceive each and every change in the music upon first listening both the rate of change and number of parameters undergoing change are dramatically reduced. This second wave of American minimalism is also characterized by a return to both the harmonies and limited functions of tonal music.¹ While many would discredit the approaches of Reich and others such as Phillip Glass and Terry Riley as banal and naive, the unabashed return of tonal harmony in their work may be viewed as a logical and possibly inevitable consequence of developments in the application of sonority in preceding decades. Reich's Variations are constructed through superimposed layers of arpeggiated ostinato material and chordal pad material. As a result of these superimposed layers, a single sonority, often a jazz inspired or mode derived harmony, is prolonged for several measures before transforming into a closely related sonority. The principal generative device in the work is to change one, or possibly two, pitches in the sonority while keeping the majority intact, a kind of common-tone modulation. In the slow sequence of sonorities Reich takes advantage of contrasts in the modality of sonorities, a technique which originated with Debussy. Of greater significance, however, are the underlying root progressions which often suggest a circle-of-fourths motion.² With Reich, and a return to an exposed derivative of functional harmony, the compositional application of sonority has come full circle.

Timbre changes in the first variation are restricted to three basic orchestrational groups. From a thematic standpoint the first group is responsible for the ostinati arpeggiations. The other two groups simply perform sustained pad material. Of all parameters in the first variation timbre change is the least eventful. Certainly the rarity of timbral change suggests structural articulation with each occurrence, yet surprisingly no clear overall pattern emerges.(figure 17.2) All of the rhythmic ostinati and arpeggiation are played by the flute, organ, and piano, or oboe, organ, and piano. Changes between flute and oboe occur at measures 49, 71, 91, subdividing the whole into four large sections. The second orchestrational group is a sustained pad played by organ, violin, viola, and cello. There are no dramatic changes in the make-up of this first pad group, but the small changes which occur in the number of sustaining tones are of passing interest in a minimalist environment.

Figure 17.1. Reich. Variations for Winds, Strings, and Keyboards
Beginning until variation II. (m. 145)

Ostinato.Fl,
org, pno.

Pad 1. org,
vln, vla

org, vln,
vla, add

1	3	5	7	9	11
Ebmaj9/G	Ebmaj9/D	Cmi11	Cmi11	Cmi11	Fmi11/C
G Aeolian	G Aeolian D Phrygian	G Aeolian C Dorian	G Aeolian C Dorian	G Aeolian C Dorian	G Aeolian C Aeolian

13	17	20	23	24
Abmaj9/C	Fmi11/C	Ab13/C	Dbmaj7/C	Bmaj7 (#11)
G Aeolian C Aeolian	Fmi pent. C Aeolian	Fmi pent. C Locrian	F Locrian C Locrian	F Locrian B Ionian

25	28	30	32
Bmaj7 (sus)	Bmaj7 (sus)	Bmaj7 (#11)/F#	Bmaj7 (#11)/F#
D# Phrygian B Ionian	D# Phrygian B Ionian	D# Phrygian (B Lydian)	F Locrian (B Lydian)

37	38	39
C#9/F	Bmaj9/D#	Bmaj7 (#11)/F#
F Locrian	F Locrian D# Aeolian	F Locrian (B Lydian)

41 Pad 2. tpt, tbn, cbs, tuba

41 G#mi11
F Lociran (Phrygian)

43 G#mi11
F Lociran (Phrygian)

47 G#mi11
G# Dorian

tpt
tbn
cbs
tuba

Ostinato: Oboe and organ.

49 G#mi11
D# Phrygian
G# Aeolian

51 Emaj9
D# Phrygian
G# Aeolian

58 Bmaj9(#11)
D# Phrygian
G# Aeolian

66 G#mi11
D# Phrygian
G# Aeolian

Ostinato: fl, org., pno,

67 F#maj7(sus)
D# Phrygian
G# Aeolian

71 F#maj7(sus)
C# mi Pent
G# Aeolian

74 G#mi11
C# mi Pent
G# Locrian

75 E9(sus)
C# mi Pent
G# Locrian

Ostinato: oboe, org.

82 Amaj7(sus)
C# mi Pent
A Ionian

83 A6
D Pent.
A Ionian

85 Ami6
D Pent.
A Dorian

87 Bmi11(b9)
D Pent.
A Dorian

91 Bmi11(b9)
D 4note
A Dorian

94 96 99 103 106

Fmaj13 (#11)/A D 4note A Aeolian

F maj13/A (C Pent.) A Phrygian

C9(sus) (C Pent.) A Phrygian

C9(sus) (Bb Pent.) A Phrygian

A dim. (Bb Pent.) A Locrian

108 112 115 123 125

Ebmaj9/G (Bb Pent.) G Aeolian

Ebmaj9(#11)/G (Bb Pent.) G Aeolian

Cmi11 (Bb Pent.) G Aeolian

Cmi11/G G Aeolian

Abmaj7(#11)/G G Aeolian

G Phrygian

cbs and tuba

127 129 136 138

Fmi11 G Aeolian F Dorian

Abmaj9 G Aeolian F Dorian

F13(sus) (G Aeolian (Bblonian))

Ebmaj9/G G Aeolian G Aeolian

140 142

Cmi11 G Aeolian G Dorian

Abmaj13(#11)/C G Aeolian C Aeolian

Figure 17.2 Points of structural articulation by timbre change

Changes in Ostinato		49		71		91		
Pad 2 (Brass) Entries	41		51	67	75	87	99	115 129

The third orchestrational group consists of brass instruments.³ Entries for the sustaining pads from this group are intermittent, occurring at measures 41, 51, 67, 75, 87, 99, 115, and 129. The brass entries appear to serve two functions: First, periodic entries by a consistent instrumental group, especially when coupled with a consistent registral shift, serves to punctuate the flow of events into sections. Secondly, trombone and tuba pitches in the vacant low register immediately clarify the harmony. Though a subjective measurement, the harmonies articulated by the brass entries will be perceived as more stable or emphatic than the remaining harmonies sustained by the ostinato and first pad groups alone. Conventional wisdom suggests one look for structural patterns in sectional divisions at the next hierarchical level. Structural patterns based on timbral groups appear to be non-existent in the first variation. There is no correlation in the timing of changes of the two streams. A strong articulation such as a brass entry or change to oboe serves only to mark the end of a given time and to refresh the ear.

The actual vocabulary of sonorities, properly termed harmonies in this context, reveal sensitivity to chord quality and probable knowledge of jazz theory. Figure 17.3 presents probable chord symbol, chord inversion, mode or modes implied by the collection of ostinato and pad 1 pitches, and a probable indication of key areas through the entire first variation. The movement is dominated by the alternation of two basic chord types; the major seventh chord (often with the #11) and the minor eleventh chord. As any jazz musician will tell you, the advantage of these sonorities is that there is little if any distinction between chord tones and passing tones. Virtually all pitches of the corresponding mode will be perceived as consonant.⁴ The predominance of these two sonorities is beneficial for two reasons. First, the listener's attention is not diverted by melodic tension at the musical surface. The smallest perceptual units default to the phrase level which assists in sustaining a long, gradual process. Secondly, the music attains just the right amount of variety in the slow oscillation from "major" to "minor", appealing to even the most naive of listeners. While more than one mode is often suggested, Reich ensures that superimposed modes "agree" by omitting pitches which conflict.⁵

Figure 17.3. Summary of chords, modes, and suggested key areas.

<u>Ms.Numb.</u>	<u>Chord Symbol</u>	<u>Inversion</u>	<u>Modes</u>	<u>Possible Key</u>
1	Ebmaj9/G	1st	G Aeolian	Bflat
3	Ebmaj9/D	Voice Leading	G Aeolian D Phrygian	Bflat
5	Cmi11	Root	G Aeolian C Dorian	Bflat
7	Cmi11	Root	G Aeolian C Dorian	Bflat
9	Cmi11	Root	G Aeolian C Dorian	Bflat
11	Fmi11/C	2nd	G Aeolian C Aeolian	Eflat
13	Abmaj9/C	1st	G Aeolian C Aeolian	Eflat
17	Fmi11/C	2nd	Fmi pent. C Aeolian	Eflat
20	Ab13/C	1st	Fmi pent. C Locrian	Dflat
23	Dbmaj7/C	Voice Leading	F Locrian C Locrian	Dflat
24	Bmaj7(#11)	Root	F Locrian B Ionian	Gflat
25	Bmaj7(sus)	Root	D# Phrygian B Ionian	B
28	Bmaj7(sus)	Root	D# Phrygian B Ionian	B
30	Bmaj7(#11)/F#	2nd	D# Phrygian (B Lydian)	F#
32	Bmaj7(#11)/F#	2nd	F Locrian (B Lydian)	F#
37	C#9/F	1st	F Locrian F Locrian	F#
38	Bmaj9/D#	1st	F Locrian D# Aeolian	F#
39	Bmaj7(#11)/F#	2nd	F Locrian B Lydian	F#
41	G#mi11	Root	F Locrian (B Lydian)	F#
43	G#mi11	Root	F Locrian (B Lydian)	F#
47	G#mi11	Root	F Locrian G# Dorian	F#
49	G#mi11	Root	D# Phrygian G# Aeolian	B
51	Emaj9	Root	D# Phrygian G# Aeolian	B
58	Bmaj9(#11)	Root	D# Phrygian G# Aeolian	B
66	G#mi11	Root	D# Phrygian G# Aeolian	B
67	F#maj7(sus)	Root	D# Phrygian G# Aeolian	B
71	F#maj7(sus)	Root	C#mi pent.	A

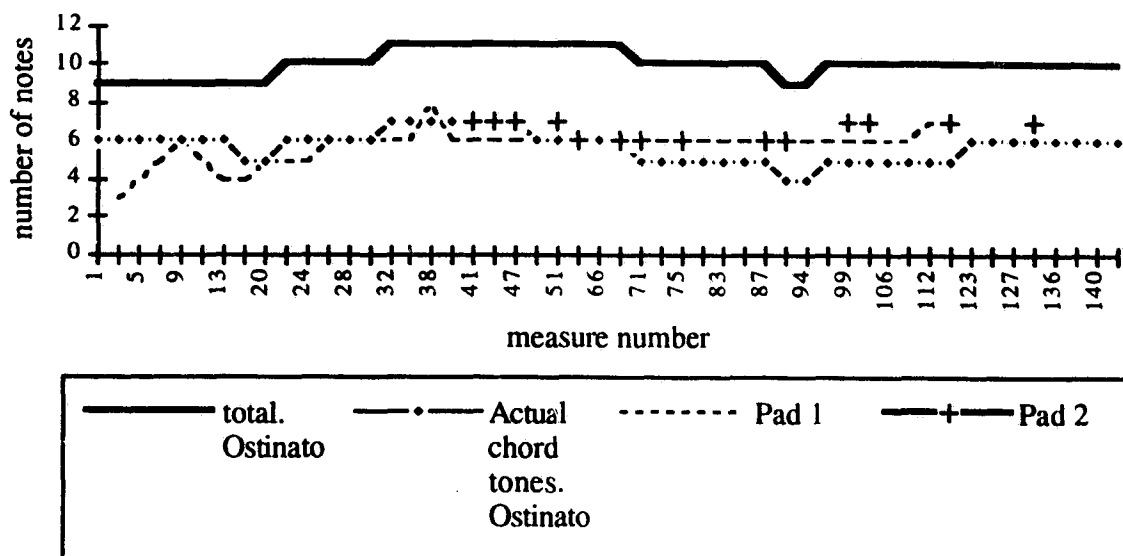
74	G#mi11	Root	G# Aeolian C#mi pent.	A
75	E9(sus)	Root	G# Locrian C#mi pent.	A
82	Amaj7(sus)	Root	G# Locrian C#mi pent.	A
83	A6	Root	A Ionian D Pent.	D
85	Ami6	Root	A Ionian D Pent.	G
87	Bmi11(b9)	Root	A Dorian D Pent.	G
91	Bmi11(b9)	Root	A Dorian D 4 note	G
94	Fmaj13(#11)A	1st	A Dorian D 4 note	C
96	Fmaj13/A	1st	A Aeolian (C Pent.)	F
99	C9(sus)	Root	A Phrygian (C Pent.)	F
103	C9(sus)	Root	A Phrygian (Bb Pent.)	F
106	A dim.	Root	A Phrygian (Bb Pent.)	Bflat
108	Ebmaj9/G	1st	A Locrian (Bb Pent.)	Bflat
112	Ebmaj9(#11)/G	1st	G Aeolian (Bb Pent.)	Bflat
115	Cmi11	Root	G Aeolian (Bb Pent.)	Bflat
123	Cmi11/G	2nd	G Aeolian	Bflat
125	Abmaj7(#11)/G	Voice Leading	G Aeolian	Eflat
127	Fmi11	Root	G Phrygian G Aeolian	Eflat
129	Abmaj9	Root	F Dorian G Aeolian	Eflat
136	F13(sus)	Root	F Dorian G Aeolian (Bb Ionian)	(Bflat)
138	Ebmaj9/G	1st	G Aeolian	(Bflat)
140	Cmi11	Root	G Aeolian	(Bflat)
142	Abmaj7(#11)/C	1st	C Dorian G Aeolian C Aeolian	Eflat

Two patterns are evident in chord progressions and key areas in the first variation. First, the sequence of key areas is an almost textbook circle-of-fourths progression. The circle-of-fourths is generally considered as the most conventional but most efficient means of

modulating between related key areas. Secondly, natural diatonic harmonies in the order of I_{maj}7, vi7, IV_{maj}7, and ii7 are typically used to prolong a given key area. In conventional functional harmony chord change from I to vi is still considered to be a prolongation of a tonic sonority just as chord change from IV to ii is still a prolongation of a subdominant functioning sonority.⁶ It is significant that dominant functioning harmonies are largely avoided. Dominant and diminished sonorities occur infrequently, at measures 23,37,75,99, 106, and 136. While nothing so banal as a literal dominant-tonic progression occurs in the piece dominant type sonorities nonetheless retain a higher degree of subjective dissonance than the major eleventh and minor seventh sonorities.⁷ The cadential function of the dominant-tonic relationship would produce unwanted segmentation to the movement as a whole. When dominant chord types are employed, the dominant function is typically de-emphasized through the addition of a suspension as in measures 75 and 99, or placed in first inversion as occurs in measures 20 and 37. In other words, while Reich wants the listener to experience, at least in a mild form, the flow of tonal-harmonic motion and circle of fourths key progression, he carefully avoids segmenting the work into a hierarchy of primary and intermediary key areas. The fact that the harmonic flow is continuous, that is without cadence, ensures that harmony not serve a structural function. Reich's finesse in so manipulating the flow of harmony and the superimposition of modes is, one must add, a significant accomplishment.

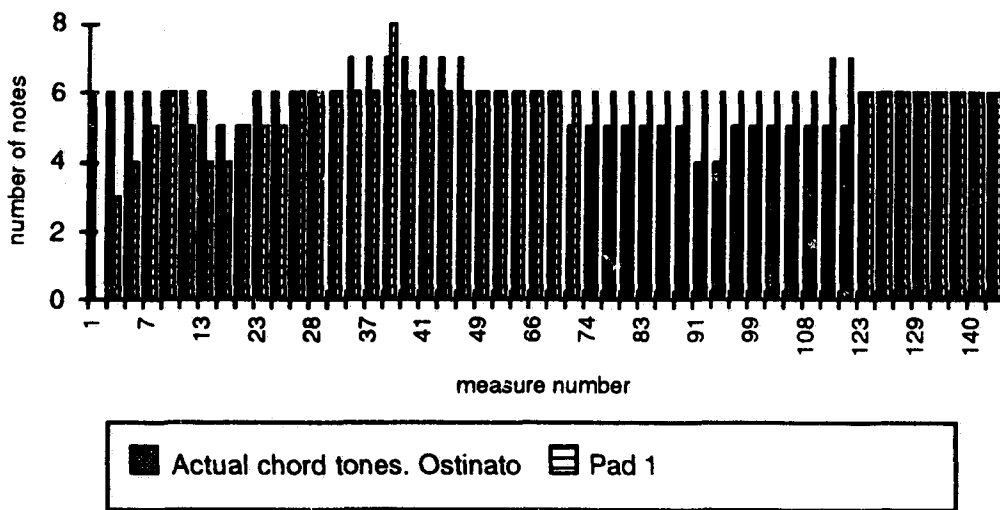
A further qualification to Reich's use of functional harmony is the frequent use of inversions instead of root position, which counteracts the inherent predictability of the chord progressions and the stability of certain chord types. For example, major seventh chords occurring as I or IV in a given key area are usually presented either in first inversion or with a suspension.⁸ It is curious to note the long uninterrupted sequence of root position voicings occurring in the middle of the movement, from measure 41 through 91. It is arguable that a succession of root position voicings in this context forms a cohesive section.⁹ While there are no clear punctuations of formal sections, statistical trends such as the frequency of root position voicings is evidence at least of structural conception.

Figure 17.4 Reich. Number of Notes in Sonorities



Note density is certainly a factor in the first variation. There is more significance to the application of this parameter than the simplicity of the texture would suggest. In a manner which harkens back to Messaien, fluctuations in the number of tones has an immediate impact on the harmonic identification of a given sonority. Specifically, there is a constant fluctuation toward the dominance of either the ostinato or Pad 1 group based on the number of actual chord tones. Figure 17.4 presents the number of tones occurring in each of the three sonority groups while the specific relationship between the ostinato and pad 1 groups is apparent in figure 17.5. Overall variety in the number of notes is extremely limited. Reich's use of density shows no large scale or structural regions. Change in density must be accounted for within the process at the musical surface. One must distinguish between the total number of tones and the number of "chord" tones. The number of actual chord tones in the ostinato exceeds that of Pad 1 until measure 38, but from measures 41-91 the process is repeated in reverse. That is, the number of chord tones in pad 1 exceeds that of the ostinato group, but through a gradual reduction of chord tones in the ostinato, not by adding to the pad. Pad 1 continues its dominance over the ostinato until measure 115, after which both sonorities have the same number of chord tones consistently. It is a minor application, but in a piece which changes so little over time subtle alterations in the relative weight of component sonorities is perceived as part of a dynamic process.

Figure 17.5. Reich. Chord Tones in Ostinato and Pad 1



Measure number	1	41	94	115
Greater number of chord tones	ostinato- Pad 1	ostinato-Pad 1	Pad 1	Even

Figure 17.6. Reich. Register of Pitch Changes

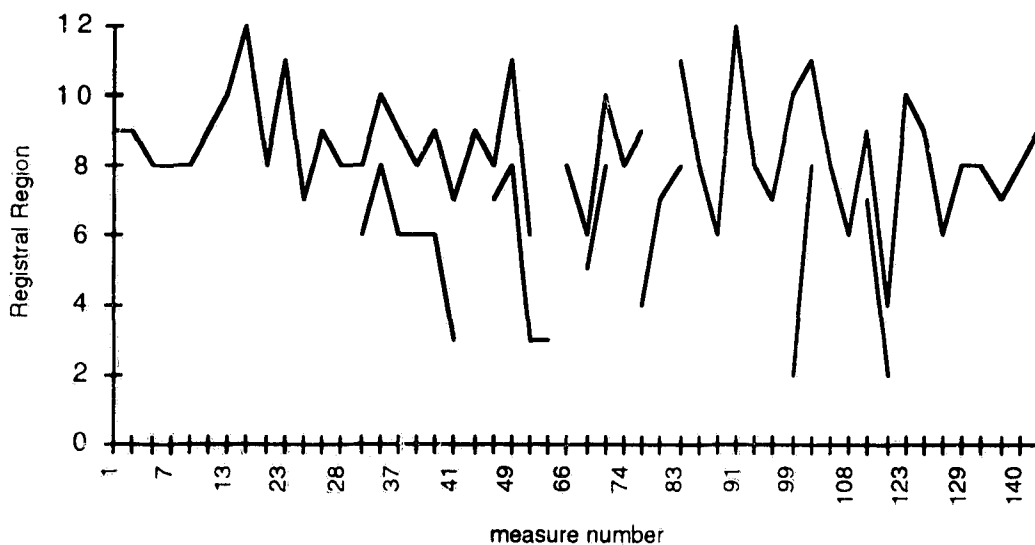


Figure 17.7. Pitch Changes

Musical notation for measures 1 through 23. The notation is on a grand staff with a treble and bass clef. Circled measure numbers are placed above the staff: 1, 3, 5, 7, 9, 11, 13, 17, 20, and 23. The music shows various pitch changes and accidentals across these measures.

Musical notation for measures 24 through 43. The notation is on a grand staff with a treble and bass clef. Circled measure numbers are placed above the staff: 24, 25, 28, 30, 32, 37, 38, 39, 41, and 43. The music shows various pitch changes and accidentals across these measures.

Musical notation for measures 47 through 83. The notation is on a grand staff with a treble and bass clef. Circled measure numbers are placed above the staff: 47, 49, 51, 58, 66, 67, 71, 74, 75, 82, and 83. The music shows various pitch changes and accidentals across these measures.

Musical notation for measures 85 through 115. The notation is on a grand staff with a treble and bass clef. Circled measure numbers are placed above the staff: 85, 87, 91, 94, 96, 99, 106, 108, 112, and 115. The music shows various pitch changes and accidentals across these measures.

Musical notation for measures 123 through 142. The notation is on a grand staff with a treble and bass clef. Circled measure numbers are placed above the staff: 123, 125, 127, 129, 136, 138, 140, and 142. The music shows various pitch changes and accidentals across these measures.

While Reich is considered a minimalist in many respects, he is to the contrary revealed as opulent in his approach to melody. Figure 17.6 is a graphic representation of the register of the pitches which change in consecutive sonorities. The specific pitches which change are given in musical notation in figure 17.7. As a stream of events this is possibly the clearest parameter of focus through the first variation. What emerges can be described as a three part compound melody, alternating high, mid, and low registers. Taken as a linear succession the resulting melodic shape is quite generous.¹⁰

Reich once said, "To facilitate a detailed listening, a musical process should happen extremely gradually. The use of hidden structural devices never appealed to me."¹¹ The importance of the statement lies not in the term "gradually" but in the words process and structure. Anyone can spin out a long, gradual composition. It is Reich's approach to the relationship between process and structure which is of note. Figure 17.8 presents all significant events based on the parameters discussed, including timbre changes and entries, number of chord tones, dominant harmonies, and chord inversions.

Figure 17.8 Summary of important events in various parameters.

	(measure numbers)								
Timbre Change in Ostinato				49		71		91	
Brass Entries		38		51	67	75	87	99	115 129
number of chord tones.			41				94		115
Inversions			41					94	
Dominant Harmonies	27	37				75		99	106

Not surprisingly, there is insufficient agreement between the parameters to ascribe any major structural subdivisions based on sonority. As such, the movement is perceived as continuous with gradual change in sonority felt more as process than structure.¹² Significant events in the parameters above simply mark the passage of time and free the short term memory to experience the next transformation. It is not necessary to hold information in memory for later structural comparison.¹³

At the turn of the century it was Debussy who initiated the separation of sonority from tonal harmonic function. Reich is the first composer to recombine them, not in a style of post modern satire or neo-tonal pastiche but as a positive synthesis. His particular brand of minimalism is both a reaction to, and a refinement of, textural approaches to composition in the preceding decade. The rhythmic vitality and engaging complexity of layered textural

composition is preserved while the compositional value of register and density change are virtually eliminated. After a relatively short vital era, register and density are again replaced by watered down harmonic function. There is no denying that the superficial appeal of the Variations is due to the ever present and vigorous rhythmic interplay. The question arises whether or not a process as gradual as Reich's would be successful in the absence of the forward momentum guaranteed by functional root progression. Probably not. Ultimately the lesson to be learned from Reich is, like it or not, functional harmony remains part of our musical language. There is, even now, utility in harmony, but it must be approached with extreme sensitivity and caution.

Footnotes

1. The term "minimalism" is often used to refer to two separate era's in twentieth century American music. The first wave of minimalism includes Feldman, John Cage, and Christian Wolff, and dates from the early 50s to early 60s. The second minimalist period dates from the late 60s to early 80s, and is generally characterized by the return of tonal harmonies and repetitive interlocking rhythmic arpeggios. The two periods have completely different aesthetic criteria and really should not be grouped under the same term.
2. Circle of fourths motion is mainly found in sequences in classical music but occurs much more frequently in jazz. While it doesn't offer the same pull of functional progression as movement from subdominant to dominant to tonic within a key, it does produce a weaker feeling of logical and inevitable progression between roots. It is a weaker functional harmony.
3. The addition of the contrabass to this group in measure 115 is interpreted simply to shore up the low C in the chord and not a structural articulation based on the addition of a new timbre.
4. George Russell, The Lydian Chromatic Concept of Tonal Organization for Improvisation, (New York: Concept Publications, 1959)
5. For example in measure 11 the active modes are suggested as G Aeolian and C Aeolian. Since an A natural in the G Aeolian mode would conflict with the A flat in the C Aeolian, the A natural is carefully omitted.
6. Felix Salzer, Structural Hearing (New York: Dover Publications, 1962) Salzer maintains that chord "progression" only occurs when chord function is changed.
7. Dominant entries may be regarded as another means of large scale division in the flow of sonorities, perhaps as the harmonic parallel of the eight articulations due to brass entry. In measures 75 and 99 dominant chord types occur as brass entries, arguably strengthening the structural effect at these moments.

8. A fourth type of voicing involves placing the seventh in the bass of a major seventh chord, such as in measure 3 and 23, but is understood as a step-wise voice leading progression in the bass to the arrival of the root of a new sonority.
9. As a curious twist, the region of the most "stable" harmony occurs in the middle section, traditionally reserved for the least stable harmony in tonal music
10. The ultimate reliance on melody which overrides the textural and sonority changes below places Reich, strangely enough, in league with the approach of Takemitsu.
11. Steve Reich, "Music as a gradual process" , rpt. in Michael Nyman, Experimental Music, Cage and Beyond, p. 133
12. If one were to stretch the point one could argue for loose structural divisions clustered around measures 37-41 and 94-99. There may be a rounded binary form at work , but with Reich form more enables the process than process defines the form.
13. As a philosophical position, Reich's commitment to music's experience in real time is more extreme than the approach of Feldman. Often Feldman restates similar sonorities which resonate in the short term memory and are associated with other sonorities in the immediately preceding measures. Surprisingly, a similar position to Reich' is found in the Symphonia of Luciano Berio. Changes in thematic material and texture simply initiate a new section without grouping into higher structural units or an overall shape. The music is to be experienced in real time only.

Conclusions

The set of seventeen works considered in the present study only scratch the surface of the enormous body of twentieth century works which explore sonority. For every generalization one can easily find an exception. Perhaps in a later study the implications of electroacoustic music and acoustic works utilizing non-pitched or "noise" components of instrumental sound can be compared with present findings. But the proliferation and diversity of twentieth century music is beyond the grasp of a single individual. One has to set limits and start somewhere. Those limits here restrict analysis to pieces which explore progressions of recognizable chords or textures easily reducible to chords, and in which the timbre is given prominent or unusual treatment. But the sample group has nonetheless proven worthwhile towards observation and conclusions with respect to the use of sonority both as a means of process and of structure, to attenuations and compensations in other conventional parameters such as melody and rhythm, and even issues of hierarchies of perception from the interpretation of repertoire rather than controlled experiment.

In retrospect, the application of sonority has been approached with more caution than was anticipated. Given the beginnings of structural application of register and density in the music of Scriabin and Debussy around the turn of the century, the exploration of sonority as process and particularly timbre change as process emerges relatively late. Surprisingly it is Webern, not Debussy or Schoenberg, through the integration of intervallic growth, timbral voicing, and registral change into small melodic cells, who first explores the applications of sonority as process. True, Schoenberg undertakes the first large scale exploration of timbral voicing in his Op. 16, #3, but timbre change simply mirrors pitch change. There is no real time growth in the timbral parameter aside from the rate of alternation. Messiaen follows Webern in the development of sonority as process, exploring dramatic real time growth in the parameters of number of notes, register, and intervallic separation. The timbral element, however, does not figure prominently with Messiaen, at least not at the surface level. Feldman is the true heir to Webern in the growth of sonority as process. Melody and rhythm are stripped away, forcing steady state chords to the surface level.

The rate of timbral change in twentieth century music is probably the single biggest departure from late romantic music. Yet if the present study is taken as a representative sample it suggests that on the whole timbre tends to be employed as a grouping mechanism and not as a process at the surface level. Examples by Takemitsu, Kotonski, Schoenberg,

and Boulez show consistent phrase and sub phrase groupings based on timbre. With Takemitsu there is certainly growth present in the weight given to certain timbres within the phrase, but the long range conception is defined by the presence of a particular family class at the phrase level. In the Kotonski example timbral commonalties between small groups of proximate sonorities allow for coherence as small phrases even though there are no clearly defined cadences. These small "sonority groups" are juxtaposed, overlapped and ultimately transformed in a continuous sequence of timbral change at the phrase or sub phrase level.¹ Again, it might be argued that Schoenberg's Op. 16 #3 is an obvious example of a process of timbral change at the surface level. But the only consistently developed parameter at the surface level is timbral voicing, and analysis in many cases suggests sub phrase divisions by voicing type. There is only one sequence in voicing which could be conceived of as a linear process. With Schoenberg timbral organization is defined at the phrase level with the surface patterns of orchestral alternation merely a reflection of a deeper structural conception. Surprisingly, the Boulez example taken from *Pli Selon Pli* emerges as the only piece in which timbre changes with each sonority and which contains enough observable timbral continuity between sonorities to be termed a timbral progression.

Interest in real time registral processes peaks with the textural compositions of Ligeti, Kotonski, and others from the late 1950s through the 1960s. But the movement of registral extremes, at least in textural composition, has in general been linked with changes in temporal density, the rate of events in time. Even in Ligeti's Chamber Concerto the real time focus remains the composite of rhythmic and melodic activity comprising the many layers of texture. The process of register change has tended towards small, regular steps at a slow rate, and corresponds roughly to a middleground structural level. The dilemma, in all likelihood, is that a faster rate of change and greater variety in the movement of registral extremes would probably be perceived as conventional melody.

Pronounced register change tends to perform a phrase and sub phrase defining function but there is disagreement among composers in terms of long range structural applications. The issue is very basic and concerns whether or not an extreme in register is invoked as a long range goal or climax. The examples by Scriabin, Debussy, Schoenberg, Kotonski, and Ligeti all point to climatic arrivals at registral extremes. In the Debussy and Ligeti examples registral extremes are delayed until the very end. In both the Kotonski and Schoenberg examples the registral climax occurs at approximately the two-third point. Kotonski arrives at a cluster in the extreme low register, the only narrow-band sonority outside the middle register in the movement. With Schoenberg the registral climax corresponds to both highest

pitch and widest total registral spread in the embellishing stream. Whether by conscientious decision or not the arrival at long range structural goals by register is an affirmation of the traditional view of music as departure, progression, and arrival. It might be expressed by motivic development and recombination, by modulation to or return from distant key areas, or by registral transfer, but this in an old, standard model. By contrast, examples by Webern, Messiaen, Feldman, Takemitsu, Boulez, and Reich do not tend towards registral climaxes, and since none of the above composers are concerned with the dramatic possibilities of motivic development nor harmonic motion, it follows that their music is not goal oriented but concerns more original approaches to musical sequence.

With the emancipation of sonority as a structural consideration comes an anticipation of new musical forms. Yet upon reflection of the present sample form is most often a reinterpretation of traditional structures with a substitution of parameters. Quasi-symmetrical arch forms are prominent, but is an arch form not an adaptation of traditional sonata and rounded binary forms to begin with? Large scale movement in register is prominent in many of the works, and the abundance of arch forms may be accountable to the particular suitability of register for the control of symmetrical and complementary shapes. The notion of a "complementary phrase", particularly with respect to registral shape in Ligeti's works, is a development which is difficult to convey with conventional parameters but ideally suited to register. Musical examples by Webern and Schoenberg correspond to conventional rounded binary or ABA forms while the Debussy prelude is basically in a binary variation form, AA'. It is interesting that Schoenberg, having already experimented with continuous variation forms, returns to a standard format when the number of parameters are increased so dramatically. The form of the Debussy Prelude appears quite conventional at first glance. The binary variation form is based upon changing the modality of repeating motive forms, but there is a slow process of registral growth and climax running through all motive transformations. The expansion of the role of sonority presents the possibility of greater structural complexity through simultaneous growth and variation processes, a dichotomy difficult to achieve by conventional parameters alone.

The most intriguing forms in the sample are of the through composed variety, which includes works by Reich, Kotonski, Messiaen, and possibly Feldman. With the Reich example larger sections could easily have been highlighted through timbre change from oboes to flutes. Instead, the timing of the timbral shifts are deliberately irregular. One wonders whether deeper structural organization through timbre change would enhance or

diminish the enjoyment of the work. Since Reich avoids cadence and seems to desire a general lack of hierarchy in the quality of the sonorities, then yes, periodic timbral structures would be inappropriate. The example from Messiaen's *Turangalila* Symphony demonstrates a continuous growth form through gradually increasing the duration of three independent bands of sonority. The resulting form, however, is not the continuous buildup one might expect but conglomerations of greater and lesser note densities. Messiaen is among the first to demonstrate acoustic sound sequences which are not directed at a particular goal, but are simply different.

It is this aesthetic position, that sounds in sequence may be compared and qualified with no other end, which also unites Feldman and Kotonski. Kotonski in particular shows perhaps the freest approach to composition and form of any composers in the sample. Kotonski employs a wide spectrum of parameters which are individually highlighted for short intervals. The ear is refreshed with new information without recourse to the sorting mechanisms required of periodic structures. This is in total contrast to Reich, who rarely provides new information yet carefully avoids structural symmetries. Feldman tends to highlight two to four distinct sonorities and plays with variations and associations with new, related sonorities. It is a game of memory and of detail and certainly one without any goal orientation. What is unexpected with Feldman, however, are groupings in chord associations suggesting large scale structural conception, and even numerical symmetries.

Even within this select group of musical examples it is rare that sonority exceeds rhythm and melody as the primary focus. There are many instances where sonority is adjusted in parallel to rhythm or supports the definition of thematic units but very few where some component of sonority may be said to be the sole object of musical discourse. The Debussy prelude, obviously, is dominated by melody. Rhythm is important for motivic identification but is not subject to development. With Debussy sonority may be thought of as filling a role vacated by rhythm, but still secondary to melody. With Schoenberg new melodic information is kept at a minimum, and yet no aspect of Op. 16 #3 is more striking than the pitch canon. It is a piece designed around pitch and even the climax of the work is largely generated by rhythmic acceleration of the pitch canon. The timbral component, even in a work of this stature and influence, is at best the third consideration as ornamentation for pitch and rhythm. The dominance of pitch was further proven by Webern through his successful two piano reduction of Op. 16, #3.

With Messiaen, register, intervallic construction, and the number of chord tones are so fully incorporated into the construction of thematic cells that it is difficult to separate sonority from rhythm and melody. Even though there is virtually no development of thematic cells they still carry an enormous amount of information in their original forms. It is this lack of "thematic" development which increases the value of sonority. Ultimately, however, one must judge in favour of rhythm as Messiaen's primary focus. It is the irregular accents, challenging virtuosic gestures, and the basic contrasts between fast and slow rhythms which guarantee sustained interest. Likewise the main focus of the third movement of the Ligeti Chamber Concerto is the rhythmic texture. Changes in register and chord quality mirror the expansions to and from greater rhythmic complexity, but the slow pace of pitch change shifts the responsibility of real time interest to rhythm. The Reich Variations are likewise focussed toward rhythmic texture and to the melodies emerging through the interlocking rhythms and accents. Sonority, in this case defined almost exclusively by chord quality, functions more as a medium for rhythmic activity than as a source of tension. The Webern quartets pose an interesting dichotomy. As with Messiaen, the rhythmic gestures in each thematic cell are striking and relatively consistent. But the chordal reduction suggests that the motivic gestures are really not necessary for the understanding of the piece. There is already movement in the expansion of intervals and note densities and the beginnings of structural symmetries based on register. Rhythm is the dominant parameter in these early Webern examples but only through overcompensation.

It would appear that an increase in the importance of sonority often necessitates an increase in rhythmic activity. This is not the case, however, with Feldman, Takemitsu, and Boulez. In the example from Takemitsu's November Steps there is virtually no discernable rhythm. In compensation there are dramatic real time transformations in sonority, and timbral change in particular. But it is not change in sonority which leads the ear from one moment to the next. A slow moving melodic counterpoint runs through the entire passage with initial and terminal pitches in soprano and bass voices highlighted. Sonority is highly complex and dynamic, but functions above all as an accompaniment to melody. Of all the composers in the study the works by Feldman and Boulez are the most challenging from an aesthetic standpoint. In these particular Feldman works there are no melodies and no rhythms. By process of elimination sonority must be the only object of focus. It is interesting, however, that the majority of associations between sonorities involve common pitch relationships. As much as Feldman seeks to be distinct in his approach he is nonetheless essentially composing slow moving melodies, really no different from Takemitsu and Ligeti.

The Boulez sample is the only one in which timbre succeeds as the primary focus. Like Takemitsu and Feldman, rhythmic gesture is eliminated through the use of primarily sustained tones and by avoiding a discernable pulse. Unlike any composer in the study Boulez utilizes a virtually continuous sequence of common timbres through all sonorities. Boulez manages to de-emphasize the effects of melody and pitch continuity. This is accomplished through a combination of three factors. First, the movement of registral extremes is severely limited. Secondly, common tone associations between consecutive sonorities are generally avoided. But lastly and of greatest utility, Boulez divides each entry into separate attack and sustain instruments. Arguably, the combination of masking the initial pitch levels of the sustain instruments and the confusion in timbral identification through the rapid transition from attack to sustaining timbres is sufficient to direct attention away from pitch information. Once focus on timbre is achieved, however, the burning question remains as to whether the sequence of sonorities contain enough of an equivalent to unresolved tension to truly engage the listener. One gets an impression from the passage in *Pli Selon Pli* of lack of intent.

It is worth remembering that what are now regarded as "rules" of harmonic progression in traditional tonal music initially came about through polyphonic voice leading. In the twentieth century functional harmony is initially abandoned but gradually returns in fragments. Arguably, the main motivation for this return is again voice leading. Early in the century functional harmony is dissolved through four developments. One is the superimposition of conventional triadic harmonies undertaken by Stravinsky, and later Bartok and Milhaud.² As a second approach Debussy employs certain chord types which generally move in parallel accompaniment of melody, and divorced of any harmonic function. Debussy then focuses upon the contrast in modality between chordal accompaniment of different melodies. Thirdly, Schoenberg, as a logical continuation of Wagnerian chromaticism, tended to employ highly altered dominant harmonies voiced in traditional choral spacing. Movement from one sonority to the next was generally accomplished through chromatic voice leading. As a fourth approach, Webern may be acknowledged for the introduction of vertical sonorities arrived at through the arbitrary superimposition of specific intervals. The modern harmonic idiom, if you will, is codified with Messiaen. Notably, voice leading is abandoned. Triadic superimposition, artificial construction by arbitrary interval patterns, and chord movement in the parallel accompaniment of melody are beautifully synthesized in the composition of non developing thematic cells.

The technique of exploiting and contrasting purely the subjective qualities of given chord types and modalities, initiated by Debussy, is continued by Messiaen. The notion is then revived by Ligeti and Takemitsu, perhaps as a reaction to the incomprehensibility of textural compositions by Xenakis and others. In the example from November Steps Takemitsu employs four basic types of sonorities: diatonic clusters, chromatic clusters, quasi-triadic harmonies, and exposed intervals. The polarization of clusters into two groups might be considered as a filtering of arbitrary textural densities into recognizable modalities. There is also a noticeable absence of synthetic chords aside from the exposed melodic intervals. In many instances the quasi triadic sonorities are not only recognizable as extended diatonic harmony, but again imply some degree of harmonic function. Traditional "dominant" harmonies often appear at penultimate moments.

In the Variations for Winds, Strings, and Keyboards Reich employs two and possibly three types of extended diatonic harmonies; minor eleventh chords, major seventh chords with the sharp eleventh (essentially the Lydian mode) and much less common dominant ninth chords with the third suspended. Two limited aspects of functional harmony are in evidence. First, Reich employs limited harmonic progression as prolongations of the same chord function group, for example, from I to vi or from IV to ii. Common tones, as is expected with all prolongational harmonies, again figure prominently. Secondly, Reich employs root and bass note progressions in conventional "circle of fourth" sequences. It is a balancing act. Reich employs favored sonorities, basically from the tonal or jazz idiom, but goes out of his way to avoid overt harmonic progression. Consequently, one is always aware of the ways in which harmony avoids tonality instead of considering new possibilities and new types of relationships between sonorities. This is a dilemma of chordal vocabulary for late twentieth century music. Composers now have license to utilize any chord, whether derived from extended diatonic harmony, chord superimposition, voice leading, or artificial construction by intervals, but divorced from the context in which that sonority was originally conceived. The problem is that the music will be gauged in accordance with the degree to which it avoids those contexts rather than for the degree to which it suggests new possibilities. Regretably, harmony has evolved into a language of titillation but with no real potency.

It was suggested at the outset that sonority might be defined as an intersection of three parameters; register and density, timbre, and subjective chord quality. The three parameters evolve at different rates yet taken as a whole, if the present examples serve as a

representative sample, the evolution of sonority throughout the twentieth century may be viewed as a single trajectory. It is a long arch form in which the initial impulse is the avoidance of functional harmony. The high point in the arch are attempts at the isolation of timbre as a singular functional parameter. The application of sonority then decays until the issue is once again the avoidance of functional harmony. Of all the pieces analyzed the Boulez example from *Pli Selon Pli* is the only one to focus exclusively on the timbral parameter and may be cited as the high point in the curve. Boulez chose to control and order timbre through the only scale available to him; by quantity. And yet subjectively the passage gains no momentum. It may be that timbre is perceived on a flat scale. That is, one may perceive different degrees of similarity and difference without gaining an impression of movement to and from points of relative stability.

For the composers involved, especially in the earlier parts of the century, the exploration of sonority must have been highly rewarding. The beauty of composition with sonority is that the new elements, timbre and register, are physical properties of sound that lay dormant all the while. It was only the mental connections which needed access. But through a combination of intuition or indoctrination by four centuries goal oriented, pitch centered Western music, there seem to be basic perceptions of similarity and continuity in the pitch domain which are prioritized above changes in timbre. Composers have tended to react to this realization in two ways. One solution is to accept sonority as a rich accompaniment of melody and to explore many levels of nuance within this secondary role. The second solution is to cloud the musical texture with a kind of information overload, either through the masking of sustain instruments by attack instruments or through the construction of ambiguous or highly complex rhythmic textures. Yet as a final thought, a common element through all examples but perhaps too obvious to mention is the equally tempered scale. While it is the authors view that a compelling logic of pure timbral progression at the musical surface is a perceptual impossibility there remains ample room for exploration of a mutual relationship between timbre and harmonies not belonging to the equally tempered scale. This at least would provide an opportunity to consider positive possibilities in the relationship between sonorities rather than the post modern view of sonority in terms of the ways in which it avoids cliché.

Footnotes

1. Music per Fati e Timpani is clearly inspired by the example of Edgard Varese in pieces such as Octandre and Integral. Varese gives the first examples of through composed forms where thematic and phrase groups are defined by timbral groups.
2. Of course, both Debussy and Schoenberg experimented with superimposed triads as well.

Further Research.

Acoustic dissonance: voicing, masking, and the critical bandwidth.

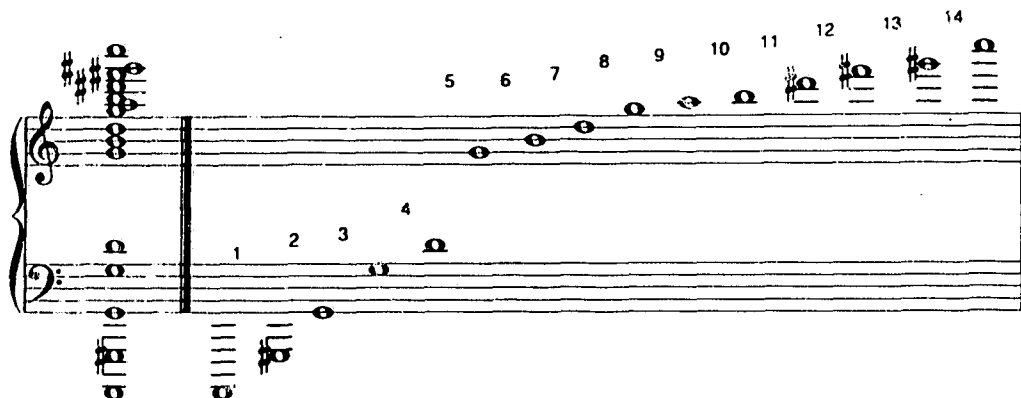
It has been practical and certainly informative to measure registral span and registral density in units termed registral regions. The arbitrary partitioning of register in alternating perfect fifths and perfect fourths above C^0 facilitated an overview of the movement of registral extremes and an approximate measure of registral density. It offered the advantage of a completely objective, quantitative scale of measurement and the familiarity of the C triad for quick mental transposition of numerical values. Quantitative comparisons of register and the number of tones permit generalizations of global trends only. In actuality register and note density are not perceived on a linear scale. The subjective interpretation of register and density must begin with the concept of acoustic masking and the critical bandwidth.

Acoustic masking may be defined as the amount or the process by which the threshold of audibility for one sound is raised by the presence of another sound. Masking effects are most noticeable when two sounds reside within a proximate registral region termed the "critical" bandwidth.¹

By voicing instruments and pitches in separate critical bands a sonority may be perceived with more clarity and loudness than the same number of tones placed within the same critical band.² It is this perceived increased "presence" which psycho-acoustician Ranier Plomp terms Perceptual Consonance. "If two tones are not in the same critical bandwidth, they will be "consonant". The Most dissonant interval arises with a frequency separation of about a quarter of the critical bandwidth"³ Analysis of sonorities in terms of the number of critical bandwidths which contain more than one tone might be a useful measure of the relative clarity of complex, non-tonal sonorities. What might be termed "simple acoustic dissonance," it is a single quantitative measurement which elegantly combines register and density mapped onto a subjective perceptual scale.

Estimates of the actual width of the critical band vary. It is thought be approximately one octave wide below 200 Hz, one third of an octave between 200 and 1000 Hz, and one fifth of octave above 1000 Hz.⁴ Figure F.1. summarizes pitch values for the critical bandwidths given by Robert Ericksen.⁵

Figure F.1. Critical Bandwidth Values from the Robert Ericksen chart.



Quantitative analyses concerning the critical bandwidth are problematic for two reasons. First, the borders of each band are not firm but taper off gradually. The critical bandwidth phenomena is better thought of as a series of overlapping filters with sloping edges. Secondly, psycho-acoustic research has revealed a wealth of control and perceptual issues and specific contexts affecting masking. Dynamics, spectrum, pitch modulation, duration, even spatial location may all influence the critical bandwidths and volume levels required for masking. 6-9

The first test analysis from the perspective of acoustic dissonance is the concluding phrase of Takemitsu's November Steps. (Figure F.2) Takemitsu seems to have an intuitive awareness of the location of the critical bands. The number of notes per sonority (Figure F.3) remains at eight or more tones for all but five of the sonorities. Yet figure F.4 reveals all but five sonorities have fewer than three critical bands with more than one tone. By and large Takemitsu's voicings are adjusted to separate critical bands which permits maximum clarity and presence. The placement of pitches in the upper registers in measure 57b, 58b and 60c are of particular note. Each sonority contains five or more upper register pitches within an octave span. The critical bandwidths, however, are much narrower in this upper region. With an almost uncanny correlation, most pitches are voiced within separate critical bands. 10

Figure F.2. Takemitsu, November Steps

Concluding phrase, m. 57- end.

The musical score is presented in three systems, each with a grand staff (treble and bass clefs) and various instrument labels. Measure numbers are circled at the beginning of each system.

- System 1 (Measures 57-59):** Labeled "Harp". Measure 57 shows a complex chordal texture. Measure 58 features a single note in the bass clef. Measure 59 shows a single note in the treble clef.
- System 2 (Measures 60-62):** Measure 60 includes "harp" in both staves. Measure 61 includes "vln ah" (violin) and "ah" (alto horn) in the treble clef, and "harp" in the bass clef. Measure 62 includes "tpt s" (trumpet) and "vlc, s" (viola) in the treble clef, and "harp" and "tbn" (trombone) in the bass clef.
- System 3 (Measures 64-70):** Measure 64 includes "vlc s" (viola) and "harp" in the treble clef, and "vln" (violin), "vla" (viola), and "cb" (cello) in the bass clef. Measure 66 includes "cb h, harp" (cello) in the bass clef. Measure 67 includes "vln ah" (violin) and "vla ah" (viola) in the treble clef, and "harp" in the bass clef. Measure 70 includes "vlc ah" (viola) in the treble clef, and "harp" and "vlc" (viola) in the bass clef. The system concludes with a double bar line.

Figure F. 3. Takemitsu, November Steps concluding phrase.
Number of tones and number of active critical bandwidths .

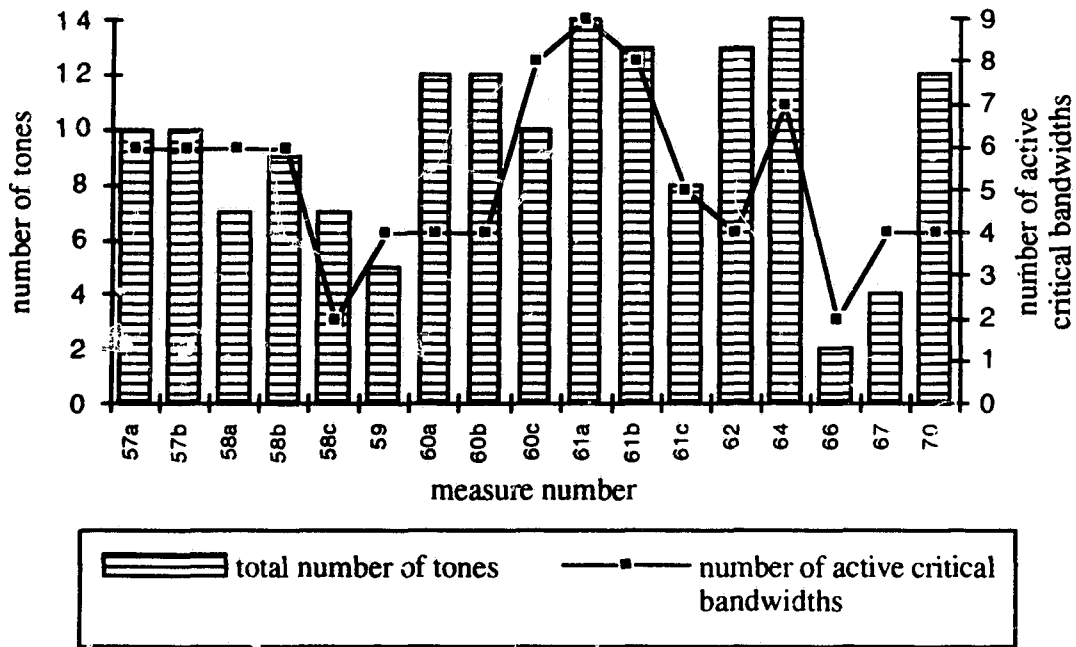
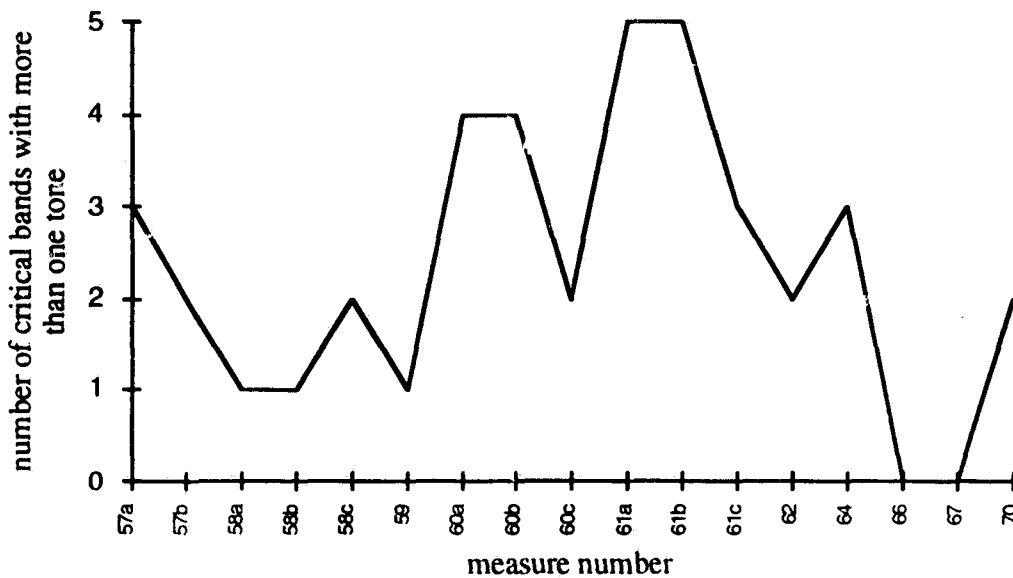


Figure F. 4. Number of critical bandwidths containing more than one tone.



From the perspective of acoustic dissonance the entire phrase may be considered an arch from with a climax of five critical bands with more than one tone at measure 61, perhaps interpretable as a drawn out motion of tension and release. (Figure F.3) There is also a curious two part division of the phrase not apparent through other methods of analysis. In the second half of the phrase, from measure 61 to the end, the number of critical bands with more than one tone moves in parallel with the total number of active critical bands. But in the first half of the phrase, from measure 57a to 60b, the number of critical bands with more than one tone moves contrary to the total number of active critical bands. The total number of active critical bands remains static, decreases, then again remains static. At the same time the number of critical bands with more than one tone decreases, then increases slightly, and again increases more emphatically. These are subtle, local processes in perceived density which may account for impressions of motion between levels of subjective dissonance and consonance throughout the phrase, impressions which arise from the relative clarity of pitch components.

As discussed previously, from time to time Takemitsu employs harmonies suggestive of tonal-harmonic function, such as altered dominant chords. As a curious coincidence, the harmony of the sonority in measure 61, the point of maximum acoustic dissonance, is in fact an altered dominant chord; quasi F7(#11). The reinforced application of acoustic phenomena with quasi-tonal function is some ways symbolic of late twentieth century attitudes toward sonority. Having early abandoned tonality in favour of non-tonal systems and ultimately pure acoustic experimentation, composers may now, with clear conscience, explore mutual relationships between the two.

Whereas acoustic dissonance in the Takemitsu example may function as a growth process at the phrase and subphrase level, an entirely different application is suggested in an example from Jeux Venitien (1960) by Witold Lutoslawski. Here relative consistency in the number of critical bands containing more than one tone may be seen as a means of maintaining continuity in the midst of huge contrasts in other parameters, a kind of smoothing filter. In the fourth movement, one of the most exciting passages in all of twentieth century music, pitch materials for given instruments tend to be confined to the same critical bandwidth permitting the reduction of sonorities in figure F.5. The passage proceeds by the sequential alternation of sonorities contrasting and registral span, the number of tones, instrumentation, and rhythm and articulation. After an initial period of

Figure F.5. Lutoslawski
Jeux Venitien, Mvt. IV

The score is divided into three systems, each with five measures. Circled numbers indicate specific measures of interest.

System 1 (Measures 1-5):

- Measure 1: vln, vla, vlc, cb
- Measure 6: texture, moving notes; fl, kl, fg, tpt, s, hn, tbn
- Measure 16: vln, vla, vlc, cb
- Measure 18: texture, moving notes; fl, ob, tpt, kl, vla h, hn, tbn, fg
- Measure 5: texture, moving notes; filled in chromatically, vln, vla, vlc

System 2 (Measures 6-10):

- Measure 23: kl, fg, hn, tpt, tbn
- Measure 27: vln, vla, vlc
- Measure 33: fl, vln, hn, tpt, vla h
- Measure 34: vln, vla, vlc
- Measure 36: fl, vla h, ob, tpt, hn, vla h, tbn, fg

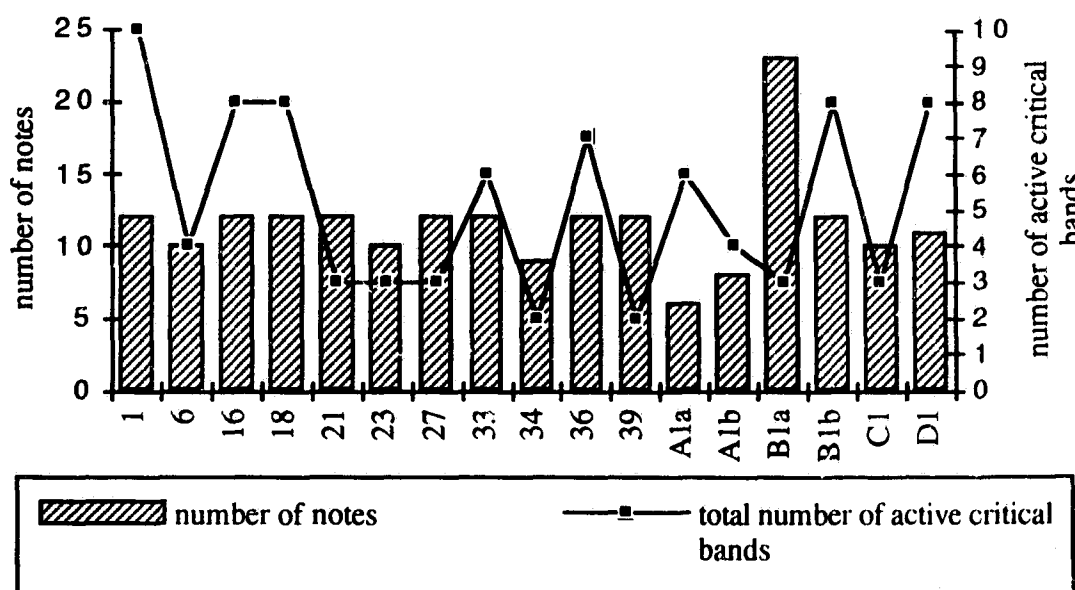
System 3 (Measures 11-15):

- Measure 39: vln, vla, vlc
- Measure A1: Piano
- Measure B1: All strings
- Measure C1: piano; tpt, tbn, horn
- Measure D1: pic, fl, kl, fg

exposition the sequence of sonorities are repeated in large scale textural canon with ever decreasing time intervals separating each entry. ¹¹

Analysis comparing the number of tones with the number of critical bandwidths containing more than one tone reveals a surprising degree of consistency throughout most of the passage. In spite of large fluctuations in register and the number of active critical bands the number of tones remains between ten and twelve for all but three sonorities. (figure F.6) The number of critical bands with more than one tone never exceeds four, suggesting a conscious awareness of voicing clarity. Also evident in figure F.7, fluctuations in the number of critical bands with more than one tone tend to be in steps of one or two bands. The movement is composed of sonorities with large numbers of notes and extreme timbral and registral variety. Yet from the perspective of acoustic dissonance and there is much less variety, suggestive of controlled linear steps.

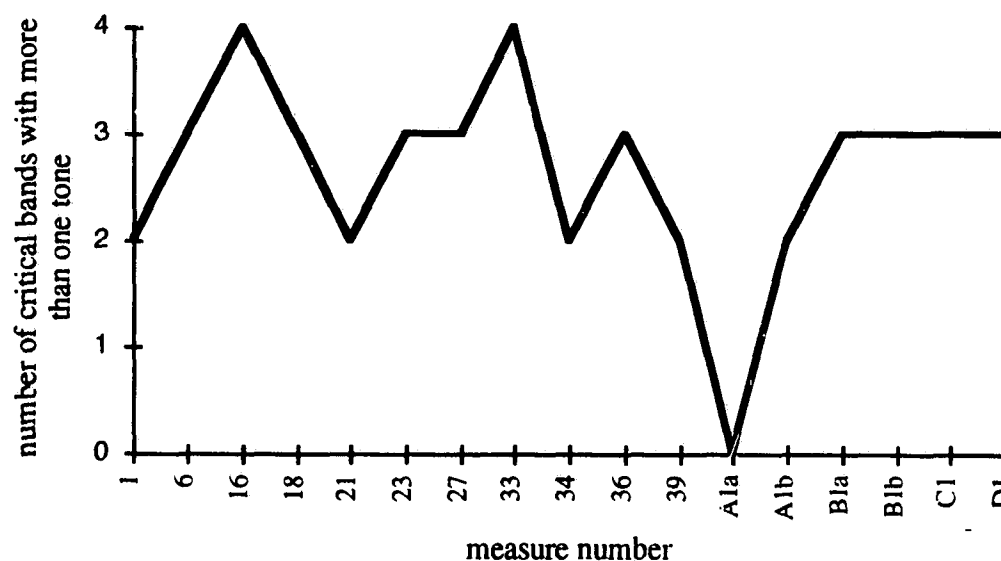
Figure F.6. Lutoslawski, *Jeux Venitien*, Movement IV, measures 1 - D1. Number of notes and number of critical bands



Admittedly, defining acoustic dissonance simply in terms of the number of critical bands containing more than one tone is a naive approach, but a start. Beyond this simple measurement lay numerous variables to control and perceptual issues to engage. For example, how is one to distinguish between critical bands containing two and more than two tones? What are the perceptual differences between sonorities with the same number of

critical bands containing more than one tone but with large differences in the total number of tones, the total number of active critical bands, and registral placement? In addition, if masking necessitates an increase in the volume of the signal or order to perceive individual pitches, what effect do adjustments in dynamic level have on sonorities distinguished by critical bandwidths? A future theory attempting to define perceptual acoustic dissonance of sonority must take into account at least six parameters: total number of tones, registral placement, total number of active critical bandwidths, number of critical bandwidths containing more than one tone, number of critical bandwidths containing three or more tones, and dynamic level. An additional consideration might be the influence of harmonic spectra on masking and critical bandwidth. For example, if a fundamental tone is masked by the presence of another tone within the same bandwidth, but strong harmonics above the fundamental remain free from interference, how might this influence the perception of acoustic dissonance? Or, to what degree may prominent harmonics of a lower pitch falling within the same bandwidth as a higher true pitch influence masking?

Figure F.7. Number of critical bands with more than one tone



Obviously, there is a point at which the number of dependant variables becomes too cumbersome for practical analysis of actual music. As the basis for composition with sonority, however, research and understanding of the finer nuances of masking and the critical bandwidth has potential utility for fresh approaches to musical process and structure. The problem lies not in the isolation of perceptual phenomena but in the

reintegration of isolated phenomena into cohesive and compelling wholes. According to Robert Ericksen:

Music can well be understood in all its dimensions in terms of grouping, the dividing of the sound world. The complexity comes not from a multiplicity of strategies but from interactions between (all dimensions), especially interactions at the micro level. The problem for music theory is to discover the musical level or levels at which (grouping) processes function. . . . Neither science nor music theory is of any great value to the practicing musician when performing or composing. Theory is a separate and distinct world that exists to satisfy our curiosity. . . The task of theory is to rationalize what musicians do.¹²

Footnotes.

1. Fletcher coined the term "critical bandwidth." Harvey Fletcher, Speech and Hearing in Communication, (New York: Van Nostrand, 1953)
2. According to Brian Moore:

For a given amount of energy, a complex sound will be louder if the energy is spread over a number of critical bands than if its is all contained within one critical band. . . If tones within the same critical band excite the same set of neurons, the total number of neural firings in response to the two tones will not be much greater than the number which would occur in response to either tone alone. See Brian J. Moore, Psychology of Hearing (London: The Macmillan press. 1977) p. 96.
3. Ranier Plomp, "The Perception of Musical Tones" in Diana Deauchs, ed. Psychology of Music (La Jolla, Ca: Academic Press, 1982.) p. 19.
4. David M. Green , "Audition: Psychophysics and Perception".(1983) in Steven's Handbook of Experimental Psychology, Volume.1 "Perception and Motivation", (Richard C. Atkinson, Richard J. Herrnstein, Gardner Lindsey, and R. Duncan Luce, Editors, New York, Brisbane, Chichester, Toronto: John Wiley and Sons, 1988. (p. 327-376) p. 336.
5. Robert Ericksen's chart of critical bandwidths come from class notes at the University of California, San Diego, and were acquired through his student, John Celona , at the University of Victoria.
- 6 To be perceived subjectively of equal intensity of "p", pitches above approximately G5 (800Hz) must be decreased to "pp" and pitches below G2 (100Hz) must be increased to "mp". Subjectively equal loudness is an important parameter to control in experiments which measure perceived intensity within and outside of critical bands. "p" corresponds roughly to 50 dB while " f" corresponds to 80 dB. Adapted from Murray Campbell and Clive Greated, The Musicians Guide to Acoustics . (London: J.M. Dent and Sons, 1987.)p. 107.

7. Experiments have concluded that the masking threshold of this complex tone was significantly lower than for a single component, ie. for a simple tone. In other words, it is easier to mask a complex tone than a simple tone. Taken from S. Buus, E. Schorer, M. Florentine, and E. Zwicker "Decision Rules of simple and complex tones" in JASA. 80(1986) 1646-1657.
8. Studies have shown that amplitude modulation of a sine tone is more detectable than frequency vibration within a critical bandwidth. This suggests that the ear may 'tune' for intensity perception rather than pitch perception when two frequencies lie within a critical band. E. Zwicker, "Die Grenzen der Horbarkeit der amplituden-modulation und der frequenzmodulation eines tones. in Acustica, 2(1952) 125-133, cited in Brian Moore, Psychology of Hearing (London: The Macmillan press. 1977)
9. It has been suggested that the critical bandwidth may increase at shorter durations. L. L Elliot, "Backward and Forward Masking" , in Audiology 10 (1971) 65-76, cited in Brian Moore, Psychology of Hearing (London: The Macmillan press. 1977)
10. Five notes within one octave would correspond to two registral regions in the previous section. It would indicate a greater level of note density than the actual perception of density due to separation into separate critical bands.
11. The Canon section begins at A1.
12. Robert Ericksen, in Diana Deutsch, Ed Psychology of Music (La Jolla, Ca: Academic Press, 1982.) p 534-535.

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