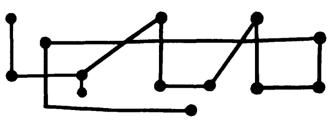
THE DYAD SYSTEM (PART ONE)



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THE DYAD SYSTEM is a generalization of a way of hearing. It is primarily a vertical way of hearing, where collections of notes, implicitly or explicitly, delineate areas or moments of specific "harmonies": pitch simultaneities that have varieties of expressive potential both internally (the character of intervallic content) and externally (the textures, densities, timbres, and energy evolutions that result from successions and combinations of these harmonies).

The Dyad System began in two different areas of musical speculation: computer-generated electronic sounds, and certain kinds of chords that I found myself more and more interested in while composing for traditional instruments. In the electronic domain, I discovered methods for using intervals to generate input parameters for the synthesis of certain classes of electronic sounds, generally known as "inharmonic" sounds.

What was most significant was that I had found a more musical way of interfacing with the electronic sounds; the timbres I could produce with a small collection of dyads provided me with a great deal of surface variety while maintaining other levels of relationships that are made to unfold at entirely different rates, and in significantly contrasting modes. Furthermore, the different levels that emerge could mutually influence each other in functionally significant and interesting ways, thereby creating a genuinely organic sense of dynamic formal construction. Lastly, the major result was that the two domains of pitch structure and electronic timbre became functionally interdependent. Working with one domain directly determines primary aspects of the other: pitch (in pairs, or dyads) generates specific electronic timbres, and electronic timbre is made up of specific dyads and their (inharmonic) spectra as a kind of "chordal" entity, or "inharmonic harmonization" of dyads.

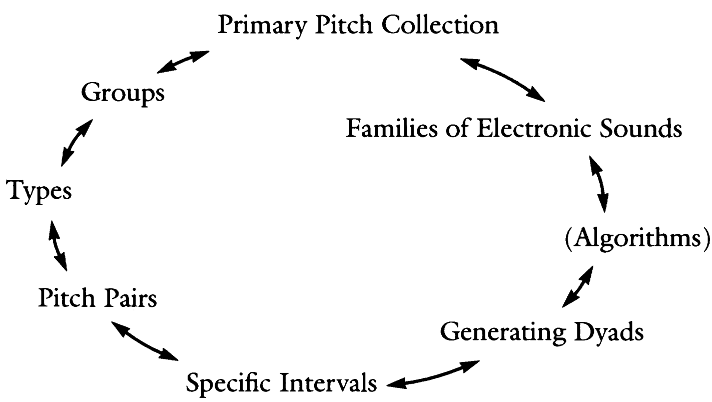
In the traditional pitch-class domain, I found I could construct the kinds of chords I prefer in terms of collections of dyads; or, conversely, the kinds of chords I like to use could be broken up into dyadic subunits, which could then be manipulated to generate related chords with different characteristics (harmonic tension, color, and so on). These dyad manipulations can be used to produce interval structures for the generation of electronic sounds, or in themselves for composing for traditional instruments.

In all cases, the dyad is the basic unit of composition, either in its normal form (defined in Part I below) or as specific pitches and pitch intervals. The relationship between dyads is the object of development by the system, what is being established by compositional use of system resources. The primary structural importance of pitches is as members of dyads, not primarily as single units by themselves. It is the working out of dyad relationships, their being moved about, and especially their being articulated as particular intervallic forms that is primary to the system. Pitch *order* is *not* a primary consideration in this system; rather the dyad *class* (irrespective of transposition) is. Obviously, the composer can deal with pitch ordering at a significant level, but it is not considered *fundamental* to the approach being proposed here.

The Dyad System, then, consists of these two domains (interval structure and the electronic sounds generated by specific intervals) and the workings out of their inter- and intra-relationships. Such workings out can take place on as many levels as the composer might wish to devise. However, even with a high degree of mutual dependence, the nature of each structural level is such that there is a considerable transparency between levels, producing perceptions of musical structure comparable, for example, to the way multiple-voice counterpoint is often perceived by focussing on one or more voices while being subsidiarily aware of the other voices, the latter contributing to the harmony and rhythm of which the voices in focus are a part.

The system is definitely biased toward a hierarchic conception of musical structure, but it invites the composer to think in terms not of fixed hierarchy or even a linear hierarchy, but rather in terms of a hierarchy that is circular or spherical: the point of entry to the hierarchical design can be anywhere along the circle (or sphere) of related dimensions, and the hierarchy reordered with respect to the point of origin; work at one level influences the choices and evolution of material at the others, but it is not even necessary to use the same level as the dominant one at all times—even the hierarchic order can evolve or be dynamically transformed during the course of the work.

The elements of the system can be viewed in a circular (or spherical slice) representation, as in Example 1 (the various terms of the elements are explained in the following sections of this paper).



EXAMPLE 1: THE ELEMENTS OF THE SYSTEM

There is no attempt to extend this system in any way to other dimensions of musical composition besides pitch and/or frequency. The Dyad System, as formulated here, leaves to the composer the challenge (and the pleasure) of designing rhythms and durations, phrasings and accents, and all other nonpitch elements in whatever way is deemed desirable, necessary, or appropriate to the pitch (frequency) structural idea, or, vice versa (and often more stimulating), building a pitch structure that expresses an initial rhythmic or durational or phrasal conception. Because of the flexibility of the Dyad System, a great deal is open to each composer's way of hearing, in the same way that composing with tonal or serial resources allows considerable differences in individual tastes and style while remaining within the constraints, no matter how freely interpreted, of the basic system.

I. Pitch Structure Dimension

In developing the pitch-structure procedures of the Dyad System, collections of six pitch classes, divided into three disjoint dyads, have proven one of the most flexible units for the elaboration and development of musical ideas. The description of the system therefore will be limited here to manipulations of hexachordal structures. However, there is no reason to exclude the use of different-sized pitch-class collections, subsequently invoking other compositional criteria for the moment-to-moment choices once the derived collections have been generated. The size of the collection is a fundamental compositional choice, and can even vary during the course of a single work. The composer's way of hearing is, as always, the primary ingredient. (In the Appendix following Part 2 of this paper, I briefly discuss the use of collections made up of 7 pitch-classes and the expanded possibilities presented by grouping the 7 pitch-classes as trichord-dyad-dyad (3+2+2), or as 2+3+2, or as 2+2+3.)

At this structural level the system deals with interval classes reduced to six fundamental dyadic intervals (which will be referred to simply as *dyads*, to distinguish them from their realization as specific interval classes in the course of a composition), all other intervals being considered inversions or octave expansions of these six classes: minor and major second, minor and major third, perfect fourth, tritone, and their enharmonic equivalents. These dyads will be labelled mn2, mj2, mn3, mj3, p4, tt, respectively (intervals will have the same sort of abbreviations, mj6 for major sixth, mn9 for minor ninth, and so on). The context will make it abundantly clear whether I am discussing, for example, "mn2" as a *dyad*, or as the *interval* "mn2" (one of the possible interval classes derived from the pitches of a particular "mn2" dyad). Generally, *interval* will be used in a specific musical context or when referring to possible compositional application; *dyad* will be used when referring to the basic system elements at a more abstract structural level, that of the grouping of intervals which have been reduced to their normalized dyadic form.

One of the levels of elaboration of the Dyad System is the real (sounding) pitch interval that a dyad will assume at each particular moment. The actual interval form is decisive in its role as generating dyad for electronic sounds; as will be discussed in Part II, a mj2 realized as a mn7, will have significantly different results as input to the electronic sound procedures than the same dyad realized as a mj9. The implications for these kinds of intervallic differences in purely instrumental works (using the system to generate pitch collections in compositions for traditional instruments without electronic sounds) are, usually, part of standard compositional practice.

Here, the procedures to be described develop pitch-class collections from intervals reduced to their normalized form as one of the six fundamental dyads. Again, this level may be the (or a) starting point of the compositional workings, or it may be a subsidiary point of development from a collection of previously articulated intervals in any form, now reduced to normal form for system elaboration.

Given a collection of six different pitch classes (three dyads), called here a *primary collection*, the Dyad System generates a large number of related six-pitch-class collections by applying the following two fundamental rules:

1. *Preserving the pitch-class content of the collection, change the dyadic disposition*;

   for a six-pitch-class collection this yields fifteen intervallic rearrangements of the three initial dyads, (including the initial dyad itself), called *groups*. The fifteen groups are collectively called a *group set*;

2. *Preserving the dyadic content of the collection, change the pitch classes that constitute the dyads*;

   for each six-note *group*, this will yield from thirty-eight to forty-two different collections (including the initial group itself), called *types*. A *type set* is the collection of all types and their twelve transpositions derived from a single group.

Depending on the dyad content of the primary collection, some groups will have three different dyads, some will have two (two identical, the third different), a few will have the same interval for all three dyads. Nor will there always be fifteen *different* dyad groups. On the contrary, it is rare that there is not at least one duplicated dyad group, and often two or three are repeated, but made up of different pitch classes; that is to say, rule 2 is sometimes implicit in the results of rule 1, just as rule 1 is usually implicit in the results of rule 2—some of the generated *types* are intervallic rearrangements of each other.

With twelve transpositions of each type there are, then, at least 456 hexachordal collections (the type set) that may be derived from a single group. Any one of these may be in turn treated as a primary collection for continuing expansion. Clearly, various degrees of repetition will occur between type sets: a derived type in a particular type set may have the same pitches as a type in another set but intervallically rearranged, but this provides means for constructing webs and bridges of cross-relations between types and groups that can be the basis of structural development.

Musical structure is typically developed by choosing a six-pitch-class primary collection, applying rule 1 to generate groups, then choosing one group and applying rule 2 to generate types. The composer can at any time back up and choose a different group to begin generating types, use a sequence of types to evolve *towards* another group which can be the basis for another set of types, or even consider any type to be a primary collection and restart the whole process.

Continued expansion by means of repeated application of the two rules to those types that can generate groups *not* found in a preceding set of groups will eventually generate all possible hexachords. What is of interest is not that one can generate the whole universe but rather the *context* in which pieces of that universe emerge, and the ways that suggest themselves for building those pieces into structural complexes that provide frameworks for in-depth musical invention. The emergence of a particular type (the *sound* of, or associated with, that type) within the context of a given group development (type set), can be the basis for a sort of "modulation" or transition to another type set context that contains different (kinds of) associations with the particular type.

This manner of structuring encourages the exploration of varieties of pitch and/or chordal successions that, even while following different kinds of relational paths, can be made to intersect, diverge, or coincide in whatever manner, and according to whatever criteria, the composer manages to devise. The potential for hierarchical structure is considerable; the degree of complexity is entirely up to the composer, and can even be one of the many dimensions dynamically worked out in the course of the piece. Or, even pursuing more variegated approaches to composition, the system offers a means for establishing clearly perceived distinctions at a variety of levels, even within those contexts that make use of extreme textural and procedural differences.

It is worthwhile emphasizing that hexachords emerge as the result of dyadic combinations, that to be a hexachord here is to be a set of three dyads; the composer hears in terms of dyads and how they are distributed, not in terms of a hexachord as a fundamental unit. This notion suggests similar thinking applied to other sized pitch collections (5 or 7 or 8, for example) now conceived as the emergent result of dyad and trichord sets.

For example, from the primary collection (C, D♭, D, E, E♭, G♭), (which I call primary collection 1, or C1), the following fifteen groups are derived, applying rule 1 (preserve the pitch-class content, change the dyadic disposition):

Group			*Dyads*			*Name*
C,D♭	D,E	E♭,G♭	mn2	mj2	mn3	C1G1
C,D♭	D,E♭	E,G♭	mn2	mn2	mj2	C1G8
C,D♭	D,G♭	E,E♭	mn2	mj3	mn2	C1G9
C,D	D♭,E	E♭,G♭	mj2	mn3	mn3	C1G10
C,D	D♭,E♭	E,G♭	mj2	mj2	mj2	C1G15
C,D	D♭,G♭	E,E♭	mj2	p4	mn2	C1G3
C,E	D♭,D	E♭,G♭	mj3	mn2	mn3	C1G6
C,E	D♭,E♭	D,G♭	mj3	mj2	mj3	C1G12
C,E	D♭,G♭	D,E♭	mj3	p4	mn2	C1G4
C,E♭	D♭,D	E,G♭	mn3	mn2	mj2	C1G2 (→ C1G1)
C,E♭	D♭,E	D,G♭	mn3	mn3	mj3	C1G11
C,E♭	D♭,G♭	D,E	mn3	p4	mj2	C1G5
C,G♭	D♭,D	E,E♭	tt	mn2	mn2	C1G13
C,G♭	D♭,E	D,E♭	tt	mn3	mn2	C1G7
C,G♭	D♭,E♭	D,E	tt	mj2	mj2	C1G14

The groups are listed in the order of their generation by the permutation procedure. The names are arbitrary, and the order in which names were assigned reflect only my personal use of them in compositional work. In particular, the number scheme implicit in the names should not be construed as having any compositional functional purpose whatsoever; they are merely and only for convenience.

The seven groups labelled C1G1 through C1G7 have three different dyads. Groups C1G8 through C1G14 have two dyads the same and one different, while only one group, C1G15 has three identical dyads. Notwithstanding pitch equivalence, exploiting a particular intervallic distribution produces a distinctly characteristic sound: using C1G12 (to generate a type set) with its pair of mj3s in contrast to C1G3 types that have no mj3, three different intervals, amongst which is the mj2 in common with C1G12, can provide clearly heard structural distinctions with far-reaching consequences for compositional workings. Further, the markedly characteristic sound of many of these groups, especially those with three different dyads, suggests treating certain of their forms as major points of articulation, while others, especially those with only two kinds of dyads, can be employed in such a way as to suggest a certain ambiguous quality: some of their forms sound like they are less well-defined as types because of the internal repetition.

Note that C1G2 has exactly the same dyad content as C1G1, but the pitch classes that comprise their dyads are not the same. In applying rule 2 to C1G1 and to C1G2, the results are nearly identical, but not quite. The differences, on the other hand, generate interesting relationships among types.

Applying rule 2 (preserving the interval content, change the pitch classes that constitute the dyads, to C1G1 (C,D♭, D,E, E♭,G♭) generates the following thirty-eight types:

	mn2	*mj2*	*mn3*		*mn2*	*mj2*	*mn3*
1:	C,D♭	D,E	E♭,G♭	20:	C,D♭	G♭,A♭	D,F
2:	C,D♭	D,E	F,A♭	21:	C,D♭	G♭,A♭	E,G
3:	C,D♭	D,E	G♭,A	22:	C,D♭	G♭,A♭	G,B♭
4:	C,D♭	D,E	G,B♭	23:	C,D♭	G♭,A♭	B,D
5:	C,D♭	D,E	A♭,B	24:	C,D♭	G,A	D,F
6:	C,D♭	E♭,F	E,G	25:	C,D♭	G,A	E♭,G♭
7:	C,D♭	E♭,F	G♭,A	26:	C,D♭	G,A	F,A♭
8:	C,D♭	E♭,F	G,B♭	27:	C,D♭	G,A	A♭,B
9:	C,D♭	E♭,F	A♭,B	28:	C,D♭	G,A	B,D
10:	C,D♭	E♭,F	B,D	29:	C,D♭	A♭,B♭	D,F
11:	C,D♭	E,G♭	D,F	30:	C,D♭	A♭,B♭	E♭,G♭
12:	C,D♭	E,G♭	F,A♭	31:	C,D♭	A♭,B♭	E,G
13:	C,D♭	E,G♭	G,B♭	32:	C,D♭	A♭,B♭	G♭,A
14:	C,D♭	E,G♭	A♭,B	33:	C,D♭	A♭,B♭	B,D
15:	C,D♭	E,G♭	B,D	34:	C,D♭	A,B	D,F
16:	C,D♭	F,G	E♭,G♭	35:	C,D♭	A,B	E♭,G♭
17:	C,D♭	F,G	G♭,A	36:	C,D♭	A,B	E,G

18:	C,D♭	F,G	A♭,B	37:	C,D♭	A,B	F,A♭
19:	C,D♭	F,G	B,D	38:	C,D♭	A,B	G,B♭

(It should be noted that although it seems as if "C, D♭" were held constant in the rule 2 elaboration, that is not how the rule works: it turns out that starting with any other mn2 merely produces transpositions of the above thirty-eight types.)

The complete type set is obtained directly by transposing each type to each of the twelve possible degrees, thereby producing a total of 456 hexachords, all related to each other by having, at least, the same dyad content; further relationships among types or groups of types can be easily (and sometimes not so easily) discovered and explored in whatever way the composer decides; in fact, these relationships can become fundamental to the work's structure, can become the piece itself.[1]

At this point it is necessary to introduce further notational conventions:

C*x*G*y* is the general notation for Group *y* derived from a primary collection *x*; hence C1G1 refers to group 1 derived from primary collection 1, and, as will be discussed below, C3G1 refers to group 1 derived from primary collection 3;

C*x*G*y*(*type*, *trans*) refers to a specific type, derived from C*x*G*y*, and its transposition level, from 0 to 11: C1G1(4, 10) is type 4, from group 1 of primary collection 1, transposed up ten semitones (mn7), C3G6(2, 4) is type 2, from group 6 of primary collection 3, transposed up four semitones (mj3), and so on.

We can begin to navigate the system resources. First, it is often useful to find all types within a complete type set that are dyadic rearrangements of other types (transposed) within the same type set.[2] In other words, we examine a type set, C1G1 here, for internal rule-1 relationships as a result of rule 2, i.e., we look for types that are identical with respect to pitch-class content but are arranged in different dyad configurations (which means that the *same* pitch-class collection can be arranged in more than one C1G1 configuration). Those which are not duplicated within a type set are here labelled *unique*. A few examples out of the entire type set follow.

C D♭	D E	E♭ G♭	type1 trans0 (C1G1) same as
D♭ D	E G♭	C E♭	type10 trans1 (C1G1)
C D♭	D E	F A♭	type2 trans0 unique

C	D♭	D	E	G♭	A	type3 trans0 (C1G1) same as
D♭	D	E	G♭	A	C	type9 trans1 (C1G1)
C	D♭	D	E	G	B♭	type4 trans0 (C1G1) same as
D♭	D	B♭	C	E	G	type35 trans1 (C1G1)
C	D♭	D	E	A♭	B	type5 trans0 unique
C	D♭	E♭	F	E	G	type6 trans0 unique
C	D♭	E♭	F	G♭	A	type7 trans0 (C1G1) same as
F	G♭	D♭	E♭	A	C	type31 trans5 (C1G1)
C	D♭	A	B	E	G	type36 trans0 (C1G1) same as
B	C	G	A	D♭	E	type29 trans11 (C1G1)
C	D♭	A	B	F	A♭	type37 trans0 unique
C	D♭	A	B	G	B♭	type38 trans0 (C1G1) same as
B	C	G	A	B♭	D♭	type33 trans11 (C1G1)

This same procedure can be used between *different* type sets, finding hexachords generated in one type set that are pitch-class identical to a type or types in another type set. This affords a convenient path for jumping back and forth between (or among) type sets (a kind of "modulation") which can support characteristic or significant points of articulation in the musical structure. For example, we might look for types in C1G3 that are (pitch-class equivalent) duplications of types generated by C1G1: (the notation "unique to C1G1" means unique to C1G1 only with respect to the type set the latter is being compared to, in this case, C1G3, not necessarily unique in its own type set or with respect to other type sets). Again, these are only a few examples out of the entire comparison.

C	D♭	D	E	E♭	G♭	type1 trans0 (C1G1) same as
C	D	D♭	G♭	E♭	E	type1 trans0 (C1G3)
C	D♭	D	E	F	A♭	type2 trans0 (C1G1) etc.
C	D	A♭	D♭	E	F	type26 trans0 (C1G3)
C	D♭	D	E	G♭	A	type3 trans0 (C1G1)
E	G♭	A	D	C	D♭	type19 trans4 (C1G3)
C	D♭	D	E	G	B♭	type4 trans0 unique to C1G1

C D♭	D E	A♭ B	type5 trans0 (C1G1)
D E	A♭ D♭	B C	type24 trans2 (C1G3)
C D♭	E♭ F	E G	type6 trans0 (C1G1)
D♭ E♭	G C	E F	type20 trans1 (C1G3)
C D♭	E♭ F	G♭ A	type7 trans0 unique to C1G1
C D♭	E♭ F	G B♭	type8 trans0 (C1G1)
F G	B♭ E♭	C D♭	type18 trans5 (C1G3)

Some of the C1G3 types not found in the C1G1 type set are as follows:

unique to C1G3	C D	D♭ G♭	G A♭	type3 trans0
unique to C1G3	C D	D♭ G♭	B♭ B	type6 trans0
unique to C1G3	C D	E♭ A♭	F G♭	type8 trans0
unique to C1G3	C D	B♭ E♭	G A♭	type34 trans0
unique to C1G3	C D	B E	G A♭	type38 trans0
unique to C1G3	C D	B E	A♭ A	type39 trans0

This reveals a great deal of hexachordal pitch-class equivalence between the two sets, many C1G1 types even having two duplicates in C1G3, which implies the degree of duplication internal to C1G3 itself. If we look at a type set generated by group that is *not* found in the C1 group set, for example C5G7 (p4, mn3, tt)—type set G7 generated from primary collection 5—which can be derived from a G1 type by a second application of rule 1, we find fewer duplications and some further interesting structural possibilities (again, a few examples):

C D♭	D E	E♭ G♭	type1 trans0 unique to C1G1
C D♭	D E	F A♭	type2 trans0 (C1G1) same as
C F	D♭ E	D A♭	type1 trans0 (C5G7)
C D♭	D E	G♭ A	type3 trans0 (C1G1) etc.
A D	D♭ E	C G♭	type12 trans9 (C5G7)
C D♭	D E	G B♭	type4 trans0 unique to C1G1
C D♭	D E	A♭ B	type5 trans0 unique to C1G1
C D♭	E♭ F	G B♭	type8 trans0 (C1G1)

F B♭	C E♭	G D♭	type21 trans5 (C5G7)
C D♭	E♭ F	A♭ B	type9 trans0 (C1G1)
A♭ D♭	C E♭	B F	type12 trans8 (C5G7)
C D♭	E♭ F	B D	type10 trans0 unique to C1G1

Some of the C5G7 types not found in the C1G1 type set are as follows:

C F	E♭ G♭	D A♭	type6 trans0 unique to C5G7
C F	G♭ A	D A♭	type16 trans0 unique to C5G7
C F	G♭ A	A♭ D	type19 trans0 unique to C5G7
C F	B♭ D♭	E♭ A	type32 trans0 unique to C5G7
C F	B D	A E♭	type39 trans0 unique to C5G7

Nor do we need to limit ourselves to exact pitch equivalence. We might, for example, identify those C1G3 types that have five ~~out of~~ six pitch classes in common with a given C1G1 type (very near equivalence, like approximate rhyming in some kinds of poetry), or only four, etc., depending on the desired kind of harmonic motion. Or, going one step further, we can find C1G3 types that have, say, five notes in common with a C1G1 type, then find a *transposition* of that C1G3 type that has *no* common tones with the C1G1 type (or one or two at most) if a high rate of pitch turnover is required, within a harmonic motion that modulates gradually from one *type* to a new one. This compound condition will be used in an example below.

Inversions abound; in fact, due to the way rule 2 generates types, every type has an inversion within its own type set. Some of those for C1G1 follow:

Original type1 trans0:		C D♭	D E	E♭ G♭	
Inverted:		G♭ F	E D	E♭ C	
in type set as:	E F	C D	E♭ G♭	type33 trans4	
in type set as:	F G♭	D E	C E♭	type38 trans5	
Original type2 trans0:		C D♭	D E	F A♭	
Inverted:		A♭ G	G♭ E	E♭ C	
in type set as:	G A♭	E G♭	C E♭	type37 trans7	
Original type19 trans0:		C D♭	F G	B D	
Inverted:		D D♭	A G	E♭ C	

in type set as: D♭ D G A C E♭ type23 trans1

We have already hinted at the possibility of using multiple applications of rule 1 and rule 2 to generate further type sets. We can thus expand the intervallic possibilities of a particular type to develop or prolong its (local or longer range) function within the musical structure by subjecting it to rule 1, which generates its fifteen groups, and then choosing those new groupings that have not already been produced by the original rule-1 expansion as the source groups for new type sets. For example, we treat as a primary collection type 9 (C,D♭, E♭,F, A♭,B) from C1G1 and, by applying rule 1, generate its group set. The new groups, those not found in the C1 set (derived from mn2, mj2, mn3), are indicated with arrows: "⟵" refers to those with three different dyads, while "←" signals those with fewer. The group referred to earlier as C5G7 emerges here as one of the newly generated groups.

C, D♭	E♭, F	A♭, B	mn2	mj2	mn3	
C, D♭	E♭, A♭	F, B	mn2	p4	tt	⟵
C, D♭	E♭, B	F, A♭	mn2	mj3	mn3	
C, E♭	D♭, F	A♭, B	mn3	mj3	mn3	
C, E♭	D♭, A♭	F, B	mn3	p4	tt	⟵ (C5G7)
C, E♭	D♭, B	F, A♭	mn3	mj2	mn3	
C, F	D♭, E♭	A♭, B	p4	mj2	mn3	
C, F	D♭, A♭	E♭, B	p4	p4	mj3	←
C, F	D♭, B	E♭, A♭	p4	mj2	p4	←
C, A♭	D♭, E♭	F, B	mj3	mj2	tt	⟵
C, A♭	D♭, F	E♭, B	mj3	mj3	mj3	←
C, A♭	D♭, B	E♭, F	mj3	mj2	mj2	←
C, B	D♭, E♭	F, A♭	mn2	mj2	mn3	
C, B	D♭, F	E♭, A♭	mn2	mj3	p4	
C, B	D♭, A♭	E♭, F	mn2	p4	mj2	

Type 32 from C1G1, for another example, yields a somewhat different group set that includes one other group (mn3, p4, tt) that is not generated either by C1G1(1, 0) or by C1G1(9, 0). As mentioned earlier, we can eventually generate all possible dyad combinations. What is, of course, highly useful in composing with these group and type sets is their potential for structural differentiation within and between varying associative contexts. Or, put differently, there is considerable potential for developmental variety to any degree of contrast while maintaining, at different structural levels, a relational coherence that can lend clarity and depth to the evolving musical form.

A C1G*x* group set (i.e. any Group x belonging to the set of groups derived from the C1 primary collection via rule 1) belongs to one of what I call the two possible families of group sets. A typical primary collection from the *second* family is (C,D♭, D,G♭, E♭,F), which I have gotten accustomed to calling my primary collection 3 (or C3); it can generate the following fifteen *groups* by applying, as before, rule 1 (preserve the pitch content, change the dyadic disposition):

Group			*Dyads*			*Name*
C, D♭	D, G♭	E♭, F	mn2	mj3	mj2	C3G1
C, D♭	D, E♭	G♭, F	mn2	mn2	mn2	C3G15
C, D♭	D, F	G♭, E♭	mn2	mn3	mn3	C3G10
C, D	D♭, G♭	E♭, F	mj2	p4	mj2	C3G14
C, D	D♭, E♭	G♭, F	mj2	mj2	mn2	C3G8
C, D	D♭, F	G♭, E♭	mj2	mj3	mn3	C3G6
C, G♭	D♭, D	E♭, F	tt	mn2	mj2	C3G3
C, G♭	D♭, E♭	D, F	tt	mj2	mn3	C3G5
C, G♭	D♭, F	D, E♭	tt	mj3	mn2	C3G4
C, E♭	D♭, D	G♭, F	mn3	mn2	mn2	C3G9
C, E♭	D♭, G♭	D, F	mn3	p4	mn3	C3G11
C, E♭	D♭, F	D, G♭	mn3	mj3	mj3	C3G12
C, F	D♭, D	G♭, E♭	p4	mn2	mn3	C3G7
C, F	D♭, G♭	D, E♭	p4	p4	mn2	C3G13
C, F	D♭, E♭	D, G♭	p4	mj2	mj3	C3G2

Then we derive the types from group C3G1 with rule 2 (preserve the dyadic disposition, change the pitch classes that constitute the dyads):

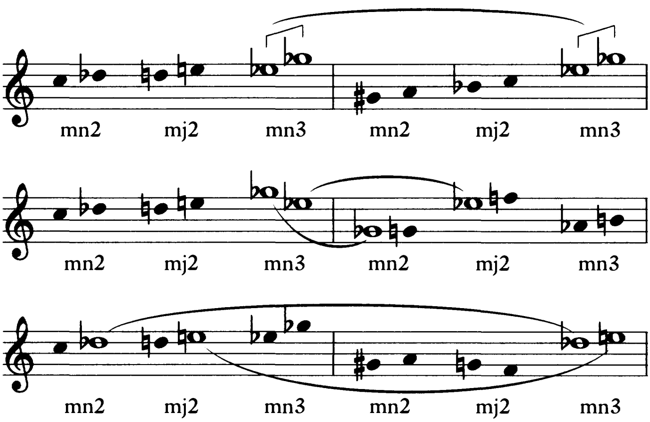
	mn2	*mj3*	*mj2*		*mn2*	*mj3*	*mj2*
1:	C, D♭	D, G♭	E♭, F	21:	C, D♭	G♭, B♭	F, G
2:	C, D♭	D, G♭	F, G	22:	C, D♭	G♭, B♭	G, A
3:	C, D♭	D, G♭	G, A	23:	C, D♭	G♭, B♭	A, B
4:	C, D♭	D, G♭	A♭, B♭	24:	C, D♭	G, B	D, E
5:	C, D♭	D, G♭	A, B	25:	C, D♭	G, B	E♭, F

6:	C, D♭	E♭, G	D, E	26:	C, D♭	G, B	E, G♭
7:	C, D♭	E♭, G	E, G♭	27:	C, D♭	G, B	G♭, A♭
8:	C, D♭	E♭, G	G♭, A♭	28:	C, D♭	G, B	A♭, B♭
9:	C, D♭	E♭, G	A♭, B♭	29:	C, D♭	B♭, D	E♭, F
10:	C, D♭	E♭, G	A, B	30:	C, D♭	B♭, D	E, G♭
11:	C, D♭	E, A♭	E♭, F	31:	C, D♭	B♭, D	F, G
12:	C, D♭	E, A♭	F, G	32:	C, D♭	B♭, D	G♭, A♭
13:	C, D♭	E, A♭	G, A	33:	C, D♭	B♭, D	G, A
14:	C, D♭	E, A♭	A, B	34:	C, D♭	B♭, D	A, B
15:	C, D♭	F, A	D, E	35:	C, D♭	B, E♭	D, E
16:	C, D♭	F, A	E, G♭	36:	C, D♭	B, E♭	E, G♭
17:	C, D♭	F, A	G♭, A♭	37:	C, D♭	B, E♭	F, G
18:	C, D♭	F, A	A♭, B♭	38:	C, D♭	B, E♭	G♭, A♭
19:	C, D♭	G♭, B♭	D, E	39:	C, D♭	B, E♭	G, A
20:	C, D♭	G♭, B♭	E♭, F	40:	C, D♭	B, E♭	A♭, B♭

What is significant is that *no* type from C1G1 is pitch-class duplicated in C3G1 nor in any other group derived from primary collection 3. And vice versa, no C3G1 type is ever generated by any group derived from primary collection 1. The system partitions the universe of possible hexachords into precisely two large "families" based upon exactly this property: no type from one family is ever duplicated in a type set of the other family. The single difference between the two families is this: the number of semitones (the *sum* of the semitones within the three separate dyads, *not* including the semitones *separating* the individual dyads from each other) in primary-collection-1 types (belonging to family I) is an even number; the number of semitones in primary-collection-3 types (family II) is odd. There is as well (unsurprisingly) a kind of characteristic sound that obtains with family-I hexachords, different from the characteristic sound generally heard with family-II hexachords. The degree of "presence" of this sound varies with context, with use, with the specific dyads being employed; but working consistently with types from one family, then with another, the sense of this sound is usually perceivable, sometimes radically dominant, sometimes only as a difference in "flavor."

The compound procedure, mentioned earlier, whereby we find types that have five tones in common with other types, becomes even more interesting for navigating between type sets of the two families. It is enough to change one pitch in a family-I type by a semitone to generate a family-II type (and vice versa). The further search for those family-II types with five tones in common (with a particular family-I type) that, upon transposition, have *no* tones in common with the original family-I type produces a wide range of potential structural relationships. What should be emphasized is that this sort of procedure, whereby prototype criteria, derived from an original musical invention, are applied to the resources of the Dyad System in order to generate different note collections displaying the same (or nearly the same) relationships, is a typical and characteristic way the system can be used, but by no means the only way.

Highly useful and frequently used criteria for navigating between types, type sets, and families of groups are based on a wide variety of common-tone or common-dyad relationships. The common tones can be fixed with respect to their dyad construction or not, from one type to another, according to the harmonic motion required at each moment. Example 2 shows the common mn3 E♭-G♭ first maintained both as common pitches as well as the common dyad, then going from a mn3 position to forming part of other dyads in the next group, or the (D♭-E) from separate dyads in one group, coming together to form a mn3 in the successive group. Again, it is important to emphasize that the *criteria* used to choose types related by common tones, how these latter will be associated from type to type or from group to group, is precisely that (major) dimension of the Dyad System determined by the composer's way of hearing, the exigencies of the work at each point and in general.



EXAMPLE 2

Another procedure might employ the type collections of six pitch classes grouped into pairs of trichords. Trichord groupings internal to each type often produce interesting relationships that can focus on different aspects of the sound quality of the types (and their successions) in question. The next two group lists show the application of rule 1 to two types derived from C3G6(mj2, mj3, mn3), but now in terms of trichord re-groupings; the newly derived groups are made up of trichord pairs, rather than three dyads. (Rule 1 can be applied to any sized pitch class group, of course, but larger groups quickly become unwieldly in actual practice. I have found groups of 6 and 7 pitch classes subdivided into trichords and dyads to be the most fruitful in terms of both compositional control and musical perception).

The notation employed here shows the dyadic characteristics of the three pitch classes in the trichord groupings according to the following scheme:

Outside_Dyad(Inside_Dyad1, Inside_Dyad2).

Specifically, *p4(mn2, mj3)* means that the trichord's three pitch classes form a perfect fourth made up of a minor second followed by a major third (F to B♭ made up of F to G♭, G♭ to B♭). Anomalies arise since the system uses only the six fundamental dyads, which doesn't allow handling accurately a perfect fifth made up (for example) of a mj3 and mn3; these are listed as p4 as the outside interval.

C3G6(1, 0) C D D♭ F E♭ G♭

C D D♭	F E♭ G♭	mj2 (mn2, mn2)	mn3 (mj2, mn2)
C D F	D♭ E♭ G♭	p4 (mj2, mn3)	p4 (mj2, mn3)
C D E♭	D♭ F G♭	mn3 (mj2, mn2)	p4 (mj3, mn2)
C D G♭	D♭ F E♭	tt (mj2, mj3)	mj3 (mj2, mj2)
C D♭ F	D E♭ G♭	p4 (mn2, mj3)	mj3 (mn2, mn3)
C D♭ E♭	D F G♭	mn3 (mn2, mj2)	mj3 (mn3, mn2)
C D♭ G♭	D F E♭	tt (mn2, p4)	mn3 (mn2, mj2)
C F E♭	D D♭ G♭	p4 (mn3, mj2)	p4 (mn2, mj3)
C F G♭	D D♭ E♭	tt (p4, mn2)	mj2 (mn2, mn2)
C E♭ G♭	D D♭ F	tt (mn3, mn3)	mj3 (mn2, mn3)

C3G6(29, 0) C D G B B♭ D♭

C D G	B B♭ D♭	p4 (mj2, p4)	mn3 (mn2, mj2)

C D B	G B♭ D♭	mn3 (mn2, mj2)	tt (mn3, mn3)
C D B♭	G B D♭	mj3 (mj2, mj2)	tt (mj2, mj3)
C D D♭	G B B♭	mj2 (mn2, mn2)	mj3 (mn3, mn2)
C G B	D B♭ D♭	p4 (mj3, mn2)	mj3 (mn3, mn2)
C G B♭	D B D♭	p4 (mn3, mj2)	mn3 (mj2, mn2)
C G D♭	D B B♭	tt (mn2, p4)	mj3 (mn2, mn3)
C B B♭	D G D♭	mj2 (mn2, mn2)	tt (mn2, p4)
C B D♭	D G B♭	mj2 (mn2, mn2)	p4 (mj3, mn3)
C B♭ D♭	D G B	mn3 (mj2, mn2)	p4 (mn3, mj3)

In the following selections, a particular trichord (C, D♭, E♭) is kept constant and two type sets (C1G1 and C3G1) are searched for all collections that have that trichord among its pitches. It should be noted that the search can be made according to whatever criteria are desired, in the sense that one or several or all type sets can be included in the search. The more type sets, the more repetition of hexachord collections will occur, but notwithstanding the identity of the *collection* the dyadic constructions are usually different, i.e., System rule 1 is implicit in all these recurrences.

The shorthand notation shows the common trichord pitches with dashes around them within the listing of the type's pitch classes, followed by the type number, its transposition, and finally the dyadic characteristics of the remaining three pitch classes in the hexachord according to the previously described scheme.

common trichord *mn*3 (*mn*2, *mj*2) [C, D♭, E♭]

a selection from type set C1G1 (family I):

			other trichord
–C– –D♭– D	E –E♭– G♭	type1 trans0	mj3 (mj2, mj2)
A B♭ B	–D♭– –C– –E♭–	type1 trans9	mj2 (mn2, mn2)
B –C– –D♭–	–E♭– D F	type1 trans11	tt (mn3, mn3)
B –C– –D♭–	–E♭– E G	type2 trans11	p4 (mj3, mn3)
B –C– –D♭–	–E♭– F A♭	type3 trans11	tt (mn3, mn3)
B –C– –D♭–	–E♭– G♭ A	type4 trans11	p4 (mn3, mj2)
B –C– –E♭–	F –D♭– E	type11 trans11	tt (mn2, p4)
G A♭ B	–D♭– –C– –E♭–	type12 trans7	mj3 (mn2, mn3)
–D♭– D F	G –C– –E♭–	type15 trans1	p4 (mn3, mj2)

F	G♭	B	–D♭–	–C–	–E♭–	type22 trans5	tt (mn2, p4)
–D♭–	D	G	A	–C–	–E♭–	type23 trans1	p4 (p4, mj2)
–D♭–	D	A	B	–C–	–E♭–	type33 trans1	p4 (mj2, mn3)
E	F	–D♭–	–E♭–	A	–C–	type37 trans4	p4 (mn2, mj3)

a selection from type set C3G1 (family II):

–C–	–D♭–	D	G♭	–E♭–	F	type1 trans0	mj3 (mn3, mn2)
B♭	B	–C–	E	–D♭–	–E♭–	type1 trans10	tt (p4, mn2)
G♭	G	A♭	–C–	–D♭–	–E♭–	type3 trans6	mj2 (mn2, mn2)
–D♭–	D	–E♭–	G	B♭	–C–	type5 trans1	p4 (mj3, mn3)
–C–	–D♭–	–E♭–	G	D	E	type6 trans0	p4 (mj2, mn3)
F	G♭	A♭	–C–	–D♭–	–E♭–	type9 trans5	mn3 (mn2, mj2)
–C–	–D♭–	–E♭–	G	A	B	type10 trans0	mj3 (mj2, mj2)
–C–	–D♭–	E	A♭	–E♭–	F	type11 trans0	mj3 (mn2, mn3)
–C–	–D♭–	G♭	B♭	–E♭–	F	type20 trans0	p4 (mn2, mj3)
D	–E♭–	A♭	–C–	B	–D♭–	type23 trans2	tt (mn3, mn3)
B♭	B	A♭	–C–	–D♭–	–E♭–	type29 trans10	mn3 (mj2, mn2)
–E♭–	E	–D♭–	F	B♭	–C–	type33 trans3	tt (mn2, p4)
A	B♭	A♭	–C–	–D♭–	–E♭–	type36 trans9	mj2 (mn2, mn2)
–C–	–D♭–	B	–E♭–	G♭	A♭	type38 trans0	p4 (mj2, mn3)

Thus, the trichord in common between family-I and family-II types can provide interesting possibilities for modulation between the two hexachord families.

SOME DETAILED EXAMPLES

To get an idea of the flexibility of the Dyad System, it will be useful to take a look at a few ways of navigating the System resources by means of common-tone criteria, each highlighting a different aspect of the System's potential. These are only some of the possible relationship criteria that can be designated.

Given a current selection, the hexachord collection (type) that is "the piece so far," we can

1. specify which pitch class(es) (from none to all six) are to be operative as common tones from the current type to the next;
2. specify only the number of common tones desired without specifying which pitch classes are to be involved;
3. specify the next particular type for which we want to see which pitches the current type selection has in common with all transpositions of the specified type (in this case the next particular type can simply be the current type selection itself, a means for prolonging the type by transposition and in conjunction with particular common tones and/or intervals);
4. adopt compound procedures, such as the one mentioned earlier, where the system looks for very near equivalence (five common tones) then finds those transpositions of the near equivalent types that have only one or two common tones with the current selection;
5. find a succession of types, related by a specified minimum number of common tones, that try to avoid repeating the exact pitch-class content of the three dyad types until all twelve possible combinations have been articulated (or the source type sets have been exhausted). For example, if DC♯ is in the current choice, the procedure will not allow the mn2 in any subsequent type to be formed by D and C♯ until all other mn2s have been used.

It should be noted that these procedures only produce *possible* choices that satisfy the current criteria, within the constraints of the system; the final choice will, of course, depend on the particular sound quality felt necessary or appropriate for each moment in the piece, be it a work with electronic sounds or for acoustic instruments alone. The composer can interact with the System choices and even the way the System produces its choices until the results fully satisfy compositional requirements.

The following chain of type selections is a demonstration of using various criteria for the construction of a type sequence. Needless to say, in a full-blown compositional context many other musical considerations will influence the procedures and group/type selections. I will examine the use of the System in actual musical works in Part III.

We start with C1G1(1, 0), and search for all types within the C1G1 type set that have *only* E♭-G♭ as common tones. In the following examples, the requested common tones are highlighted by surrounding dashes. The types listed are the output generated by some of the procedure programs that manage the Dyad System's resources.

C	D♭	D	E	E♭	G♭	type1	trans0

C1G1

A♭	A	F	G	–E♭–	–G♭–	type38	trans8
B♭	B	G	A	–E♭–	–G♭–	type37	trans10
–G♭–	G	–E♭–	F	A♭	B	type34	trans6
G	A♭	–E♭–	F	–G♭–	A	type33	trans7
A	B♭	F	G	–E♭–	–G♭–	type32	trans9
B♭	B	F	G	–E♭–	–G♭–	type26	trans10
B♭	B	–E♭–	F	–G♭–	A	type18	trans10
G	A♭	A	B	–E♭–	–G♭–	type5	trans7

Most of the possible candidates, in this type set only, keep the E♭-G♭ in the mn3 dyad of the type; three of them have the E♭-G♭ split apart as members of other dyads, a different kind of relationship, and certainly useful for a different kind of type succession. We choose C1G1(37, 10).

B♭	B	G	A	–E♭–	–G♭–	type37	trans10

Now we look for all types, staying in the C1G1 type set, that have the G-A mj2 in common with (37, 10).

C1G1

A♭	–A–	F	–G–	D♭	E	type37	trans8
C	D♭	–G–	–A–	F	A♭	type26	trans0
–G–	A♭	D	E	–A–	C	type24	trans7
C	D♭	–G–	–A–	D	F	type24	trans0
D♭	D	–G–	–A–	F	A♭	type21	trans1
A♭	–A–	C	D	E	–G–	type14	trans8
D♭	D	F	–G–	–A–	C	type14	trans1

And again, some possibilities maintain the G-A as the type's mj2 dyad, others split the two pitch classes up into different dyads. We are choosing as common tones pairs of pitch classes that form the very intervals that make up the group characteristics, so for now we decide to keep the common tones as a common dyad as well. The next choice is C1G1(21, 1).

D♭	D	–G–	–A–	F	A♭	type21	trans1

Lastly (for this first series of selections), we look for a mn2 common dyad, D♭-D.

C1G1

E♭	E	C	–D–	B♭	–D♭–	type38	trans3
–D♭–	–D–	B♭	C	E♭	G♭	type34	trans1
–D–	E♭	B♭	C	–D♭–	E	type33	trans2
C	–D♭–	E	G♭	B	–D–	type15	trans0
B	C	–D–	E	B♭	–D♭–	type10	trans11
–D♭–	–D–	E	G♭	C	E♭	type10	trans1
–D–	E♭	E	G♭	B♭	–D♭–	type5	trans2
B♭	B	C	–D–	–D♭–	E	type1	trans10
C	–D♭–	–D–	E	E♭	G♭	type1	trans0

For this series we can suggest a sort of closure by choosing type1, but transposed a mn7, i.e., C1G1(1, 10), rather than the original C1G1(1, 0)—which was a possibility. Again, it must be emphasized that the means of actually articulating these dyads, the *real* interval form they will take, is a fundamental consideration in making these choices. In a complete compositional environment the choices are made under the determining influence of linear-harmonic considerations (which include local and large-scale rhythm and phrasing, orchestration, electronic sound generation and so on), or rather the *complete* compositional context of which the hexachord selection is a (major) part. Whether one would consider returning to type1 at this stage, or whether it would even be considered some kind of "closure," is entirely dependent on how these note collections are being used, their intervallic deployments, and the effect that the variety of other compositional criteria being developed simultaneously have on the work's progress.

B♭	B	C	–D–	–D♭–	E	type1	trans10

Now we begin a second series, still using the same type set of group C1G1 and the dyads of that group as the basis of the common tones, but we will choose types that split up the dyad pitches between members of other dyads in the type. The common tones are the mn2 B♭-B.

C1G1

–B♭–	–B–	G	A	F	A♭	type38	trans10

–B♭–	–B–	G	A	E♭	G♭	type37	trans10
A	–B♭–	F	G	A♭	–B–	type33	trans9
–B♭–	–B–	F	G	G♭	A	type27	trans10
–B♭–	–B–	F	G	E♭	G♭	type26	trans10
A	–B♭–	E♭	F	A♭	–B–	type23	trans9
–B♭–	–B–	E♭	F	G♭	A	type18	trans10
F	G♭	A	–B–	G	–B♭–	type11	trans5

The choice is type23. I am here making sure there is a fairly wide variety of types, in order to provide a certain degree of continuing contrast in harmonic change. Later, different contextual criteria will suggest the use of another kind of change rate.

A	–B♭–	E♭	F	A♭	–B–	type23	trans9

Now we use the mj2 dyad, E♭-F, as the common-tone source, and choose a type that, again, splits up that dyad.

C1G1

G♭	G	–E♭–	–F–	D♭	E	type38	trans6
–F–	G♭	D	E	C	–E♭–	type38	trans5
–F–	G♭	D♭	–E♭–	E	G	type33	trans5
E	–F–	C	D	–E♭–	G♭	type33	trans4
G♭	G	D♭	–E♭–	D	–F–	type27	trans6
C	D♭	–F–	G	–E♭–	G♭	type16	trans0
D♭	D	–F–	G	C	–E♭–	type15	trans1
D♭	D	–F–	G	–E♭–	G♭	type11	trans1
D	–E♭–	–F–	G	D♭	E	type10	trans2
C	D♭	–E♭–	–F–	E	G	type6	trans0
D♭	D	–E♭–	–F–	E	G	type1	trans1

Here, the choice, (27, 6), keeps the E♭ in the mj2 dyad, and reinterprets the F as part of the mn3.

G♭	G	D♭	–E♭–	D	–F–	type27	trans6

Now let us suppose we are getting ready to change to another type set, derived from the group C1G3(mj2, p4, mn2), as a major structural move. The next dyad as a common-tone collection could be p4 (G♭-D♭). We might have prepared the change locally by some sort of workings internal to the articulations of the preceding type selections that, in some way, could have begun to evidence the p4 interval class. It can be noticed too that the actual choice of common tones was such that no pitch was repeated as a common tone until the second occurrence of the E♭ here. We have used nine out of twelve (E♭-G♭, G-A, D-D♭, B-B♭, F-(repeated E♭)) as common tones; this progression could be a determining factor for further choices, the order of common tones, *their* dyadic relationships, and so forth. To keep things relatively straightforward, this demonstration does not take account of the common tones as a separate collection for structural purposes,[3] but a certain degree of pitch-class turnover is intentionally maintained.

The type set is now changed to C1G3, and the possible types with the p4 common tones to the last C1G1 type are as follows:

C1G3

–G♭–	A♭	E	A	C	–D♭–	type33	trans6
A♭	B♭	–G♭–	B	C	–D♭–	type31	trans8
–G♭–	A♭	B	E	C	–D♭–	type17	trans6
A♭	B♭	–D♭—	G♭–	B	C	type16	trans8
E	–G♭–	A♭	–D♭–	B	C	type14	trans4
E	–G♭–	A♭	–D♭–	B♭	B	type13	trans4
E	–G♭–	A♭	–D♭–	A	B♭	type12	trans4
B♭	C	–D♭—	G♭–	A♭	A	type11	trans10

The choice keeps the common dyad split between other dyads.

A♭	B♭	–G♭–	B	C	–D♭–	type31	trans8

We now look for mj2 A♭-B♭ common tones (still using common dyads that directly reflect the type set currently in use: p4, mj2, mn2)

C1G3

F	G	E♭	–A♭–	A	–B♭–	type31	trans5
–A♭—	B♭–	E	A	D	E♭	type28	trans8
D	E	–B♭–	E♭	–A♭–	A	type28	trans2
D	E	–B♭–	E♭	G	–A♭–	type27	trans2

-A♭—	B♭-	D	G	E	F	type23	trans8
-A♭—	B♭-	D	G	E♭	E	type22	trans8
F	G	-B♭-	E♭	-A♭-	A	type16	trans5
D	E	F	-B♭-	-A♭-	A	type9	trans2
D	E	F	-B♭-	G	-A♭-	type8	trans2
-A♭—	B♭-	A	D	E	F	type4	trans8
-A♭—	B♭-	A	D	E♭	E	type3	trans8
D	E	E♭	-A♭-	A	-B♭-	type3	trans2

The choice again splits the mj2 into separate dyads.

D	E	E♭	-A♭-	A	-B♭-	type3	trans2

And, finally, we search for a mn2, E♭-E, which is *not* the mn2 dyad in the current choice, C1G3(3, 2).

C1G3

D♭	-E♭-	B	-E-	G♭	G	type32	trans1
D♭	-E♭-	B	-E-	F	G♭	type31	trans1
F	G	D♭	G♭	-E♭-	-E-	type30	trans5
-E♭-	F	B	-E-	C	D♭	type29	trans3
B	D♭	G	C	-E♭-	-E-	type26	trans11
-E♭-	F	B	-E-	G♭	G	type25	trans3
D♭	-E♭-	G	C	-E-	F	type20	trans1
D♭	-E♭-	G♭	B	-E-	F	type16	trans1
F	G	G♭	B	-E♭-	-E-	type6	trans5
B	D♭	C	F	-E♭-	-E-	type2	trans11

But now let's reverse the procedure of the last few choices: we *do* group the E-E♭ as the mn2 of the chosen type.

F	G	G♭	B	-E♭-	-E-	type6	trans5

Now let's say we want to change the procedure. We might want first to prolong type6 by a transposition that will produce a certain kind of harmonic motion; then using that kind of harmonic motion we will gradually slide back to type1 and prepare for a jump to another type set. First we see how many, and which, pitch classes the current type6 choice has in common with all possible transpositions of itself.

C1G3

–B–	D♭	C	–F–	A	B♭	type6	trans11
B♭	C	–B–	–E–	A♭	A	type6	trans10
A	–B–	B♭	–E♭–	–G–	A♭	type6	trans9
A♭	B♭	A	D	–G♭–	–G–	type6	trans8
–G–	A	A♭	D♭	–F–	–G♭–	type6	trans7
–G♭–	A♭	–G–	C	–E–	–F–	type6	trans6
–F–	–G–	–G♭–	–B–	–E♭–	–E–	type6	trans5
–E–	–G♭–	–F–	B♭	D	–E♭–	type6	trans4
–E♭–	–F–	–E–	A	D♭	D	type6	trans3
D	–E–	–E♭–	A♭	C	D♭	type6	trans2
D♭	–E♭–	D	–G–	–B–	C	type6	trans1
C	D	D♭	–G♭–	B♭	–B–	type6	trans0

The desired harmonic motion can be achieved by changing only three notes at a time, so we choose a transposition of type6 that has three common tones to (6, 5).

–G–	A	A♭	D♭	–F–	–G♭–	type6	trans7

The kind of motion we want continues as the result of a compound procedure, similar to what we've already demonstrated. Here we search for those types that have a transposition with five notes in common with type6 (a very near equivalent), and then choose a version that has only three common tones.

C1G3

–A–	B	–A♭–	–D♭–	–G♭–	–G–	type40	trans9
–A–	B	–A♭–	–D♭–	–F–	–G♭–	type39	trans9
E♭	–F–	–D♭–	–G♭–	–A♭–	–A–	type32	trans3
E♭	–F–	–D♭–	–G♭–	–G–	–A♭–	type31	trans3
–G–	–A–	E♭	–A♭–	–F–	–G♭–	type30	trans7
–F–	–G–	–D♭–	–G♭–	–A–	B♭	type26	trans5

–G– –A–	–D♭––G♭–	E –F–	type24	trans7
E♭ –F–	–A♭––D♭–	–G♭– –G–	type16	trans3
–A– B	–D♭––G♭–	–G– –A♭–	type15	trans9
–F– –G–	–A♭––D♭–	–A– B♭	type7	trans5
–G– –A–	–A♭––D♭–	E –F–	type5	trans7 ⟵
–F– –G–	–G♭– B	–A♭– –A–	type1	trans5

Having chosen type5 (with the arrow) we search for those transpositions of type5 that have only three pitch classes in common with the currently selected type6:

G A	A♭ D♭	F G♭	type6	trans7

C1G3

–A– B	B♭ E♭	–G♭– –G–	type5	trans9
–G♭––A♭–	–G– C	E♭ E	type5	trans6
–F– –G–	–G♭– B	D E♭	type5	trans5
E –G♭–	–F– B♭	–D♭– D	type5	trans4
E♭ –F–	E –A–	C –D♭–	type5	trans3
C D	–D♭––G♭–	–A– B♭	type5	trans0

and we choose one:

E♭ –F–	E –A–	C –D♭–	type5	trans3

Repeat the procedure, searching for types with five common tones to (5, 3):

C1G3

–D♭––E♭–	–C– –F–	–A– B♭	type39	trans1
–F– G	–E– –A–	–C– –D♭–	type38	trans5
–D♭––E♭–	–C– –F–	A♭ –A–	type38	trans1
–E♭– –F–	B –E–	–C– –D♭–	type29	trans3
–D♭––E♭–	–A– D	–E– –F–	type25	trans1
–E♭– –F–	–A– D	–C– –D♭–	type24	trans3
–D♭––E♭–	G –C–	–E– –F–	type20	trans1
G –A–	–C– –F–	–E♭– –E–	type19	trans7

–D♭–	–E♭–	–E–	–A–	B	–C–	type11	trans1
–A–	B	–C–	–F–	–E♭–	–E–	type9	trans9
–D♭–	–E♭–	–E–	–A–	–F–	G♭	type7	trans1
–E♭–	–F–	–E–	–A–	–D♭–	D	type6	trans3
–E♭–	–F–	–E–	–A–	B	–C–	type4	trans3
B	–D♭–	–C–	–F–	–E♭–	–E–	type2	trans11 ⟵

Now choosing type2, find its transpositions having three pitch classes in common with the current type5.

E♭	F	E	A	C	D♭	type5	trans3

C1G3

B♭	–C–	B	–E–	D	–E♭–	type2	trans10
–A–	B	B♭	–E♭–	–D♭–	D	type2	trans9
A♭	B♭	–A–	D	–C–	–D♭–	type2	trans8
G	–A–	A♭	–D♭–	B	–C–	type2	trans7
–E–	G♭	–F–	B♭	A♭	–A–	type2	trans4
–D♭–	–E♭–	D	G	–F–	G♭	type2	trans1

This is the first time C is a common tone.

B♭	–C–	B	–E–	D	–E♭–	type2	trans10

For this hypothetical structure, we could consider that we are approaching some sort of major arrival point, for which type1 is a likely candidate (for a cyclical form). But first, we can delay the arrival by a secondary development based on type2 trans10. This could allow us to anticipate or prepare or otherwise elaborate a subsidiary level of the work's structure. We apply rule 1 to C1G3(2, 10) for this local expansion via a derived group; depending on the projected form of or process for the structure, a new C1 group can be anticipated, or a group not in the C1 group set could be chosen. Rule 2 is then applied to the chosen group and the associated type set is generated as source materials for the passage to be worked out.

B♭, C	B, E	D, E♭	mj2	p4	mn2	← C1G3(2, 10)
B♭, C	B, D	E, E♭	mj2	mn3	mn2	← C1G2 (not C1G1)
B♭, C	B, E♭	E, D	mj2	mj3	mj2	

B♭, B	C, E	D, E♭	mn2	mj3	mn2	
B♭, B	C, D	E, E♭	mn2	mj2	mn2	
B♭, B	C, E♭	E, D	mn2	mn3	mj2	← C1G2 (not C1G1)
B♭, E	C, B	D, E♭	tt	mn2	mn2	
B♭, E	C, D	B, E♭	tt	mj2	mj3	⟵ not a C1G1 group
B♭, E	C, E♭	E, D	tt	mn3	mn3	
B♭, D	C, B	E, E♭	mj3	mn2	mn2	
B♭, D	C, E	B, E♭	mj3	mj3	mj3	
B♭, D	C, E♭	B, E	mj3	mn3	p4	⟵ not a C1G1 group
B♭, E♭	C, B	E, D	p4	mn2	mj2	
B♭, E♭	C, E	B, D	p4	mj3	mn3	⟵ not a C1G1 group
B♭, E♭	C, D	B, E	p4	mj2	p4	

We can, minimally, suppose that the delaying (or prolonging) passage derived from type2 trans10 returns to that particular form:

C1G3

B♭ C   B E   D E♭   type2   trans10

Or the passage could proceed directly to the type1 form chosen next, which could represent a sort of closure, via three common tones to the preceding type: (From here on I will list only the selected type and the criteria by which it was chosen, not all the possible types that meet the criteria).

C1G3

D♭ E♭   D G   E F   type1   trans1

First, three common tones.

D♭ –E♭–   –D– G   –E– F   type1   trans1

Then prolong type1 with a transposition of itself; change the number of common tones, thereby radically altering the pitch turnover rate: here, one common tone only.

C1G3

G♭	A♭	–G–	C	A	B♭	type1	trans6

This choice might be considered an arrival point (or take-off point for the next structural block); we might modulate to a family-II series, starting with C3G7 (p4, mn2, mn3) whose interval relationships to C1G1 (mn2 and mn3 in common) and C1G3 (p4 and mn2 in common) suggest some interesting developments.

We search for C3G7 types with only one common tone to the current choice, C1G3(1, 6). From the twenty possibilities, we choose

C3G7

–C–	F	E♭	E	B	D	type16	trans0

At this point the composition might then continue with a different kind of articulation or texture or electronic sound, and be developed by selections within the domain of family-II groups and types following identical or analogous selection criteria.

Another approach can effectively exploit the relationships of material available even in a single type set utilizing variation-like techniques. For example, if we take the choices of a particular type sequence, we can generate other sequences of the exact same choices but with different transposition relationships between them, hence different common-tone relationships, which significantly transform implications for structural development. While unfolding the type-cycle variants, we can consider prolonging, or delaying, or otherwise elaborating, single types with their own subsidiary cycles based on rule 1 type regrouping. A simple such succession using the first six choices of the preceding sequence follows.

C1G1

C	D♭	D	E	E♭	G♭	type1	trans0
B♭	B	G	A	–E♭–	–G♭–	type37	trans10
D♭	D	–G–	–A–	F	A♭	type21	trans1
B♭	B	C	–D–	–D♭–	E	type1	trans10
A	–B♭–	E♭	F	A♭	–B–	type23	trans9
G♭	G	D♭	–E♭–	D	–F–	type27	trans6

Now a second cycle: the succession of types is the same but transpositions are changed, hence their common tone relationships as well.

–G–	A♭	A	B	B♭	–D♭–	type1	trans7
E♭	E	C	D	–A♭–	–B–	type37	trans3
A	B♭	–E♭–	F	D♭	–E–	type21	trans9
A♭	–A–	–B♭–	C	B	D	type1	trans8
E	F	–B♭–	–C–	E♭	G♭	type23	trans4
–C–	D♭	G	A	A♭	B	type27	trans0

A third cycle (exchanging the order of the two types following the recurrences of type1):

D	E♭	E	G♭	F	–A♭–	type1	trans2
–G♭–	G	C	–D–	B♭	D♭	type21	trans6

(possibly regroup {21, 6} as C1G7 (tt, mn3, mn2) → G♭,C, G,B♭, C,D♭ for a prolongation or developmental or delaying sub-cycle before returning to the main sequence).

A♭	A	F	–G–	–D♭–	E	type37	trans8
–A♭–	–A–	B♭	C	B	D	type1	trans8
F	G♭	–C–	–D–	D♭	E	type27	trans5
B	–C–	–F–	G	B♭	–D♭–	type23	trans11

Begin a fourth cycle with rule 1 further regrouping elaborations:

E♭	E	–F–	–G–	G♭	A	type1	trans3

regroup as C1G6 (mj3, mn2, mn3) → E♭,G, E,F, G♭,A, . . . and so on.

Finally, we take a look at a compound procedure that maximizes associative variety among dyads, while proceeding by common tones from type to type. First, the *precise* dyad content, the particular pitch classes that make up the dyad, is *not* allowed to be repeated until (if possible) all twelve versions of that dyad have been utilized. Second, the common tones must be different from type to type, although a common tone used between choices 1 and 2 can recur between choices 3 and 4, but *not* between 2 and 3. The number of common tones, in this particular version of the compound procedure, may be at most two, while one and none are also accepted. The order of occurrence of the dyads is not a determining factor, the composer can adjust this aspect of the generated materials "by hand" if desired (in fact, one real-time option while executing the program that implements these criteria is the interactive accepting or not of the current choice—the composer can refuse the current choice and the program will find the next valid candidate); the idea is to create different progressions of types based on this nonrepetition criterion as a means of harmonic—chordal—variation within the constraints of the Dyad System. Since a single type set is quickly exhausted before a complete cycle of twelve dyad types is generated (even with the possibility of two passes through the entire type set), the procedure allows for searching several type sets (whose dyadic composition can be similar or very different), producing an alternation or mixture of groups, which has the benefit of further enriching the composition's structural resources. Some examples of this compound procedure follow. As before, the common tones are surrounded by dashes.

We might begin by using only C1G8 (mn2, mn2, mj2), yielding in six type choices all twelve possible mn2s.

C D♭	D E♭	F G	type2	trans0	<C1G8>
–E♭– E	G♭ –G–	A♭ B♭	type7	trans3	<C1G8>
F –G♭–	A –B♭–	B D♭	type12	trans5	<C1G8>
–D♭– D	G A♭	E♭ –F–	type20	trans1	<C1G8>
–A♭– A	B♭ B	C –D–	type1	trans8	<C1G8>
–B– –C–	E F	D♭ E♭	type16	trans11	<C1G8>

Starting with the same original type—C1G8(2, 0)—we use C3G9 (mn2, mn2, mn3) as an alternate type set. The associative differences and similarities are most suggestive.

C D♭	D E♭	F G	type2	trans0	<C1G8>
–E♭– E	G♭ –G–	A♭ B♭	type7	trans3	<C1G8>
F –G♭–	A –B♭–	B D	type13	trans5	<C3G9>
–B– C	E –F–	D♭ E♭	type16	trans11	<C1G8>
–D♭– D	G A♭	–E♭– G♭	type21	trans1	<C3G9>
–A♭– A	B♭ B	C –D–	type1	trans8	<C1G8>

A second series, as above.

C D♭	D E♭	F G	type2	trans0	<C1G8>
G♭ –G–	A B♭	–D– E	type10	trans6	<C1G8>
B C	E♭ –E–	F A♭	type13	trans11	<C3G9>
–F– G♭	B♭ –B–	G A	type16	trans5	<C1G8>

D♭ D	–G– A♭	E♭ –G♭–	type21	trans1	<C3G9>
E F	–A♭– A	B♭ C	type12	trans4	<C1G8>

A third series, as above but starting with a type4 rather than type2.

C D♭	D E♭	G A	type4	trans0	<C1G8>
–D♭––D–	E F	G♭ A♭	type7	trans1	<C1G8>
–G♭– G	B♭ B	A C	type12	trans6	<C3G9>
E♭ E	A♭ –A–	F –G–	type16	trans3	<C1G8>
B C	–F– G♭	D♭ –E–	type21	trans11	<C3G9>
G A♭	A B♭	–B––D♭–	type1	trans7	<C1G8>

We now start with the same type4 as the preceding series, but use C3G8 (mj2, mj2, mn2) as the second type set; the mn2s and mj2s can thus be mixed in a significant number of different ways. We don't get a complete batch of mn2s and mj2s, however: eleven of the former, ten of the latter.

C D♭	D E♭	G A	type4	trans0	<C1G8>
E F	A♭ –A–	B♭ –C–	type12	trans4	<C1G8>
B D♭	–E– G♭	–A♭– G	type18	trans11	<C3G8>
A B♭	–B– C	–D♭– E♭	type1	trans9	<C1G8>
F G	G♭ A♭	E –E♭–	type7	trans5	<C3G8>
–G♭––G–	B♭ B	C D	type12	trans6	<C1G8>
E♭ F	A♭ –B♭–	–D– D♭	type20	trans3	<C3G8>

The next series use three-dyad types, making it more difficult to satisfy the double criteria; in fact, we never get a complete batch of twelve of any of the dyad types. First we use only the C1G1 type set beginning with C1G1 (5,0). We get eleven out of the twelve possible dyad versions for each of the three dyad types.

C D♭	D E	A♭ B	type5	trans0	<C1G1>
–E– F	G A	B♭ –D♭–	type7	trans4	<C1G1>
D E♭	G♭ A♭	–G––B♭–	type12	trans2	<C1G1>
B C	E –G♭–	–D– F	type16	trans11	<C1G1>
G A♭	D♭ E♭	A –C–	type20	trans7	<C1G1>
B♭ B	F –G–	–D♭– E	type25	trans10	<C1G1>

E♭	–E–	C	D	–F–	A♭	type34	trans3	<C1G1>
A	B♭	B	D♭	–C–	–E♭–	type1	trans9	<C1G1>
F	G♭	A♭	–B♭–	–B–	D	type7	trans5	<C1G1>
–A♭–	A	E♭	–F–	E	G	type27	trans8	<C1G1>
D♭	D	–A–	B	–E♭–	G♭	type29	trans1	<C1G1>

Same as above, with the same initial type C1G1 (5,0), but beginning the search later in the type set, i.e., starting with type32; here we obtain only ten out of the twelve dyad versions for each of the three dyad types.

C	D♭	D	E	A♭	B	type5	trans0	<C1G1>
A	B♭	F	G	E♭	G♭	type32	trans9	<C1G1>
D	–E♭–	B	D♭	E	–G–	type34	trans2	<C1G1>
A♭	A	B♭	C	–B–	–D–	type1	trans8	<C1G1>
E♭	E	G♭	–A♭–	G	–B♭–	type6	trans3	<C1G1>
B	C	–E♭–	F	D♭	–E–	type11	trans11	<C1G1>
G	A♭	–C–	D	B♭	–D♭–	type16	trans7	<C1G1>
–B♭–	B	E	G♭	–D–	F	type21	trans10	<C1G1>
–G♭–	G	D♭	E♭	A	C	type25	trans6	<C1G1>
–D♭–	D	–A–	B	F	A♭	type31	trans1	<C1G1>

A third version (variation), starts with C1G1 (27,0) as the initial group; we get a full complement this time.

C	D♭	G	A	A♭	B	type27	trans0	<C1G1>
D	E♭	E	G♭	B♭	–D♭–	type5	trans2	<C1G1>
F	–G♭–	A♭	–B♭–	A	C	type6	trans5	<C1G1>
B	–C–	E♭	–F–	D♭	E	type11	trans11	<C1G1>
–D♭–	D	G♭	A♭	–E–	G	type16	trans1	<C1G1>
B♭	B	F	–G–	C	E♭	type24	trans10	<C1G1>
E	–F–	–C–	D	G♭	A	type29	trans4	<C1G1>
–A–	B♭	B	D♭	E♭	–G♭–	type3	trans9	<C1G1>
G	A♭	–B♭–	C	–B–	D	type6	trans7	<C1G1>
–A♭–	A	D♭	E♭	–D–	F	type17	trans8	<C1G1>
–E♭–	E	–A–	B	G	B♭	type21	trans3	<C1G1>
G♭	–G–	D	–E–	F	A♭	type33	trans6	<C1G1>

Now we alternate type sets, C1G1 with C1G3 (mj2, p4, mn2); both have three different intervals but there are two dyad types in common between them, mn2 and mj2; hence the system is working with four different intervals. This version generates eleven types, or eleven mn2s and mj2s, and only six mn3s and five p4s.

C	D♭	D	E	A♭	B	type5	trans0	<C1G1>
–E–	F	G	A	E♭	G♭	type10	trans4	<C1G1>
–G♭–	A♭	B♭	–E♭–	B	C	type12	trans6	<C1G3>
G	–A♭–	–C–	D	D♭	E	type17	trans7	<C1G1>
E♭	F	A	–D–	G♭	–G–	type20	trans3	<C1G3>
–E♭–	E	B♭	C	–F–	A♭	type24	trans3	<C1G1>
B	D♭	G	–C–	–A♭–	A	type29	trans11	<C1G3>
D	E♭	E	G♭	–G–	B♭	type2	trans2	<C1G1>
A	B	C	F	D♭	–D–	type7	trans9	<C1G3>
–A–	B♭	–D♭–	E♭	E	G	type13	trans9	<C1G1>
A♭	–B♭–	D	–G–	F	G♭	type24	trans8	<C1G3>

This time we alternate C1G3 with C3G1 (mn2, mj3, mj2), a family-II group. This is a useful way of interrelating family-I and family-II type sets, as in this case where there are two intervals in common (mn2 and mj2).

C	D♭	D	E	A♭	B	type5	trans0	<C1G1>
E♭	–E–	G	A	B♭	–D♭–	type13	trans3	<C1G1>
D	–E♭–	–G–	B	G♭	A♭	type16	trans2	<C3G1>
E	F	B♭	C	–G♭–	A	type20	trans4	<C1G1>
D♭	D	A♭	–C–	E♭	–F–	type24	trans1	<C3G1>
–A♭–	A	E	G♭	B	–D–	type30	trans8	<C1G1>
F	–G♭–	E♭	G	–B–	D♭	type32	trans5	<C3G1>
A	B♭	C	D	–D♭–	E	type6	trans9	<C1G1>
–B♭–	B	–D–	G♭	F	G	type13	trans10	<C3G1>
–G–	A♭	D♭	E♭	A	C	type20	trans7	<C1G1>
B	–C–	–A♭–	B♭	D	F	type35	trans11	<C1G1>

Now we alternate type sets C1G1 and C5G7. Both type sets again have three different intervals, but only one interval, mn3, is common between the two types; thus we are working with five different intervals in this type series. While we manage to generate, in this particular configuration, twelve types, we have a complete batch of twelve only of mn3s, all others have only six.

C	D♭	D	E	A♭	B	type5	trans0	<C1G1>
–D–	E♭	F	G	G♭	A	type6	trans2	<C1G1>
A♭	D♭	C	–E♭–	B♭	E	type11	trans8	<C5G7>
–E–	F	A	B	G	–B♭–	type16	trans4	<C1G1>
E♭	A♭	–A–	C	–G–	D♭	type17	trans3	<C5G7>
–E♭–	E	–A♭–	B♭	B	D	type18	trans3	<C1G1>
–E–	A	–B♭–	D♭	C	G♭	type19	trans4	<C5G7>
B	–C–	–G♭–	A♭	D	F	type25	trans11	<C1G1>
–F–	B♭	D♭	E	A	E♭	type27	trans5	<C5G7>
–B♭–	B	C	D	–E♭–	G♭	type2	trans10	<C1G1>
D♭	–G♭–	E	G	–D–	A♭	type5	trans1	<C5G7>
A	B♭	–D♭–	E♭	F	–A♭–	type14	trans9	<C1G1>

Lastly, we use three type sets as sources, C1G1, C5G7, and C3G1; all six dyad types are being tracked by the procedure. The following version (yielding sixteen choices) is one of the few in this particular configuration that go beyond a succession of ten before exhausting the sources. We get "incomplete" dyad collections: eleven mn2s, mj2s, and mn3s; five mj3s, p4s, and tts. Other slight changes can generate different varieties and different successions: start with a C5G7 or C3G1 type, or simply change the order of type set scanning (C1G1, C3G1, C5G7 instead of the order shown), and so on. At any rate, there is no reason *not* to work with incomplete collections; on the contrary, things can get interesting when incomplete dyad collections are hooked together to complement or contrast or interact with each other in ways that can become structurally significant. I must again emphasize that what is far more pertinent to a musically satisfying and expressive structure is the character of these chordal-harmonic and/or textural-timbral successions that these series suggest, how notes appear, disappear, and reappear in altered harmonic-timbral contexts, the dynamic of this complex flux, and not their statistical properties.

C	D♭	D	E	A♭	B	type5	trans0	<C1G1>
–D–	E♭	F	G	G♭	A	type6	trans2	<C1G1>

A♭	D♭	C	–E♭–	B♭	E	type11	trans8	<C5G7>
F	G♭	–B♭–	D	G	A	type15	trans5	<C3G1>
E♭	E	–A–	B	–F–	A♭	type20	trans3	<C1G1>
–E♭–	–A♭–	B♭	D♭	G♭	C	type22	trans3	<C5G7>
A	–B♭–	G	B	–C–	D	type29	trans9	<C3G1>
–G–	A♭	E♭	F	D♭	E	type32	trans7	<C1G1>
–D♭–	G♭	B	D	A	–E♭–	type33	trans1	<C5G7>
–G♭–	G	F	–A–	A♭	B♭	type35	trans6	<C3G1>
B	C	D♭	E♭	D	–F–	type1	trans11	<C1G1>
G♭	–B–	G	B♭	–D–	A♭	type3	trans6	<C5G7>
E	F	A	D♭	–G♭–	–A♭–	type15	trans4	<C3G1>
–D♭–	D	B♭	C	–E–	G	type35	trans1	<C1G1>
–B♭–	E♭	A	–C–	F	B	type38	trans10	<C5G7>
A♭	–A–	D♭	–F–	E	G♭	type18	trans8	<C3G1>

Needless to say, the procedures illustrated here barely scratch the surface of the considerable potential the Dyad System can provide for creating musical structures of (to) any degree of complexity.

The sorts of structures illustrated thus far furnish the pitch-class and dyad materials in a kind of abstract form. If the piece is for traditional instruments without electronic sounds, the next task is the deployment of the pitches to correspond to the specific sound the composer is trying to capture. If the piece involves electronic sounds, then the next task is the deployment of the pitches as input to the sound-synthesis algorithms, or rather the arranging of the dyads into their registral positions, the specific intervals that will determine the quality of the electronic sounds: in Part II of this paper we will see that these dyadic dispositions take on another function, and they are known within the electronic dimension as the Generating Dyads.

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Notes

1. The preparation of lists of Dyad System groups and types has been encoded in a series of computer programs in the Prolog language. For notation and computational simplicity, these programs recognize only "flats," not "sharps," but this is not to be taken as my bearing any ill will toward "sharps"; the choice was made in honor of my dear friend and former teacher Arthur Berger, who hasn't used a sharp sign in decades.

   These programs also load all types and their transpositions of as many and whichever groups desired into the data base and allow the user to carry out various operations on them. The types retain their group, type and transposition information in the data base.

   A compiled version (for PC) and source code can be found at the author's website: <http://www.jamesdashow.net>

2. The Prolog predicate in the Dyad System is

   compare_Tsets(*CxGx*, *CyGy*):-

   which, with ordinary backtracking, steps through all *CxGx* types, at transposition = 0, and finds all *CyGy* types that are identical with respect to pitch class, irrespective of pitch-class ordering, and also reports those *CxGx* types that are ***not*** generated by *CyGy*, i.e., are unique to *CxGx* with respect to *CyGy*.

3. Sections of my 4/3-TRIO for violin, cello, and piano use manipulations of the common tone collections as fundamental to the musical structure.