Listening and Composing

By Jason Eckardt

Long before I was a composer, I was a listener. Listening has always shaped my compositional decisions, and it has always been the primary influence on the evolution of my compositional techniques. The intense investigation of the nature of listening—in particular, trying to comprehend how I understand the music that I hear—has most powerfully molded the way that I write music.

The music I like to hear is music that surprises and beguiles me. It is music that is unpredictable and volatile, and that resists easy categorization. While the immediate features of the music I write intentionally embody the above qualities, I am deeply concerned with establishing a subtle, underlying continuity in my works. Specifically, I seek to imbue my compositions with a sense of harmonic relatedness. One way in which I achieve this is by imposing limitations on ways in which the pitch materials are organized.

In tonal music, the perception of harmonic relatedness is linked to several phenomena: fixed intervallic structures of scales, invariant pitch-class content within each individual scale, and different harmonic functions of scale degrees and chords in tonal progressions. My music, which is atonal and chromatically saturated, does not maintain the invariant pitch-class content of scales, nor does it exhibit the harmonic functions characteristic of progressions in tonal music.[1] What my harmony does share with tonal music, however, is interval-class invariance. In tonal music, one can modulate from one key to another and maintain a sense of harmonic relatedness. While some tonal modulations result in little pitch-class duplication between keys, these keys are still harmonically related, due to the invariant interval vector of identical pitch-class set types that comprise their respective diatonic scales. A harmonic relation that results from shared intervallic properties of pitch-class set types informs the harmonic organization of my music. Harmonic relatedness is achieved through the articulation of parametrically defined musical segments comprised of identical unordered pitch-class set types and their unordered subsets or supersets.

My works explore microtonal harmony, using an aggregate that divides the octave into twenty-four equidistant pitch classes. A twenty-four pitch-class octave, notated in quarter tones, facilitates my use of set-theoretical techniques (adjusted to mod 24).[2] Composing for acoustic instruments in

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the mod 24 environment presents particular challenges. In musical situations with certain acoustic instruments, passages using quartertones may be difficult or impossible to perform in some registers or in rapid gestures. Instruments limited in their pitch production to only semitonal pitches (when used idiosyncratically), such as piano and pitched percussion, present additional limitations.

To address these practical considerations, I developed a harmonic system that combines two kinds of unordered pitch-class set-types: quartertonal and semitonal. These two kinds of sets are interchanged depending on the musical context, allowing me to compose a greater variety of instrumental gestures while still incorporating quartertones.

In my composition *Polarities,* two unordered pitch-class sets, one quartertonal and one semitonal, are used as the set-types from which other subsets and supersets are drawn. They are [0,1,2,7,8,12] and [0,2,4,6,12,14].[3] The choice of the [0,2,4,6,12,14] was prompted by its inversionally combinatorial property, which enables me to form the semitonal aggregate using the transpositional/inversional operation T22I. Additionally, these two set-types share set type [0,2,8,12] (fig. 1),[4] a tetrachord that contains all of the semitonal interval classes, allowing maximal intervallic variety within gestures to be composed with the set-type. (Generally, pitch-class set-types with the greatest variety of interval classes were chosen as subsets, for the reason stated above.) By exploiting this shared subset, and others like it, I create harmonic relatedness between sets.

From these [0,1,2,7,8,12] and [0,2,4,6,12,14] hexachords, particular subsets are derived (see fig. 2a).[5] All pitch-class set-types share some subset with some higher cardinality set of their own kind (semitonal or quartertonal). For example, [0,2,4,10] is embedded within [0,2,4,10,12], which itself is embedded within [0,2,4,6,12,14] (fig. 2b). Similarly, [0,1,6,8] is embedded within [0,1,2,7,8], which is embedded within [0,1,2,7,8,12] (fig. 2c). These subsets themselves also share subset relations between semitonal and quartertonal set types. For example, [0,2,4,10] and [0,1,2,7,8] share a [0,2,8] trichord subset (fig. 2d), while [0,2,4,10,12] and [0,1,2,7,8,12] share [0,2,8], [0,2,12], [0,4,10], and [0,4,12] trichord subsets (fig. 2e).

These pitch-class set types are used as the pitch material for the parametrically defined segments. Segments consisting of different multiplicities of pitch classes are derived as subsets of the two source hexachords. Quartertonal passages appear simultaneously with semitonal ones, all harmonically related by shared subsets. Figure 3 illustrates a representative passage from *Polarities,* where quartertonal and semitonal sets are used. The tetrachordal gesture in m. 26 is pitch-class set-type [0,1,6,8]. The

Figure 1: Shared [0,2,8,12] subset between [0,1,2,7,8,12] and [0,2,4,6,12,14].

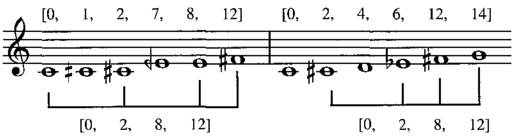


Figure 2a: Subsets derived from [0,1,2,7,8,12] and [0,2,4,6,12,14] hexachords.

Subsets derived from [0,2,4,6,12,14]:

Cardinality	*Pitch-class set-type*
3	[0,2,4], [0,2,8], [0,2,10], [0,2,12]
4	[0,2,4,10]
5	[0,2,4,10,12]

Subsets derived from [0,1,2,7,8,12]:

Cardinality	*Pitch-class set-type*
3	[0,1,2], [0,1,6], [0,1,8], [0,3,10]
4	[0,1,6,8]
5	[0,1,2,7,8]

Figure 2b: Subset relations among semitonal pitch-class set-types.

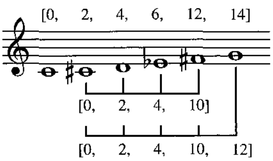


Figure 2c: Subset relations among quartertonal pitch-class set-types.

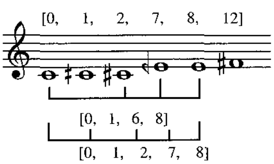


Figure 2d: Subset relations among quartertonal pitch-class set types.

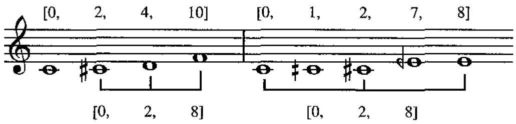
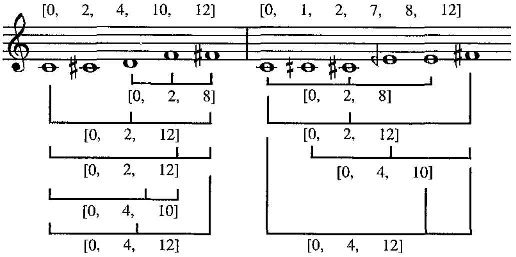


Figure 2e: Subset relations between [0,2,4,10,12] and [0,1,2,7,8,12].



three gestures that follow, form, respectively, [0,2,12], [0,2,4,10], and [0,1,2,7,8] pitch-class set-types (all subsets derived from either the [0,1,2,7,8,12] or [0,2,4,6,12,14] hexachords). They share multiple subset relations. The [0,1,6,8] tetrachord type in m. 26 is embedded in the pentachord type [0,1,2,7,8] in m. 27. Both share [0,2,8] with the [0,2,4,10] tetrachord type in m. 26, and all share [0,2] with the [0,2,12] trichord in m. 26.

For segments comprised of pitch-class sets with a cardinality greater than six, a pitch-class set with a cardinality of six or less, taken from the hexachord or subset types listed in figure 2a, is intersected with some other pitch-class set-type from figure 2a by using a transpositional/inversional operation. This operation yields some multiplicity of intersecting pitch classes whose cardinality is less than the cardinality of the larger set, producing a pitch-class superset with a cardinality greater than six.[6] In figure 4a, the middle gesture is comprised of a [0,2,4,6,8,12,14,16] octachord surrounded by trichord gestures that contain pitch-class set-types [0,2,10] and [0,1,8], respectively. The [0,2,4,6,8,12,14,16] octachord is a superset yielded from intersections of the pitch-class set-type [0,2,4,6,12,14] and a transposition of that hexachord by a minor second (fig. 4b). Through pitch-class set-type inclusion, the adjacent [0,2,10] and [0,1,8] pitch-class set-types are related to the [0,2,4,6,8,12,14,16] octachord through subset content. Additionally, the octachord is also related to pitch-class set-types

Figure 3: Adjacent semi- and quartertonal pitch-class sets, mm. 26–27 (clarinet).

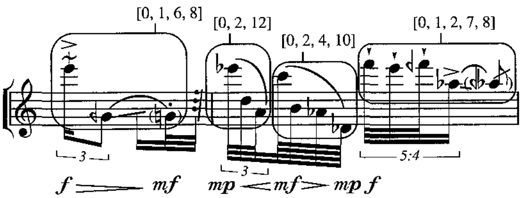


Figure 4a: Pitch-class superset, mm. 131–32 (cello).

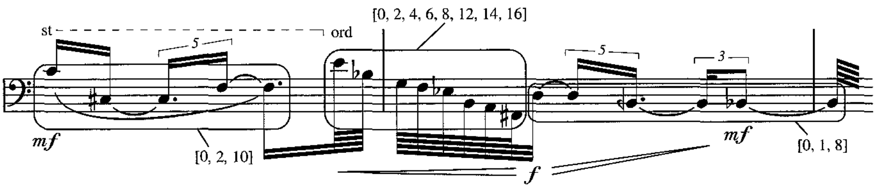


Figure 4b: Superset formation.

with a cardinality of six or less, and supersets derived from them, that characterize the harmony throughout the composition.

Thus far, pitch-class set-types have been discussed with regard to their subset and superset relationships. What is equally important to me are the pitch-class sets' pitch-class relationships to one another. To maintain a chromatically saturated environment, I use transpositional/inversional operations that yield little or no pitch-class intersection from set to set, determined through the use of T and I matrices.[7] These operations are applied to provide the transpositional/inversional levels of successive pitch-class sets. Figure 5a illustrates two adjacent segments that share no intersecting pitch classes. If C = 0, the first segment, a [0,1,2,7,8] pentachord, can be represented as the unordered pitch-class set {2,3,4,9,10}, or at transposition level 2 (T2). The following segment, a [0,1,2] trichord, is presented at T19, or {19,20,21}. The transpositional relationship between these unordered pitch-class sets may be described as T17 (fig. 5b). T17 was chosen as the pitch-class operation because it yields no intersections between the

Figure 5a: Adjacent gestures sharing no pitch classes, mm. 110–11.

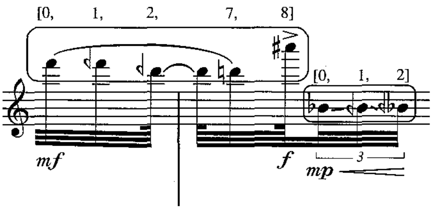


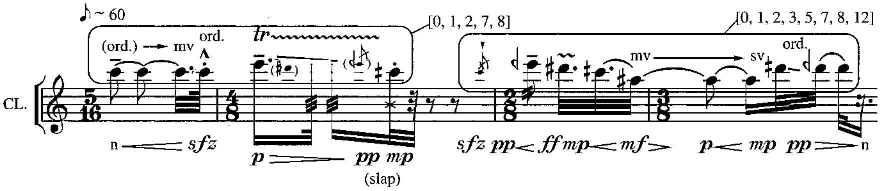
Figure 5b: Transpositional relationship between sets.

two pitch-class sets. As a result of this transformational strategy, the harmonic environment, while not necessarily aggregate-forming, nevertheless supplies the degree of chromatic saturation I seek.

There are several other pitch-class set operations that also yield no pitch-class intersections. Which specific pitch-class set operation to use is not formalized. Rather, I make these decisions contextually, since different pitch-class set operations yield different pitch classes. Most often, the avoidance of pitch-class repetition in a passage composed of several pitch-class sets is the primary factor influencing my decision of which pitch-class set operation to use. Not every situation calls for minimal pitch-class intersection between pitch-class sets. In some contexts, I use the T- and I-matrices to provide transpositional/inversional levels that generate pitch-class sets with partial or maximal pitch-class intersection between them. Figure 5c illustrates two pitch-class sets with maximal pitch-class intersection. The first gesture is comprised of the pitch classes C, E, D♯, E𝄳, and C𝄲, forming the [0,1,2,7,8] set-type. The second gesture adds three new pitch classes, A♯, D𝄲, and D𝄳, to the previous five to form the [0,1,2,3,5,7,8,12] pitch-class set-type.

Crucial to the deployment of the harmonic materials in my music is the manner in which these pitch-class sets are articulated within the music. I conceive the musical surface as the succession of the local, moment-to-moment events that constitute the musical flow. While I seek to establish continuity through my harmonic resources, I also try to encourage perceptual segmentation, the mental "breaking up" of this flow into smaller

Figure 5c: Maximal pitch-class intersection in adjacent gestures, mm. 1–4 (clarinet).



parts, through parametric manipulation. The harmonic motion of the musical surface, for example, is characterized by distinct harmonic areas that move at various rates; but as subset- and superset-related pitch-class sets are used to define harmonic groupings and events, the beginning and ending of these groupings is defined by parametric changes in the musical surface. By parametrically differentiating groups, I articulate the aforementioned pitch-class sets as perceptually discrete, independent local structures. I intend that the listener infer patterns and invariances among these structures, ultimately leading to the inference of middleground and large-scale formal divisions.

Recent work in music theory and cognitive psychology supports my intuitions regarding how various parameters, in collaboration, encourage perceptual segmentation. In their writings on the contemporary repertoire, Tenney and Polansky, Uno and Hübscher, Berry, Nonken, and Lerdahl and Jackendoff concur that changes in individual parameters on the musical surface contribute to cognitive grouping structures.[8] These scholars agree that the strongest factors for grouping are proximity (in time) and similarity (in all other parameters). The determination of structure in atonal music may be linked to the comparison of patterns and processes inferred from the characterization of the musical surface. It is through these comparisons that a listener defines musical event groups as similar or dissimilar to one another, and then posits segmentation boundaries in the music.

The importance of parametric change in the perception of atonal music has also been supported by empirical studies. Work by Clarke and Krumhansl (1990: 213–52) suggests that when listening to atonal works, listeners rely heavily on parametric characteristics to accurately encode, organize, and remember musical details. In an experiment conducted by Deliège (1989: 213–39), listeners, regardless of degree of experience listening to atonal music, appeared to privilege the attributes of timbre, texture, and density to insert perceptual "cues," the mental markers that delineate perceived structural boundaries at points of parametric change. Perhaps most importantly, Krumhansl has shown that listeners are able to extract characteristics from the musical surface of an atonal work and generalize insightfully about its musical materials.[9]

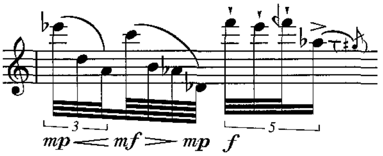
To encourage the perception of the segments as distinct from one another, I manipulate parameters of the musical surface: pitch, rhythm, timbre, articulation, register, and dynamics. The temporal proximity of event groups is perhaps the most important factor contributing to the segmentation of the musical surface. Where I place event groups temporally within a work is not determined systematically; this is usually dictated by processes of accretion or degradation that characterize the background structure of large sections of a composition. I also take into account temporal segregation, in terms of whether groups are temporally adjacent (one directly following the other, without pause) or temporally non-adjacent (separated in time by some kind of pause, but not interpolated with other events). Similarity between groups may be inferred from comparisons of the groups themselves. The degrees of similarity or dissimilarity are not quantified. This is a contextual decision that is often related to the articulation of phrases (middleground segments consisting of several event groups) in individual melodic lines. My techniques only suggest ways in which I might use individual parameters operating on a musical event group to encourage the perception of boundaries between a musical event group and the groups adjacent to it. More specifically, I endeavor to make event groups dissimilar enough to be perceived as separate local units.

Non-pitch parameters contributing to the perception of musical event groups as distinct from one another are outlined below. These parameters are variously applied in order to articulate groups, as exemplified by my composition *Polarities.*

1. *Rhythm.* Musical passages in this piece may be characterized as rhythmically regular or irregular. Regular rhythms can be defined as at least three consecutive attacks characterized by the same temporal interval between each attack; for example, three adjacent eighth notes in succession possess, contextually, a high degree of regularity. An irregular rhythm is characterized by different temporal intervals between successive attacks in a single melody. A shift from one to the other contributes to the perception of a boundary between the two segments of a passage. A change in the speed of a regular rhythm to another regular rhythm can also encourage the inference of a perceptual boundary at the point of rhythmic acceleration or deceleration. Figure 6a illustrates three shifts in rhythm from irregular (C, C♯, F, in three different durations), to regular (a descending sixty-fourth-note figure), and back to irregular (D, B𝄳, B♭, in three different durations).[10] In figure 6b, two adjacent gestures are characterized

Figure 6a: Events differentiated by changes from irregularity to regularity, mm. 131–32 (cello).

Figure 6b: Events differentiated by change in speed of regular rhythms, m. 27 (clarinet).



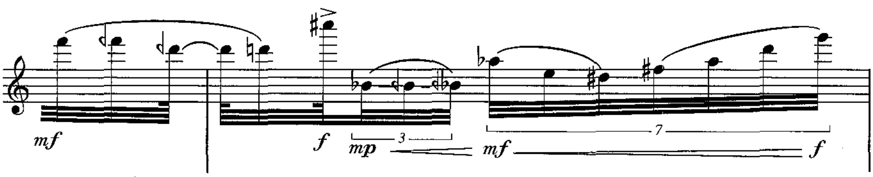
by their regular rhythms moving at different speeds. A gesture featuring regular thirty-second-note triplets precedes a gesture consisting of four consecutive sixty-fourth notes. The relative changes in either regularity or speed between the gestures in these two examples distinguish them as separate, to some extent, from one another.

The change in speed between one regular rhythm and another, as well as the shift from regularity to irregularity or vice-versa, may only be perceived retroactively. The temporal space between two rhythmically contrasting event groups that are regular and irregular is construed as a continuation of the former gesture until the latter's rhythmic identity is recognized. Similarly, two gestures that are rhythmically periodic can only be identified as different rhythms after the later gesture has been rhythmically established, since the temporal space between the two groups is only an indication of the final duration of the former group's rhythm.

2. *Register.* The register in which an event or group is presented can distinguish it from other events or groups around it, particularly if there is a large registral space between one event or group and the next. In figure 7, the flute moves between two distinct registral areas. The first gesture is stratified in the registral area between D𝄳6 and C♯7.[11] The following gesture is placed in a noticeably lower register, from B𝄳♭4 to B𝄳4. The final gesture ascends to the two octaves above that range (D♯5 to G6), representing a return to the registral area of the first gesture.

3. *Articulation.* Articulation can be defined as a particular kind of musical enunciation that a performer affects in the musical realization of a sound. I manipulate articulation to facilitate the perceptual segmentation

Figure 7: Events differentiated by register, mm. 110–11 (flute).



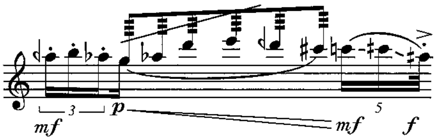
of the musical surface. Figure 8 depicts changes in articulation. The triplet marked staccato is contrasted with the slurred grace-note passage that follows. These two gestures can be interpreted as distinct from one another because of their change in articulation.

In addition to the changes noted above, the grace-note gesture exhibits another shift in articulation: fluttertongue. Fluttertongue is distinct from the staccato/legato shifts in articulation in that, like tremolo-bowing on string instruments, it is really a change in rhythm, one whose individual attacks are too rapid to be perceived as such. Other interparametric articulations include glissando and vibrato. Glissando is a manipulation of pitch, in which one pitch does not discretely move to another. This type of change in pitch is articulated in infinitesimally small increments between one pitch and another. Vibrato is a combination of either pitch (alternating movement above and below a primary pitch and other pitches) or dynamic (alternating movement between amplitude levels) and rhythm (the rapidity and periodicity of the pitch deviation or dynamic flux).[12] I consider these types of performance realization to be "articulations," in the sense that they are modes of sound production that are probably closer to the staccato/legato continuum of musical perception than to the other parameters mentioned.

4. *Dynamics.* Dynamics, relative degrees of amplitude, enhance the perception of segments on the musical surface. Two types of dynamic change are represented in figure 6b. The first is a direct shift from one dynamic to another. At the close of the sixty-fourth-note figure, the dynamic level has reached *mezzo piano.* The quintuplet gesture that follows suddenly increases this level to *forte.* The second type of dynamic change is gradual: crescendo and decrescendo. The thirty-second-note triplet begins at *mezzo piano* in figure 6b, then witnesses a steady crescendo to *mezzo forte,* which in turn decrescendos over the course of the sixty-fourth-note gesture to *mezzo piano.*

What differentiates this latter type of parametric transformation (a gradual shift of a parametric identity over time, as opposed to a sudden parametric change) is that the process itself internally defines the segment in which it occurs. In my music, the initiation and termination of these processes starts or ends at the beginning or end of a musical event group

Figure 8: Events differentiated by changes in articulation (clarinet).

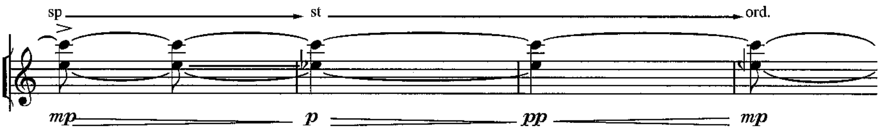


whose boundaries I mean to articulate. Because of their transitory nature, crescendi and decrescendi as indicators of change to aid in segmentation are probably weaker than immediate changes in dynamic. It is my perception that any gradual transition from one parametric state to another is weaker than a direct shift in that parameter.

5. *Timbre.* Timbre may be one of the strongest factors to signify change on the musical surface. My music does not generally exhibit direct changes in timbre in their most blatant form; I generally do not distinguish gestures by shifting from one instrument to another in a single melodic line. Instead of this overt change in timbre, I use subtler types of timbral change to articulate gestures, often by manipulating the timbre of an individual instrument, usually in relation to shifts in articulation. In figure 8, the grace notes are articulated as a fluttertongue; the addition of the fluttertongue articulation clouds the partials of the clarinet's pitches, resulting in a less timbrally coherent sound[13] and a distinctly different timbre. This shift in clarinet articulation is therefore heard as a change in timbre, related to a string instrument switching from bowed to plucked, or a percussion instrument being struck with mallets of different hardnesses.

The strongest boundaries between event groups posited by timbral change result from one unchanging timbre suddenly changing to another. Additionally, a steady transformation of timbre over time from one kind of timbre to another, like a steady increase or decrease in dynamic, also indicates parametric change between segments. Like gradual dynamic transformations, I use timbral transformations that start at the beginning of the event group and finish just before—or arrive at—the beginning of the next event group to define boundaries. Figure 9 illustrates a gradual timbral transformation, a transition between bow positions on the strings of the cello. The first double-stop (C–E) is sounded *sul ponticello.* It then moves steadily to *sul tasto,* with the completion of the glissando from E to E♭. Finally, the bow movement reverses its trajectory to arrive at the normal bow position *(ordinario)* at the shift from E♭ to E𝄳. Similar timbral transformational effects could be produced by changes in bow attack position *(col legno* to *ordinario),* or changes in bow pressure (*ordinario* to "crunch" bow).

Figure 9: Events differentiated by timbral transformation, mm. 26–29 (cello).



6. *Segregation.* Perhaps the strongest indicator of a segment boundary in music is segregation: a perceptible pause, or temporal space, between event groups.[14] Event groups that are temporally adjacent, where one event group begins just as the previous group ends, are less strongly perceived as two separate segments. Figure 10a shows two temporally non-adjacent event groups. While both segments feature multiple types of articulation, dynamic, rhythm, and timbre (in the fluttertongued and slap-tongued pitches), they are clearly separated by the silence between them, which facilitates their perception as separate event groups.

The listener can infer pauses in the music without absolute silence. If an event group ends with a sound whose duration is significantly longer than other durations in the event group, that long duration may play the role of a silence in aiding segmentation. A space between two event groups, even in the context of multiple events occurring simultaneously, could be understood as nearly equal to silence. Figure 10b shows two clarinet gestures separated by a rest, while the cello simultaneously holds a double stop throughout the clarinet pause. While there is not complete silence, the space created between the two clarinet gestures encourages the hearing of the two gestures as separate. There are many reasons why the clarinet takes perceptual precedence. The clarinet is much more active—both in its internal parametric changes and in the number of elements that comprise its gestures—and could be said to be in the musical foreground. The cello is static by comparison, directing the listener's attention toward the clarinet. Further, the relegation of the cello to the background may encourage the listener to hear the two clarinet gestures as separate segments, and to emphasize the musical rest between them, since the cello is clearly playing a secondary role.

As previously suggested, rhythm, register, articulation, dynamics, timbre, and segregation are closely related. For example, register affects timbre: the timbre of the flute changes as its pitch moves from the lowest register to the highest. Similarly, certain types of articulation affect the perception of timbre or loudness (for example, an accent mark increases loudness, and may affect the timbre of a violin bowed more strongly to facilitate the accent, which subtly changes the bow pressure, bow position,

Figure 10a: Events differentiated by segregation, mm. 1–4 (clarinet).

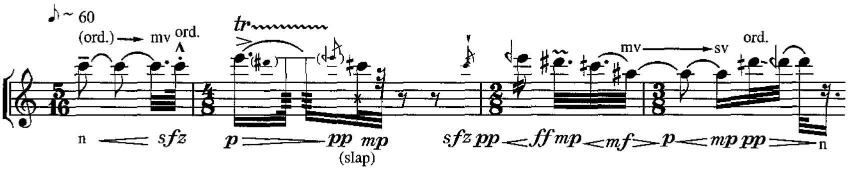
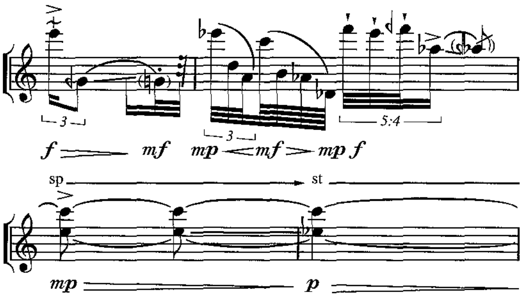


Figure 10b: Groups differentiated by segregation during multiple simultaneous events, mm. 26–27 (clarinet and cello).



and angle of attack on the string, as well as right-hand finger pressure on the fingerboard). For my purposes, the more overt characteristics of parameters are assumed to be more perceptually relevant than the subtle, simultaneous parametric characteristics with which they are intertwined.

As several theorists have noted,[15] not all parameters influence the perception of change on the musical surface equally. For example, segregation by rest is probably the most important factor in perceptual segmentation. But the contextual relevance of changes in some parameters cannot be underestimated. One can imagine a work that exhibits a particular trait in some parameter over a long period of time. If this parameter were to suddenly change, that change might be more perceptually salient (and might more strongly contribute to segmentation) than it would be in a context in which that parameter was in a perpetual state of transformation. Additionally, degrees of change within parameters can be major factors in perception. For example, a dynamic change from *mezzo piano* to *mezzo forte* may not be as perceptually salient as a change from *pianissimo* to *fortissimo.* To accommodate such differences in context and scale, one would have to develop elaborate systems of parametric weighting to be applied in compositional situations. Such an undertaking would have to consider the difficult issue of quantitative or quasi-quantitative values of parameters in different contexts.[16]

The relative strength or weakness of a boundary encourages the mental establishment of grouping structures at hierarchically higher or lower levels. Neither gestural similarity nor higher levels of grouping structure, however, are subject to systematic organization in my compositions. The gestural similarity of two segments, particularly in the domains of pitch and rhythm, can weaken the boundary articulated by the repetition of material; repetition that suggests segmentation on a local level may suggest a larger grouping at a higher level. Figure 6b illustrates such a relationship: both slurred gestures feature gestural contours that are unidirectionally descending, rhythmically regular, and begin with the descending interval of a minor ninth. The quintuplet figure that follows is marked with a *martellato* articulation, is registrally invariant, and is sounded with a much louder, *forte* dynamic. Therefore, the boundary between the quintuplet gesture and the two gestures preceding it might be stronger than the boundary between the first two gestures because the first two gestures are parametrically and gesturally similar and adjacent.

All of the examples I have given, excluding figure 10b, are monophonic. As presented here, my compositional techniques address only the segmentation of single lines of music, or "streams."[17] An exception is the presentation of a registral compound line, a single melodic projection that alternates between discrete registers, which may be perceived as two simultaneous lines, providing that the registral area is not significantly deviated from in each registrally stratified submelody. Two separate melodies, while part of one larger melodic line, are implied through their registral disparity. Figure 11a illustrates such a compound line. The notes above the staff, E♭6, A♭5, and E6, are registrally distinct from the simultaneous lower line, an ascending figure of D4, G4, C♯5. Despite the identical staccato articulation and *forte* dynamic, these two submelodies of the larger gesture may be perceived as independent.

Different types of melodic separation within a single melodic line may be articulated using parameters other than register. In figure 11b, the clarinet projects two distinct lines through differences in articulation (*martellato* marks on the attacked grace notes {C, E, B♭}, opposing the unmarked measured notes), dynamic (*sforzando* markings on the grace notes opposing the *piano* crescendoing to *mezzo piano* markings on the glissandi notes), and rhythm (short grace notes opposing longer measured notes). Timbre may also distinguish a submelody in a larger melodic line. Figure 11c illustrates a long line articulated by clarinet slaptongues (marked by "x" on the note stem) within an extended phrase segment of non-slaptongue clarinet pitches.

Figure 11a: Events differentiated by compound line, m. 31 (clarinet).

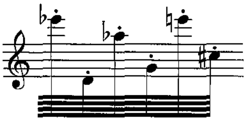


Figure 11b: Events differentiated by articulation, dynamics, and rhythm, m. 8 (clarinet).

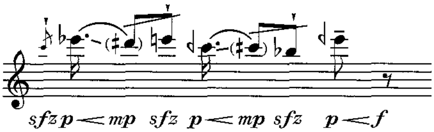
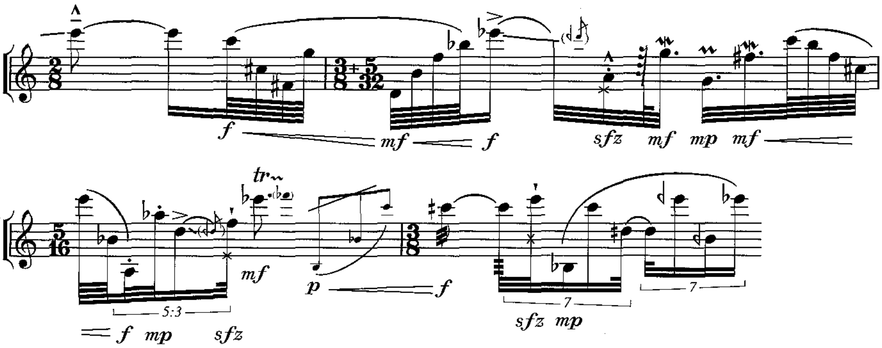


Figure 11c: Events differentiated by timbre within a phrase, mm. 33–36 (clarinet).



I do not endeavor to formalize a model to predict the apprehension of multiple segments simultaneously. However, the perception of multiple simultaneous segments is of great interest to me, as is evidenced by the polyphonic density of my musical textures. I believe that it is possible for a listener to segment multiple streams simultaneously. Just how many simultaneous streams can be perceived and remembered, with regard to my music, is a matter of compositional intuition. Further questions involve how multiple segments with overlapping boundaries are simultaneously perceived in my compositions. In figure 11d, the flute and violin participate in one melodic projection while the marimba, punctuated by rhythmic accents from the viola and cello, follows its own independent trajectory. Neither melody shares any rhythmic simultaneities with the other, nor, since both are continuous melodies, do they share perceptible segment boundaries. Despite the increased perceptual complexity that results from nonsynchronic segment overlaps, such as those illustrated by the two instrumental groups in figure 11d, I think that it is possible to segment simultaneous streams.

A second type of overlapping occurs in figure 11d. The flute's first gesture ends on A♭, a pitch doubled in the same register by the violin. This A♭ is the first pitch of the violin's ascending three-note gesture. A four-note violin gesture follows, ending on C♯, a pitch doubled in the same register by the flute. The flute continues after the doubled C♯ with another gesture. The A♭ and C♯ doubled pitches in this passage may be perceived as members of both the flute and violin gestures resulting in segment overlaps. Since horizontally overlapping segments obscure the segment boundaries, I try to reinforce each segment's boundary, in this case by using timbral, articulative, dynamic, and rhythmic means.

My compositional techniques do not formalize the "vertical" harmonic relationships that result when segments are presented simultaneously. While my basic constraint is the avoidance of pitch-class duplication in simultaneous presentations of segments, the manner in which I combine these segments is an individual, contextual decision. While shared subsets within simultaneous horizontal and vertical presentations of pitch-class sets may generate a perceptible harmonic correlation, I do not prescribe any specific relationships of transposition/inversion between the two.

I am not attempting to create a music that is maximally cognitively transparent; this is not the kind of music that interests me. However, in seeking to locate an intriguing balance between continuity and disjunction in my music, I find myself continually evaluating and reevaluating the listening process itself. While the results of cognitive-psychological studies of atonal music are far from conclusive or comprehensive, my awareness of this research has greatly influenced my compositional techniques. It has helped me to create what I relish as a listener.

Figure 11d: Overlapping boundaries, m. 97 (flute, marimba, violin, viola, and cello).

Notes

1. Although still not resulting in tonal harmonic function, pitches could be stratified in atonal harmonic environments to give them contextual structural significance.

2. Using the integer model of pitch, modulo 12 has been used to describe octave equivalence of semitonal pitch classes, as opposed to the register-dependent definition of pitch. Modulo 12 may be defined as "two integers b and c are equivalent modulo 12 if and only if b = 12·n + c for some integer n." Octave equivalence

of pitch classes in a 24-tone octave may be defined as "two integers b and c are equivalent modulo 24 if and only if b = 24·n + c for some integer n." See Rahn 1980: 22–24; Forte 1973: 5–6.

3. All pitch-class sets from this point forward are notated in mod 24.

4. Other subsets are shared between the [0,1,2,7,8,12] and [0,2,4,6,12,14] hexachords. Only the subset with the highest cardinality, in this example and the others that follow, is noted.

5. Sets containing one or two pitch classes are not considered in the list of possible subset derivations. Derivations limited to one- and two-cardinality pitch-class sets seem too constrained and of little perceptual impact as a subset. I do not mean to imply that one- and two-cardinality pitch-class sets have no perceptual salience. However, because high numbers of interval-class types are present in the larger subsets, I do not believe that one- and two-cardinality pitch-class sets carry the same perceptual import as larger cardinality subsets. Multiple trichord derivations (as opposed to single subset derivations of pitch-class set-types with greater cardinalities) are employed to offer a wider range of trichord possibilities. Because of the high number of trichord derivations possible from the greater-cardinality sets, more trichord derivations are represented than in the subsets derived from greater cardinality sets.

6. "Superset" is used here to describe a pitch-class set in which a smaller pitch-class set is embedded in a larger set, resulting in an all-inclusive shared subset relation between the smaller pitch-class set and the superset of which it is a part. See Forte 1973: 25.

7. See Morris 1987: 70–73.

8. See Lerdahl and Jackendoff 1983: 297–98; Tenney 1988; Tenney with Polansky 1980: 205–41; Berry 1976: 37; Uno and Hübscher (n.d.); and Nonken 1999.

9. Krumhansl 1991: 401–11. This study documents responses to Olivier Messiaen's *Modes de valeurs et d'intensités.*

10. All segments represented in the examples that follow articulate some or all of the following: [0,1,2,7,8,12] and [0,2,4,6,12,14] hexachords, their subset derivations given in figure 2a, and supersets generated by pitch-class operations involving intersection.

11. The convention used to label the registral placement of pitch classes is suggested by the Acoustical Society of America. The number identifies the registral octave, based on the pitch class C in which the pitch class appears. Middle C is written as "C4," and each C above or below it is understood as beginning a new octave. For example, the octave that begins one octave above middle C is written as C5, C𝄲5, C♯5 . . . B𝄲5.

12. Gradual shifts in transformation, such as the ones discussed in the dynamic and timbral domains, might also be considered. However, the extremely limited capacity of acoustic instruments to perform these types of transformations (with exceptions such as a shift from *molto vibrato* to *senza vibrato*) does not make this type of change in articulation particularly useful for acoustic compositions.

13. Timbral coherence is defined by Bregman as a sound with a distinct set of partials that remain the same over time. Incoherent sounds are composed of a constantly shifting set of partials. See Bregman 1990: 104–06.

14. If all of the smallest local events on the musical surface are segregated, the size of the temporal space between events may become an important factor. Adjacent events that are close together might encourage the perception of them as being more connected than that of other adjacent events with larger spaces between them.

15. See Tenney with Polansky 1980: 208; Lerdahl and Jackendoff 1983: 298.

16. Weighting of parameters in analyses of post-tonal works has been applied by Tenney with Polansky 1980: 217–39; Uno and Hübscher (n.d.); and Nonken 1999.

17. See Bregman 1990: 642–54.

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