Balanced Chord Spacing in Elliott Carter's Fifth String Quartet

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Elliott Carter's music has been subject to extensive analysis in the realms of rhythm and harmony. His conception of harmony, laid out in the *Harmony Book*, relies heavily on the theory of pitch-class sets. This theory is founded on the abstraction of pitch-classes, which must be realized as specific pitches in the final compositional product. This has several profound implications for the sound of the piece, depending on the instruments chosen, the range of these instruments, the dynamic level, and the spacing of notes within a chord, among others. In particular, the resultant chord spacing, which often has larger registral gaps between some adjacent note pairs than others, is essential to our experience of harmony. This study focuses on chord spacing choices in Carter's Fifth String Quartet, with emphasis on the *Adagio sereno* and *Capriccioso* movements. In both movements, as well as in the entire piece, Carter chooses to emphasize relatively balanced pitch distribution and balanced chord spacing. More specifically, although extremes in spacing choices add occasional drama to the musical narrative, balance is maintained by complementary extremes which restore overall equilibrium.

The Fifth Quartet is the first of many works in Carter's "late-late style."[1] In this period, Carter's music began to assume a leaner style, contrapuntally, harmonically, and eventually, rhythmically. Carter seems not to have used registral all-interval twelve-note chords in the Fifth Quartet,[2] choosing instead to rely on a "core" collection of harmonies consisting of the two all-interval tetrachords[3] and the all-trichord hexachord.[4] This limited harmonic palette is supplemented with unions of the core harmony set-classes. John Link has studied these secondary chords, and uses the name "derived core" to refer to set-classes of cardinalities 5 through 8 generated by unions of the "core" harmonies.[5] Derived core harmonies appear in the Fifth Quartet as both melodic and harmonic pitch-class material.

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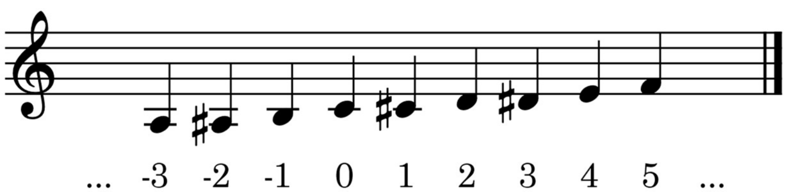
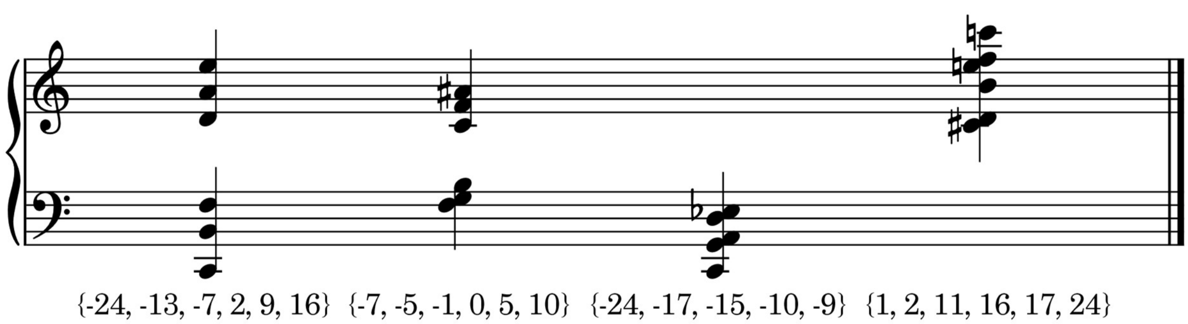
[1] David Schiff, *The Music of Elliott Carter*, Second edition (Ithaca: Cornell University Press, 1998), 92.
[2] Emmery, 233-234.
[3] The all-interval tetrachords are set-classes [0146] and [0137] (18 and 23 in Carter's list of tetrachords in the *Harmony Book*). These set-classes are Z-related and have an interval-class vector of [111111], which means that each interval-class occurs exactly once in any of the 48 pcsets in the two set-classes. They are the only tetrachords with this property, and have direct implications for chord spacing, as is discussed later.
[4] The all-trichord hexachord is set-class [012478], or 35 in Carter's list of hexachords in the *Harmony Book*. It contains all twelve trichordal set-classes as abstract subsets, a property found in no other hexachord. Some of the trichords appear once (such as [012]), while others appear more than once ([016] is found five times). This contrasts with the AITs, which contain each interval-class exactly once.
[5] John Link, "Harmony in Elliott Carter's Late Music," *Music Theory Online* 25:1 (April 2019). Link lists a table of derived core harmonies from pentachords to octochords, although nonachords and decachords are also possible using the same generating process.

Previous Theoretical Work

Chord spacing, as mentioned previously, depends on the realization of Carter’s harmonic material as specific pitches. Foundational analytical concepts regarding pitch and spacing can be found in the work of Robert D. Morris.[6] He identifies pitches with integers in what he calls *pitch-space* (shown in Example 1), where 0 is C4, positive integers represent pitches above C4 (measured in semitones), and negative integers represent pitches below C4 (also measured in semitones). When pitches are grouped into melodies or harmonies, these can be represented by mathematical sets of pitches, called *pitch sets*[7] (shown in Example 2). Morris groups pitch sets into equivalence classes by transposition (but not inversion), called *pitch set-classes*[8] (shown in Example 3). A pitch set-class (or PSC) is identified by its *spacing*,[9] a list of adjacent pitch intervals from low to high. All the pitch sets in Example 3 belong to the pitch set-class [6, 9, 7, 3]. For simplicity, the term “chords” will often be used, but it is important to remember that “chord” and “pitch set” mean the same thing in this paper.



EXAMPLE 1. Pitches in pitch space. C4 is represented by 0.



EXAMPLE 2. Pitch sets are sets of pitches (a mathematical abstraction of chords).

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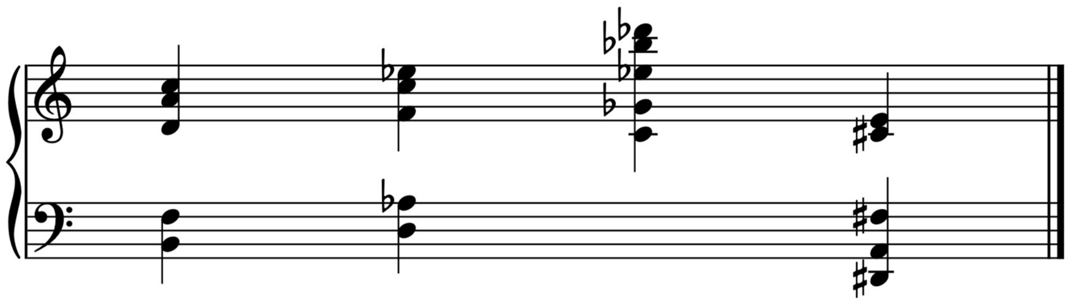
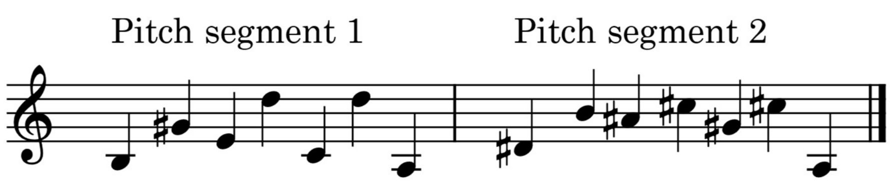
[6] Robert D. Morris, *Composition with Pitch-Classes: A Theory of Compositional Design* (New Haven: Yale University Press, 1987): chapter 2.
[7] These are not the more familiar pitch-class sets; pitch sets are sets of pitches, not pitch-classes. As with pitch-class sets, duplicate pitches are discarded in pitch sets, so the cardinality of a pitch set might be less than the number of notes in the texture.
[8] A more detailed exposition of pitch set theory can be found in Morris, *Composition with Pitch Classes*, chapter 2.
[9] Morris, 54.



EXAMPLE 3. Pitch set-classes group pitch sets that are equivalent by transposition.

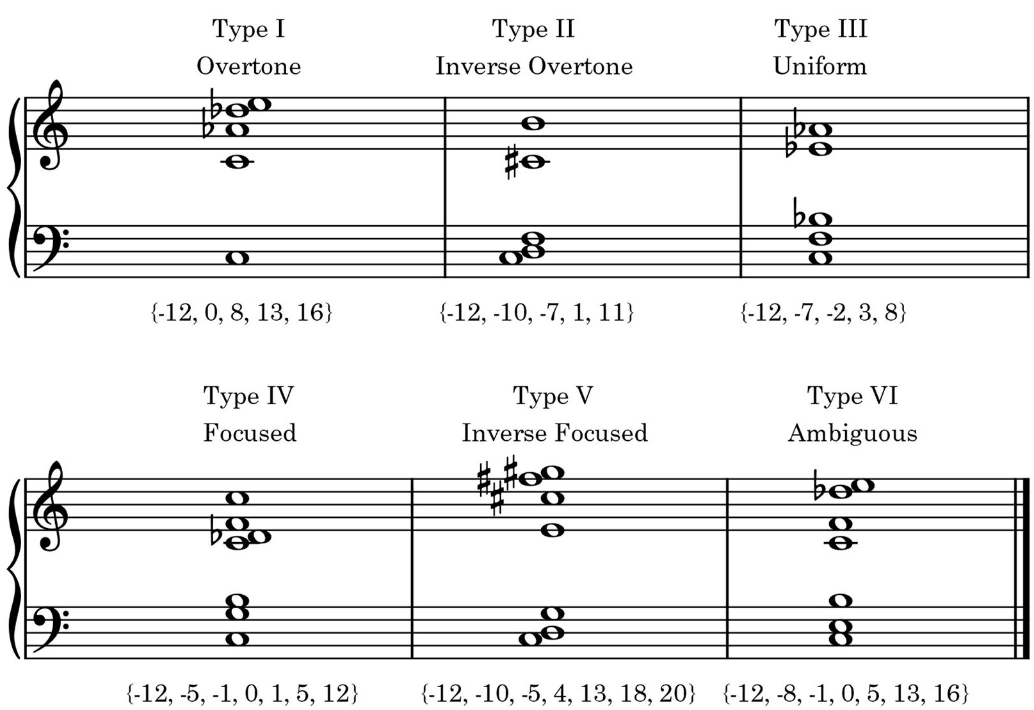
Contour theory offers a more general description of melodic pitch relationships. To form a *contour*, the actual size of pitch intervals is discarded, leaving only whether one pitch is higher than, lower than, or equal to another pitch. For instance, in Example 4, there are two melodies represented as ordered pitch segments. While the intervals between adjacent pitches are different, both pitch segments reduce to the same contour. This demonstrates that they have the same basic shape. Contours are made of “contour pitches,” starting at 0 for the lowest note in the contour and increasing with register.



EXAMPLE 4. A contour shows the registral order of pitches in a pitch segment (or melody). The prefix “ps” means “pitch segment” or “pitch set,” and the prefix “cs” means “contour segment.”

To characterize chord spacing, Morris describes generic *spacing types* of I through VI (Example 5).[10] These spacing types are labeled based on the vertical distribution of pitches in a chord. For example, Type I has the largest interval between adjacent pitches at the bottom, with interval sizes decreasing consistently as the pitches rise in register. This is somewhat like the spacing of the harmonic series, so it is labeled "overtone spacing."

Each of the six spacing types can describe many different chords of varying cardinalities. However, not all spacing types can apply to chords of cardinalities 1 to 3. All chords of cardinalities 1 and 2 could be labeled as Type III, since any two notes are spaced "uniformly." Similarly, chords of cardinality 3 could match types I-III, but not types IV-VI. Chords of cardinality 4 or greater could fit any of the six basic spacing types. The spacing type is a simple and intuitive classification method, but its generality limits the nuance with which individual chord spacings can be compared.

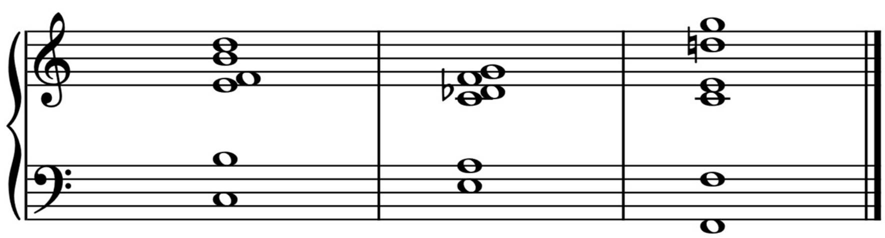


EXAMPLE 5. Morris's six spacing types group chords by the distribution of intervals between adjacent pitches.

[10] Morris, *Composition with Pitch-Classes*, 54.

The Chord Spacing Contour and Chord Spacing Index

To compare chord spacings effectively, a metric needs to be sufficiently general to catch many similarly spaced chords. It must also be precise enough to allow a clear description of the spacing. The three pitch sets in Example 6 are spaced similarly, even though they belong to different pitch set-classes. They fall into spacing type VI (“ambiguous”). Contour theory can be applied to the spacing intervals of a pitch set to capture this similarity. A *chord spacing contour* takes the spacing used to define a pitch set-class and converts it to a contour. These three pitch sets, although defined as “ambiguous” by Morris’s six spacing types, reduce to the same spacing contour, <4, 2, 0, 3, 1>. The spacing contour clearly indicates the relative sizes of pitch intervals in the spacing of a pitch set. Happily, it also significantly reduces the number of spacings that need to be considered in Carter’s Fifth Quartet. There are 3,139 unique pitch sets and 1,581 unique pitch set-classes in the quartet. There are only 296 unique spacing contours. Of these 296, only 71 appear with a cumulative (summed) duration of 1 second or greater in the entire quartet.



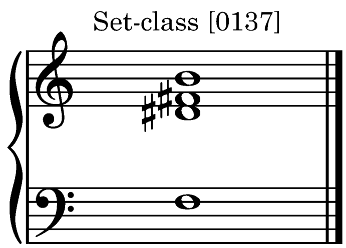
ps{-12, -1, 4, 5, 11, 14}	ps{-8, -3, 0, 1, 5, 7}	ps{-19, -7, 0, 4, 14, 19}
PSC[11, 5, 1, 6, 3]	PSC[5, 3, 1, 4, 2]	PSC[12, 7, 4, 10, 5]
csc<4, 2, 0, 3, 1>	csc<4, 2, 0, 3, 1>	csc<4, 2, 0, 3, 1>

EXAMPLE 6. The chord spacing contour applies contour theory to the intervals between adjacent notes in a chord. Here, all three chords have the same spacing contour despite belonging to different pitch set-classes. The prefix “PSC” means “pitch set-class,” and the prefix “csc” means “chord spacing contour.”

The spacing contour has several key features. First, since this is a contour of intervals rather than a contour of pitches, its elements are “contour intervals” rather than “contour pitches.” Second, sometimes it makes sense to label a rest as a “null” chord (of cardinality 0).[11] This null chord, as well as “chords” with just one note, has a null spacing contour shown with empty angle brackets. Finally, the spacing contour is affected by the interval-class vector of a

[11] This is done when considering computational features, such as how often a particular chord spacing occurs over the entire Fifth Quartet. The program needs to do something with these two chord types, and it is useful to compare chords with no spacing to chords with particular spacings.

pitch-class set. For example, the chord in Example 7 comes from measure 110 of the Quartet, and is a member of set-class [0137]. Its spacing contour has no duplicate intervals. In fact, since this is an all-interval tetrachord, and its interval-class vector is [111111], it is impossible to revoice this chord to produce duplicate spacing intervals.



ps{-7, 3, 6, 11}
PSC[10, 3, 5]
csc<2, 0, 1>

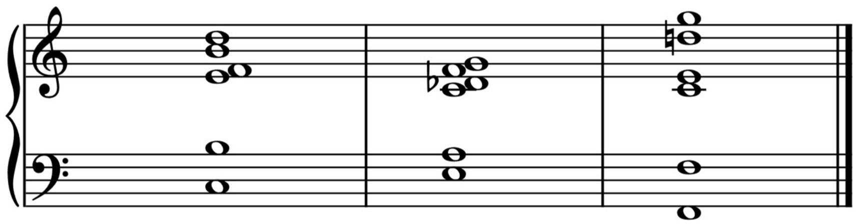
EXAMPLE 7. This chord from measure 110 has a spacing contour with no duplicate intervals.

Not all chord spacings are equally important. If a spacing occurs often, it is prominent simply due to its frequency. The *spacing frequency* is the number of occurrences of that spacing within a specified phrase, section, or the entire piece.[12] A chord (and therefore, its spacing) can also be prominent simply because it is sustained for a long time. The sum of the durations of all occurrences of a chord spacing is called the *cumulative duration*.

Like any simplified representation of a chord, the spacing contour discards information, some of which might be useful. The three chords in Example 6 have the same spacing contour, but the notes in the second and third chords are distributed more evenly in register than in the first chord. The *chord spacing index* (CSI) captures this difference in registral distribution (Example 8). The chord spacing index averages the pitches in the chord, then adjusts this average to produce only values between 0 and 1. The formula for the spacing index for chord Q depends on three parameters. First, μ_Q is the mean of the pitch integers in Q. Second, $p_{l,Q}$ is the lowest pitch in Q. Third, $p_{h,Q}$ is the highest pitch in Q. The formula for the spacing index i_Q is as follows:

$$i_Q = \frac{\mu_Q - p_{l,Q}}{p_{h,Q} - p_{l,Q}}$$

[12] This is labeled “spacing” frequency to avoid confusion with the much more common use of “frequency” to indicate the number of cycles per second in a sine tone.



ps{-12, -1, 4, 5, 11, 14}	ps{-8, -3, 0, 1, 5, 7}	ps{-19, -7, 0, 4, 14, 19}
PSC[11, 5, 1, 6, 3]	PSC[5, 3, 1, 4, 2]	PSC[12, 7, 4, 10, 5]
csc<4, 2, 0, 3, 1>	csc<4, 2, 0, 3, 1>	csc<4, 2, 0, 3, 1>
CSI: 0.596	CSI: 0.556	CSI: 0.548

EXAMPLE 8. The chord spacing index provides additional detail about the distribution of pitches in a chord.

Chords that are evenly spaced have a spacing index of 0.5. Chords with pitches tending toward the registral bottom of the chord have lower spacing indices, and chords with pitches tending toward the registral top of the chord have higher spacing indices. Example 8 shows the three chords with the same spacing contour from Example 6, along with the CSI values. The CSI values for these three chords demonstrate the difference in spacing between chords 2 and 3, and chord 1. Finally, it is important to note that a CSI of 0 or 1 cannot exist, since the notes in a chord cannot be only at the top or bottom of the chord's spacing. Also, if a chord has only one note (or is a "null" chord), the interval between its top and bottom notes is 0, so the CSI is undefined. The CSI for a two-note chord is always 0.5.

Three of the spacing types in Example 5 have even pitch distribution about an imaginary central axis. Chords with these spacing types have a CSI of 0.5 and an inherent element of registral "balance." Furthermore, if the mean CSI of each movement tends toward the same value, the chord spacing of the entire piece is balanced. While Carter's Fifth Quartet contrasts sharply with music from the eighteenth century in harmony, form, and use of rhythm, the shared value of balance provides a common thread that links both styles together. Balance was a key virtue of sonata form in the Classical era, as noted by James Hepokoski and Warren Darcy. In *Elements of Sonata Theory*, they write,

> Sonata form emphasized short-range topical flexibility, grace, and forward-driving dynamism combined — in both the short and long range — with balance, symmetry, closure, and the rational resolution of tensions.[13]

Later, in a discussion of repeats in sonata form, they observed,

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[13] James Hepokoski and Warren Darcy, *Elements of Sonata Theory: Norms, Types, and Deformations in the Late-Eighteenth-Century Sonata* (Oxford: Oxford University Press, 2006): 15.

> Central to the concept of the grand sonata or symphony is a system of schematic repeat-conventions, balances, symmetries and proportions that call attention to and help to define the genre.[14]

Carter's Fifth Quartet does not use repeats or sonata structure. However, it does make significant use of balance in chord spacing.

Salami Slice Analysis

This analytical work is based on a computational study of the score, using a program written in Python and the music21 library.[15] The program is a "salami slice" analyzer,[16] considering each unique collection of pitches that sound at the same time as a distinct chord (or "slice"). It extracts twenty-three features for each slice, shown in Table 1. The analyzer assumes a machine-like performance, where each note is played for the exact duration corresponding to its notated length and the prevailing tempo.

The Fifth Quartet

Carter wrote that the Fifth Quartet is based on the chamber music rehearsal process, where performers "try out fragments of what they later will play in the ensemble."[17] This fragmentation is realized in the structure of the piece, which is divided into twelve movements rather than the traditional three or four. The odd-numbered movements (except movement 1) are designated "Interlude" and contain material that "has been played and…will be played."[18] The even-numbered movements consist of four fast movements (*Giocoso, Presto scorrevole, Allegro energico,* and *Capriccioso*) and two slow movements (*Lento espressivo* and *Adagio sereno*). This analysis singles out movements 10 (*Adagio sereno*) and 12 (*Capriccioso*) for special consideration.

Most movements of the Fifth Quartet have a clear registral climax. The graph in Figure 1 plots unique pitch onsets for the entire piece, as a function of time. The *Introduction* peaks at m. 20, with A♭7 in Violin 1, the highest pitch in the piece. This is also the first climax of the quartet, and this pitch occurs five times over the course of the entire piece. The registral climax of the Fifth Quartet is found in the longest movement, *Adagio sereno* (movement 10), which consists almost entirely of natural harmonics. It is clearly visible on this graph because the lower register is mostly absent. The climax is achieved by using A♭7 twice and by eliminating the lower registers. Until the last few measures of the movement, no pitches are used below C4.

[14] Hepokoski and Darcy, 21.
[15] The repository is available at https://github.com/fleximeter/analyzer.
[16] Christopher W. M. White and Ian Quinn, "The Yale-Classical Archives Corpus," *Empirical Musicology Review* 11, no. 1 (2016): 51.
[17] Elliott Carter, *String Quartet No. 5* (New York: Hendon Music, 1995): iii.
[18] Carter, iii.

Feature name	**Feature description**
Measure no.	The measure number in which the slice began
Start time (seconds)	The onset time, in seconds, from the beginning of the piece
Duration (seconds)	The duration of the slice, in seconds
IOI (interonset interval)	The interonset interval of the slice, in seconds
Quarter length	The duration of the slice, in quarter notes
Chord multiset cardinality	The number of notes in the slice, including duplicate pitches
Chord cardinality (positive space, Burt 2012)	The number of unique pitches in the slice
Match between chord cardinality and chord multiset cardinality (T/F)	Whether or not the chord cardinality and chord multiset cardinality features are identical (flags the presence of duplicate pitches)
Negative space (Burt 2012)	The number of registral half-step slots that are not filled in by a pitch in the slice. Only applicable if no notes are sounding.
Upper negative space (Burt 2012)	The space between the highest pitch in the chord and the highest pitch in the piece (or movement)
Internal negative space (Burt 2012)	The empty space between the highest and lowest pitches in the chord
Lower negative space (Burt 2012)	The space between the lowest pitch in the chord and the lowest pitch in the piece (or movement)
Median trajectory (Burt 2012)	The relationship between the registral center of the chord and the registral center of the piece
Morris pitch-class set name (Morris 1987)	The combined Forte and prime-form names of the pitch-class set-class
Carter chord number (Carter 2002)	Carter’s chord number
Core harmony (T/F) (Link 2019)	Whether or not the harmony is a “core” harmony
Derived core harmony (T/F) (Link 2019)	Whether or not the harmony is a “derived core” harmony
Derived core associated Carter chords (Link 2019)	The Carter chord numbers that were combined to produce a derived core harmony
Pitch-class set	The pitch-class set
Pitch set (Morris 1987)	The pitch set
Pitch set-class (Morris 1987)	The pitch set-class
Chord spacing contour	The chord spacing contour (CSC)
Chord spacing index	The chord spacing index (CSI)

TABLE 1. The 23 features extracted by the salami slice analyzer.

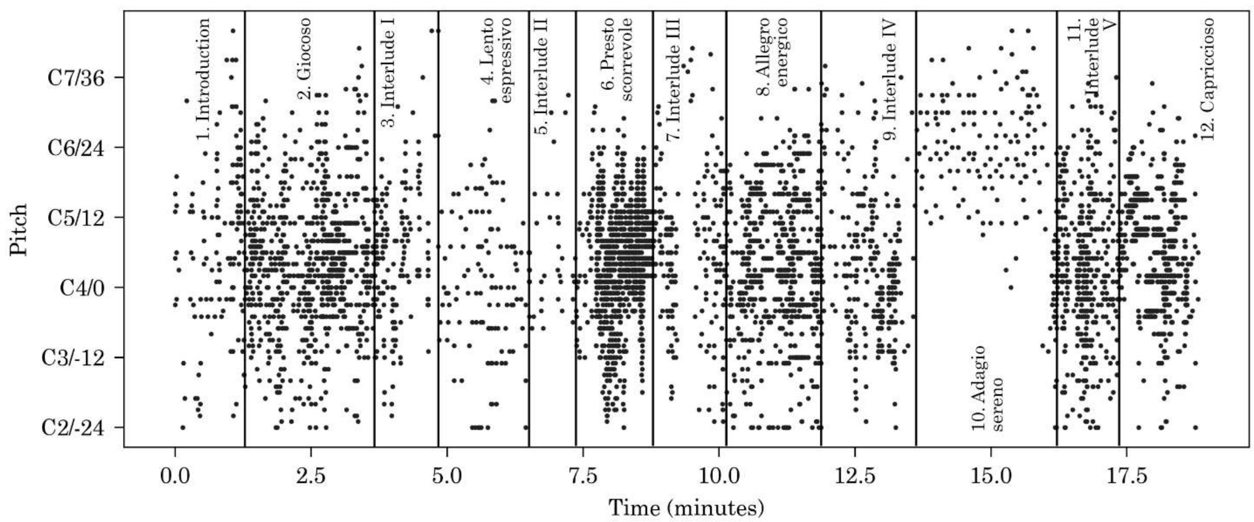

FIGURE 1. Pitch onsets in Elliott Carter's *String Quartet No. 5*.

Formal climaxes are also achieved by introducing chords with higher cardinalities to the texture. Figure 2 is a chord cardinality graph for the Fifth Quartet, and Table 2 shows the average chord cardinality values for each movement. When considering the average chord cardinality for each movement, several trends become clear. First, the interludes have considerably sparser average chord cardinality than the other movements. Second, the interludes become progressively denser as the quartet progresses, which complements their discursive nature. Third, the densest movements are the two slow movements, the *Lento espressivo* and the *Adagio sereno*; the latter is denser than any other movement, which befits its position as the registral climax of the Fifth Quartet.

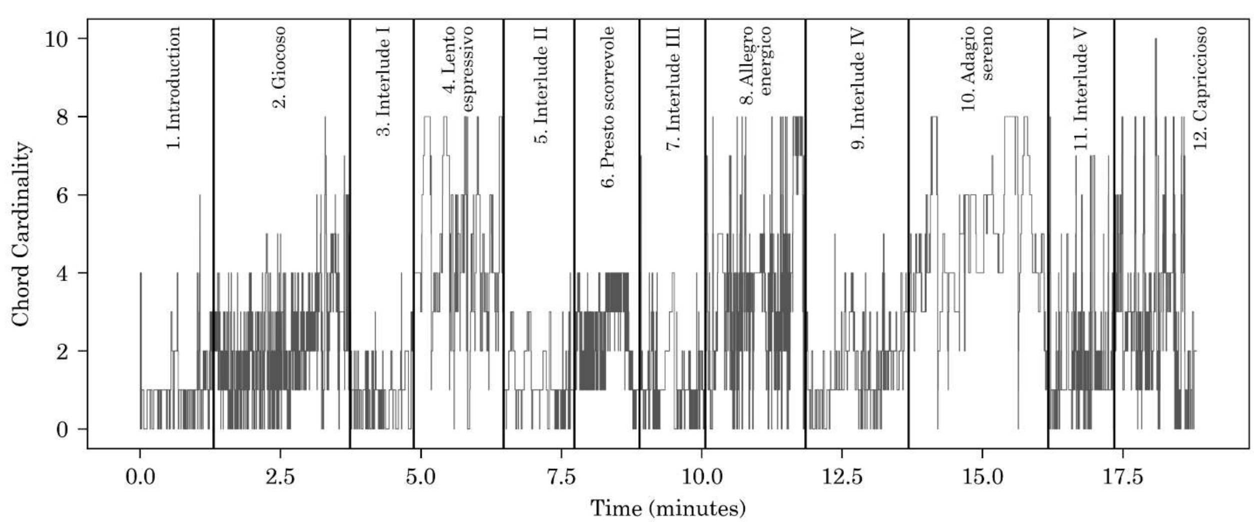

FIGURE 2. Chord cardinality in Elliott Carter's *String Quartet No. 5*.

Section	**Avg. chord cardinality**
Full piece	2.541
1. *Introduction*	0.778
2. *Giocoso*	2.075
3. *Interlude I*	0.891
4. *Lento espressivo*	4.371
5. *Interlude II*	0.949
6. *Presto scorrevole*	2.492
7. *Interlude III*	1.285
8. *Allegro energico*	3.778
9. *Interlude IV*	1.430
10. *Adagio sereno*	4.924
11. *Interlude V*	1.649
12. *Capriccioso*	3.041

TABLE 2. Average chord cardinality for the Fifth Quartet and for each movement.

Table 3 shows the ten most common chord spacing contours in the Fifth Quartet. The most common contour is the null contour, which occurs when all voices are resting, or if only one pitch is sounding. The second most common contour consists only of the contour interval 0. It applies to all pitch dyads. The prominence of these two contours are a nod to the frequently sparse texture in the quartet. The eight other contours in this table are nonduplicative two- and three-interval contours, describing three and four-note chords respectively. This is at least in part because the most common harmonic tetrachords in the quartet are the all-interval tetrachords, which can only be spaced with these six spacing contours unless a note is doubled at the octave. The most common spacings by duration for trichords, tetrachords, and pentachords have the largest interval at the bottom, and contain no duplicate contour intervals, suggesting a kind of Type I (overtone) spacing. Interestingly, the most common tetrachord spacing is the contour <2, 0, 1> rather than <2, 1, 0>. Perhaps Carter found a less regular spacing type to be of greater interest.

Spacing contour	**Spacing frequency**	**Cumulative duration**
<>	1,510	462.778
<0>	1,308	184.405
<1, 0>	606	71.287
<0, 1>	485	55.253
<2, 0, 1>	188	38.833
<2, 1, 0>	167	28.196
<1, 2, 0>	180	26.270
<1, 0, 2>	143	20.707
<0, 2, 1>	116	16.022
<0, 1, 2>	116	12.298

TABLE 3. Ten most common spacing contours in the Fifth Quartet.

Table 4 shows the average chord spacing index for the entire piece and for each movement separately. Every movement in the quartet has an average CSI close to 0.5, suggesting that there is a tendency for the pitches in a chord to be distributed in balance about a central axis. The graph in Figure 3 is a step plot of CSI values for the Fifth Quartet. In some regions, CSI values change so quickly and dramatically that the plot line cannot be seen. The graph tells a remarkably different story from the previous table of CSI values. It turns out that CSI values frequently diverge significantly from the mean. The graph shows why the average CSI value for each movement is still near 0.5 – it is because chords with high CSI values are balanced by chords with low CSI values.

Section	**Avg. chord spacing index**
Full piece	0.515
1. *Introduction*	0.498
2. *Giocoso*	0.494
3. *Interlude I*	0.538
4. *Lento espressivo*	0.517
5. *Interlude II*	0.517
6. *Presto scorrevole*	0.510
7. *Interlude III*	0.526
8. *Allegro energico*	0.528
9. *Interlude IV*	0.535
10. *Adagio sereno*	0.514
11. *Interlude V*	0.491
12. *Capriccioso*	0.517

TABLE 4. Average chord spacing index for the Fifth Quartet and for each movement.

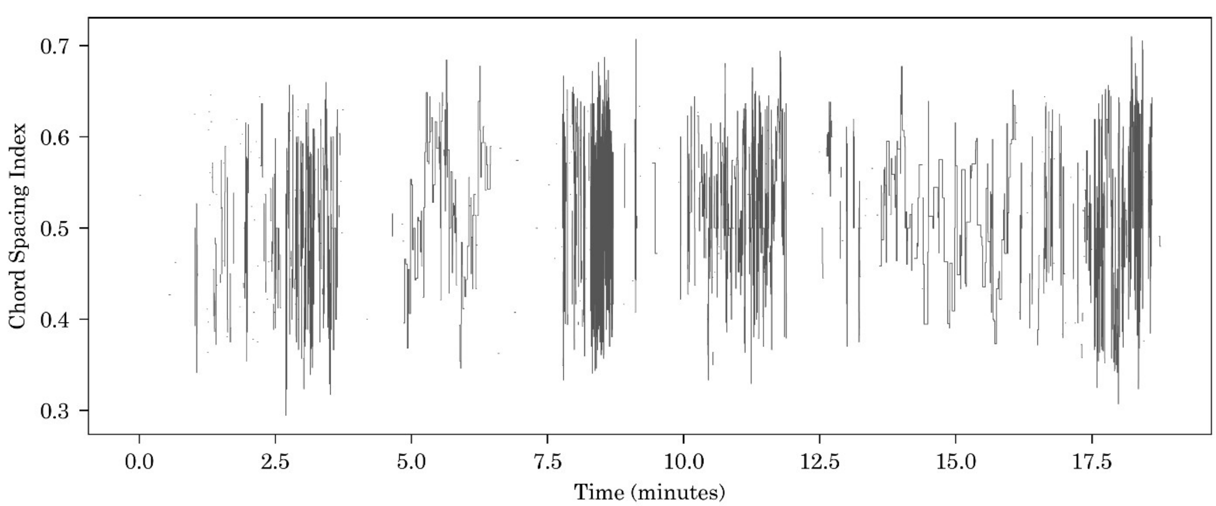

FIGURE 3. Chord spacing indices in Elliott Carter's *String Quartet No. 5*.

Movement 10: *Adagio sereno*

The *Adagio sereno* is strikingly unlike any other movement in the Quartet. While the *Lento espressivo* is also slow, the *Adagio sereno* is longer, denser, has an even lower notated tempo, and is positioned in the registral stratosphere. As in the *Lento espressivo*, core and derived core set-classes account for most of the vertical sonorities. The registral peculiarity of the *Adagio sereno* exists because of Carter's heavy reliance on natural harmonics. Carter could have paired the use of harmonics with a disproportionate emphasis on Type I spacing in the classic "overtone" sense, but he did not do so. In fact, the *Adagio sereno* has lower CSI (0.514) than the three movements that immediately precede it.

The ten most prominent spacing contours by cumulative duration are shown in Table 5. Again, <2, 0, 1> is the most common contour for tetrachords, and in this case is the most common contour in the movement. This suggests that the all-interval tetrachords may be the most prominent harmonic set-class in the *Adagio sereno*, which is confirmed by Table 6.

From a study of the *Adagio sereno*, several conclusions can be drawn. First, the exclusive use of harmonics upsets the registral balance of pitch in the Quartet, without producing a comparable change in the average CSI. Second, spacing is closely tied to the harmonic palette of movement 10. Finally, Carter is quite successful at integrating his harmonic practice with a significant textural restriction. By using only natural harmonics, he placed a significant limitation on the pitches available for realizing his preferred core and derived core harmonies. The *Adagio sereno* features balanced chord spacing despite this restriction.

Spacing contour	**Spacing frequency**	**Cumulative duration**
<2, 0, 1>	16	10.698
<0>	25	10.354
<1, 0>	13	9.708
<2, 1, 0>	5	9.271
<1, 2, 0>	10	8.385

Spacing contour	**Spacing frequency**	**Cumulative duration**
<1, 0, 2>	2	6.875
<3, 0, 1, 2>	4	5
<2, 0, 1, 0, 2>	1	4.458
<3, 0, 2, 1, 2>	1	4.125
<>	9	3.958

TABLE 5. Ten most prominent spacing contours in movement 10, *Adagio sereno*.

Set-class	Set-class frequency	Cumulative duration
[0146]	10	15.427
[0137]	8	10.573
[012478]	4	8.604
[01367]	4	7.542
[026]	6	5.042

Set-class	Set-class frequency	Cumulative duration
[0147]	4	4.479
[013467]	1	4.458
[012467]	2	4.25
[01458]	1	4.042
[01257]	1	3.854

TABLE 6. Ten most common salami-slice set-classes in movement 10, *Adagio sereno*.

Movement 12: *Capriccioso*

The *Capriccioso*, like the *Adagio sereno*, uses one timbre – pizzicato – until the final measures. This poses a unique problem for studying chord spacing. Until now, the assumption was made that all notes ring for their notated duration with equal volume. But pizzicato has no sustain in its sonic envelope. As usual, this movement is filled with surface polyrhythms, meaning that often none of the instruments are attacking a note or multiple stop at the same time.

The problem of what does and does not constitute a chord in the *Capriccioso* can be addressed by creating a harmonic reduction. Example 9 shows measures 317 and 318 of the Fifth Quartet, and Example 10 shows a reduction of the entire movement. In measure 318, repeated pitches were collapsed into a single chord. The same is done in the next measure. However, the sparse pitches in the violin parts appear more contrapuntal than harmonic in nature, so they were not included. Unfortunately, while this is helpful for showing harmony in the *Capriccioso*, there is very little chord or contour duplication in the reduction.

CSI values can still be considered, though. The computed CSI of the *Capriccioso* is 0.517, while the reduction has an average CSI of 0.537. The contrapuntal activity in this movement is largely responsible for this discrepancy, and unsurprisingly, the reduction's average CSI is compatible with the average CSI values of the other movements.

Ultimately, the most interesting chord spacing features of the *Capriccioso* are individual moments. In measure 321, there is a climactic twelve-note chord (with sixteen pitches, four of which are duplicates). It has similar spacing to Type IV (focused) spacing. Its spacing is intriguing – it contains two pairs of notes a semitone apart, and a pair of notes a whole step apart. The incidence of semitones and whole steps is not uncommon in this reduction; it is particularly noticeable in mm. 309-321, and less so thereafter. Finally, the reduced chord of m. 330 is relatively evenly spaced, a good choice for the penultimate measure in the quartet, as it reinforces the importance of balance in chord spacing throughout the work.

EXAMPLE 9. Measures 317-318 of the Fifth Quartet.

EXAMPLE 10. Reduction of movement 12, *Capriccioso*.

Conclusion

A comprehensive study of the Fifth Quartet reveals that Carter aims at balance in the distribution of chord spacing at the global level, which plays a large role in maintaining overall aural cohesion in this piece. The focus on balance is rendered especially clear in the slow movements, such as the *Adagio sereno*, where chords are often sustained for relatively long durations. Balance is present in the fast, highly contrapuntal movements as well, including the final *Capriccioso*, as each movement trends closely toward an average CSI of 0.5. In the *Adagio sereno*, spacing contour choices are sometimes tightly constrained by harmony (for example, the requirement that AITs have no duplicate spacing intervals when realized as four-note chords). By contrast, the prolongational reduction of the *Capriccioso* does not emphasize any particular spacing contour, but does bring large chords into focus, particularly the twelve-note chord in m. 321.

Additional study in chord spacing would be highly instructive for Carter's earlier music. Spacing might reveal orchestration trends in the concertos and other large ensemble works. Particularly interesting would be a study of the music of the 1970s and 1980s, where registral twelve-note chords formed an essential part of Carter's compositional vocabulary.

The trends in chord spacing in the Fifth Quartet likely owe much to subconscious choices made during the compositional process, so it is possible that the global balance found in chord spacing would be complemented by other musical parameters in a meaningful way, such as the use of variety in dynamics and rhythm. It is also possible that similar use of balanced spacing is present in the work of other composers, including in the music of earlier eras. While Carter's style is distinctly his own, it can still be compared to that of earlier composers such as J. S. Bach and Mozart, whose music is far-removed on the surface from the chaotic atonal sound-world of the Fifth Quartet, yet has a similar concern for structure, harmony, and counterpoint.

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