

Ligeti's Distant Resonances with Spectralism

Benjamin Levy

Abstract:

This chapter examines the relationships between György Ligeti and spectralism, both in terms of a similar repertoire of compositional techniques (including the use of interpolations, difference tones, and instrumental synthesis) and in terms of a more general aesthetic outlook or attitude.

Many spectralists, including Gérard Grisey, Tristan Murail, Horațiu Rădulescu, Kaija Saariaho, and Claude Vivier, have acknowledged varying degrees of influence from or respect for Ligeti, but also take care to differentiate their own works from his precedent. Conversely, in his later career, Ligeti found ways of expressing both admiration for and independence from spectralism.

A comparative examination of these composers' prose writings and musical compositions reveals some connections that are deeper, and others which are more superficial. Moreover, looking at these composers' statements in their historical context can illuminate the political, artistic, and pragmatic reasons for their rhetorical positions. In the end, the ways in which both Ligeti and the spectral composers responded to ideas of "distance"—in the acoustic imitation of echoes and reverberations, but also the experience of geographical, cultural, and emotional distances common to their historical moment—form their most enduring connections.

Keywords: György Ligeti, Gérard Grisey, Tristan Murail, Horațiu Rădulescu, Kaija Saariaho, Claude Vivier, distance, interpolation, difference tones, instrumental synthesis

Positioning Ligeti and Spectralism

György Ligeti has often been seen as a forerunner to spectralism and an influence on composers including Gérard Grisey, Tristan Murail, Horațiu Rădulescu, Kaija Saariaho, and Claude Vivier, to mention only a few. Ligeti figures into comments that these composers have made about their influences and aesthetics, and similarly, Ligeti's writings about his own works seem to resonate with foundational ideas in this movement. Blurring the lines between harmony and timbre, emphasizing gradual transformations of material, and delving into the inner workings of sound—all of these are characteristic of both Ligeti and the composers associated with the spectral school and are at the source of many of their connections. For Grisey, the sense of dilated time found in works like *Lontano* and *Clocks and Clouds* elevated Ligeti into the holy trinity of influential predecessors—the holy spirit, next to Messiaen the father, and Stockhausen, the son.¹ Pierre-Albert Castenet refers to him as one of the “three ‘ees’” along with Claude Debussy and Giacinto Scelsi;² and Julian Anderson, in his “A Provisional History of Spectral Music,” makes the claim for the extended reach of his influence, saying that Ligeti’s “preoccupation with slow rates of change and dense, continuously evolving textures... had an obvious effect not merely on Grisey and Murail but later on the music of Kaija Saariaho as well.”³

Ligeti and the spectral composers operated in a shared compositional space bounded by what can be seen as three common artistic orientations: formative experiences with electronic music (and through these a greater appreciation of acoustics), the desire to set themselves apart from integral serialism, and, more broadly, a strong interest in musical systems that fall outside the Western classical tradition. Triangulating between these electroacoustic, post-serial, and non-Western influences, it is not surprising that they share certain features. By looking at comments these composers have made about each other and through the comparative analysis of some of

their respective works, this chapter looks at the basis for the connection between Ligeti and spectralism, and also investigates its limits.

Coming to prominence in the shadow of serial composition and its luminaries, such as Karlheinz Stockhausen and Pierre Boulez, Ligeti and the spectral composers adopt similar strategies to differentiate themselves from the perceived establishment in new music. They intertwine musical and political reasoning in ways that follow Theodor Adorno's "The Aging of the New Music" and Cornelius Cardew's "Stockhausen Serves Imperialism," to name just two of the more polemic examples.⁴ In his "Decision and Automatism in Structure Ia," for instance, Ligeti's questions about integral-serial procedures in Boulez's piece originate in musical features but quickly extend to more philosophical points. Many of these complaints have to do with the perceptibility of the work's serial structure and its treatment of musical parameters, both individually and in combination. Dynamics, for example, are more likely to be perceived as general areas rather than fixed values and to be understood in relation to their surrounding context; thus the ability to discern and identify twelve distinct and consistent dynamic levels becomes highly problematic. Dynamics are also related to the perception of timbral features, for example, Boulez's attack characteristics. Moreover, register affects how both dynamics and accent are heard. Ligeti observes, then, that timbre is not truly an independent domain, but depends on interrelationships with other parameters, and cannot be treated in a parallel way with pitch or duration—a transplantation he considers arbitrary and "pointless."⁵

While these observations may seem to be a simple matter of artistic difference, Ligeti often couches them in much stronger language. While he is careful not to make wholesale equivalencies, he does discuss these issues in terms of freedom and control, comparing the compositional situation to a self-constructed prison or a neurosis, and questioning the degree to

which automatic processes are chosen for their rigid internal consistency rather than for their audible result.⁶ Slavish submission to the arbitrary strictures of a system is characterized even more starkly in “Metamorphoses of Musical Form” in which Ligeti describes “the fetish of total integration” leading to “an imitative academicism that is certainly no better than the traditional sort.”⁷ While he spares the leading figures from this direct criticism, Ligeti paints integral serialism as a whole as driven by dogma at the expense of perceptual concerns. This maps onto Ligeti’s descriptions of interpersonal politics within this circle of composers. In later reflections, Ligeti moves freely from discussing musical ideologies to characterizations of individual personalities and their actions. For example, in an extended talk about Darmstadt with Eckhard Roelcke, he slips from the artistic to the political, describing Heinz-Klaus Metzger’s attack on Luigi Nono as “pure political propaganda” and Stockhausen’s treatment of Cardew as an act of “colonialism.”⁸

Such charged discourse around artistic innovations goes a degree farther with early texts by many of the spectralists. Eric Drott has observed how these writings mix objective, scientific, or academic language describing and legitimizing their compositional aesthetic with more impassioned exhortations that read as manifestos and have political undercurrents, recalling the language of new social movements following the upheavals of 1968. In doing so, they adopt anti-authoritarian stances, rejecting the reification of societal categories and pushing for a renegotiated and more fluid status for the individual within the collective.⁹ Particularly important to this line of argument is the notion that the separate parameters of pitch, rhythm, dynamics, and timbre, so rigidly defined within the integral serial mindset, were false—disproven by research into acoustics and, moreover, suspect in their reflection of values taken from one leading parameter (pitch) and forcibly ascribed to others, almost as an act of violence.

G rard Grisey’s early formulations of spectral music often rely on undercutting the separation of fixed parameters exemplified by integral serialism. In his “La Musique: le devenir des sons,” he outlines his conception of a new music that is differential, liminal, and transitory, stating that the “main contribution” of this position “consists of the liquidation of fixed categories in favor of Synthesis and Interactivity on the one hand, and in approaching an optimal balance between the Conceptual and Perceptual on the other.”¹⁰ As Grisey delves into the implications of his approach, he frequently pivots from purely acoustic features to politicized characterizations of the ideologies involved. The differential nature of sound, for example, demands that one respect “the different ‘races and ethnicities’ of sound,” and as such, Grisey argues, his approach opposes the hierarchies of “tonal and neo-tonal colonialism” on the one side, and resists the false egalitarianism of “serial and post serial leveling,” on the other, since this threatens to eliminate difference altogether.¹¹ Later in this essay, while explaining how a liminal music would take advantage of ambiguities between traditional categories, Grisey attacks serialism again, stating very directly that research on psychoacoustic thresholds “reveals such a network of correlations that the very notion of parameters as defined and isolated by serial music seems obsolete and unable to account for sonic phenomena.”¹² In his 1998 essay, “Did You Say Spectral?,” Grisey posits the “integration of all sounds,” and particularly “the integration of harmony and timbre within a single entity,” as some of the compelling consequences of the spectral approach.¹³ Here, either consciously or not, he echoes Ligeti’s description of *Lontano*, in which, according to the composer, “the quality of tone color switches over to the quality of harmony, and harmonic-polyphonic metamorphoses gain the appearance of tone-color transformations.”¹⁴ Both composers, then, cite issues of perception as reasons to reject integral serialism as unnatural, and in response both place similar importance on timbre as the source of

diversity, fluidity, and progressive innovation in their music and of radical nonconformance in their greater artistic personae.

When differentiating themselves from serial composition, their rhetorical devices are similar, but as they come into increasing contact, Ligeti and the spectralists begin to forge new narratives to maintain distinction from one another. Grisey and Rădulescu had relatively direct contact with Ligeti, attending his Darmstadt seminars, but even the composers who did not still tend to position themselves with respect to his music, and to do so in specific ways. Kaija Saariaho's works from the 1980s, stemming from her time in Paris and early experiences at IRCAM, seem to stand out as the ones most closely tied to the main current of spectralism and also those in which the influence of Ligeti is most pronounced.¹⁵ In an interview with Ivanka Stoianova, Saariaho says, "Of course during a certain period I liked Ligeti very much: I only later discovered that he had done a lot in the direction in which I wanted to go myself."¹⁶ Her statement contains two points that are common to many of these composers' narratives concerning Ligeti: that she discovered their commonality only indirectly or in retrospect, and that she went further in this particular direction.

Horațiu Rădulescu's interview with Bob Gilmore is even more telling in this regard. In it he brings up Ligeti on several occasions, simultaneously appealing to him as an authority while also separating his work from truly spectral practices. Rădulescu emphasizes Ligeti's approval of his own String Quartet no. 4, but he is quick to add that the older composer "never knew exactly the spectral technique, I think."¹⁷ At a later point in the interview, Rădulescu recalls his reply to a comment from Harry Halbreich that "Schoenberg is your grandfather, and Scelsi your father." Rădulescu answered, in his charming turn of phrase, "It's true. And maybe an uncle is Ligeti."¹⁸ In his assessment, then, Rădulescu acknowledges Ligeti, but places him outside the direct lineage

of the spectral school, and seems to exclude his membership based on a lack of knowledge of the essential techniques or particular tools of the trade.

In several of his articles and lectures, Tristan Murail posits Ligeti as a direct influence on Grisey—a precedent for the formal smoothness of *Jour contre-jour* and for the transformation of complex textural states in *Modulations*, discussed below.¹⁹ More often, however, Murail pairs Ligeti with Scelsi as precursors who intuitively appreciated the “decomposition” of sounds into a close scrutiny of their component parts. One can see how the division between spectral attitude and technique runs through these narratives. While Rădulescu seemed to exclude Ligeti based on technique, Murail actually downplays this when compared to having the right outlook:

The connection... lies in this attitude, more than in a comparable style or aesthetic; the compositional techniques are completely different, except for a few superficial similarities (microtones, attention to dynamics, continuous processes). But this attitude... is crucially important. It is a complete change of viewpoint, a wholesale reversal of the western musical tradition, which for centuries has been based on combination and superposition. We no longer seek to com-pose, juxta-pose, or super-pose, but rather to *de-compose*, or even more simply, to *pose* the sonic material.²⁰

Grisey also emphasizes attitude, which for him favors an absolute music, at least when setting forth the orthodox vision of the movement’s aims. Paraphrasing his now-famous formulation, the model for spectral music should be sound itself, not literature, mathematics, or any of the other arts or sciences.²¹ This distinction between attitude and technique is an important framework to examine, and through the analytical examples that follow I will first suggest ways in which similarities between Ligeti’s techniques and spectral ones are more than superficial. Then I will

question the extent of the similarity between Ligeti and the spectralists, both in attitude and in the aesthetic objectives they sought out in their music.

Acoustics, Perception, and Spectral Techniques

Ligeti's work in the electronic music studio of the WDR, and the foundation in acoustics he gained there, provide some initial evidence for the sophistication of his knowledge, going beyond mere intuition. The development of material for his unfinished *Pièce électronique no. 3* is an important case study in this regard. Like Grisey's *Modulations*, the composition is based on harmonic and subharmonic spectra.²² Here, Ligeti worked out the frequencies to divide each of the four octaves between 500 and 8000 hertz into possible arrangements with different numbers of partials. He hoped that arrangements of harmonically related components would lead to the perception of a virtual fundamental and that closely spaced components in the high registers would produce the related psychoacoustic effect of difference tones. He describes his original conception of the piece to Péter Várnai, saying, "My idea was that a sufficient number of overtones without the fundamental would, as a result of their combined acoustic effect, sound the fundamental.... I imagined that slowly, different composite sounds would emerge and slowly fade away again like shadows."²³ In actuality he found that these were more difficult to achieve than he first imagined, requiring more precise control than the equipment in Cologne would allow, but his compositional plan for the work bears out many of these designs.

A sub-group within structure 3 makes a compelling arrangement in which a low pitch sequence could emerge from the succession of harmonic spectra. Ligeti constructs a progression of seven spectra, as shown in [Example 1](#). With some allowance for rounding, these fall very close to the natural overtones of virtual fundamentals between 36 and 100 Hz. The number of partials and their specific frequencies are chosen to fit within the octave between 500 and 1000

Hz, and some of the spectra are minimally distorted (no more than 8 Hz) in order to sustain the 1000-Hz frequency as a common tone across all the spectral chords. With this octave acting as a kind of formant region, the spectra gradually contract, raising the implied fundamental, before relaxing it slightly lower at the end of the sequence.

Insert Example 1. here

From this rather conspicuous attempt to use difference tones, formant regions, and virtual fundamentals, Ligeti moves in a more intuitive direction with his instrumental compositions, yet one can still tell that these were conceived with knowledge of the acoustic effects that he learned in Cologne. Significant passages often involve high, loud clusters in the woodwinds—conditions likely to produce difference tones in the audible range. Consider, for example, one of the most striking passages in the work *Atmosphères*: letter G (m. 40) where a cluster in the piccolos (F7 to G#7) suddenly plummets to the basses, playing a quadruple-forte cluster from C#1 to G#1. In a piece that privileges smooth transitions and gradually evolving sound, it is possible that a low, rumbling difference tone might appear beneath the piccolos, and help prefigure the motion to the basses. In turn, the upper harmonics and surface noise of the basses will reach into the higher registers, each side of this dramatic moment helping actualize the negative space first below, and then above the pitches notated in the score.²⁴ Ligeti also features loud, high-frequency woodwind sounds in the ninth of the *Ten Pieces for Wind Quintet*. In fact, he describes this piece as a conscious attempt to use difference tones, which he had observed in acoustic settings but first came to understand through his work in the electronic studio.²⁵

Another feature of Ligeti's music can be seen in connection to the common spectral technique of interpolation. Joshua Fineberg describes the importance of interpolations in achieving a "smooth transformation from one state to another," remarking that "these are used in almost all aspects of the music, especially pitches and rhythms."²⁶ Saariaho discusses

Example 1. Ligeti, *Pièce électronique no. 3*, harmonic spectra from structure 3

	Spectrum 1	Spectrum 2	Spectrum 3	Spectrum 4	Spectrum 5	Spectrum 6	Spectrum 7
Frequency in Hz	1000	1000	1000	1000	1000	1000	1000
	964						
		958					
			950				
				937			
	928				928		
		917					917
			900			900	
	893						
		875		875			
	857				857		
			850				
		833					833
	821			812			
			800			800	
		791					
	785				785		
	750	750	750	750			750
	714				714		
		708					
			700			700	
				687			
	678						
		667					667
			650				
	643				643		
		625		625			
	607						
			600			600	
		583					583
	571				571		
				562			
			550				
		541					
	535						
Number of partials	14	12	10	8	7	5	6
Implied Fundamental	36 Hz	42 Hz	50 Hz	62 Hz	72 Hz	100 Hz	84 Hz
Approximate Structure	partials 15-28	partials 13-24	partials 11-20	partials 9-16	partials 8-14	partials 6-10	partials 7-12

interpolations extensively in her article “Timbre and Harmony: Interpolations of Timbral Structures,” and her *Vers le blanc* (1982), represented in **Example 2a**, stands out as perhaps the most extreme example of interpolation.²⁷ In this work for tape, the basic pitch structure of the piece is a gradual transition from one three-note chord to another, slowly gliding over the course of fifteen minutes. This motion is coupled with timbral transformations including the establishment of formant regions of different sizes and interpolations between different phoneme models.²⁸ Most approaches to interpolation, however, subdivide such processes into discrete steps, helping execute the transitional process in stages. For example, Fineberg also presents the derivation of harmonies for Section VIII of Murail’s *Désintégrations*, transcribed in **Example 2b**. In the upper system, the treble element begins on the 21st partial of C#1 and moves by quarter tone, while the bass begins on the 3rd partial and moves by half-step, gradually distorting the overall structure. To this framework, Murail adds other notes and even alters the order of the chords, in a process of “permutation, filtering, and complementation.”²⁹

Insert Example 2a. here

Insert Example 2b. here

Insert Example 2c. here

Grisey’s *Modulations* also features interpolated harmonies forming the background of much more complicated textures. In this work, Grisey defines theoretical chord structures based on the spectra of brass mutes. The lower part of **Example 2c** shows the harmonic spectrum of a cup mute and two progressively inharmonic distortions (chords d, d', and d'').³⁰ The upper part of **Example 2c** shows the progression of harmonies found in one of the four instrumental groupings in the score (group A'), from rehearsal number 37 to 39. The interval structure of the initial chord replicates the mute in its original form (chord d), but with the fifth raised by a quarter tone. Through several steps, Grisey arrives at the interval structure of chord d', and by the last chord he

Example 2a. Saariaho, *Vers le blanc*, pitch structure

A single staff of music in bass clef. It shows a pitch structure consisting of a series of notes that rise and then fall. A bracket below the staff indicates a duration of 15'.

Example 2b. Murail, *Désintégrations*, interpolations for section VIII

A grand staff (treble and bass clefs) showing a sequence of notes. The notes are mostly whole notes, with some half notes. The sequence consists of seven measures.

A grand staff showing a complex sequence of notes. The notes are mostly whole notes, with some half notes. The sequence consists of seven measures, numbered 1 through 7. The notes are arranged in a way that suggests a permutation of a set of notes.

A single note in a bass clef staff, with a dotted line below it.

Permutation, filtrage, complémentation

A single note in a treble clef staff, with a dotted line below it.

A grand staff showing a complex sequence of notes. The notes are mostly whole notes, with some half notes. The sequence consists of seven measures, numbered 1 through 7. The notes are arranged in a way that suggests a permutation of a set of notes.

Example 2c. Grisey, *Modulations*, interpolations for rehearsal numbers 37-39

The musical score consists of six staves. The first five staves are for instruments: Viola 2, Viola 3, Harp, Bassoon, and Trombone. The sixth staff is for Theoretical Chord Structures. Rehearsal numbers 37, 38, and 39 are marked at the beginning of the first three measures of each staff. The score includes various accidentals (sharps, flats, naturals) and arrows pointing to specific notes, indicating pitch deviations. Below the theoretical chord structures, there are two diagrams showing the inharmonic distortion for each measure.

Violated sonority: d
(partials 2, 3, 4, 7, and 10)

Inharmonic Distortion: d'

Inharmonic Distortion: d''

Accidentals with arrows (e.g. ♭) indicate approximately 1/6-tone deviation from the written pitch.
Altered accidentals (e.g. ♯) indicate quarter tones.

The theoretical chord structures are for reference and do not sound in this section of the piece.

arrives at a structure approaching d". These chords, however, are only the start of a generative process building up one of the most complicated textures of the piece. The pitches shown in this example are found as the high-points of melodic neumes (slurred groupings in the score) that refer back to the *Prologue of Les espaces acoustiques*. These melodic fragments introduce other notes below the given pitch, and they are then put into canon with one another, sometimes with repetitions or permutations. Parallel processes unfold simultaneously in instrumental groups B', C', and D', which use chords based on different mutes. The dense texture makes the chords hard to discern at first. They emerge, however, as the melodic elements become more uniform, decelerate, and come into greater coordination as part of a global trajectory that Grisey describes as the "progressive coagulation" of the texture from a polyphony of twenty voices to a polyphony of chordal blocks.³¹ The interpolations in pitch, then, help regulate other processes of temporal unfolding and textural transformation, resulting in a complex, nebulous, and shifting whole. It is this type of passage in *Modulations* that Murail cites as particularly reminiscent of Ligeti, and a comparison to the Chamber Concerto may help substantiate this similarity.³²

In Ligeti's works from the 1967 organ etude *Harmonies* onward, he uses a particular type of chromatic voice leading, in which the most common types of transformation are those that either move a note of the chord a semitone away, or those that add or remove a pitch from the collection, allowing for a slow and measured rate of change. This kind of voice leading links together pillar chords that are often plotted out in the sketches through incremental steps, much like those generated by interpolation. In sketches for the second movement of the Chamber Concerto, for example, Ligeti works with an eight-voice harmonic skeleton. The initial harmony mixes major seconds with major and minor thirds, stretching from E3 to D5. Through a meandering series of chromatic shifts over the first twenty-six measures, this contracts to a

chromatic cluster from A#3 to F4. Through this time, then, the uppermost voice has traveled nine semitones down, while the lowermost has moved up by six, compressing the original shape in an irregular way, with different voices changing at different speeds.

While Ligeti plots out the entire movement as a large harmonic skeleton in his sketches, he realizes this in varied ways, adding nuance to the evolving texture of the piece. The opening harmonies are voiced in different and changing instruments, so that the uppermost voice of the sketch is given to the first violin, transferred to the oboe d'amore, and then to the clarinet as it moves from D to C# to C natural in measures 1–6. The Hammond organ takes the entire progression in more straightforward fashion from measures 9 to 12, and starting in measure 13, the clarinet arpeggiates the underlying chord as a compound melody, and other instruments follow in canon. After achieving a complete chromatic cluster in measure 27, Ligeti begins thinning the texture down to a three-note cluster in measure 34, before resetting the texture through the use of a tritone signal harmony voiced through many octaves.

The second half of the work then begins a new process, beginning from two widely separated harmonies in measure 40—a [025] signal harmony in the bass (C#3, E3, F#3) and a diatonic cluster in the treble (A^b5, B^b5, C6, D6, E^b6)—and proceeding to a resonant chord of stacked perfect fifths, spanning from B0 to C6 in measure 77.³³ This arrival is shown in

Example 3, both in his sketch and my reconstruction of this part of the harmonic skeleton. Here Ligeti combines the modes of presentation seen in the first half. The upper sonority is voiced in canonic polyphony while the lower one proceeds in more sustained tones. Each evolves at its own rate of speed, complicating the temporal structure of the work, but they eventually coalesce in a unified presentation, revealing the underlying chords that bring the movement to its close.

As in *Désintégrations* and *Modulations* this gradual harmonic process is a framework that supports more complex changes in texture and orchestration.

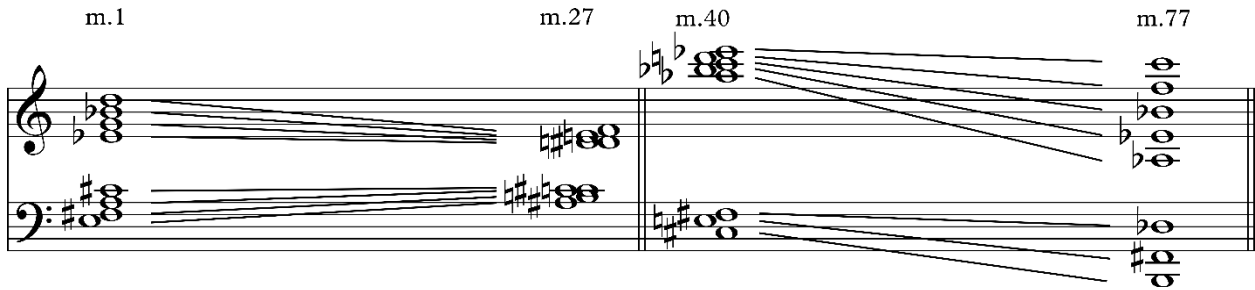
Insert Example 3a. here

Insert Example 3b. here

In addition to modeling sonorities off of idealized harmonic and subharmonic structures, spectral composers often used more complex instrumental sounds as models. The now classic example of this idea is the instrumental synthesis of a low trombone sound in Grisey's iconic *Partiels*, where the source sound is stated first in the instrument itself, then echoed, expanded, and enlivened by the ensemble. Many of these instrumental sounds contain distortions and deviations from the ideal, which became a source of compositional approaches using noise and further blurring the line between pitch and timbre. For example, in her 1986 composition, *Lichtbogen*, Kaija Saariaho models the basic sonorities of the piece from extended techniques on the cello. Julian Anderson explains that "The generative sources for its harmonies were two sound-spectra from the cello: the first a complex, multiphonic sound obtained by playing a natural harmonic with gradually increased bowing-pressure; the second a glissando between two natural harmonics resulting in a complex, irregularly oscillating series of pitches."³⁴ Saariaho's own description adds that the structures derived from these analyses "are often combined [with] the original playing manners of the analysed sound, so that harmony and timbral thinking stem from the same source."³⁵

In the opening passages of *Lichtbogen*, centered around F#4, this plays out in clear order. First, Saariaho brings in very pure sounds—the alto flute and contrabass harmonic, *senza vibrato*. As seen in the spectrograph ([Example 4](#)), this yields a bare fundamental. The sound is treated with reverberation and quickly adds upper partials as other strings join, *crescendo*, and move from *sul tasto* to normal position. The partials widen on the spectrograph as they add vibrato,

Example 3a. Ligeti, Chamber Concerto, II, large-scale pitch structure



Example 3b. Ligeti, Chamber Concerto, II, details from sketches of the harmonic skeleton. Reproduced with permission from the György Ligeti Collection of the Paul Sacher Sacher Foundation, Basel



Opening passage



Arrival on a chromatic cluster



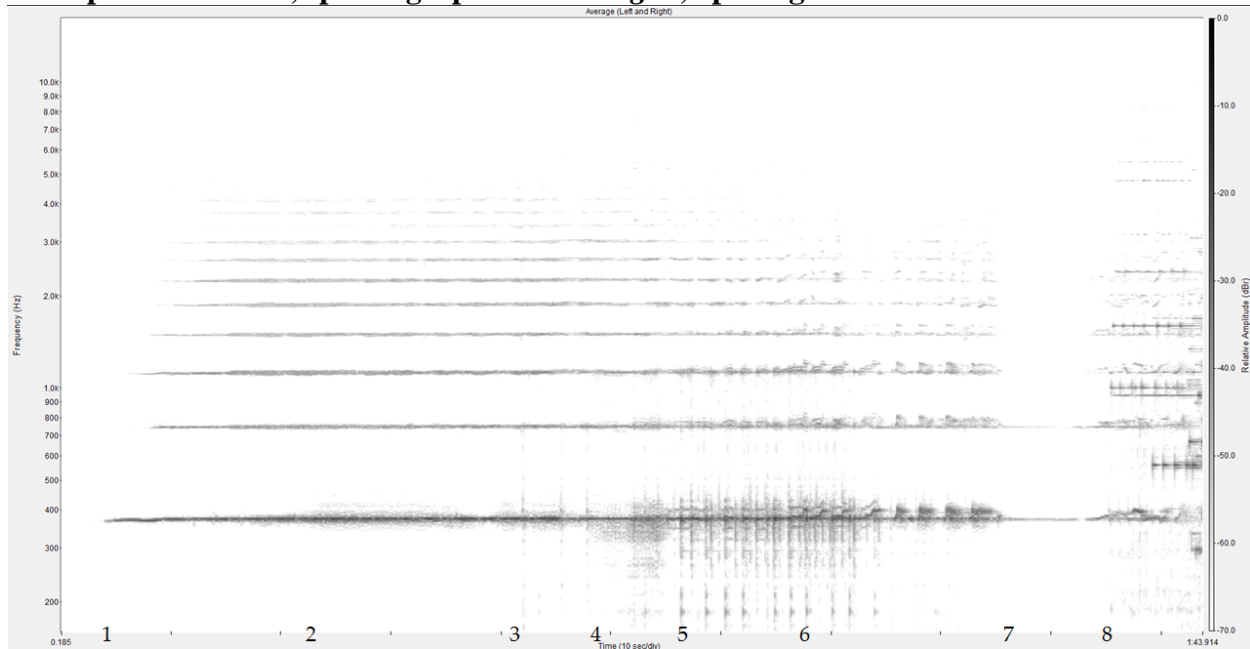
Arrival on a chord of stacked fifths

tremolo, microtonal glissandi, and intermittent attacks in the other instruments, pushing gently towards noise. At the end a contrabass harmonic—close to one of the source sounds of the piece—returns to the lone fundamental. The second section augments many of these timbral effects as more purely pitch-based ideas, adding notes above the F# fundamental that are generally displaced by a semitone from one of the stronger partials, capturing some of the tension of one of these transient states.³⁶ Later gestures use increased bow pressure to bend the pitch and introduce noise elements to the source sound more dramatically at the climax of the piece, before returning to pitch. Saariaho has spoken of the axis between pitch and noise as an important organizing principle in her work, and here it plays out from the microcosmic elements of her source sounds to the large-scale formal design of *Lichtbogen*.³⁷

Insert Example 4. here

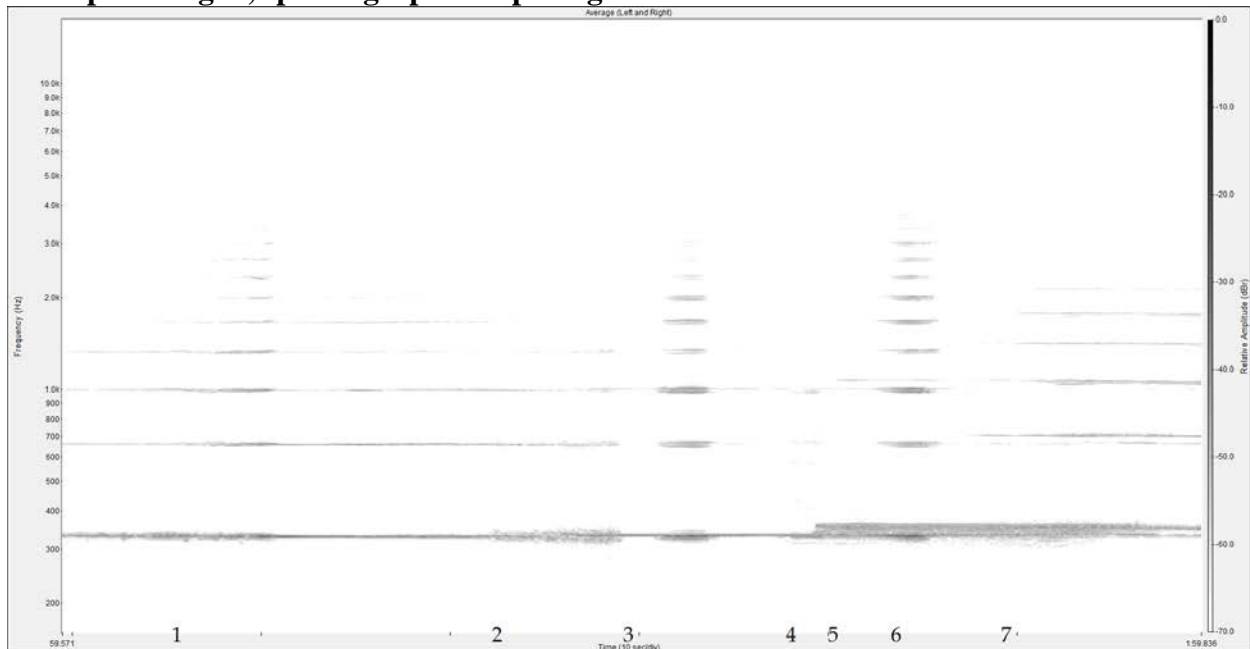
While Ligeti makes no claim to have modeled his Cello Concerto (1966) on any particular source sound, the opening of the first movement contains striking similarities to *Lichtbogen*, and can be heard as an important precedent to the style of instrumental synthesis found in this piece. The progression from a sparse fundamental, to a richer harmonic sound, to a noisier sound plays out in the same order, and is followed by the addition of non-harmonic tones clouding, distorting, and widening the pitch spectrum of the original sound. An interchange between the solo cello and ensemble is seen in the spectrograph of **Example 5**. Ligeti begins with very pure sounds, builds up brighter upper partials, and then pulls back in a few successive gestures, rather than one continuous arc. The solo cello's *espressivo* gestures often lead in this regard. The resulting increase in harmonic upper partials at 1'31" and 1'43" prepare the entrance of the brighter brass instruments at 1'47" (up to this point only the much sparser wind sounds of the clarinet and flute have been heard). At the same time, the cello also leads another kind of process: a move to a diffuse tremolo at 1'37" widens the fundamental seen on the spectrograph;

Example 4. Saariaho, spectrograph of *Lichtbogen*, opening



- | | |
|---|---|
| 1. Alto flute, joined by strings, crescendo | 5. More frequent attacks in all instruments |
| 2. Strings go from sul tasto to normal position, adding vibrato | 6. Slight glissandi |
| 3. Piano attacks begin | 7. Return to contrabass harmonic |
| 4. Viola tremolo, followed by other strings, flute flutter-tongue | 8. Semitone-related pitches added to the strongest partials |

Example 5. Ligeti, spectrograph of a passage from the Cello Concerto



- | | |
|--|---|
| 1. Strings crescendo, add vibrato, cut back to solo cello (1'06") | 4. Tremolo in solo cello (1'37") |
| 2. Tremolo, ensemble strings (1'22") | 5. Trill in clarinet, E-F (1'39") |
| 3. Cut back to solo clarinet (1'29")
followed by solo cello, espressivo (1'31") | 6. Espressivo gesture in solo cello (1'43") |
| | 7. Brass entrance, E-F (1'47") |

this is then transferred to become a trill in the clarinet, widening the band even further, and crossing the perceptual threshold from timbre to pitch. Together these set in motion further pitch expansions that accelerate through the movement, and while the cello is not literally a source sound for the piece, its timbral inflections are activated and amplified in pitch as the ensemble responds to the sonic gestures of the soloist.

Insert Example 5. here

Eclectic Influences and Questioning Spectral Attitude

Returning to think about spectral attitude, however, Ligeti and Saariaho seem to use these techniques not so purely as the investigation of acoustic properties, but in much more human terms. Saariaho, for example, gives a multivalent account of her aesthetic aims in *Lichtbogen*. She cites not only the sonic properties of her source sounds, but also the inspiration of the northern lights of her native Finland, Henry Vaughan's poem "The World," and, in her use of electronics, a childhood experience. In an interview with Ivanka Stoianova, she says:

Even as a child I loved to play with my father's tape recorder: you could sing very close to the microphone with a very intimate, very soft voice and then you could play the same thing back very, very loud. This is a little bit of what I did later with the regular instruments at my disposal... the playing techniques which themselves produced a soft, clear sound, partially on the edge of the audible; a sound, which I sought to amplify and then to alter, which evokes a somewhat unreal feeling: something very intimate, but that fills an entire stage.³⁸

Ligeti, too, when describing the culmination of the first movement of the Cello Concerto, tends to personify the unfolding events. As the movement continues, he achieves a registral separation of soloist and ensemble through gradual chromatic separation from a signal harmony.

At measure 36, Ligeti switches from the previous cluster to B^bs voiced across six octaves. Like the E of the opening, these start to spread chromatically, each octave evolving in a slightly different way, until a sudden cut-off at measure 54 leaves only the most widely separated registers: the soloist on F#7 and two contrabasses on G#1 and A1. In Ligeti's formulation, however, these are not simply investigations of acoustic extremes, coming into focus as the end goal of a kind of gradual transformation, they also have poignant associations: "In the first movement, the end suggests being alone and forsaken: the solo cello remains above the abysmally deep basses as if at an immeasurable height, until its dangerously thin, whistling flageolet finally breaks."³⁹ Compared to the type of spectral attitude put forth by Murail and Grisey—where one simply "poses" the sound, or where music is seen as an exploration of sonic realities through acoustics and perception—this affective and deeply emotional content stands somewhat at odds.

As this preference for absolute music softens in later spectral composition, it often does so by replacing this sense of scientific inquiry with one of spiritual or mystic exploration. Signs of this are seen even as early as Grisey's *Jour, contre-jour* (1978–79), in which differently scaled temporal structures are imbued with references to the Egyptian *Book of the Dead*; such Egyptological themes become even more explicit in *Anubis-Nout* (1982) and *Quatre chants pour franchir le seuil* (1997–98). A tendency towards mysticism can be found in Rădulescu as well, whose concept of "sound plasma" recognizes sound as being in constant flux—similar to Grisey's ideas of liminality and hybridization—but glosses this in a particularly spiritual way. Rădulescu writes that "the transformations of sound plasma occur according to two different speeds, one 'planetary,' the other 'cosmic,'" and he links these to concepts of "paraconsciousness" and to types of ritual and magical states of the soul.⁴⁰ From his earliest

spectral composition, *Credo* for nine cellos (1969), to *A Doini*—an “abstract prayer” that seems to have caught Ligeti’s attention in 1974—a characteristic mixture of Christian faith and Eastern mysticism pervades his music.⁴¹

An eclectic spirituality is also prominent in the works of Jonathan Harvey. He acknowledges the influence of Rudolf Steiner on works including, *Inner Light* (1973–77), and his upbringing as a chorister is seen in *Mortuos plango, vivos voco* (1980), which uses the great tenor bell at Winchester Cathedral as a source sound. His later interest in Buddhism and other eastern religions comes up in compositions from *Bhatki* (1982) to *Body Mandala* (2006) and other pieces that create an aura of ritual. He has described the importance of timbre as something amorphous and hard to quantify, “a concept that disappears into other things... but which reappears in an indefinable way in aesthetic experience.” And he goes on to say that “this particular interchange between reason and soul is highly illuminating, and brings the ‘indefinable’ into ever sharper definition.”⁴² For Harvey, and others working with more mystical applications of spectral techniques, this is akin to expanding one’s consciousness; dissolving recognizable images or categories of sound becomes a parallel to relinquishing the boundaries of self-identity, or releasing the ego in a way that is so important to Buddhism and other meditative practices.

Ligeti, in contrast, quite explicitly rejects this kind of religiosity in the music of Claude Vivier, while still praising his originality, technique, and the way he created vivid imaginary musical worlds.⁴³ As Ligeti came into closer dialogue with spectral composers and their practices, he took special care to separate his works and overall aesthetic. At times Ligeti seems to disparage this kind of mysticism, and at other times he labels spectralism as a school, with the same kind of pejorative connotations of cold and technical academicism that were leveled

against serialism. In introducing his *Hamburg Concerto*, for example, he distinguishes his use of natural horns and non-equal-tempered tuning systems by declaring, “However, I do not write fashionable overtone music, but rather use the overtones for non-harmonic chord combinations. I haven’t created a strictly ordered system, but rather, I let the sounds loose—in their own organization—thereby establishing different types of tonal coherence than those in the tradition.”⁴⁴ Yet in his sketches for this piece, Ligeti reveals that affinities with these composers were on his mind. In a prose sketch for a projected first movement, Ligeti references Grisey specifically when contemplating the use of continuous transformations and natural horns with different tunings. Moreover, he connects the general idea of metallic spectra to the names of Murail, Grisey, and Vivier.⁴⁵

While rejecting certain aspects of Vivier’s aesthetic, Ligeti clearly admired others. Vivier is the only composer associated with spectralism to receive an extended appreciation in Ligeti’s collected writings, and with his focus on using spectral techniques to evoke distant lands and cultures, he provides another illuminating case study in comparison to Ligeti. In Vivier, this feeling often occurs through the creation of artificial languages and through the use of arresting chords including microtonal components. Vivier has called his *Prologue pour un Marco Polo* “a meditation on a state of being—that of the misunderstood searcher” and the invented language he uses suggests “the general incomprehension that poor Marco hit up against.”⁴⁶ Acoustically in his *langue inventée*, the timbres of different syllable changes combine with instrumental effects to produce an otherworldly and incomprehensible utterance—straddling the line between language and pure sound. As a student of Stockhausen, his immediate influence is most likely *Stimmung*, but moments in Ligeti’s earlier *Aventures* also use rapid syllable changes and timbral effects to approach the same grey area and haunting effect.

In Vivier's music that makes explicit references to an imagined East, he often combines this invented language with *les couleurs*: chords derived by the principle of combination tones, especially those that use sums of the frequencies of harmonic partials above a generating dyad.⁴⁷ One goal of these spectral chords, which often introduce closely spaced microtonal pitches into the texture, is to create the acoustic effect of roughness. Roughness occurs when components of a sound have frequencies close to one another, and has been an important acoustic property, described by Stephen McAdams and Bruno Giordano as "an elementary timbral attribute based on the sensation of rapid fluctuations in the amplitude envelope. It can be generated by proximal frequency components that beat with one another."⁴⁸ As such, the category of roughness relates to sensory dissonance in intervals and to the perception of tension more generally. Grisey himself invokes the idea of roughness as an appealing way to work directly on psychoacoustic perception, outside of any particular tuning system or the culturally learned categories of consonance and dissonance that accompany it.⁴⁹ In his later music, Ligeti, too, would use closely spaced, microtonal sonorities to generate roughness as part of a greater expressive purpose, separating his music from the Western tradition of equal temperament.

In the introduction to the score for *Bouchara*, Vivier states that "the degree of roughness of the sonorous material depends directly upon the fundamentals" of the generating dyad. This relationship can be seen clearly in an examination of the progressions shown in **Example 6**. The voice part is given in the lowest staff, the generating dyad (formed by the bass and the horn, which doubles the voice an octave below) in the next highest, and the *couleur*, voiced by the winds and string harmonics in the upper two staves, respectively.⁵⁰ Generally speaking, intervals like the octave and perfect fifth will produce more overlap between the summation tones in the *couleur* and the natural harmonic series of the generating dyads' fundamentals.⁵¹ Thus the

combination tones produced by the C–G fifth in **Example 6** are remarkably less rough and more resonant than those produced by the other intervals, with many of the upper components matching harmonic partials of C and G. All of this gives this chord a particularly strong harmonicity not found in those generated by other intervals. While Vivier tends to avoid octaves, which would generate the most overlap between the harmonic series and potential combination tones, he does use perfect fifths frequently, including the last syllable of the title word, *Bouchara*, whenever it occurs in the first body section of the piece. Each time, the resonance given to this important syllable has a distinctly audible clarity or resolution from roughness to harmonicity.

Insert Example 6. here

Ligeti's *Hamburg Concerto* presents interesting parallels to Vivier's use of roughness and harmonicity to enter into microtonal sound worlds. This piece features natural horns using different fundamentals, each generating notes based on their harmonic series. As in *Bouchara*, these components join into complexes with unique moments of resonance and sonic conflict deriving, at least indirectly, from the relationship between the underlying fundamentals. Through the course of the fifth movement, suggestively entitled "Spectra," there are three extended passages where the solo horn joins the ensemble horns: measures 1–4, 5–7, and 8–13. These overlap with similar material in the woodwinds, brass, and strings, but the horns begin the movement together, they continue as a unified strand, and their harmonic glissando in measures 16–17 helps bring the movement to a close. The four ensemble horns consistently work with partials above an E fundamental, while the solo horn changes between different conflicting fundamentals, including B^b, A^b, F, A, and E^b, always leaving the tuning of the indicated partials uncorrected above the given fundamental, as instructed in the score. The uncorrected partials—

Example 6. Vivier, *Bouchara*, progressions from the first body section

Musical score for the first progression. It consists of four staves. The top two staves are treble clef, the third is bass clef, and the bottom is treble clef. The music is in 4/4 time. The lyrics are: *Ou... Bou - cha - ra*

Musical score for the second progression. It consists of four staves. The top two staves are treble clef, the third is bass clef, and the bottom is treble clef. The music is in 4/4 time. The lyrics are: *Bou - cha - ra*

especially the seventh (or fourteenth), eleventh, and thirteenth—show significant deviation from their equal-tempered counterparts, creating one type of tension by pushing the limits of harmonicity, or what we commonly reconcile as being related to the same fundamental.⁵²

Within this arrangement, however, Ligeti has two additional ways of creating tension through acoustic roughness. The first occurs when there are adjacent higher partials above the same fundamental. **Example 7a** shows all of the simultaneities in the horns, represented as partials above a given fundamental. The ensemble horns commonly use such arrangements; for example, the chord that opens the movement voices partials 5, 6, 7, and 9, and the chord that ends this phrase in measure 4, has shifted up to partials 8, 9, 10, and 11. Many of these notes sound within a critical bandwidth of one another, creating fast-beating sonorities and the sensation of acoustic roughness. A second way of intensifying conflict arises from the solo horn, which uses a different fundamental to introduce clashing components to the sound. **Example 7b** shows the second statement's sonorities, now calculated as frequencies. Anchored through the octave, fifth, and root in horns 2 and 4, the ensemble falls into a near-perfect harmonic sonority on E; meanwhile, the solo horn rubs against this in many ways, playing overtones from the tritone related B^b fundamental that are close, but distinctly off from the notes of the ensemble, growing in inharmonicity and then pulling back, as it executes a microtonal slide through inflections of the notes between B and D#. Through these measures the major second between B and C#, as notated, is split into five different frequencies (494.4, 524.4, 535.6, 550, and 576.8 Hz) many of which sound simultaneously or in direct succession.

Insert Example 7a. here

Insert Example 7b. here

These measures of tension all seem to release in the last dyad of the sonority, a fairly conventional major second between C# (now over an A fundamental in the solo horn) and D#.

Example 7a. Ligeti, *Hamburg Concerto*, V (“Spectra”), simultaneities in the horns, expressed as partials above a given fundamental

mm. 1-4		AA					BB											
Solo Horn in	Bb	8	8	6	6	9	9	9	9	7	7	10	10	10	10	11	11	11
Horns in E																		
Horn 1	9	9	9	10	10	9	9	11	11	11	11	12	13	13	14	14		11
Horn 2	6	6	6	7	7	6	6	8	8	8	10	10	11	11	11	11		9
Horn 3	7	7	7	8	8	7	7	9	9	9	11	12	12	12	13	13		10
Horn 4	5	5	5	6	6	4	4	6	6	6	8	8	9	9	10	10		8

mm. 5-7		A								
Solo Horn in	Bb	3	4	4	7	5	5	9	9	10
Horns in E										
Horn 1				10	9	9	12	13	14	15
Horn 2	4	3	3	3	3	3	3	3		
Horn 3				2	2	2	2	2	2	
Horn 4										

mm. 8-13		CC					DD																	
Solo Horn in	F	8	8	6	6	6	8	8	8	7	7	7	10	10	11	11	11	11						
Horns in E																								
Horn 1	9	9	12	12	11	11	11	10	10	10	9	9	9	9	9	9	13	13	14	15				
Horn 2				5	5	5	5	8	8	8	7	7	7	7	7	7	10	10	9	11	11	12	12	
Horn 3				7	7	7	7	12	12	12	12	12	12	12	12	11	11	11	11	11	12	12	13	13
Horn 4				2	2	2	2	2	2	2	6	6	6	6	6	6	9	9	9	5	9	9	11	11

Here each pitch is only slightly flat from equal temperament (-14 and -12 cents, respectively) and the intensely beating 11 hertz difference just before the bar line has progressively widened to a difference of 52 and then 68 hertz, crossing the threshold from being a liminal sonority—hard to reconcile as separate pitches and more likely to be heard as a single pitch, beating or fluctuating in intensity—to being a commonly recognizable interval. Although Ligeti’s technique is certainly different from Vivier’s, it is still the shift from a tritone relationship to a perfect fifth relationship between the generating fundamentals that helps alleviate acoustic roughness at the end of the phrase.

The horn has a long history of associations with distance, and in Ligeti’s work another layer of personal connections adds potential meaning to these techniques. Ligeti’s first use of “uncorrected” natural harmonics on the horn comes in his *Concert Românesc*, a piece in which he tries to capture the experience of hearing a bucium, a type of Romanian alphorn.⁵³ The use of the horn often suggests ideas of physical distance—rustic instruments sounding from a mountainside or post horns approaching from afar—but moreover, for Ligeti this kind of usage brings up associations with distant lands, and in this way forms another connection to the music of Vivier. While Ligeti used microtones in compositions like *Ramifications* and the Double Concerto, his approach takes a distinct turn in his works from the 1980s. In discussions of his works from the Piano Concerto and after, Ligeti consistently links his use of alternate tuning systems and microtones to non-Western or folk music and to his “growing dissatisfaction with the equal-tempered system.”⁵⁴ He cites his increased familiarity with Harry Partch and with musical traditions from Indonesia, Southern Africa, and Papua New Guinea as sources for discontent with the limitations of equal temperament, and in a discussion of his Violin Concerto, he adds the music of Vivier to this list. Ligeti discusses this aspect of Vivier’s music in terms

very similar to his own, praising Vivier's ability to transcend the mere "conglomeration" of eclectic influences and produce something that was original: "his own fantasy—a type of dreamed up folklore."⁵⁵ While in his own music he skirts issues of exoticism in using these materials, saying, "it is not foreignness in itself that is my goal, but rather complexity, and exoticism only exists in this concerto, if at all, as an allusion."⁵⁶ Whether or not one accepts this explanation, it points to a common, if multifaceted, concern arising from the growing awareness of the richness of non-Western traditions. The same zeitgeist that informs works like these, or Murail's use of Tibetan and Mongolian source sounds in *L'Esprit des dunes*, also informs the politicized wording Grisey uses to critique serialism for its inability to recognize difference.

Conclusions

With Ligeti, then, these spectral techniques often evoke different kinds of distance: not only the acoustic imitation of echoes and reverberations or a sense of geographical distance, but also particularly modern states of emotional distance and presence. In the Cello Concerto, the solo part interacts with the orchestra, leading the ensemble across the threshold from timbre to pitch, but then becoming separated in register, capturing the sense of alienation that Ligeti ascribes to the ending. The use of the natural horn is also complex, connecting associations with his childhood in Transylvania to a wider network of tuning systems outside equal temperament, and thus, these new microtonal harmonies become emblematic of the conceptual distance he tried to place between himself and his contemporaries. A recognition of the different manifestations of this concern with distance and the role it plays in narratives about his music and career might also reveal new types of connections emerging across the different stylistic periods of the composer's work.

These concerns are not unique to Ligeti, however, and in fact, they are shared by many of the spectral composers. Beside the alienation of the Cello Concerto stands the electronically estranged intimacy of Saariaho's *Lichtbogen*, and the mystique of the unapproachable or incomprehensible is common to both Vivier and Ligeti, as are their feelings of being misunderstood. These composers—expatriates and travelers in their own lives—seem to be attracted to themes about the allure of foreign locations and nostalgia for a distant home, and these are reflected by titles including *Lontano*, *L'amour de loin*, and *Et je reverrai cette ville étrange*. In turn, this preoccupation with distance relates to the outsider status they all sought to cultivate in their artistic identities. Using Ligeti as a foil to spectral composition, then, highlights some of these commonalities, and beyond pointing out similarities in technique, I hope that it also problematizes the role of attitude, especially as the spectral movement begins to drift from its concern with the acoustical foundations of music and turns to wider expressive ideas. Perhaps we can find just as meaningful a set of connections in their responses to a shared historical and political moment as we find in their shared interest in the deconstruction of sound. Identifying as outsiders, both musically and rhetorically, they were able to develop their compositional resources in a variety of ways in order to express the physical, cultural, and emotional distances that were common to their experiences—and it is in this greater network of relationships that we may find the most enduring links between Ligeti and spectralism.

References

- Adorno, Theodor W. "The Aging of the New Music." Translated by Robert Hullot-Kentor and Frederic Will. In *Essays on Music*, edited by Richard Leppert, 181–202. Berkeley: University of California Press, 2002.
- Anderson, Julian. "Seductive Solitary: Julian Anderson Introduces the Work of Kaija Saariaho." *Musical Times* 133, no. 1798 (December 1992): 616–19.
- Anderson, Julian. "A Provisional History of Spectral Music." *Contemporary Music Review* 19, no. 2 (2000): 7–22.
- Baillet, Jérôme. *Gérard Grisey: Fondements d'une écriture*. Paris: L'Harmattan, 2000.
- Barlow, Clarence. *On Musiquantics*. Mainz: Johannes Gutenberg Universität, 2012.
- Cardew, Cornelius. "Stockhausen Serves Imperialism." In *Stockhausen Serves Imperialism and Other Articles*, 46–55. London: Latimer New Dimensions, 1974.
- Castanet, P.A. "Gérard Grisey and the Foliation of Time." Translated by Joshua Fineberg. *Contemporary Music Review* 19, no. 3 (2000): 29–40.
- Christian, Bryan. "Combination-Tone Class Sets and Redefining the Role of *les Couleurs* in Claude Vivier's *Bouchara*." *Music Theory Online* 20, no. 2 (2014).
- Dalbavie, Marc-André. "Notes sur *Gondwana*." *Entretiens* 8 (1989): 139–45.
- Drott, Eric. "Spectralism, Politics and the Post-Industrial Imagination." In *The Modernist Legacy: Essays on New Music*, edited by Björn Heile, 39–60. Burlington VT: Ashgate, 2009.
- Fineberg, Joshua. "Appendix I: Guide to the Basic Concepts and Techniques of Spectral Music." *Contemporary Music Review* 19, no. 2 (2000): 81–113.
- Fineberg, Joshua. "Appendix II: Musical Examples." *Contemporary Music Review* 19, no. 2 (2000): 115–34.
- Gilmore, Bob. "'Wild Ocean': An Interview with Horațiu Rădulescu." *Contemporary Music Review* 22, nos. 1–2 (2003): 105–22.
- Gilmore, Bob. *Claude Vivier: A Composer's Life*. Rochester: University of Rochester Press, 2014.
- Grisey, Gérard. "La Musique: le devenir des sons." *Darmstädter Beiträge zur neuen Musik* 19 (1984): 16–23.
- Grisey, Gérard. "Did You Say Spectral?" Translated by Joshua Fineberg. *Contemporary Music Review* 19, no. 3 (2000): 1–3.
- Grisey, Gérard. "Les derives sonores de Gérard Grisey, Entretien avec Guy Lelong." In *Ecrits, ou l'invention de la musique spectrale*, edited by Guy Lelong with Anne-Marie Réby, 235–43. Paris: Editions MF, 2008.
- Harvey, Jonathan. "The Mirror of Ambiguity." In *The Language of Electroacoustic Music*, edited by Simon Emmerson, 175–90. London: Macmillan Press, 1986.

- Hasegawa, Robert. "Gérard Grisey and the 'Nature' of Harmony." *Music Analysis* 28, no. 2–3 (2009): 349–71.
- Kankaanpää, Vesa. "Dichotomies, Relationships: Timbre and Harmony in Revolution." In *Kaija Saariaho: Visions, Narratives, Dialogues*, edited by Tim Howell, Jon Hargreaves, and Michael Rofe, 159–76. Burlington, VT: Ashgate, 2011.
- LeBaron, Anne and Denys Bouliane. "Darmstadt 1980." *Perspectives of New Music* 19, no. 1–2 (1980): 420–41.
- Lemke, Sascha Lino. "'...sublimiert zu einem ständigen klanglichen Werden...': Gérard Griseys 'Modulations pour 33 musiciens.'" In *1001 Mikrotöne*, edited by Sarvenaz Safari and Manfred Stahnke, 237–310. Neumünster: von Bockel Verlag, 2015.
- Levy, Benjamin. *Metamorphosis in Music: The Compositions of György Ligeti in the 1950s and 1960s*. New York: Oxford University Press, 2017.
- Ligeti, György. Music Manuscripts. György Ligeti Collection. Paul Sacher Foundation, Basel.
- Ligeti, György. "Pierre Boulez: Decision and Automatism in Structure 1a." In "Young Composers." Special issue, *Die Reihe* 4, English ed. translated by Leo Black (1960): 36–62.
- Ligeti, György. "Metamorphoses of Musical Form." In "Form—Space." Special issue, *Die Reihe* 7, English ed. translated by Cornelius Cardew (1965): 5–19.
- Ligeti, György. *Ligeti in Conversation*. Translated by Gabor J. Schabert, Sarah E. Soulsby, Terence Kilmartin, and Geoffrey Skelton. London: Ernst Eulenburg, 1983.
- Ligeti, György. "Träumen Sie in Farbe?" *György Ligeti im Gespräch mit Eckhard Roelcke*. Vienna: Paul Zsolnay Verlag, 2003.
- Ligeti, György. *Gesammelte Schriften*. Edited by Monika Lichtenfeld. 2 vols. Mainz: Schott, 2007. [See especially: "Zur Musik Claude Viviers." Vol. 1: 497–501; "Über mein Concert Românesc und andere Frühwerke aus Ungarn." Vol. 2: 151–53; "Zu meinen Bläserquintetten," Vol. 2: 156–58; "Konzert für Violoncello und Orchester." Vol. 2: 243–44; "Lontano." Vol. 2: 245–46; "Hamburgisches Konzert." Vol. 2: 311–12; "Violinkonzert (Urfassung)." Vol. 2: 302–4; "Violinkonzert (definitive Fassung)." Vol. 2: 304–6.]
- McAdams, Stephen and Bruno Giordano. "The Perception of Musical Timbre." In *The Oxford Handbook of Music Psychology*, edited by Susan Hallam, Ian Cross, and Michael Thaut, 72–80. New York: Oxford University Press, 2009.
- Moisala, Pirkko. *Kaija Saariaho*. Urbana: University of Illinois Press, 2009.
- Morrison, Landon. "Sounds, Signals, Signs: Transductive Currents in Post-Spectral Music at IRCAM." PhD diss., McGill University, 2019.
- Moscovich, Viviana. "French Spectral Music: An Introduction." *Tempo* 200 (April 1997): 21–27.
- Murail, Tristan. "Scelsi, De-composer." Translated by Robert Hasegawa. *Contemporary Music Review* 24, nos. 2–3 (2005a): 173–80.

- Murail, Tristan. "Scelsi and L'Itinéraire: The Exploration of Sound." Translated by Robert Hasegawa. *Contemporary Music Review* 24, nos. 2–3 (2005b): 181–85.
- Murail, Tristan. "Villeneuve-lès-Avignon Conferences, Centre Acanthes, 9–11 and 13 July 1992." Translated by Aaron Berkowitz and Joshua Fineberg. *Contemporary Music Review* 24, nos. 2–3 (2005c): 187–267.
- Pressnitzer, Daniel and Stephen McAdams. "Acoustics, Psychoacoustics and Spectral Music." *Contemporary Music Review* 19 no. 2 (2000): 33–59.
- Rădulescu, Horațiu. *Sound Plasma: Music of the Future Sign or My High D*. Munich: Edition Modern, 1975.
- Rose, François. "Introduction to the Pitch Organization of French Spectral Music," *Perspectives of New Music* 34, no. 2 (1996): 6–39.
- Saariaho, Kaija. "Programme note: *Lichtbogen*" (1986). Accessed January 31, 2017 and August 17, 2021. <http://saariaho.org/works/lichtbogen/>
- Saariaho, Kaija. "Timbre and Harmony: Interpolations of Timbral Structures." *Contemporary Music Review* 2, no. 1 (1987): 93–133.
- Savage, Roger H. W. *Structure and Sorcery: The Aesthetics of Post-War Serial Composition and Indeterminacy*. New York: Garland Publishing, 1989.
- Stoianova, Ivanka. "Kaija Saariaho: Im Inneren des Klangs: Die Wege des Bewußtseins." In *Klangportrait: Kaija Saariaho*, edited by Susanne Winterfeldt, 20–32. Berlin: Musikfrauen, 1991.
- Wilson, Charles. "György Ligeti and the Rhetoric of Autonomy." *Twentieth-Century Music* 1, no. 1 (2004): 5–28.

¹ Gérard Grisey, "Les derives sonores de Gérard Grisey, Entretien avec Guy Lelong," in *Ecrits, ou l'invention de la musique spectrale*, ed. Guy Lelong with Anne-Marie Réby (Paris: Editions MF, 2008), 235.

² P.A. Castanet, "Gérard Grisey and the Foliation of Time," *Contemporary Music Review* 19, no. 3 (2000): 39–40.

³ Julian Anderson, "A Provisional History of Spectral Music," *Contemporary Music Review* 19, no. 2 (2000): 12.

⁴ Theodor W. Adorno, "The Aging of the New Music" in *Essays on Music*, ed. Richard Leppert, trans. Robert Hullot-Kentor and Frederic Will (Berkeley: University of California Press, 2002), 181–202; Cornelius Cardew, "Stockhausen Serves Imperialism," in *Stockhausen Serves Imperialism, and Other Articles*, 46–55 (London: Latimer New Dimensions, 1974). The following discussion is also indebted to Eric Drott, "Spectralism, Politics and the Post-Industrial Imagination," in *The Modernist Legacy: Essays on New Music*, ed. Björn Heile, 39–60 (Burlington VT: Ashgate, 2009) and to Charles Wilson, "György Ligeti and the Rhetoric of Autonomy," *Twentieth-Century Music* 1, no. 1 (2004): 5–28.

-
- ⁵ György Ligeti, “Pierre Boulez: Decision and Automatism in Structure 1a,” in “Young Composers,” special issue, *Die Reihe* 4, English ed., trans. Leo Black (Bryn Mawr, PA: Presser, 1960): 36–62. The quote is on p. 39.
- ⁶ *Ibid.*, see wording on 36–37, 53, and 61–62.
- ⁷ György Ligeti, “Metamorphoses of Musical Form,” in “Form—Space,” special issue, *Die Reihe* 7, English ed., trans. Cornelius Cardew (Bryn Mawr, PA: Presser, 1965): 5–19. The quote is on p. 10.
- ⁸ György Ligeti, “*Träumen Sie in Farbe?*” *György Ligeti im Gespräch mit Eckhard Roelcke* (Vienna: Paul Zsolnay Verlag, 2003), 97 and 95. All translations are the author’s unless indicated otherwise.
- ⁹ Drott, “Spectralism, Politics.”
- ¹⁰ Gérard Grisey, “La Musique: le devenir des sons,” *Darmstädter Beiträge zur neuen Musik* 19 (1984): 16.
- ¹¹ *Ibid.*, 16–17.
- ¹² *Ibid.*, 19.
- ¹³ Gérard Grisey, “Did You Say Spectral?” trans. Joshua Fineberg, *Contemporary Music Review* 19, no. 3 (2000): 2.
- ¹⁴ György Ligeti, “*Lontano*” in *Gesammelte Schriften*, ed. Monika Lichtenfeld. (Mainz: Schott, 2007), 2:245.
- ¹⁵ For a similar appraisal and more discussion of the composer’s life and works, see Pirkko Moisala, *Kaija Saariaho* (Urbana: University of Illinois Press, 2009), esp. 76–77.
- ¹⁶ Quoted in Ivanka Stoianova, “Kaija Saariaho: Im Inneren des Klangs: Die Wege des Bewußtseins,” in *Klangportrait: Kaija Saariaho* 20–32 (Berlin: Musikfrauen, 1991). The quote is on p. 23.
- ¹⁷ Bob Gilmore, “‘Wild Ocean’: An interview with Horațiu Rădulescu,” *Contemporary Music Review* 22, nos. 1–2 (2003): 106.
- ¹⁸ *Ibid.*, 109.
- ¹⁹ Tristan Murail “Scelsi and L’Itinéraire: The Exploration of Sound,” trans. Robert Hasegawa, *Contemporary Music Review* 24, nos. 2–3 (2005): 181–85, esp. 184; and “Villeneuve-lès-Avignon Conferences, Centre Acanthes, 9–11 and 13 July 1992,” trans. Aaron Berkowitz and Joshua Fineberg, *Contemporary Music Review* 24, nos. 2–3 (2005): 187–267, esp. 247–48 and 267n21.
- ²⁰ Tristan Murail, “Scelsi, de-composer,” trans. Robert Hasegawa, *Contemporary Music Review* 24, nos. 2–3 (2005): 173. The italics are in the original.
- ²¹ Grisey, “La musique,” 22.
- ²² On harmonic and subharmonic structures in Grisey, see François Rose, “Introduction to the Pitch Organization of French Spectral Music,” *Perspectives of New Music* 34, no. 2 (1996): 15–16. I discuss the genesis and structure of *Pièce électronique no. 3* in greater

-
- detail in chapter 2 of my *Metamorphosis in Music: The Compositions of György Ligeti in the 1950s and 1960s* (New York: Oxford University Press, 2017), esp. 62–71.
- ²³ György Ligeti, *Ligeti in Conversation*, trans. Gabor J. Schabert, Sarah E. Soulsby, Terence Kilmartin, and Geoffrey Skelton. (London: Ernst Eulenburg, 1983), 37. Grisey also uses the metaphor of “shadow tones” to describe combination tones (see Rose, “Introduction,” 21).
- ²⁴ Roger H.W. Savage makes an analogous claim that the low D#–E semitone opening *Apparitions*, could generate an upper-register combination tone adumbrating the ending of the first movement. See his *Structure and Sorcery: The Aesthetics of Post-War Serial Composition and Indeterminacy* (New York: Garland Publishing, 1989), 87.
- ²⁵ Ligeti makes his interest in difference tones explicit in “Zu meinen Bläserquintetten,” *Schriften*, 2:157. Daniel Pressnitzer and Stephen McAdams also discuss this phenomenon, using the quintet as an example in “Acoustics, Psychoacoustics and Spectral Music,” *Contemporary Music Review* 19 no. 2 (2000): 33–59, esp. 44.
- ²⁶ Joshua Fineberg, “Guide to the Basic Concepts and Techniques of Spectral Music,” *Contemporary Music Review* 19, no. 2 (2000): 108.
- ²⁷ Kaija Saariaho, “Timbre and Harmony: Interpolations of Timbral Structures,” *Contemporary Music Review* 2, no. 1 (1987): 93–133. Example 2a is based on figure 6 of this article.
- ²⁸ For more detail on the use of the CHANT program to execute complex interpolations between different phoneme models in *Vers le blanc*, see chapter 1 of Landon Morrison, “Sounds, Signals, Signs: Transductive Currents in Post-Spectral Music at IRCAM” (Ph.D. diss. McGill University, 2019).
- ²⁹ Joshua Fineberg, ed. “Appendix II: Musical Examples,” *Contemporary Music Review* 19, no. 2 (2000): 115–34. The text is found in Example 2b, which is based on a figure from p. 125. Murail’s *Gondwana* has been analyzed as another type of interpolation, in which the transitional chords are generated as hybrid structures, combining different elements from the preceding and subsequent chords, rather than by transposing elements. In addition to Fineberg and Rose, see Marc-André Dalbavie, “Notes sur *Gondwana*,” *Entretemps* 8 (1989): 139–45 and Viviana Moscovich, “French Spectral Music: An Introduction,” *Tempo* 200 (April 1997): 21–27.
- ³⁰ These chord labels follow Jérôme Baillet, *Gérard Grisey: Fondements d’une écriture* (Paris: L’Harmattan, 2000), 128. They are identified as derived from the analysis of cup-mute sounds in Anne Lebaron and Denys Bouliane, “Darmstadt 1980,” *Perspectives of New Music* 19 no. 1–2 (1980): 420–41, especially their figure 2, which presumably originated from Grisey’s lecture; see also the detailed analysis in Sascha Lino Lemke’s “‘...sublimiert zu einem ständigen klanglichen Werden...’: Gérard Griseys ‘Modulations pour 33 musiciens,’” in *1001 Mikrotöne*, ed. Sarvenaz Safari and Manfred Stahnke, 237–310 (Neumünster: von Bockel Verlag, 2015). François Rose differs substantially, and presents these chord structures with different labels in Examples 8 and 18 of his “Introduction.”
- ³¹ Grisey, “La musique,” 23.
- ³² Murail, “Villeneuve-lès-Avignon,” 267n21.

-
- ³³ Jérôme Baillet (*Gérard Grisey*, 8–9) has noted that this spacing of the [025] signal harmony in Ligeti’s *Lux Aeterna* and *Lontano* has acoustic significance and can be understood as the 6th, 7th, and 8th partials above a missing fundamental.
- ³⁴ Julian Anderson, “Seductive Solitary: Julian Anderson Introduces the Work of Kaija Saariaho,” *Musical Times* 133, no. 1798 (December 1992): 617.
- ³⁵ <http://saariaho.org/works/lichtbogen/>, webpage accessed, 1/31/2017
- ³⁶ According to Vesa Kankaanpää “Dichotomies, Relationships: Timbre and Harmony in Revolution” in *Kaija Saariaho: Visions, Narratives, Dialogues*, ed. Tim Howell, Jon Hargreaves, and Michael Rofe (Burlington, VT: Ashgate, 2011), 159–76, esp. 167–70, these come from a nine-note constellation, derived from a spectral analysis of the perceptually prominent partials of one of these transitional cello sounds, some of which have been rounded significantly to accommodate the equal-temperament of the keyboard instruments.
- ³⁷ See, for example, Saariaho, “Timbre and Harmony,” 94–97.
- ³⁸ Stoianova, “Kaija Saariaho,” 25.
- ³⁹ György Ligeti, “Konzert für Violoncello und Orchester,” in *Schriften*, 2:243.
- ⁴⁰ Horațiu Rădulescu, *Sound Plasma: Music of the Future Sign or My High D* (Munich: Edition Modern, 1975), 17.
- ⁴¹ Ligeti presided over the SIMC (Società Italiana per Musica Contemporanea) competition in Rome where this piece received special mention. See Gilmore “Wild Ocean,” 122n2.
- ⁴² Jonathan Harvey, “The Mirror of Ambiguity,” in *The Language of Electroacoustic Music*, ed. Simon Emmerson, 175–90 (London: Macmillan Press, 1986), 179.
- ⁴³ See “Zur Musik Claude Viviers” in *Schriften*, 1:497–501.
- ⁴⁴ György Ligeti, “*Hamburgisches Konzert*,” in *Schriften*, 2:312.
- ⁴⁵ These references come from an early page of the sketches for this piece, scanned as Image 00005 in the György Ligeti Collection of the Paul Sacher Foundation, Basel, in the Musikmanuskripte for the *Hamburgisches Konzert*. The pages that follow also contain references to Bruckner, Gesualdo, and types of African and Romanian folk music.
- ⁴⁶ Vivier’s own program note, as quoted in Bob Gilmore, *Claude Vivier: A Composer’s Life* (Rochester: University of Rochester Press, 2014), 180–81.
- ⁴⁷ Bryan Christian has identified these as combination-tone class (CTC) sets; my discussion in this section is indebted to his “Combination-Tone Class Sets and Redefining the Role of *les Couleurs* in Claude Vivier’s *Bouchara*,” *Music Theory Online* 20, no. 2 (2014).
- ⁴⁸ Stephen McAdams and Bruno Giordano, “The Perception of Musical Timbre,” in *The Oxford Handbook of Music Psychology*, ed. Susan Hallam, Ian Cross, and Michael Thaut, 72–80 (New York: Oxford University Press, 2009), 77. Roughness is also a major topic in Daniel Pressnitzer and Stephen McAdams, “Acoustics, Psychoacoustics and Spectral Music,” *Contemporary Music Review* 19, no. 2 (2000): 33–59.

-
- ⁴⁹ See Grisey, “La musique,” 16; it is significant that this discussion of roughness as a substitute for more culturally contextualized terms directly precedes the passage about the “races and ethnicities of sound” cited above.
- ⁵⁰ The bass sounds an octave below the written pitch, but it is the frequency of the written pitch that Vivier uses in his calculations. The winds in this section are consistently voiced from low to high as bassoon, clarinet, oboe, and flute. The string harmonics are notated as they sound in the top staff, given the octave transposition of the clef. These progressions can be compared to measures 26–27 and 32–33.
- ⁵¹ For example, when the interval of a perfect fifth (3:2) occurs any even integer multiplied to the melody will yield a result equal to one of the harmonic partials above the bass, and when this is added to another whole-number multiple of the bass, will remain within the same harmonic series. This can be generalized further by observing that for a perfect fourth (4:3), when the multiplier of the melody is divisible by three, the summation tone is a harmonic of the bass, and so forth, with such harmonic summation tones quickly becoming rarer (especially at lower orders) as their generating intervals become more complex.
- ⁵² More discussion of the effect of larger prime numbers on harmonicity is found in Clarence Barlow, *On Musiquantics* (Mainz: Johannes Gutenberg Universität, 2012) and in Robert Hasegawa, “Gérard Grisey and the ‘Nature’ of Harmony,” *Music Analysis* 28, no. 2–3 (2009): 349–71.
- ⁵³ György Ligeti, “Über mein *Concert Românesc* und andere Frühwerke aus Ungarn,” in *Schriften*, 2:151–53. The quote is on p. 151.
- ⁵⁴ György Ligeti, “Violinkonzert (definitive Fassung),” in *Schriften*, 2:304–6). The quote is on p. 306.
- ⁵⁵ György Ligeti, “Zur Musik Calude Viviers,” in *Schriften*, 1:497–501). The quote is on p. 499.
- ⁵⁶ György Ligeti, “Violinkonzert (Urfassung),” in *Schriften*, 2:302–3). The quote is on p. 303.