

Bertha Spies

Signification in atonal, amotivic music? Extending the properties of actoriality in Ligeti's second string quartet

Abstract: In the absence of melodic and motivic structures, how does signification function in atonal music? By extending the properties of actoriality, this article focuses on the goal-directedness of kinetic energy as an independent property of actoriality. The demonstration focuses on various modalities of goal-directed kinetic energy in meaningful segments of György Ligeti's second string quartet (1968) in order to promote an understanding of the overall design. Because time and space are integrated in the various modalities of atonal musical processes, a conceptual framework for making sense of signification in Ligeti's string quartet as a whole becomes possible.

Keywords: musical semiotics, actoriality, kinetic energy, atonal music, Ligeti, string quartet

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Atonal music is often regarded as difficult to understand and therefore also arduous to appreciate and to enjoy. The most obvious reasons are the absence of the familiar major-minor system and the lack of tonal melodies and melodic motives that, as “the immediate present,” are directly accessible on the level of “firstness,” to borrow Charles S. Peirce's terms. In 1904 he wrote that “[t]he typical ideas of firstness are qualities of feeling, or mere appearances” (Bergman and Paavola 2003: *CP* 8.329).

Tonal music as a means of expression provides a ready-made system to support semiotic investigation, because functional tonal harmony creates a goal-directed process, “a narrative arch whose structural beginning and ending tones lead toward a goal, i.e., to the dominant-tonic cadential progression” (Tarasti 1994: 28). When the focus is on the horizontal aspect of musical texture, melodic

motives such as the rhetorical figures of the Baroque period facilitate communication between the music and the listener.¹

In the absence of functional tonal harmony, melodic motives can still act as musical subjects to provide fertile ground for understanding musical significance, even if the motives are not embedded in tonality. When segmentation is regarded as the first step in semiotic analysis, the Swiss music theorist Ernst Kurth regards “the motif, as the offspring of a certain kinetic energy” as the smallest unit (Tarasti 1994: 101). According to musicologist Nicholas Cook, “semiotic analysis in practice concentrates on motifs and melodies” (1987: 152) and Lawrence Zbikowski also regards motifs as a basic-level category. He specifically refers to the composer of atonal music, Arnold Schoenberg, who said that “musical comprehension begins at the motivic level, for such a level maximizes both efficiency and informativeness” (2002: 34).

If a motif is regarded as a kind of subject or topic, then its temporal unfolding may be regarded as the development of a musical discourse. “If a topic, taken at its literal meaning, is a subject to be discussed, then it is clear that this can only take place in time, so that a certain temporal commitment becomes necessary” (Agawu 1991: 50). In semiotic terms, a melody or theme may be compared to a musical actor and actorial analysis then focuses on the theme(s) of a composition and the motifs that constitute the theme(s). “In the phases of development of European rationality it was the two-bar melodic-harmonic entity that was assigned the task of carrying and representing the subject of music” (Tarasti 1994: 101, 104–105).

In a previous article I showed that signification is enhanced when tracing the temporal unfolding of melodic motifs as they are transformed in the course of a composition. More specifically, this hermeneutic approach has shown how “a static musical sign can become a dynamic sign when its signification changes in the course of a composition” to reveal changing psychological states (Spies 2006: 207, 213).² For example, the systematic disintegration of circular melodic figures in Alban Berg’s atonal opera *Wozzeck* signifies the systematic disintegration of the protagonist’s psyche. “[W]hen spatial images are transformed into temporal ones, the idea of circularity travels from the literal to the figurative, from the con-

¹ David Lidov uses the rhetorical sigh-figure in music (the “slow, two-note, stepwise descending figure specified for grief”) as an example for the following statement: “When small musical units are felt to be signs of specific sentiments or concepts, then they play a role within the musical continuum like that of a lexical unit” (2010: 589).

² The fact that the five compositions used in the empirical section of the 2006 article are all text-bound was a great help in determining extra-musical messages in a work as a whole.

crete to the abstract, from a lower level to a higher level of signification where symbols represent the inner landscape” (Spies 2002: 57).

But in the absence of melodic motifs a semiotic investigation of atonal music becomes extremely complex. For Fred Lerdahl, author of *Atonal Prolongational Structure*, it is a critical point that “[a]tonal music almost by definition does not have stability conditions. Its pitch space is flat; sensory consonance and dissonance do not have any syntactic counterpart. How then is pitch reduction to be developed?” (2009: 73). In this article the music is not reduced to pitch structures because it is investigated in its original environment. But the rest of Lerdahl’s statement is valid. So, one may well ask: Is it at all possible for atonal, amotivic music to serve as vehicle for signification? If the answer is affirmative, then how does this music communicate meaning?

I shall argue that a strategy to facilitate understanding of atonal music is achievable if the definition of actoriality within a semiotic approach is broadened and extended, as well as specified in greater detail. This broader definition that I have in mind links specifically with two definitions of actoriality provided by Tarasti: “Actorial articulation signifies, besides distinction of *theme-actors*, the distribution of actoriality in the form of thematics or other ‘anthropomorphic’ elements of the text” and “If we identify melody or theme with a musical actor, then the actorial analysis of music is the analysis of the motifs constituting a theme, and the *reduction of those motifs to their energizing, kinetic tensions*” (1994: 48, 101, my italics). In the empirical section below the concept of “theme-actors” (first definition) will be extended by showing that atonal music textures exhibit “energizing, kinetic tensions” that could be perceived for their own sake and not regarded as reductions of motifs (second definition), which is of secondary importance.

The purpose of extending the properties of actoriality is to facilitate the understanding of atonal music through interdisciplinary connections with semiotics. Although Richard Steinitz believes that “[f]or music that eschews semantic structure and conventional logic, a theory of signs should be helpful,” it is “a debate too complex, and so far inconclusive, to enter here” (2003: 170). Steinitz specifically refers to György Ligeti’s second string quartet, which will be used in the demonstration below.

When searching for signification in atonal, amotivic music, the obvious solution is to rely on a strategy that links with strategies that have proven to be successful in the tonal idiom, but a strategy that lends itself to being translated into the atonal environment. The goal-directed effect of functional tonal harmony provides one such a possibility, because “[t]he most powerful framework for analyzing pure signs is one that gives pride of place to the dynamic quality of Classic music [sic], to the sense of directed motion” (Agawu 1991: 51). The next step is

then to find a similar performative effect in atonal music, and, finally, to determine the ways in which directional tendencies are established in this music. A goal-directed effect in atonal music is created by the temporal manipulation of musical features such as texture, density, dynamics, intensity, register and timbre to create, maintain, and dissolve tension.

The strategy proposed here focuses on music as process, on music as a temporal, kinetic event, and by locating musical tension in the ways in which kinetic energy is created.

In view of the fundamentally processive nature of music, musical logic cannot be based on the logic of a static world, where phenomena are either this or that, but on a logic that depicts the constant changes of phenomena from one state to another. Consequently, musical signification should be based on the continuous becoming and changing of musical figures. (Tarasti 1994: 18)

The property most appropriate for the purposes of a semiotic investigation of the atonal work chosen for the demonstration below, namely, György Ligeti's second string quartet (1968), is the concept of kinetic energy and its various modalities.³

Purely on the basis of atonal music being of comparatively recent origin (the twentieth century), considering the many centuries in which tonal music was the norm, it is obvious that scholars do not have the same volume of systematized knowledge to rely upon as in the case of traditional tonal music. Furthermore, atonality is associated with modernism in music, a time in which experimentation and the cult of originality flourished. The high degree of self-reference in atonal music complicates the formulation of general laws, conceptualization and standardizing of terminology upon which semiotic investigations rely. In a specific reference to actoriality, Tarasti maintains that “[f]rom the semiotic viewpoint, the strong connection of actoriality with a specific style period of Western art music might be viewed as a restriction that threatens the general validity of the whole theory” (1994: 106).

Furthermore, spatiality and temporality, the categories of articulation of tonal space and temporal organization respectively, also rely heavily on traditional harmony, melody, rhythm and meter (Tarasti 1994: 48). Apart from studies specifically aimed at examining pre-twentieth-century music (Agawu 1991; Hatten 1994, 2006), other semiotic investigations use almost no atonal music in their demonstrations, for example Nattiez (1990), Monelle (1992), Tarasti (1994, 1995, 2002), Lidov (1995), Agawu (1999), Gritten and King (2006). Indeed, in the preface

³ Six chapters of my doctoral dissertation are based on an analysis of this work (1990).

to *A Theory of Musical Semiotics* Tarasti acknowledges that “[t]here could have perhaps been more [analyses], particularly of contemporary music” (1994: xiii).

This situation is complicated further by the focus on the message of a single work that represents a move away from universality, and toward more particularity. “[G]eneral semiotics has lately moved in another direction, namely, toward the study of unique, individual phenomena. In this case, one need not try to reduce the object to a code system, but may conceive of it in a more phenomenological and hermeneutic way so as to understand its originality” (Tarasti 2002: 66, 67). Apparently much still needs to be done in this direction because in 2010 David Lidov writes that an analysis of music “in terms of the unique categories of pattern established within each work” is not as fully developed as the existing analytical systems that are concerned with *a priori* grammar (2010: 593).

1 Actoriality in Ligeti’s second string quartet (1968)

My proposal for the extension of actorial properties is based on an analysis of the second string quartet of György Ligeti (1923–2006), composed during the period described as high modernism in music. I have chosen this work because the absence of traditionally structured melody, harmony, and rhythm as organizational features resulted in a new language that has fascinated me in many ways. In the *Neue Zeitschrift für Musik* of 1972 Rolf Gaska described it as a masterpiece in the string quartet genre. Ten years after its completion the composer stated that the String Quartet Nr. 2 is “the work that embodied his ideas most clearly” (Steinitz 2003: 174, 167).

Because this string quartet has no melodic themes and only one conspicuous melodic motif in five movements (in measure 40 of the last movement), one may well ask: What constitutes the subject? Instead of traditional melodic, harmonic, and rhythmic effects, Ligeti uses processes of various kinds that involve texture, tempo, intensity (dynamics), density, register, etc., to create various kinds of kinetic energy. In the resulting sound-masses with their novel textures, change, either gradual or abrupt plays a crucial role. Asynchronic effects are common and synchronic moments are functional, serving, for example, as point of departure for transformation or as points of arrival in the case of meaningful segments. When combining horizontal lines in which the notes move at different speeds (e.g., at five, six, seven and eight impulses to the beat) micropolyphony is the result. You can see the lines on paper, but you cannot hear the independent lines. Instead it creates the effect of a mass of sound slowly moving through space.

If the properties of actoriality can be extended to accommodate atonal music, a large repertory of twentieth-century music could be included in the scope of semiotic investigation. The potential of kinetic energy *per se* to function as a musical actant will add a new dimension to the properties of actoriality. Kinetic energy creates direction toward a goal comparable to the forward movement in chord progressions of functional tonal harmony, for example, the pull of the dominant toward the tonic. Tarasti defines kinetic energy as “the melodic course streaming through and binding together all the tones . . . In Greimasian terms, kinetic energy is not a temporal-rhythmic but a spatial category. Thus one may conclude that, as regards musical actoriality, the energy of some theme-actors can be determined by purely spatial factors” (1994: 100). Kinetic energy is, therefore, closely linked to the space in which it functions. The various ways in which kinetic energy is created, how it generates tension and how it resolves, are processes that have a temporal-spatial character.

Listening to music is like travelling through an imaginary space (Tarasti 1994: 78), following the horizontal lines that link pitches as they form melodies, melodic motifs or layers or bands of sound, the latter being relevant to this investigation. The band of sound may have various characteristics, for example, the variety in the number of layers of sound create various densities, bands of sound may have different textures (porous or thick), the dynamics may be high or low or it may rise or fall, the speed of the point-like impulses per beat may increase or decrease, etc. Tarasti identifies three kinds of musical spaces, namely, point-like spaces (separate sounds and pitches), transitions from one point to another, and musical spaces that “consist of whole fields, which are not felt as conglomerates of discrete tone points but as more or less articulated sonorous masses or timbres” (1994: 84–85). It is this third category that is crucial for the understanding of Ligeti’s second string quartet. Consequently, this article concentrates on the dynamic nature of the temporal unfolding within space, on the way in which kinetic energy functions in sound masses. In the demonstration below the idea that space is a static, formal construct is substituted with the integration of space and time when investigating the processes of musical transformation.

2 Extending the properties of actoriality in atonal music – demonstration

Goal-directedness in Ligeti’s second string quartet is the result of the various ways in which kinetic energy is created. This multifaceted nature of kinetic energy is a justification for regarding it as an actant. It builds and dismantles tension

by systematically setting up and eroding bands of sound through various kinds of processes that involve change. These changes on the surface of the music that provides information on the first level of signification constitute a movement toward or away from points of arrival, a familiar phenomenon in tonal music. The empirical section deals with two familiar questions, but now in an atonal environment: How does the composer create directional tendencies in atonal music? What constitutes the point of arrival in atonal music as a climax in a work or cadence at the end of a phrase in tonal music does?

The first part of the demonstration shows how understanding of musical processes in this atonal string quartet can facilitate signification in meaningful segments of the music, and the second part shows how these processes shape the overall design of the work; in other words, it shows how the musical product is determined by musical processes and not the other way round.

2.1 Modalities of kinetic energy – the musical process

In a musical process something is happening, a change is taking place (Tarasti 2002: 77). The way in which Ligeti fashions sonic material characterizes him as a sculptor of sound. He describes this sculptural approach to the shaping of sound masses as follows:

[S]ounds and musical coherence always arouse in me ideas of consistency and color, of visible and recognizable form . . . Sound fields and masses that flow together, alternate with, or penetrate one another; suspended nets that tear or become knotted; damp, viscous, spongy, fibrous, dry, brittle, granulous and compact materials; threads, short flourishes, splinters and traces of all kinds; imaginary edifices, labyrinths, inscriptions, texts, dialogues, insects, states, occurrences, coalescence, transformation, catastrophe, decay, disappearance; all these are elements of this non-puristic music. (Ligeti in Steinitz 2003: 81–82)

Memories from Ligeti's childhood, such as the sound of man-made, ticking mechanisms from his uncle's printing works or his father's typewriter influenced his way of thinking and doing. When he was about five years old, he received a collection of short stories by Gyula Krúdy. In some of the stories a widow lived alone on the Hungarian plains in an isolated house filled with her husband's clocks, barometers, and hygrometers. Ligeti remembers: "Nobody comes, maybe for a hundred years. Nothing happens. So there is a combination of movement, which is machine-like, and absolutely nothing . . . a timelessness . . . no beginning and no end" (Steinitz 2003: 196, 9, 8). The whole third movement of his second string quartet is based on the sound of man-made ticking mechanisms (see Example 2).

Ligeti regards musical structure as the “imaginary spatialization of temporal processes” and refers specifically to the importance of “direction of flow” (Bernard 1987: 210; Ligeti 1960: 19). More specifically, kinetic energy can be fashioned in such a way as to create a direction of flow or a “sense of directed motion,” mentioned by Kofi Agawu when he refers to the dynamic quality of classical music (1991: 51). Because a sound field can “become modalized when moving toward or away from some fixed point or center of a musical space” (Tarasti 1994: 85), I shall discuss three ways in which kinetic energy functions as a performing subject.

2.1.1 Kinetic energy acting as directional tendency in a band of sound

The obvious starting point to determine how the composer creates directional tendencies in atonal music is the beginning of each movement. “As the initial element in a finite structure, a beginning establishes certain premises or points of reference, and our perception of subsequent events in that structure is inevitably informed by beginning processes” (Agawu 1991: 56). All five movements have a clearly defined point of departure, that is, a single note (E in the first movement and G# in the second), two neighboring notes (A and B in the third movement), three neighboring notes (G, G#, and A in the fourth), and two notes a minor third apart (D# and F# in the final movement).

From these points of departure, bands of sound develop systematically and in various ways to generate kinetic energy in all five movements, acting as an introduction to the significant point of arrival where a new section is introduced. This goal-directed kinetic energy at the beginning of each movement can be compared to directional flow in harmonic progressions of tonal harmony.⁴ The effect of progression is created by, among other ways, a systematic thickening or broadening of the sound band, by various styles of playing, by raising the dynamic and/or pitch level or by asynchronously speeding up the points of attack within the sound band.

Movement I, measures 1–11: A systematic asynchronous thickening of the sound band created by bowed tremolo figures expands from E to five notes, E, F#, G, G#, A in measure 14. Starting with an explosive dissonant clash that momentarily incorporates D# and F, marked *sfff*, the ensuing dynamic level is very low (*ppp*). (Listen on YouTube at <http://www.youtube.com/watch?v=1qGw4WSpivA&feature=relmfu>.)

⁴ This approach is work specific because each composition may suggest its own way of signification.

Fig. 1: Example 1. First movement, measures 1–11

Movement II, measures 1–12: Kinetic energy is generated by asynchronously applying various styles of playing the same note (G#), for example *senza vibrato*, *poco vibrato*, *molto vibrato*, *flautando*, *col legno*, *sfpp*, etc. From measure 5 onwards the sound band systematically fans out incorporating microtonal shifts to reach a filled up major third (G, A, B), which resolves onto F# in all four parts in measure 12.² The general dynamic level remains low (from *pp* to *ppp*). (Listen on YouTube at 5' 14".)

Movement III, measures 1–12¹: The systematic and asynchronous increase in the number of impulses per beat creates direction at the beginning of the third movement. The repeated notes on A and B are played pizzicato, recalling the mechanical devices of Ligeti's youth (discussed above). In measure 8 the band of sound starts to expand asynchronously to reach a vertical structure in measure 12 (C, E, C#, G#). The dynamic level changes from *p* to *f possibile*. (Listen on YouTube at 10' 10".)

Movement IV, measures 1–18: Marked *presto*, *furioso*, *brutale*, *tumultoso* and played *sempre fff*, this movement signifies ferocious disorder as opposed to the mostly quiet, restrained order of the previous movement. Here the band of sound broadens in a fragmented, unsynchronized, and unsystematic way from G, G#, A

Come un meccanismo di precisione (very even, without accentuating the bar subdivisions; nowhere should the impression of a barline be created.)
(vorgleichmäßig, ohne Betonung der Taktunterteilungen spielen: der Eindruck einer Taktstrichlinie soll sich nirgends ergeben.)

Mit freier Hand, ohne Bogen / With free hand; put bow down

*NB. In diesem Satz sind &, h, k, falls nicht geändert, für die Dauer der jeweiligen Takte gültig.
 In this movement &, h, and k are valid for the whole bar, unless changed.*

Fig. 2: Example 2: Third movement, measures 1–10

in measure 1 through measures marked alternatively *grave* and *presto* to arrive at a thick band of sound in which chords are attacked asynchronously (measure 18). (Listen on YouTube at 13' 19".) Out of this ferocious opening section crystallizes a serene three-note formation in measure 19 marked *subito molto calmo*, *subito pp*, *senza vibrato* (YouTube at 13' 43", see 2.1.3 below).

Movement V, measures 1–12: After the *ffff* climax in the previous movement (mm. 48³–50) and ending the fourth movement with its furious accents at the *fff* level, the final movement opens with peaceful finger tremolos on the minor third D#, F#, played *sempre pp*. The systematic increase in the number of impulses per beat creates a kinetic energy that signifies progression. The number increases asynchronously from 3 (cello), 4 (viola), 5 (second violin), and 6 (first violin) in the first measure to a synchronized 8 impulses per beat in measures 8 and 9 while the tremolos systematically change into rippling figures. (Listen on YouTube at 15' 20".)

From measure 13 the width of the sound band increases unexpectedly, marked *sempre pp*, when three instruments play unsynchronized rapid figures with notes widely spaced over a sustained open fifth played by the cello. The point of arrival in measure 18 is a stationary chord consisting of 7 notes that spans almost 4 octaves (YouTube at 16' 23").

♩ = 74 Allegro con delicatezza - stets sehr mild - / - always very mildly -
*„wie aus der Ferne“ Stets abgeduldet, *liquid, ohne jede merkbare metrische Einteilung bzw. Pulsation, stets sehr gleichmäßig. **)*
*„as though from afar“; without accents, *) liquidly, with no perceptible metrical division or pulsation; very even at all times. **)*




Fig. 3: Example 3: Fifth movement, measures 1–3

The reversal of the creation of tension, namely the dissolving of tension, is created by the desynchronous systematic contraction of the sound band. For example, near the end of the first movement the broadly spaced chord in measure 79³ systematically telescopes over five measures to reach a dense F#, G#, A, B^b in the middle register (m. 84²). (Listen on YouTube at 4' 30".)



Fig. 4: Example 4: First movement, measures 79–84

Fig. 5: Example 5: First movement, measures 64–70

2.1.2 Harmonic transformation acting as directional tendency

Apart from generating tension through the manipulation of kinetic energy in the band of sound, the systematic transformation of one chord into another also creates a directional tendency. In an asynchronous way Ligeti introduces individual tones (which he calls “parasitizing tones”) to erode an existing sound structure in order to create a new sound structure over time (Häusler 1970: 505). (Listen on YouTube at 3’ 18”.)

In measure 64 a porous static vertical structure (B, A, E, F) is transformed asynchronously through parasitizing tones to reach another static vertical structure (E, G, C#, F) in measure 67. A descending flash of sound arrives at a stable point of arrival (B, D, E) in measure 70, a note formation that could be regarded as the representation of the golden section in miniature format (see also 2.1.3 and 2.2.1 below). When expressed in number of semitones (the smallest interval of traditional music notation), the two intervals that constitute this three-note formation can be expressed as 3 + 2. Ligeti calls this three-note formation consisting of a minor third plus a major second a signal (Bernard 1987: 236). For the purposes of this demonstration the term “Ligeti signal” will be used here.

A semitone (A#, B) in measure 34 of the second movement, is also systematically and asynchronously transformed to create directed motion. The ensemble reaches a static four-note chord that acts as a point of arrival in measures 39–41. Other examples of harmonic transformation occur in measures 51–55 of the second movement and measures 37–44² of the last movement.

2.1.3 Crystallization acting as directional tendency

A third way in which Ligeti creates a sense of direction is the reversal of harmonic transformation, namely the process of crystallization. A neutral sound mass

The image displays a musical score for four staves, numbered 15 through 19. The score is characterized by dense, complex rhythmic patterns and dynamic markings. Key markings include:

- Measure 15: *Subito Prestissimo sifrenato (♩ = 160)*, *Sub III molto feroce*.
- Measure 16: *(quasi eco) flautando*, *ppp*, *Sub III molto feroce*.
- Measure 17: *Impetuoso accelerando molto*, *ord.*, *crec. molto III feroce*.
- Measure 18: *brutale*, *ord.*, *crec. molto III feroce*.
- Measure 19: *Subito Sostenuto (♩ = 50)*, *brutale*, *(quasi eco) flautando*, *ppp*.

 The notation includes various note values, rests, and dynamic markings such as *ppp*, *pp*, *mf*, and *fff*.

Fig. 6: Example 6: First movement, measures 15–19

is systematically transformed in such a manner that an interval, a three-note formation or a chord that was hidden in the original band of sound eventually crystallizes.

The crystallization of previously hidden cells is typical of Ligeti's style (Ligeti 1971: 510; Häusler 1970: 505). He describes the process of crystallization as follows: "The crystal is potentially there in the solution but becomes visible only at the moment of crystallization. In much the same way you could say that there is [in my music] a state of supersaturated polyphony, with all the 'crystal culture' in it, but you cannot discern it" (in Bernard 1987: 211). In measure 19 of the first movement a Ligeti signal (here F, A^b, B^b) crystallizes from the dense band of sound created by fast-moving accentuated lines played by all instruments in measures 17 and 18. (Listen on YouTube at 45".)

A similar Ligeti signal appears 19 bars before the end of the first movement as a point of arrival at the end of a descending sound flash (see Example 5, measure 70) and also 19 bars into the fourth movement (F, A^b, B^b), constituting the first point of arrival in this ferocious movement. The synchronized vertical structure in measure 79³ of the first movement crystallizes from a micropolyphonic texture (mm. 77–79³) to create a point of arrival. Measures 13³–18 and 30–36 of the last movement are also examples of crystallization that create directed motion.

This discussion of kinetic energy focuses on musical processes, on various ways in which temporally organized music is spatialized in meaningful segments of Ligeti's string quartet to create tension or goal-directedness. By creating directional tendencies in Ligeti's string quartet, kinetic energy therefore functions as an actant.

Extending the properties of actoriality in this way also clarifies the process of signification of the musical structure as a coherent whole and as product. The

second part of the empirical section will demonstrate how the overall design of the work is shaped by these processes.

2.2 From musical process to musical product

When listening to music, the effect of contrast speaks directly to the listener as a first level of signification, whether it concerns contrast of dynamics, of tempo, register, density or texture.⁵ The immediacy of contrast is also that musical characteristic that facilitates the understanding of the overall design in atonal music. Contrast is created by changes in the music, whether they are gradual or sudden.

In music, it is true that slight changes in the sound cause apparent changes of meaning; but the changes are pretty well commensurate, and there are hardly ever any changes that cause no change of meaning. From the point of view of analysis, the most vital aspect of metalanguage concerns the names and properties of *segments*, those shorter or longer bits of language of music which are strung together syntactically, or can be grouped paradigmatically, to make up the medium as *parole* or *langue*. (Monelle 1992: 59)

Where the potential of meaningful segments of music to generate goal-directedness is investigated in the first part of the demonstration, the potential of contrast and change to illuminate signification in the work as a whole will be investigated next. At more or less two thirds of the way in each movement a contrasting musical idea occurs. In tonal music, this point in the overall design is often marked by a climax in the music. On a very basic level, when learning to write 8-measure melodies in tonal style, students are often advised to create a climax after the middle of the melody. In Ligeti's string quartet, this point that divides the whole into a longer and a shorter section creates a relationship that more or less resembles the golden section division of 0.618.

This overarching asymmetric shape can also be found on a micro level in the asymmetric proportions of the Ligeti signal, a prominent three-note formation in this quartet (see Example 5).⁶ This correspondence of ratio between the smallest unit and the overall design could be regarded as a manifestation of the

⁵ Contrast is also the point of departure in an article in which I argued for a reversal of the hierarchic binary opposition of product-process in the educational environment (Spies and Taljaard 2003).

⁶ Elsewhere I have discussed atriadic three-note formations in Ligeti's second string quartet (Spies 2005).

Polish-born mathematician Benoit Mandelbrot's fractal geometry (Steinitz 2003: 274). Mandelbrot's theory of fractal geometry includes the idea of repetition and scaling that artists find attractive because of its aesthetic properties. "Fractal patterns repeat themselves at ever-decreasing sizes, like nesting Russian dolls, or as the overall form of a cauliflower is replicated in its smallest florets. Such self-similarity, says Mandelbrot, is as appealing in art as it is a perennial concept in nature" (Steinitz 2003: 274).

As a schoolboy Ligeti excelled in mathematics and at the time a career in the natural sciences was the obvious first choice. Later on traces of his interest in the sciences shows in the music he writes and the combination of science and music eventually manifested in a conference of 1996 in which he and Mandelbrot spoke about "Fractals and Music" and "Music and Mathematics." However, Ligeti does not pursue scientific knowledge for its own sake: "In my music one finds neither that which one might call 'scientific' nor the 'mathematical,' but rather a unification of construction with poetic, emotional imagination" (in Steinitz 2003: 274, 277).

The fact that the golden section division features as an overarching structural design within all five movements of Ligeti's string quartet facilitates understanding of the work as a whole. After the mainly dense micropolyphony in the first part of the first movement, in measure 53 all instruments are involved in establishing a new porous section that is characterized by wide leaps within the individual lines as well as wide open spaces between the lines. Marked *molto capriccioso, con eleganza*, this point divides the first movement into two sections, resulting in an approximate golden section division of 0.602 . . . (length of movement: 88 measures). In the graphic representation of the five movements appearing at the end of the article, the position of the golden section division is shown as GS.⁷

In the second movement, following three measures of disoriented, asynchronous playing, a synchronized, tonal "added sixth" chord in measure 33⁴ results in an approximate golden section division of 0.602 . . . (length of movement: 56 measures). The third movement follows the reverse procedure, when a fragmented field of sound in measure 30 interrupts the existing coherent ensemble texture, creating an approximate golden section division of 0.638 . . . (Length of movement: 47 measures.)

Cutting short unsynchronized, ferocious playing in the fourth movement, a sustained Ligeti signal (G, B^b, C) in measure 43 (marked *subito molto calmo*,

⁷ The use of measure numbers should not be regarded as a mathematically accurate method, because measures within movements may differ in length.

subito pp) creates an approximate golden section relationship of 0.682 . . . (length of movement: 63 measures). In measure 50 of the last movement, all four instruments play the same six-note melodic figure, starting with a Ligeti signal and moving in parallel lines a semitone apart, establishing an approximate golden section relationship of 0.617 . . . (length of movement: 81 measures). What is conspicuous about this interjection is the sudden high dynamic level marked *subito fff*, *marcato*, framed by very low dynamics. This strong marker creates a relationship that, compared to the preceding four movements, comes closest to the accurate golden section of 0.618.

The micro format of the golden section, that is the Ligeti signal, also features in the overall design of two movements. The fast repeated notes on A and B, played asynchronously at the beginning of the third movement (Example 2) form a Ligeti signal with F#, which is repeated as the only note in five measures at the end of the movement. In the middle of the movement a vertical F#-A is filled up chromatically by repeated notes played by all the instruments to form a lengthy contracted band of sound in measures 21–30. Where the last movement is framed by fingered tremolos on D# and F# appearing at the beginning and the end of the movement (before its final disintegration in m. 80), the missing member, namely, G#, is played by the whole ensemble as a point of arrival at the end of measure 36 (marked K in the graphic representations of the two movements at the end of the article).

A second structural characteristic that is common to all five movements relates to density, more specifically the contraction of the sound band more or less in the middle of each movement. This contraction can be described as a kind of knot, because when each movement is represented graphically, the knot separates two sections that fan out backward toward the beginning and forward to the end of the movement. This “bow” shape of the sound spectrum can also be compared to the shape of a butterfly. (See the graphic representations of the five movements.) Ligeti also uses “knot” in connection with the webs spun by silkworms when he describes a dream he had as a child:

As a small child I once had a dream that I could not get to my cot, to my safe haven, because the whole room was filled with a dense confused tangle of fine filaments. It looked like the web I had seen silkworms fill their box with as they change into pupas . . . In places knots formed, thickening into an almost solid mass, caverns opened up where shreds of the original web were floating about like gossamer. (Ligeti in Steinitz 2003: 7)

The following table gives the position of the knot in each movement. The knots that are clearly visible in the five graphic representations at the end of the article (indicated by “K”) can also be heard on YouTube.

Table 1: Position of the knot

Movement	Length in measures	Position of the knot	Nature of the knot
I	88	m. 48, marked <i>subito fff, subito feroce</i> (YouTube at 2' 18")	Ferocious playing in m. 48 interrupts the micropolyphony marked <i>molto legato, molto calmo, sempre senza vibrato</i> .
II	56	m. 28 (YouTube at 7' 45")	After asynchronous playing covering the broadest sound spectrum, the dynamic level varying from <i>pppp</i> to <i>sfff</i> , all four instruments play E in the middle of the range in m. 28, marked <i>pp sempre</i> .
III	47	mm. 21–29 (YouTube at 11' 31")	Asynchronous impulses increase to 16 per beat, sound band systematically contracts to F#, G, A ^b , A. (F#, A ^b and A shift microtonally toward G.)
IV	63	mm. 37–40, <i>ferocissimo, subito presto, sub. fff</i> (YouTube at 14' 22")	This is the only occurrence of micropolyphony in this movement: Ferocious playing within a restricted space, E-C# in the middle of the range.
V	81	mm. 36–40 (YouTube at 17' 44")	The sound band contracts to a trill on G# (mm. 36, 37) after which it expands asynchronously to trills on E, F, A, B, just below middle C. At the end of m. 40 the only <i>bona fide</i> melodic motif in the work as a whole (D, C#, F), a variant of the Ligeti signal, enters, marked <i>molto espressivo</i> .

A significantly positioned porous texture provides a third structural characteristic that appears in four of the five movements. With the exception of the fourth movement, a porous effect occurs just after the knot in the other movements, all instances contributing toward representation of the butterfly shape in sound.

The ferocious fourth movement signifies a general effect of incoherence through its random use of a variety of textures and styles of playing. It contrasts with the mechanistically ordered third movement and the general tranquility of the final movement, the sound at the end vanishing into nothingness. The fact that the fourth movement does not follow the butterfly shape may show that in the case of Ligeti's second string quartet, rational, mathematical procedures may

Table 2: Position of porous effects

Movement	Porous section	Length of movement (position of knot)
I	mm. 53–64, anticipated in m. 49	88 measures (m. 48)
II	mm. 31–33, anticipated in m. 27	56 measures (m. 28)
III	mm. 30 ² –33	47 measures (mm. 21–29)
V	mm. 53–56	81 measures (mm. 36–40)

provide insight into structures (products) but that they do not always provide the final answer where aesthetic experience is concerned.

3 Conclusion

By extending the properties of actoriality in atonal music, this article proposes a strategy to facilitate signification in atonal, amotivic music. It focuses on the goal-directedness of kinetic energy as an independent property of actoriality and the artistic and effective ways in which it is created in Ligeti's second string quartet. The way in which tension is created and resolved in atonal, amotivic music serves as a substitute for signification of conventional harmonic and melodic structures of the major-minor system of tonality.

Because time and space are integrated in the various modalities of atonal musical processes, a conceptual framework is set up for making sense of signification in Ligeti's second string quartet. The structural resemblance between the micro format of the Ligeti signal and the large scale macro format of all five movements enhances understanding of the work as a whole. This approach, which relies on the temporal unfolding of the music, shows that musical structure is more than a pre-existing template, it becomes a living thing, namely, the result of musical processes that communicate messages that may differ from work to work. It also shows that content determines form and not the other way round, which could be regarded as a legacy of tonal analysis. Where traditional analysis of music often takes the musical structure, that is the musical product, as its point of departure, this article uses musical processes to guide musical signification to arrive at significant conclusions about the overall design.

Appendix: Graphic representations of the five movements

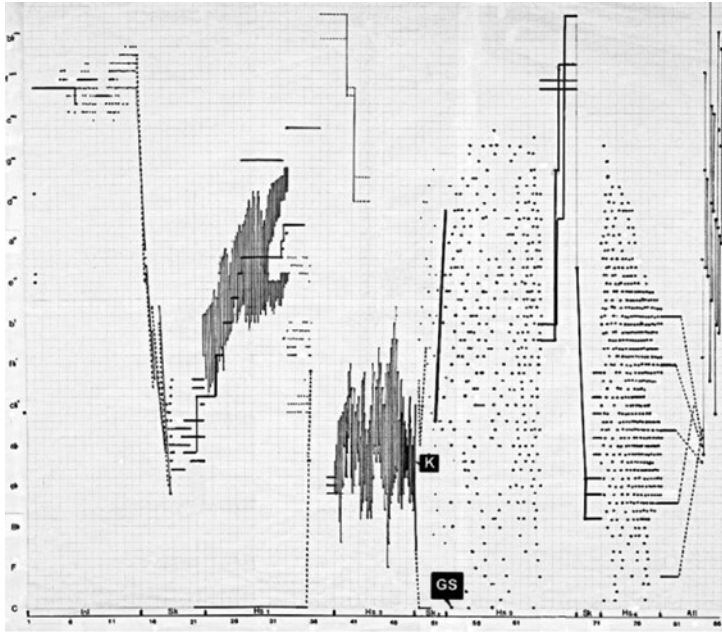


Fig. 7: First movement

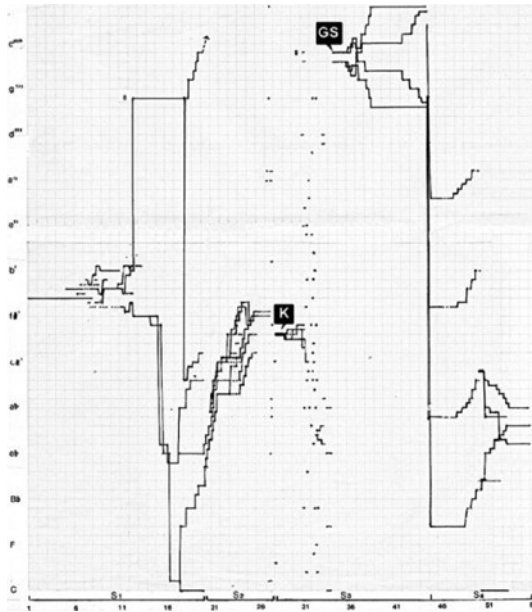


Fig. 8: Second movement

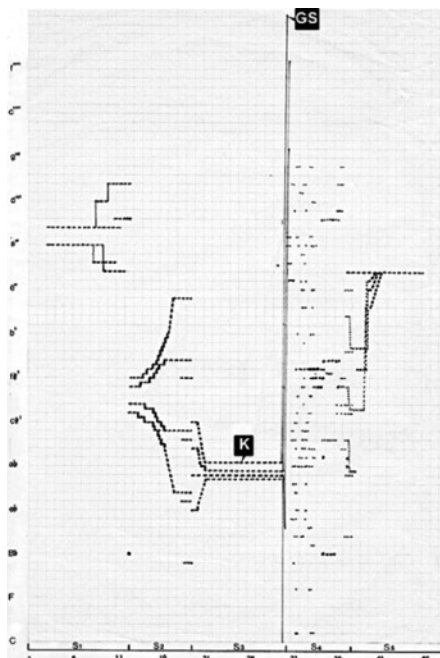


Fig. 9: Third movement

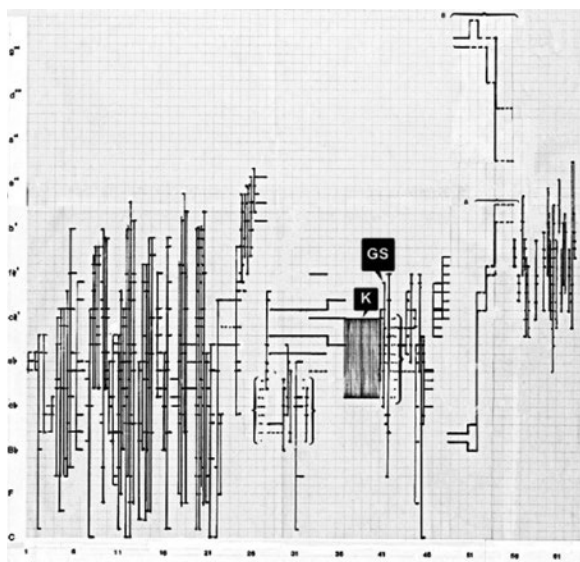


Fig. 10: Fourth movement

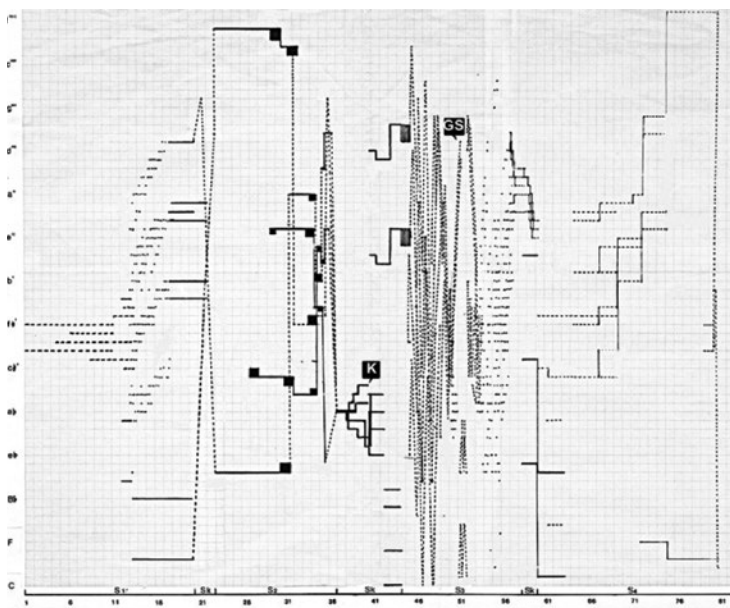


Fig. 11: Fifth movement

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Bionote

Bertha Spies (b. 1943) is Professor Extraordinary at the University of Pretoria <spies.bertha@gmail.com>. Her research interests is in music theory. Her publications include “‘Music is life’ – The influence of transcendentalist philosophy on Ives’s *Concord Sonata*” (with W. Weyer, 2007); “Renewal of education in South Africa: The problem of implementation” (2011); “Thematic physiognomy creates access to three divergent twentieth-century compositions” (2011); and *African arts* (in press).