Inside the Cadenza of Schoenberg's Piano Concerto*

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The cadenza of the Piano Concerto (Op. 42) is the most extended and sophisticated trichordal passage in Arnold Schoenberg's twelve-tone *oeuvre.* With its kaleidoscopic explosion of trichords and bewilderment of gestures, the cadenza is both a brilliant virtuosic display and the *heart* of the Concerto. This article attempts to provide several "ways into" the cadenza, and to shed light on the compositional processes of Schoenberg's mature style. Part I establishes a theoretical framework. It introduces basic terms and definitions, advances a construct called a *trichordal complex,* and explores its salient characteristics. Part II uses the trichordal complex to analyze the structure, rhetoric, and drama of the cadenza.

I. Initial Considerations

Hexachordal inversional combinatoriality is a staple of Schoenberg's "American" period works such as the Violin Concerto (Op. 36), Fourth Quartet (Op. 37), Fantasy (Op. 47), and the subject of this study, the Piano Concerto (Op. 42).[1] Example 1 illustrates this procedure by arranging two of the Piano Concerto's rows in pitch space. Rows P_2 and I_7 and their retrogrades, R_2 and RI_7, share the same (unordered) hexachords. As is well known, hexachordal inversional combinatoriality divides the 48 rows of the row-class into twelve distinct quartets, or *regions.*

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[1] For discussions of the relationship between the row of the Concerto and the unfolding of its hexachordal regions see Rothstein 1980, Mead 1989, and Alegant and McLean 2001. Other discussions of Schoenberg's twelve-tone music include Alegant 1996 and 2001; Babbitt 1961 and 1962; Friedmann 1995; Haimo 1990; Hyde 1985 and 1993; Kurth 1992; Lewin 1962, 1967, and 1995; Mead 1985 and 1987; Peles 1983–84; and Samet 1987. The present article builds upon Alegant 2001, which summarizes the partitioning strategies in the Concerto and traces the history of the trichordal configurations that coalesce in the cadenza.

Example 1. Rows P_2 and I_7 divided into their discrete hexachords (all ∈ 6–9[012357]).

P_2 ⇒ ⇐ R_2

I_7 ⇒ ⇐ RI_7

{ A, B, C♯, D, D♯, E } { F, G♭, G, A♭, B♭, C }

{ F, G♭, G, A♭, B♭, C } { A, B, C♯, D, D♯, E }

Example 2. The trichordal complex with rows P_2 and I_7.

	← Y →		← Z →	
X(P_2) ➡	2 9 1	4 3 B	5 7 0	8 A 6
X(I_7) ⇒	7 0 8	5 6 A	4 2 9	1 B 3
	↑ 3–4[015]	↑ 3–4[015]	↑ 3–9[027]	↑ 3–6[024]

A *trichordal complex* is a two-dimensional construct built from the discrete trichords of two inversionally-combinatorial rows.[2] Example 2 illustrates the trichordal complex with P_2 and I_7. The example gives the pitch classes and set classes of the eight trichords, which belong to three different set classes: 3–4[015], 3–9[027], and 3–6[024]. There are four ways to combine the trichords of the trichordal complex into partitions. A *partition* is defined as an unordered collection of non-intersecting pitch-class sets that comprises an aggregate, or total chromatic.[3] Two partitions arise when the trichordal complex is sliced vertically in half, two more when it is sliced horizontally. These partitions belong to three different mosaics. A *mosaic* is defined as the set of partitions that are related by the operations of transposition and inversion. The trichords of P_2 create one partition from a mosaic, called X; the trichords of I_7 create another partition, also from X. (These partitions belong to the same mosaic because their pitch-class sets relate by inversion.) These partitions are labeled $X(P_2)$ and $X(I_7)$. Taking the first two trichords of P_2 and the first two trichords of I_7, a third partition arises from another mosaic, Y. Members of Y are built exclusively from 3–4[015] trichords. Finally, if we combine the last two trichords each of P_2 and I_7, we have a fourth partition from a third mosaic, Z, which has two pitch-class sets belonging to 3–9[027] and two belonging to 3–6[024].

We can think of X, Y and Z as parsing schemes that uniquely partition the trichordal complex. X induces a linear partitioning and profiles the discrete trichords of a single row. Y and Z schemes, on the other hand, take the opposing trichords of two rows: Y

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[2] We can also use the trichordal complex to model the passages in Schoenberg's *Klavierstücke* Op. 33a and b, particularly mm. 21–31 and 52–56 of the former and mm. 23–32 of the latter. Both works derive their complexes from the discrete trichords of inversionally-combinatorial rows. It is an interesting exercise to enumerate the set-class inventories of these works and see the ways in which these hexachords are realized (or buried) on the surface. The discussion of the complex in this article follows Alegant 2001: 14–16.

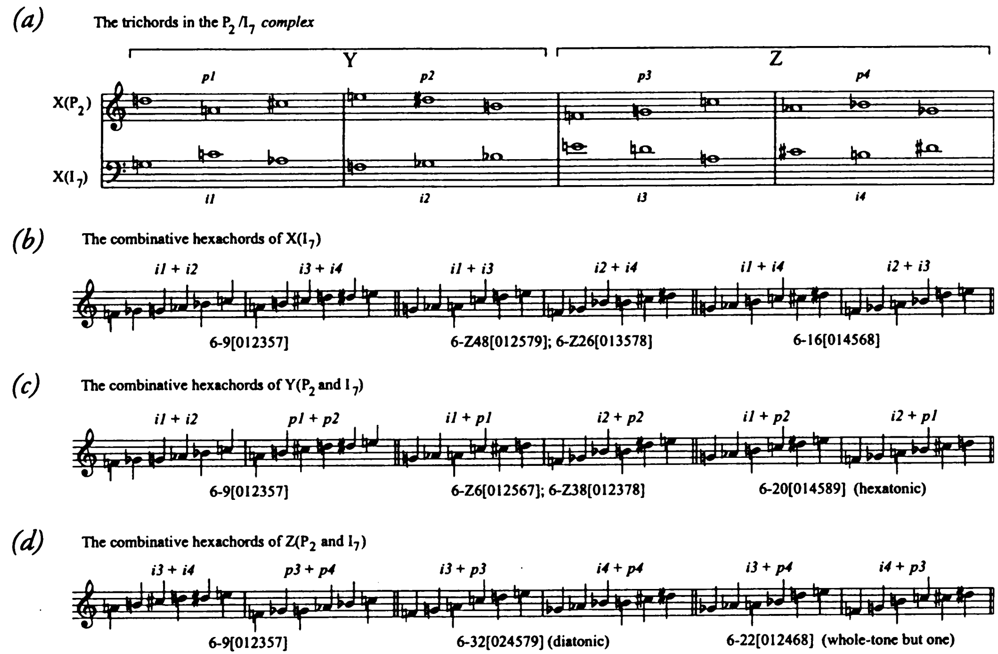
[3] The terms "partition" and "mosaic" are used differently in the literature. Martino 1961 uses "mosaic" to refer to a partition that divides the aggregate into segments of equal size. Kurth 1992 and 1999, and Mead 1998 and 1992 use "mosaic" and "mosaic class" in the way that I use "partition" and "mosaic" here. The discussion in the text follows that in Alegant 2001.

extracts the first two trichords of inversionally-related rows while Z takes the last two. (For this reason, I include both rows as arguments for Y and Z mosaics.) Each scheme possesses different properties, and induces a different batch of hexachords. See Example 3a, which reproduces the trichords of the P_2/I_7 complex. The trichords of I_7 are labeled *i1* through *i4*, those of P_2 are labeled *p1* through *p4*. Henceforth, upper-case letters denote row transforms; lower-case letters their constituent trichords. Example 3b lists the hexachordal set-class inventory for partition $X(I_7)$. (The inventory for partition $X(P_2)$ contains different pitch-class sets but the same set classes.) The example "freezes" the pitches and stem directions of trichords *i1–i4* to show more clearly the generation of hexachords.[4] The trichords of $X(I_7)$ produce three pairs of complementary hexachords: *i1* + *i2* and *i3* + *i4* yield 6–9[012357], the set class of the row's discrete hexachords; *i1* + *i3* and *i2* + *i4* produce the Z-pair 6–Z48 and 6–Z26; and *i1* + *i4* and *i2* + *i3* form 6–16[014568]. These hexachords define the set-class inventory for all partitions in mosaic X. Example 3c shows the set-class inventory for Y configurations, built from the [015] trichords of inversionally-combinatorial P and I rows. Trichords *i1* + *i2* and *p1* + *p2* form the row's discrete 6–9[012357] hexachords; *i1* + *p1* and *i2* + *p2* generate 6–Z6 and 6–Z38; and *i1* + *p2* and *i2* + *p1* yield members of 6–20[014589], the all-combinatorial "hexatonic" collection. Example 3d lists the inventory for Z configurations, which combine the [024] and [027] trichords of inversionally-related rows. Z's trichords create two members of 6–32[024579], the all-combinatorial diatonic hexachord, and two members of set-class 6–22[012468], a "whole-tone-but-one" collection.[5]

[4] For discussions on the interrelationship of trichords and the hexachords they generate see Babbitt 1955 and 1961, Dubiel 1990, Martino 1961, Morris and Alegant 1988, and Rouse 1985.

[5] Headlam 1996 identifies set-class 6–22[012468] as a "WT+" hexachord and examines the roles of such hexachords in the music of Alban Berg (see especially pp. 67–94). I have found Examples 3a, b, and c useful as ear-training exercises and guidelines for improvising. It is an easy enough task to recognize the various realizations of the three trichordal set-classes in the complex (namely [015], [024], and [027]). The hexachords, however, present a greater challenge. Needless to say, the more familiar one is with the hexachordal inventories, the better one appreciates the harmonic and melodic inner-workings of the cadenza.

Example 3. The raw materials of the trichordal complex.



The *trichordal complex* provides Schoenberg with a vast supply of raw materials. Example 4 outlines just a glimpse of its potential. Example 4a arranges the trichords of partition $X(P_2)$ in a linear fashion, but leaves the order of the pitch-classes open to various compositions and permutations. Example 4b realizes the trichords of $X(P_2)$ as blocked chords, in a chorale texture that leaves unspecified the composition of the vertical and horizontal dimensions. Examples 4c and 4d display realizations of $Y(P_2/I_7)$ and $Z(P_2/I_7)$ that contain ordered and unordered components. As we will soon see, each type of abstract design appears in the cadenza.[6]

In terms of hearing these trichords and hexachords, it is easy enough task to trace the progression of [015], [015], [027], and [024] through individual rows or partitions. With a bit of practice, one can also learn to distinguish the inventories of mosaics X, Y, and Z, and to recognize their "signature" hexachords. In general terms, hexachords in mosaic Y have more interval-class 1s than interval-class 2s, whereas those in mosaic Z have more interval-class 2s than interval-class 1s. For this reason we might characterize Y sonorities as "crunchier" and Z's hexachords as "smoother."[7] More specifically, 6–20[014589] hexachords are found only in Y mosaics, and always combine the first trichord of one row with the second trichord of another row. In contrast, 6–32 hexachords are native to Z mosaics, and arise either by conflating the [027]s of *p3* + *i3*, or the [024]s of *p4* + *i4*.[8] (An appendix offers additional suggestions for hearing and discerning the hexachordal set-classes of these mosaics.)

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[6] Morris 1987 has much to say about the compositional implications and realizations of pitch-class designs (see especially pp. 2–22).

[7] The interval-class vectors for these set-classes bear out the weighting of even versus odd interval classes. Y's hexachords, 6–Z6/Z38 and 6–20, have interval-class vectors of [421242] and [303630], respectively. Z's hexachords are 6–22 and 6–32, which have vectors [143250] and [241422]. I attribute the "peanut butter analogy" (i.e., "crunchy" versus "smooth") to Andrew Mead.

[8] It should be noted that the inventories of X, Y, and Z do not specify every harmony that appears in the cadenza: occasionally, other compositions of p and i trichords appear, most notably *p1* + *i3*, *p4* + *i1*, and *p2* or *i3*. These collisions are marked by pitch-class duplications between trichords; such duplications are invariably realized as (and distinguished by) octave doublings. By and large, these doubled chords occur at points of rest.

Example 4. A sampling of X, Y, and Z designs.

(a)	$X(P_2)$:	< { 2 9 1 } { 4 3 B } {5 7 0 } { 8 A 6 } >					
(b)	$X(P_2)$:	2	4	5	8		
		9	B	0	6		
		1	3	7	A		
(c)	$Y(P_2/I_7)$:	{ 2 9 1 }				{ 5 6 A }	
				4	0		
				3	7		
				B	8		
(d)	$Z(P_2/I_7)$:	< 5 7 0 >		< 4 2 9 >		< 8 A 6 >	1
							B
							3

II. Analysis of the Cadenza

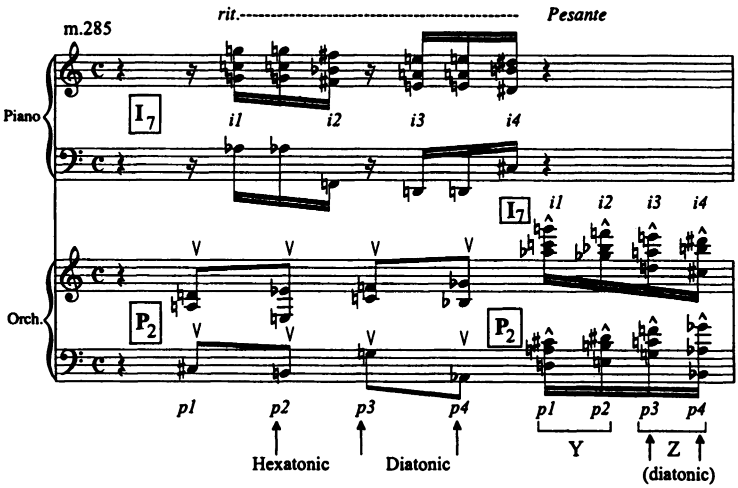
The Piano Concerto contains four interconnected movements: Andante (mm. 1–175), Molto Allegro (mm. 176–263), Adagio (mm. 264–329), and Giocoso (mm. 330–492). The cadenza (mm. 286–99) is situated some twenty measures into the Adagio. It has a "lead-in" passage, three subsections, and a *denouement* that reintegrates the orchestra into the third movement. The lead-in to the cadenza is shown in Example 5. The top portion of the example reproduces the trichords of the P_2/I_7 complex; the bottom portion provides an annotated score of m. 285. The lead-in serves as a "call to arms" for the trichordal structuring of the cadenza. At the *ritardando*, the piano verticalizes the trichords of partition $X(I_7)$ while the orchestra verticalizes the trichords of $X(P_2)$. At the *pesante*, the orchestra compresses the partitions of the complex into the span of four sixteenth notes. Harmonically, these partitions furnish the building blocks for the piano's initial outburst in the cadenza proper.

Let us take a closer look at the hexachords formed by the combinations of trichords. The first three and last three sixteenth-note attacks in the piano project *i1* + *i2* and *i3* + *i4*, and form the row's discrete 6–9[012357] hexachords. Collections from mosaic Y arise from the pairing of the first two orchestral trichords of P_2 with the first three piano attacks of I_7. 6–Z6[012567] and 6–20[014589] are strongly asserted: the former combines the initial trichords of P_2 and I_7 while the latter represents the first hexachordal simultaneity. (The remaining hexachord of the Y inventory, 6–Z38[012378], is formed by the staggered presentation of *p2* + *i2*. It is somewhat buried in the texture.) The last two trichords in each partition profile set classes from mosaic Z, including 6–32[024579], which pairs *p3* and *i3*, and the whole-tone-but-one 6–22, which combines *p4* and *i3*. The *pesante* summarizes and compresses the preceding collections, with crystal-clear presentations of $X(I_7)$ and $X(I_2)$ in the upper and lower orchestra. The chord-against-chord presentations of *i1* + *p1* and *i2* + *p2* create 6–Z6 and 6–Z38 from mosaic Y, while *i3* + *p3* and *i4* + *p4* generate 6–32 from mosaic Z.

Part I. Example 6 provides an annotated score of measures 286–90. The P and I rows in the example are labeled in upper-case and boxed; the trichords are shown in lower case. Double lines

Example 5. The lead-in to the cadenza.

		i1	*i2*	*i3*	*i4*	
I_7:	<	{780}	{56A}	{249}	{B13}	>
P_2:	<	{129}	{34B}	{057}	{68A}	>
		p1	*p2*	*p3*	*p4*	



Example 6. Cadenza, part I (mm. 286-290).

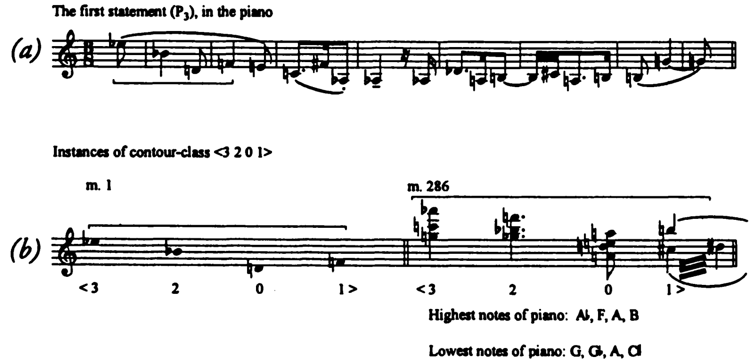
indicate modulations from one region to another. The trichordal structuring of the opening is unmistakably clear: the entire section is comprised of three-note groupings, all of which are presented in "open" spacing (i.e., with spans of sevenths and ninths between the outer members of the chords). The section contains five gestures, which, on the basis of dynamics and melodic figuration, group into two subsections. The first two gestures continue the P_2/I_7 complex that was asserted in the lead-in passage. The first gesture announces I_7, and the second gesture introduces P_2 on the second eighth note of m. 287. Gestures three and four begin on the second eighth notes of mm. 288 and 289 respectively; they bring a new complex based on rows P_7 and I_0. The fifth gesture begins on the downbeat of m. 290 and continues the trichords of the P_7/I_0 complex. The drop to a ***pp*** dynamic and the thinning of texture bring the section to a close.

Let us take a closer look at the harmonic, melodic, and voice-leading elements of these measures. The first gesture opens with a huge burst of energy that brings the trichords of $X(I_7)$ in a ***ff*** dynamic. The piano reiterates the vertical trichords of the upper orchestra at the *pesante*, but reconfigures them via "slot-machine" transformations in order to project different melodic ideas.[9] As a result, the A♭6 atop the first piano trichord "trumps" the G6 of the orchestra's first *pesante* chord. One primary feature of the opening gesture is the association of the right-hand's initial four-chord sequence with the melodic shape of the first four notes of the Concerto. The original presentation of the P_3 row is shown in Example 7a; the first four attacks, <E♭, B♭, D, F> are bracketed. Example 7b shows that the opening melodic gesture belongs to the contour class <3 2 0 1>, which is to say that the first note is the highest pitch, the second note is the second-highest pitch, the third note is the lowest pitch, and the fourth note is the second-lowest

[9] Alegant 2001 discusses the "slot-machine transformations" among the realizations of trichords in works by Webern, Schoenberg and Dallapiccola, and shows how the transformations fix the pitch-classes in the vertical dimension (the "harmony") but vary the pitch-classes in the horizontal dimension (the "voice leading").

pitch.[10] The topmost notes of the right-hand's trichords in the first gesture belong to this same contour class: A♭ is the highest note, F is next, A is lowest, and B is next-to-lowest. The lowest notes in the right-hand's trichords, <G, G♭, A, C♯>, also represent contour class <3 2 0 1>. Additionally, the opening of the Concerto and the right-hand chords of the first gesture have short-long-short-long rhythms that seem almost "lilting."[11] Thus, the piano begins with a varied recollection of the opening tune (a standard practice in a Classical concerto) before venturing into less familiar territory.

Example 7. Contour association between the opening of movement 1 and the cadenza.



Let us return to Example 6. Another important feature of the piano's two-fisted outburst is the *nesting* of I_7's trichords: the right hand in m. 286 presents $X(I_7)$ in long-note values while the left hand cycles through its trichords at a faster rate of speed. This nesting brings to light X's entire hexachordal inventory and exposes

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[10] See Friedmann 1985, Marvin and Laprade 1987, and Morris 1993 for definitions and analytical illustrations of contour classes. Incidentally, one cannot verticalize the trichords of a P or I row and at the same time fashion the top notes of these trichords into an exact transposition of the opening *Kopfmotiv*, for there is no descending perfect fourth available between the notes of the first and second trichords.

[11] A more subtle connection: the tempo of the opening tune is ♩. = 44, and the initial tempo for the cadenza is ♩ = 44.

all of the pair-wise unions of its trichords.[12] The realization of X(I_7) concludes with the *i4* tremolo in the right hand during the last quarter-note of m. 286. The right hand then plays X(R_2), reversing the order of trichords played by the lower instruments of the orchestra during the *pesante* lead-in. Two surface details warrant consideration. The first is the dislocation of *i4* in the left-hand during the first half of m. 287: *i4* is separated from *i3* (which falls on the downbeat) and adjoined to *p4*. The beginning of m. 287 thus adumbrates two instances of 6–32[024579], which is native to Z's inventory. (These 6–32 hexachords are boxed in the example and indicated by arrows leading from the letter D, which stands for "diatonic.") The second detail concerns the repetition of *p4* and *p3* in the left hand on beat three and the accented G♯4s and F4. The G♯–F dyad recalls the right-hand's A♭–F dyads in the nesting of X(I_7) in m. 286. It also activates the "tenor" voice and marks this register for future development. This dyad will return, conspicuously, at the climactic recapitulation of the cadenza.

The third gesture begins immediately after the dotted lines in m. 288. This gesture brings a new region based upon I_0 and its combinatorial partner, P_7. The modulation from I_7/P_2 to I_0/P_7 is smoothed by pitch invariance between C♯5 in the right hand and B♭4 in the left hand. Dotted slurs connect the common pitches that link the last trichords of P_2 to the first trichords of I_0. The landscape changes with the *piano* dynamic on the second eighth note of m. 289. The fourth gesture highlights two exquisite presentations of 6–32[024579]. The first 6–32 occurs on the second beat of m. 289, as *i4* joins with *p4*. The same collection is projected by the right-hand trichords in m. 298: <F♯6, E6, G♯5> of *i4* followed by <B6, D♯5, C♯5> of *p4*. These 6–32 hexachords are

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[12] The opening of the Fourth Quartet, Op. 37, instances a similar multi-dimensional presentation of trichords. In the Quartet, *p1* = {291}, *p2* = {A53}, *p3* = {408}, and *p4* = {76B}. The first violin plays melodic trichords while the remaining instruments accompany with trichords, rotating "clockwise." The resultant design is nearly isographic to the opening of the cadenza in the Piano Concerto:

vln 1	*p1*	*p2*	*p3*	*p4*
vln 2 + viola + cello	*p2 p3 p4*	*p3 p4 p1*	*p4 p1 p2*	*p1 p2 p3*

boxed in Example 6 and labeled D. An RI-association cements the relationship between these trichords, the first truly melodic ideas: note that the succession of <-2, -8> semitones is circularly permuted to <-8, -2>. The RI-relationship also governs the melodic notes that frame these trichords, namely the D6 that goes across the bar line of m. 289 and the accented grace-note F5 on the downbeat of m. 290. <D, F♯, E, G♯> is, in a sense, answered by its RI-transposition <B, D♯, C♯, F>.[13] The fifth gesture begins in m. 290, with a ***pp*** dynamic and a series of grace note attacks. The first such attack (on the downbeat of m. 290) emphasizes the F5 of the right-hand's [027]. Particularly striking is the hexatonic collection (labeled "H") that is formed by the left-hand's *i2* + *p1* at the end of m. 289. This collection marks the close of part I.

Example 8 reconsiders the pitch realization of the right-hand through a registral lens or "filter."[14] For reference, Example 8a reproduces the uppermost notes of the five melodic gestures in the right hand. Example 8b highlights the presentations of [013] "strands" in three registral strata. The top system of Example 8b details the voice-leading connections in the highest register. It isolates the highest pitches of the first three statements: A♭6, G6, and B♭6, the local climax. The middle system extracts F6, E6, and D6, the notes-immediately-after-the-highest-pitches in the first three partitions. The lowest system shows the pitches that are tied across the bar line, B5, C♯6, and D6. As Example 8b shows, each strand is a member of set-class [013]. The middle and lower strands converge on D6, and mark this pitch as a point of arrival. The fifth gesture returns to chordal presentations in the right hand. Fittingly, the upper voices of this gesture adduce two more [013]s, the lower of which reiterates an octave lower the content of the middle strand.

Part II. Example 9 provides an annotated score for measures 291–294. The second part of the cadenza is more volatile than the first, owing to rapid shifts in tempo, dynamics, and register. Its principle gesture derives from the grace-note gesture heard at the

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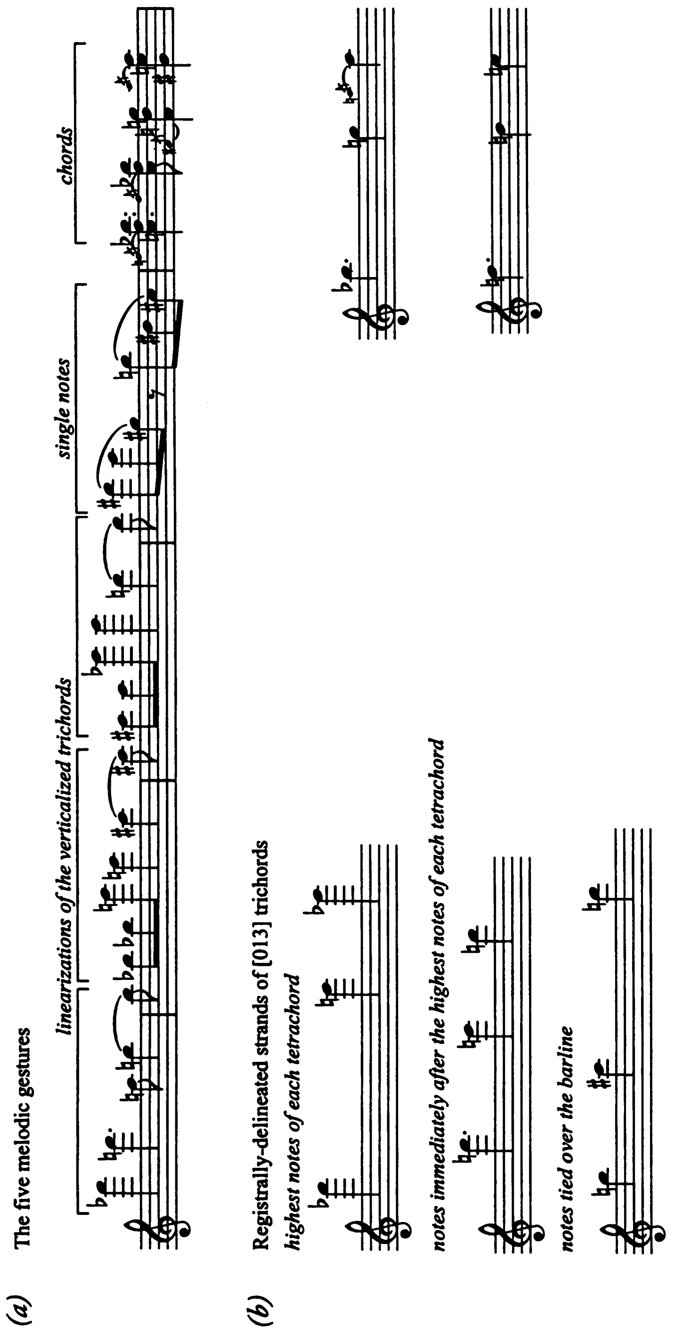
[13] In terms of performance implications, one could easily use "finger pedal" to join the D6 and F5 to their adjoining trichords.

[14] Peles 1983 explores in considerable depth the analytical applications of filters in Schoenberg's Third String Quartet, Op. 30.

Example 8. Voice-leading strands in mm. 286-290.

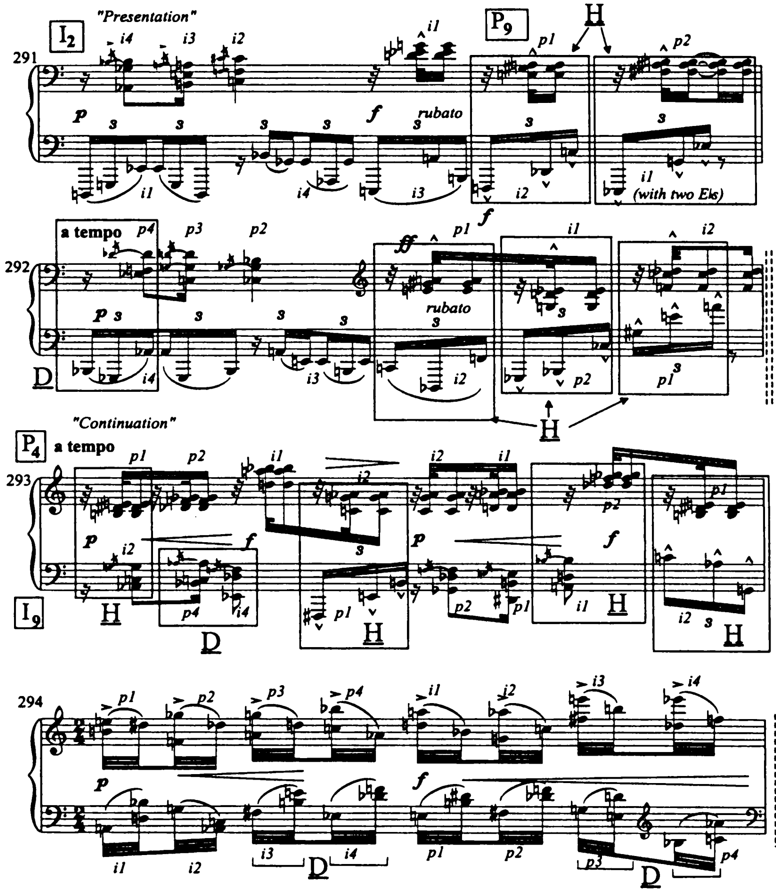


conclusion of part I. In terms of phrase structure, part II resembles in several ways a prototypical "sentence." The "presentation" houses a basic idea (m. 291) and its repetition (m. 292); the "continuation" (mm. 293–294) is characterized by an increase in surface activity, melodic fragmentation, and rhythmic acceleration.[15] The presentation heralds a new region based on I_2 and its counterpart, P_9. The basic idea contrasts grace-note gestures in the right hand with oscillating trichordal arpeggios in the left hand. The rests and abrupt changes in dynamics effectively divide the right-hand trichords into a partitional "hemiola," with four groups of three instead of three groups of four. Perhaps the most striking feature of the presentation is the proliferation of 6–20 and 6–32 hexachords. (These are boxed in the example and designated H and D, respectively.) In mm. 291–292 Schoenberg permutes the trichords of P_9 and I_2 and creates a backdrop of Y and Z hexachords, including five *forte* presentations of 6–20 and a solitary, *piano* 6–32 at beginning of m. 292. The "crunchiness" of the 6–20s is accentuated by the fact that the trichords are now in closed position.

The continuation of the sentence modulates to new region based on P_4 and I_9. The right-hand trichords fashion a pitch-class palindrome, <*p1*, *p2*, *i1*, *i2*, *i2*, *i1*, *p2*, *p1*>, while the left-hand trichords alternate grace-note gestures and arpeggios; together, the hands continue to assert Y and Z hexachords. The continuation ends in m. 294 with back-to-back complexes that are marked by invertible counterpoint between the trichords of $X(P_4)$ and $X(I_9)$. This measure, the thickest and most technically challenging of the cadenza, can be heard as an expansion of the orchestra's material in the *pesante* of the lead-in (m. 285). Each trichord in the complex is divided into two-plus-one configurations that result in a steady stream of vertical trichords. Some of the trichords are familiar—such as the first two simultaneities of m. 294, members

[15] The prototypical sentence is outlined by Schoenberg in *Fundamentals of Musical Composition*, ed. Gerald Strang (London: Faber and Faber, 1967). See also William Caplin, *Classical Form: A Theory of Formal Functions for the Instrumental Music of Haydn, Mozart, and Beethoven* (New York: Oxford University Press, 1998). The influence of classical phrase-building procedures is often evident in Schoenberg's music—especially in the American period works.

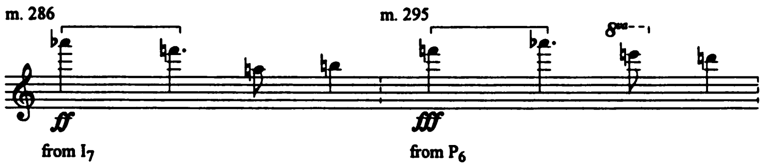
Example 9. Cadenza, part II (mm. 291-294).



of [027] and [015]—but others are new, including [012], [013], [025], and [037] sonorities. These foreign set-classes contribute a sense of partitional "dissonance." This dissonance, coupled with an intensification of texture and dynamics, drives toward part III.

Part III. The third part of the cadenza recalls two ideas of the opening section. Example 10 gives the score for mm. 295–99. Part III begins by recapitulating the nesting of trichords from measure 286, although the trichords are drawn from a P row instead of an I row. Example 11 shows that the gestures in mm. 286 and 295 share the same rhythmic profile as well as the {F6, A♭6} dyad that sits atop the first two trichords.[16]

Example 11. Upper line associations in mm. 286 and 295.



Returning to Example 10, a rest and a *subito piano* in m. 296 follow the nested presentation of $X(P_6)$, allowing the smoke to clear and the dust to settle. Two diatonic hexachords then surface, recalling the 6–32s that were framed in m. 289. The first 6–32 joins <C, D, B♭> in the left hand with <G, E♭, F> in the right hand; the second combines <E, B, A> and <C♯, F♯, G♯>. (These hexachordal collections are boxed in the example and labeled D.) The "smoothness" of these 6–32s is especially welcome

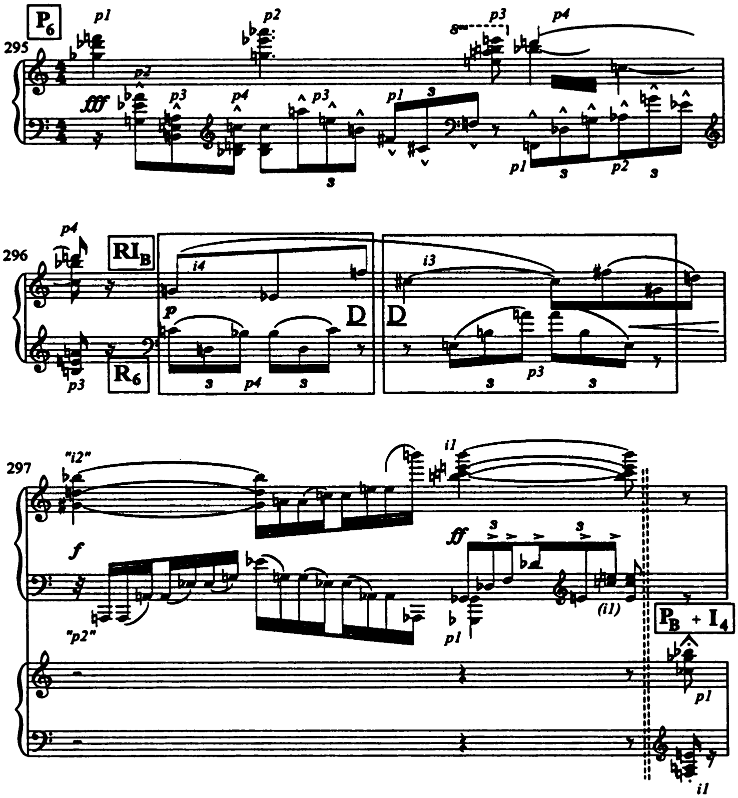
[16] A bit of conjecture: Suppose Schoenberg wanted to begin the recapitulation with a prime transform so that he could highlight the inversional relationship between the top notes of the right-hand trichords of mm. 286 and 295. Suppose further that he wanted to maintain the {F6–A♭6} of the first two trichords. Only two prime rows in the row-class fulfill both objectives (given the constraints of slot-machine transformations):

P_6, with A♭ in its first trichord and F in its second trichord: <615, 873...>, and

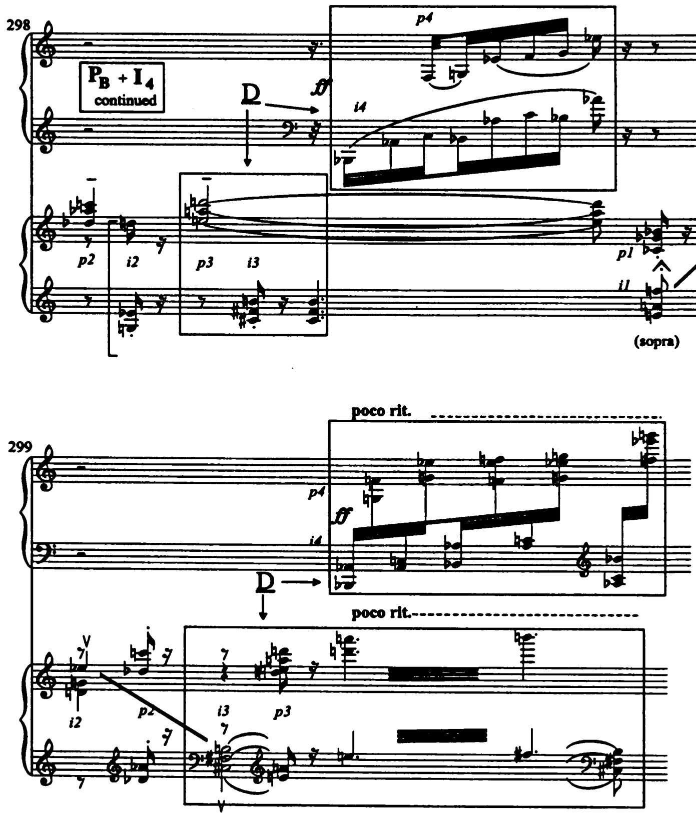
P_8, with F in its first trichord and A♭ in its second trichord: <837, A95...>.

Of these, P6 alone enables Schoenberg to balance the falling interval-class 3 (minor third) of the I_7 row with a rising interval-class 3.

Example 10. Cadenza, part III (mm. 295-299).



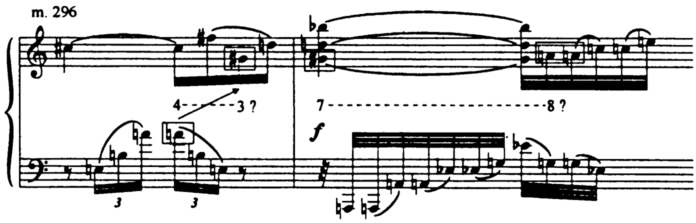
Example 10 (continued).



after the barrage of strident trichords in the retransition and recapitulation (mm. 294–295). Toward the end of m. 297, a ***ff*** flourish of *i1* and *p 1*—bolstered by octave doublings—brings the cadenza proper to a close.

Two details in mm. 296–297 warrant further consideration. The first is shown in Example 12. The peculiarity here concerns the registral and rhythmic realizations of A4 and G♯4 in the unraveling of rows RI_B and R_6. These pitches are boxed in the example. I am especially struck by the voice-leading of the A4 in the left-hand arpeggios to G♯4 in the right hand an eighth note later: it sounds and *feels* like a 4–3 suspension. In a similar vein, the right hand's G♯4 is restruck in the *forte* chord on the downbeat of m. 297, and subsequently moves to A4. This voice-leading resembles a 7–8 retardation over the bass note A. Whether these are legitimate 4–3 and 7–8 figures is moot (for I would be loathe to argue voice-leading merits in a serial piece). The interesting thing is the emphasis nearly every performer gives to the A4s and G♯4s.[17]

Example 12. "Tonal" references.



The right hand is from RI_B: <7 3 5 1 6 8 2 A 9 0 4 B>

The left hand is from R_6: <A 2 0 4 B 9 3 7 8 5 1 6>

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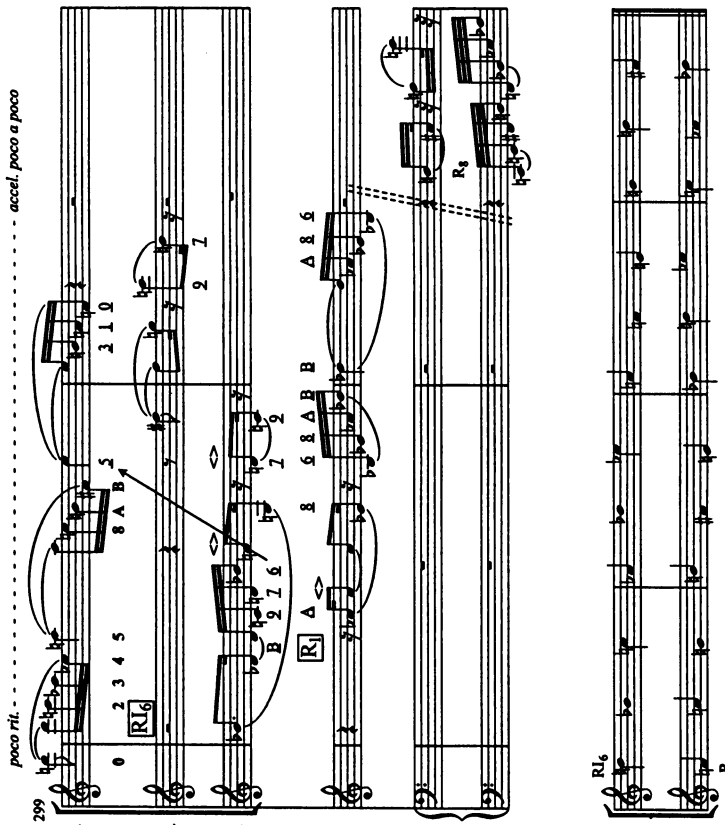
[17] The performers sampled include Pierre Amoyal, Emmanuel Ax, Alfred Brendel, Glenn Gould, Paul Jacobs, Maurizio Pollini, and Peter Serkin. Two observations: first, given that G♯4 and A4 are in all likelihood played by the thumbs, it would be hard not to emphasize them. Second, it is instructive to evaluate these performances from the standpoints of conception and sound. On one extreme are the "romantic" approaches (Ax, Jacobs, and especially Amoyal), which feature a heavy use of pedal, a full tone, and a great deal of rubato; on the other side are "classical," or abstract interpretations (Brendel and especially Pollini), which espouse less pedal, a drier tone, and a straight-ahead presentation. It is also fascinating to compare the discrepancies in performance practice, particularly in the approach to and execution of the recapitulation.

The second detail to consider concerns the right-hand slur at the end of m. 296, which encompasses <F♯, G♯, D>, and the *forte* trichord on the downbeat of m. 297. Both sonorities are [026] trichords. If these [026]s sound out of context, they should: they are the first (and last) instances of this set-class in the cadenza. In a manner of speaking, the right-hand trichord on the downbeat of m. 297 is "wrong": it should be {A, B♭, D}, not {G♯, B♭, D}. The left-hand trichord is equally "wrong": it should be {E♭, G, A♭}, not {E♭, G, A}. In other words, the first half of m. 297 features a voice exchange, in which the hands swap G♯ (alias A♭) and A. The "right" hexachord arises, 6–Z38[012378], but it is partitioned into inversionally-related [026]s instead of [015]s. In the broader scheme of things, the "anticipation" of D4, the retardation of G♯4, the formation of [026]s, and the unraveling of rows signal the dissolution of the strict trichordal structuring that has governed—indeed, *defined*—the preceding fifteen measures. This is the "beginning of the end" of the cadenza.

The denouement. The *ff* flourish of *i1* and *p1* leads into a denouement that reintegrates the orchestra into the Adagio movement. During the pick-up to m. 298, the piano and orchestra modulate to a trichordal complex based on P_B and I_4. At this point set-class 6–32 comes to the fore. The orchestra combines *p3* and *i3* in a stacked arrangement of [027]s while the piano combines *p4* and *i4* in a rising arpeggio of [024]s. Diatonic hexachords return in m. 299, with slight variations, and lead us to an orchestral interlude (mm. 299–301). Example 13 provides an annotated score of the interlude, along with realizations of rows RI_6 and R_1 for reference. The most intriguing aspect of this passage is the fact that Schoenberg is able to maintain *trichordal* structuring and project a *tetrachordal* surface. (In a sense, he is able to have his cake and eat it, too.) This feat is achieved by partitioning the trichords into a series of two-versus-one patterns (similar to the retransition passage in m. 294). By way of illustration, Example 13 offers two sets of order numbers. The boldface order numbers trace the elements of RI_6; the underlined order numbers trace the elements of R_1. (Order numbers **0** and $\underline{0}$ represent the first notes of the rows, and **11** and $\underline{11}$, the last.) The initial flute idea, <D, C, A♭, E♭>, is made up of order numbers {**0**, **2**, **3**, **5**} of row RI_6; the bassoon dyad, <B♭, D>, *Example 13. The orchestral interlude (mm. 299-301).*



comprises order numbers {1, 4}. In terms of attack points, however, we can easily discern—and reconstruct—the trichordal elements of RI_6: the first three and next three attacks bring <D, B♭, C> and <A♭, D♭, E♭>. Similar two-versus-one schemes govern R_1 and the piano's statement of R_8, in which two-versus-one fragments are combined into four-versus-two arrangements.[18] Eventually, the realization of rows becomes more linear and less trichordal—so much so that by m. 304 trichordal structuring has become a distant memory.

❖ ❖ ❖

Example 14 considers the preceding observations in a broader framework. It details the distribution of trichords and mosaics in the cadenza's three subsections. The example lists the procedures used to develop the trichords, the rows and mosaics used, the arrangement of right-hand and left-hand trichords, and the dynamic levels. This satellite view of the cadenza highlights the "Lego-like" combinations of trichords in the single-row partitions of mosaic X and the double-row partitions of Y and Z.

We can make several observations about the trajectory of the cadenza and the roles played by its three phases. Phase I erupts with a huge burst of energy. It establishes X schemes (the linear partitions of individual rows) as the featured mode of presentation, and a harmonic rhythm of one partition per measure. One row from each of the two regions, P_2/I_7 and P_7/I_0, is endowed with a nested presentation of trichords. In a few places trichords are implanted, or interjected into the texture of an opposing row; such instances of mixture "plant" foreign sonorities from the Y and Z inventories.[19] These sonorities are foregrounded in the next

[18] A variant of this partitional procedure occurs near the end of the *Klavierstück* Op. 33a, in mm. 37 and 38, where Schoenberg partitions the row's discrete tetrachords into three-versus-one arrangements that maintain tetrachordal integrity yet also project melodic trichords.

[19] For instance, in m. 287, the *p4* trichord in the right hand combines with the *i4* trichord in the left hand to fashion set-class 6–32, the all-combinatorial hexachord from mosaic Z; in m. 288, the intrusion of *p1* in the left hand combines with *i1* to generate the Y sonority 6–Z6[012567]; in m. 290, back-to-back compositions of *i1* and *p2* articulate 6–20, also of Y. These set-classes all return, more forcefully, in phase II.

Example 14. Schematic representation of trichords in the cadenza.

Phase I: A huge burst of energy that fades (*ff* ⇒ *pp*) — Primarily X formations — Occasional mixing of P and I trichords

	nested I	P and I overlap		another nested I *p1* implanted	nested P, scumbled mixture of p and i	
mm.	286	287		288	289	290
Rows:	I_7	R_2	//	I_0 hints of P_7	now P_7	hints of I_0 //
Right hand:	i1 i2 i3 i4	p4 p3 p2 p1		i1 i2 i3 i4	p4	p3 p1 p2
Left hand:	i2 i3 i4 i4 i3 i1 i1 i2 i3	i4 p4 p3 p2	p3 p4	i2 i3 i4 i1 p1 i1 p1 i2 i1	p4 p3 p1 p2	p1 p2 i1 i2 i2 p1
Dynamics:	*ff*			*p*	> *pp*	

Phase II: A sentence — Superimposition of P and I brings Y and Z formations — Energy builds to m.296

	P and I trichords scumbled and counterposed hexatonic flavors (p1 + i2, p2 + i1)			P and I trichords (gradually) aligned energy builds to the recap. (m.296)		
mm.	291	292		293	294	
Rows	I_2 (basic idea) and P_9	(basic idea repeated)	//	P_4 and I_9 (continuation)		//
Right hand	i4 i3 i2 i1 p1 p2	p4 p3 p2 p1 i1 i2		p1 p2 i1 i2 i2 i1 p2 p1	p1 p2 p3 p4 i1 i2 i3 i4	
Left hand	i1 i4 i3 i2 i1	i4 i3 i2 p2 p1		i2 p4 i4 p1 p2 p1 i1 i2	i1 i2 i3 i4 p1 p2 p3 p4	
Dynamics:	*p* *f*	*p* *f*		*p* < *f* *p* < *f*	*p* < < *f* < <	

Phase III: Recapitulation — Summary (with complete *trichordal complexes)* — **Close** (with a return to X formations)

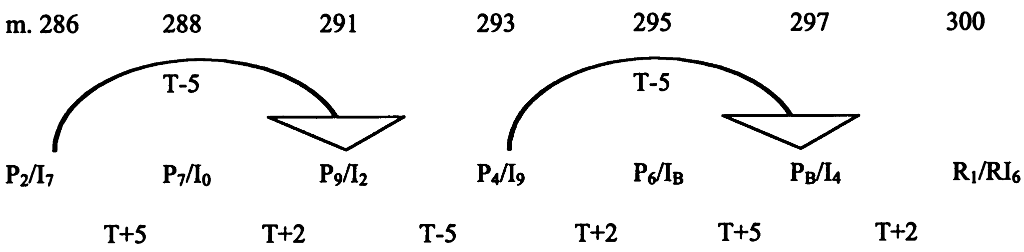
	Recap. of m.286 (nested P instead of I)			Realignment,	consolidation,		*denouement*		
mm.	296	297		298	299		300		
Rows	P_6	R_6 and RI_8	//	P_8 and I_4		//	R_8	RI_1	//
Right hand:	p1 p2 p3 p4	i4 i3 i2 i1		i1 i2 i3 i4	i1 i2 i3 i4		p4 p3 p2 p1	i4 i3 i2 i11	
Left hand:	p2 p3 p4 p4 p3 p1 p1 p2	p4 p3 p2 p1		p1 p2 p3 p4	p1 p2 p3 p4				
Dynamics:	*fff (!)*	*p* < *f* < *ff*		ORCHESTRA re-enters					

section. The landscape changes dramatically in phase II, which unfolds as a sentence. Here, Schoenberg alternates, scumbles, and juxtaposes the trichords of inversionally-related rows, and subsequently exhausts the harmonic inventories of mosaics Y and Z. The juxtaposition and permutation of P and I sonorities, especially in the continuation (mm. 293–294), create a number of 6–20 and 6–32 hexachords (the set-classes that were adumbrated in phase I). The continuation, with its dynamic fluctuations and acceleration of harmonic rhythm, drives toward the telescoped recapitulation that begins phase III. Phase III contains the dynamic and registral climax of the cadenza. It recalls the linear nestings of X from the first gesture (m. 296), and recaptures the all-combinatorial Y and Z collections from the previous phases. In m. 298 the orchestra reenters, and Schoenberg re-aligns and consolidates the trichords of the P_B/I_4 complex, restoring order to the presentation of mosaics and bringing the cadenza proper to a close.

Example 15 offers a transformational view of the cadenza's hexachordal regions. It measures the distance in semitones between the P and I rows of the regions. As an illustration, the distance in directed semitones between the first two regions, P_2/I_7 and P_7/I_0, is T_{+5}. Observe that all of the successive regions of the cadenza are related by moves of 5 and 2 semitones. (We can surmise that the transformation in m. 293 is T_{-5} instead of T_{+5} because the former would return us prematurely to the P_2/I_7 region—the region with which the cadenza opens.) The significance of the <+5, -2> motions lies in their ability to capitalize on the invariance between the trichords of T_2-related rows.[20] We can see this in the lower portion of Example 15, which collates the trichords of a trio of T_2-related pairs, P_7/I_0, P_9/I_2, and P_B/I_4. Note that P_7 and P_9 share the unordered trichord {489}; I_0 and I_2 share {015}; P_9 and P_B share {6AB}, and I_2 and I_4 share {237}. Note, too, that these regions maintain the same unordered 6–20 collections, {014589} and {2367AB}. Similar intersections relate the other trio of rows in the

[20] Mead 1988 discusses the trichordal invariance between T_2-related regions in the first movement, and argues that the associations of trichords in mm. 112-114 stem from the intervallic properties of the tone row. One can find in the other movements of the Concerto many instances of $<T_5, T_2>$ transformations between successive regions.

Example 15. A transformational view of the cadenza.



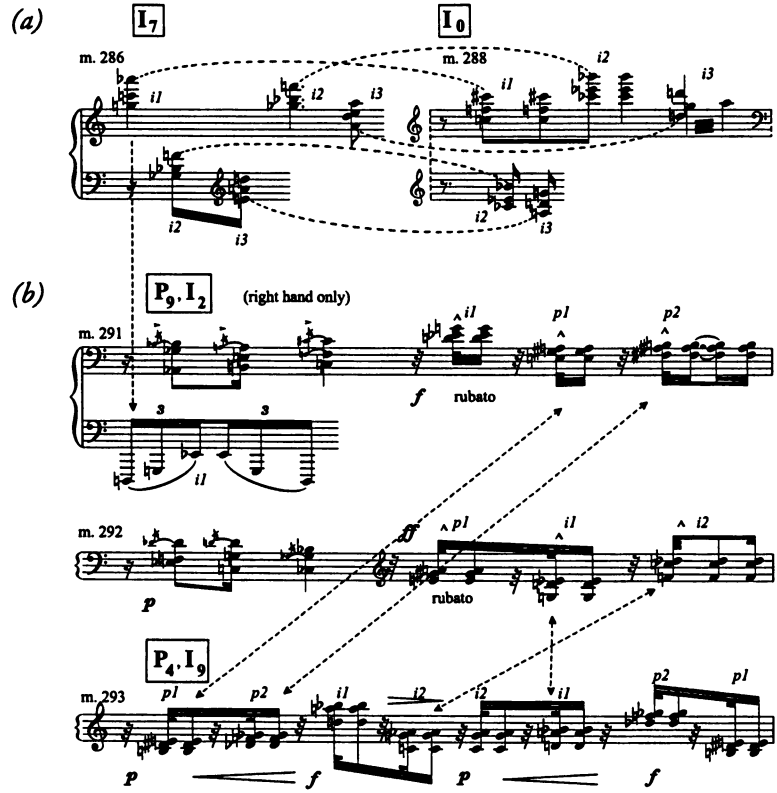
P_7:	726	*984*	A05	1B3
I_0:	*051*	AB3	972	684

P_9:	*948*	BA6	027	351
I_2:	273	*015*	B94	86A

P_B:	B6A	108	249	537
I_4:	495	237	1B6	A08

$Y(P_7/I_0)$, $Y(P_B/I_4)$, $Y(P_9/I_2)$ share the unordered collections {014589} and {2367AB}

Example 16. Some T_5-relationships among trichords.



cadenza, P_2/I_7, P_4/I_9, and P_6/I_B. Thus, the chains of <+5, -2> motions build a network of 3–4[015] trichords and 6–20[014589] hexachords.

Example 16 highlights some of the surface-level T_5-relationships among trichords. (The generic label T_5 describes transposition by five semitones in pitch-class space.) T_5-arrows connect the trichords of I_7 in m. 286 (the first gesture of part I) with the trichords of I_0 in m. 288 (the third gesture). The first trichord of I_7, *i1*, is transposed seven semitones lower in I_0 (with C♯ enharmonically translated as D♭); trichords *i2* and *i3* are transposed seven semitones up. Another T_5-relationship connects *i1* in the right hand of m. 286 with *i1* in the left hand of m. 291 (these are the beginnings of phases I and II). Still other mappings relate the trichords in the continuation. The point is that the T_5-relationships are not theoretical conceits—they are aurally compelling on both the small scale and the large.

III. Final Considerations

In order to place the cadenza of the Piano Concerto into a broader context, let us consider it in relation to the cadenzas of the Violin Concerto, Op. 36. Schoenberg wrote three cadenzas for the Violin Concerto. One occurs at the end of the first movement; another, a "quasi-cadenza," lies in the middle of the third movement; a third concludes the last movement.[21] The first and third cadenzas accomplish several things: they subject the row to various trichordal, tetrachordal, and hexachordal partitions; they exploit the associations among different rows in the row-class; and, most importantly, they recall and recontextualize prominent

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[21] The first cadenza of the Violin Concerto begins in m. 233 of the first movement, and is announced by a fermata (!). The quasi-cadenza occurs in mm. 533–542 of the third movement; it is measured. The third cadenza (mm. 647–708), is the capstone of the Concerto. It contains measured and unmeasured passages, and alternates accompanied and solo material. Lewin 1962 and Mead 1985 discuss aspects of the first movement's cadenza. The former offers a close reading of the segmental associations among three-, four-, five-, and six-note collections in the first-movement cadenza; the latter focuses on long-range connections among collections in the first movement, including those between mm. 89 and the conclusion of the cadenza.

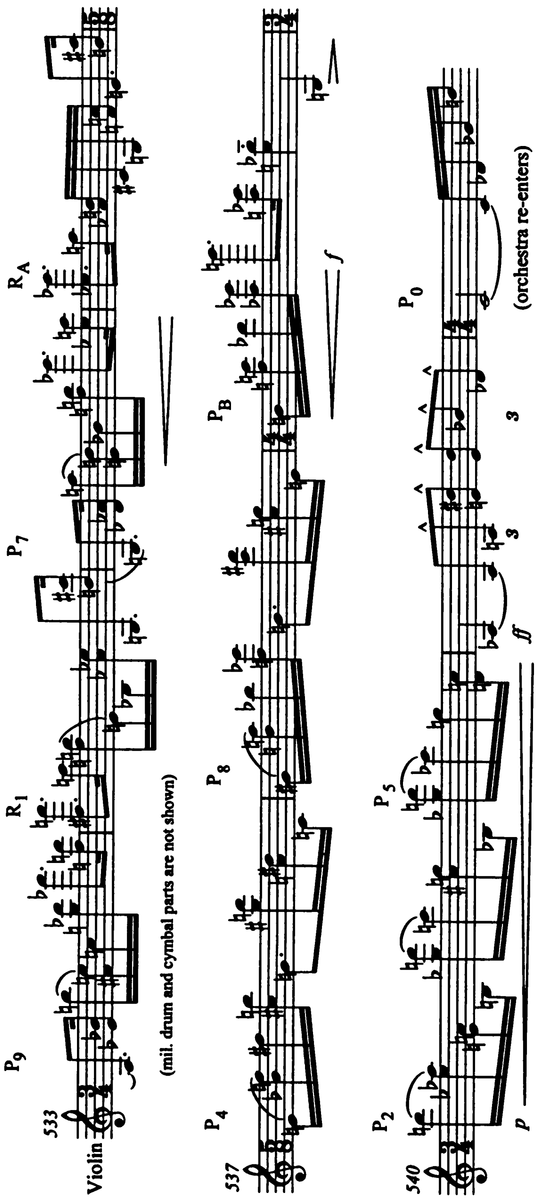
thematic material—the main tunes, so to speak.[22] The quasi-cadenza (mm. 533–542) tells a different story, however. It is reproduced in Example 17, which shows the violin part but omits the military drum and cymbal accompaniment. The trichordal structuring of the quasi-cadenza is immediately apparent. The violin unfolds a number of prime and retrograde rows, all of which are parsed into discrete trichords. The trichords belong to set-classes [016], [027], [016], and [036]. The harmonic rhythm is regular (save for a partitional "hemiola" in mm. 540–541), and the trichordal partitioning is strikingly *un*varied: each row unfolds in a linear, one-through-twelve manner.[23] (Indeed, the quasi-cadenza resembles a trichordal etude.) I would argue that this modest quasi-cadenza is the predecessor of the cadenza in the Piano Concerto. The differences in scope and complexity between the violin's quasi-cadenza and the piano's more elaborate offering can be attributed to the piano's ability to project—and differentiate—two rows at the same time. While the violin has at its disposal only the successive trichords of single partitions, the piano enjoys the resources of the entire trichordal complex: two partitions from mosaic X and one partition each from mosaics Y and Z. A richer harmonic palette deserves a larger canvas.

By way of conclusion, I would assert that the trichordal complex is an ideal tool with which to analyze the cadenza. It enables us to model the permutations and manipulations of trichords. It allows us to chart the progressions of harmonies that arise from the combinations of [015], [024], and [027] trichords. It enables us to formalize what it means to realize mosaic X, hear

[22] The culmination of the violin's first-movement cadenza is its recollection of the initial two-note groupings in the opening. Though the dyads are restated at different pitch levels, the rhythm and articulation render the connection unmistakable. The cadenza in the third movement goes even further: it recalls ***at pitch*** the violin's opening thematic material of the first movement, and recalls the main tunes of the first and second movements.

[23] Perhaps the most striking feature of the quasi-cadenza is the lack of invariance among the trichords. In fact, the rows "cycle through" their discrete trichords with a minimum degree of pitch-class duplication. This is in stark contrast to the cadenza of the first movement, which, as Lewin 1962 shows, highlights the invariant trichords of different rows. (For instance, row P_x possesses the same trichordal collections as row I_{x+4}.)

Example 17. Quasi-cadenza of the Violin Concerto, mm. 533ff.



$P_0 = \langle 0\,1\,6\;\;2\,7\,9\;\;3\,4\,A\;\;B\,5\,8 \rangle$

mosaic Y and its 6–20[014589] hexachords, and anticipate mosaic Z and its 6–32[024579] hexachords. And it sets into relief the techniques Schoenberg uses to fashion his trichordal and hexachordal landscape, namely: nesting, compression, interpolation, realignment, consolidation, partitional hemiola, and two-versus-one schemes. It must be said, however, that these techniques are not unique to the cadenza of the Piano Concerto—we can find precedents in the Third Quartet (Op. 30), the Variations for Orchestra (Op. 31), the *Klavierstücke* (Op. 33), the Violin Concerto (Op. 36), and the Fourth Quartet (Op. 37). What is truly unique about this cadenza is Schoenberg's ability to create a beautiful and powerful mini-drama from just three trichordal set-classes.[24]

Appendix: Toward Hearing the Hexachordal Set-Classes in the Cadenza

Here I offer some suggestions for identifying the set-classes in the inventories of mosaics X, Y, and Z. There are many ways, of course, to learn to hear set-classes. Interested readers may wish to consult Friedmann 1990 and Morris 1994. The first step is to play the trichords of a particular trichordal complex (such as the P_2/I_7 complex in Example 3) until they are (immediately) recognizable. Then focus on the hexachordal set-classes that are built from members of the same trichordal set-class. These three collections are 6–9[012357] and the all-combinatorial collections 6–20[014589] and 6–32[024579].

- One configuration of 6–9 (that which is formed by initial trichords of P or I rows) is generated by transpositionally-related [015]s that are two semitones apart (observe that

[24] One final observation: nineteen measures after the conclusion of the piano cadenza, Schoenberg writes an orchestral cadenza (mm. 319–325). This orchestral version imports the materials of the piano's cadenza, and embellishes them in an even more remarkable exhibition of partitioning and motivic development. This flourish is followed by a four-measure, improvisatory passage that leads gracefully into the Giocoso movement. The association between the piano cadenza and the orchestral cadenza is cemented by many factors: the *Più Largo* indication, the same MM marking of ♩ = 44, a return to trichordal structuring, and the accented, forte left-hand melody tetrachord, <D♭, B♭, D, E>, that recalls the rhythm and contour of the piano's opening right-hand melody in m. 286.

the pitch-classes of *p1* are two semitones higher than those of *p2*, whereas the pitch-classes of *i1* are two semitones lower than those of *i2*).

- 6–20, the hexatonic entry, comprises inversionally-related [015]s (namely, *i1* and *p2*, and *i2* and *p1*).
- 6–32 combines inversionally-related [027]s (*i3* and *p3*), and two [024]s (*i4* + *p4*).

Once these hexachords are mastered, one can then associate the combinations of individual trichords with the inventories of mosaics X, Y, or Z. For instance, how does *i3* interact with the other trichords in mosaic Z? The Z inventory is generated by combinations of *i3*, *p3*, *i4* and *p4*. These trichords yield three hexachords, 6–9, 6–32, and 6–22.

- *i3* + *i4* make 6–9[012357], which is in part distinguished by a four-note chromatic run, {E, D♯, D, C♯}. (6–Z38[012378] is the only other hexachord (in these inventories) with a four-note chromatic run; the difference is that 6–Z38 has a larger gap in the middle, and an ic1 on the "outside" instead of an ic2. To compare, 6–9 contains {E, D♯, D, C♯} plus {B, A} whereas 6–Z38 houses {E, D♯, D, C♯} plus {A, G♯}. Another way to build 6–9 is to take an ascending [027], insert a note between the notes of interval-class 2, and construct an ascending [024] on this note. For example, build a [027] on E♭: {E♭, F, B♭}; split the difference between E♭ and F, and build a [024] on this E: {E, F♯, G♯}. The resultant sonority, {E♭, E, F, F♯, G♯, B♭} is a 6–9 hexachord.
- *i3* plus *p3* make 6–32[024579], the diatonic all-combinatorial hexachord.
- *i3* and *p4* create 6–22[012468], the only whole-tone-but-one hexachord.

Y's inventory is larger. Mosaic Y contains only [015] trichords, which generate three complementary pairs of set-classes: 6–9 (which is produced in a different way than the 6–9 in mosaic Z); 6–20[014589], the hexatonic collection; and the Z-pair 6–Z6[01257] and 6–Z28[012378].

- *p1* and *p2* generate 6–9 (a configuration of T_2-related trichords; the resultant collections has the characteristic four-note chromatic fragment on either end);

- *p1* and *i2* form 6–20[014589], which is marked by its symmetrical arrangement of interval-classes 1 and 3 (and also by a lack of interval-classes 2 and 6).
- *p1* + *i1* unite inversionally-symetrical trichords in such a way as to create a "barbell" hexachord: {C, C♯, D—gap—F, F♯, G}.
- *p2* + *i2* create 6–Z38[012378] hexachords, which are mentioned above.

It remains to investigate the hexachords of mosaic X, which include 6–9, 6–16[014568] and the Z-pair 6–Z48 and 6–Z26. 6–9 is discussed above; 6–16 is produced by the "inside/outside" arrangement of trichords (namely, the *i1* + *i4*, and *i2* + *i3*), and the pair 6–Z48/6–Z26 are formed by alternating trichords (namely, *i1* + *i3*, and *i2* + *i4*). These collections are somewhat less frequently encountered.

Practice maintaining, or "freezing" a given trichord and combining it with other trichords of its mosaics. For instance, one could begin with *i2*, {F, G♭, B♭}, and add to it the other X and Y trichords. Finally, improvise on these trichords.

References

Alegant, Brian. 1993. "The Seventy-Seven Partitions of the Aggregate: Analytical and Theoretical Implications." Ph.D. dissertation, University of Rochester, 1993.

________. 1996. "Unveiling Schoenberg's Op. 33b." *Music Theory Spectrum* 18/2: 143–166.

________. 2001. "Cross-Partitions as Harmony and Voice Leading in Twelve-tone Music." *Music Theory Spectrum* 23/1: 1–40.

Alegant, Brian and Don McLean. 2001. "On the Nature of Enlargement." *Journal of Music Theory* 45/1: 31–71.

Babbitt, Milton. 1955. "Twelve-Tone Invariants as Compositional Determinants." *The Score and IMA Magazine* 12: 53–61.

________. 1961. "Set Structure as a Compositional Determinant." *Journal of Music Theory* 5: 72–94.

________. 1962. "Twelve Tone Rhythmic Structure and the Electronic Medium." *Perspectives of New Music* 1: 49–79.

Dubiel, Joseph. 1990. "Three Essays on Milton Babbitt, Part I." *Perspectives of New Music* 28: 216–261.

Forte, Allen. 1973. *The Structure of Atonal Music.* New Haven: Yale University Press.

Friedmann, Michael. 1985. "A Methodology for the Discussion of Contour: Its Application to Schoenberg's Music." *Journal of Music Theory* 29/2: 223–248.

________. 1990. *Ear Training for Twentieth-Century Music.* New Haven: Yale University Press.

________. 1993. "Motive, Meter and Row: Conflicting Imperatives to the Performer in Schoenberg's *Klavierstück* Op. 33b." *Ex Tempore* 6: 29–49.

Haimo, Ethan. 1990. *Schoenberg's Serial Odyssey: An Evolution.* Oxford: Clarendon.

Headlam, David. 1990. "Row Derivation and Contour Association in Berg's *Der Wein.*" *Perspectives of New Music* 28/1: 256–293.

________. 1996. *The Music of Alban Berg.* New Haven: Yale University Press.

Hyde, Martha. 1985. "Musical Form and the Development of Schoenberg's Twelve-Tone Method." *Journal of Music Theory* 29: 85–143.

________. 1993. "Schoenberg: Dodecaphony." In *Models of Musical Analysis: Early Twentieth Century Music*, ed. Jonathan Dunsby. Oxford: Blackwell Publishers, 56–80.

Kurth, Richard. 1992. "Mosaic Polyphony: Formal Balance, Imbalance, and Phrase Formation in the Prelude of Schoenberg's *Suite*, Op. 25." *Music Theory Spectrum* 14: 188–208.

Lewin, David. 1962. "A Theory of Segmental Association in Twelve-Tone Music." *Perspectives of New Music* 1/1: 89–116.

________. 1967. "A Study of Hexachord Levels in Schoenberg's *Violin Fantasy.*" *Perspectives of New Music* 6: 18–32.

________. 1995. "Generalized Interval Systems for Babbitt's Lists, and for Schoenberg's String Trio." *Music Theory Spectrum* 17/2: 81–118.

Martino, Donald. 1961. "The Source Set and Its Aggregate Formations." *Journal of Music Theory* 5: 224–273.

Marvin, Elizabeth West and Paul A. Laprade. 1987. "Relating Musical Contours: Extensions of a Theory for Contour." *Journal of Music Theory* 31/2: 225–267.

Mead, Andrew. 1985. "Large-Scale Strategy in Schoenberg's Twelve-Tone Music." *Perspectives of New Music* 24/1: 120–157.

________. 1988. "Some Implications of the Pitch-Class/Order Number Isomorphism Inherent in the Twelve-Tone System: Part One." *Perspectives of New Music* 26: 96–163.

________. 1989. "Twelve-Tone Organizational Strategies: An Analytical Sampler." *Intégral* 3: 93–169.

Morris, Robert and Brian Alegant. 1988. "The Even Partitions in Twelve-Tone Music." *Music Theory Spectrum* 10: 74–101.

Morris, Robert. 1987. *Composition with Pitch-Classes: A Theory of Compositional Design*. New Haven: Yale University Press.

________. 1993. "New Directions in the Theory of Musical Contour." *Music Theory Spectrum* 15/2: 205–228.

________. 1994. "Recommendations for Atonal Music Pedagogy in General; Recognizing and Hearing Set-Classes in Particular." *Journal of Music Theory Pedagogy* 8: 75–134.

Peles, Stephen. 1983–84. "Interpretations of Sets in Multiple Dimensions: Notes on the Second Movement of Arnold Schoenberg's *String Quartet #3*." *Perspectives of New Music* 22: 303–352.

Rahn, John. 1980. *Basic Atonal Theory*. New York: Longman.

Rothstein, William. 1980. "Linear Structure in the Twelve-Tone System: An Analysis of Donald Martino's *Pianississimo*." *Journal of Music Theory* 24: 129–165.

Rouse, Steven. 1985. "Hexachords and Their Trichordal Generators: An Introduction." *In Theory Only* 8/8: 19–43.

Samet, Bruce. 1987. "Hearing Aggregates." Ph.D. diss., Princeton University.