TRACING THE RELATIONSHIP BETWEEN SPACE AND COLOR IN TWO OF BEETHOVEN’S PIANO SONATAS

OP. 2 #1 AND OP. 57

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The present research was instigated by a desire to understand sound color and its imperative role in the process of composition.1 Surely, in writing a piece of music, any composer acts as a designer of specific sounds. Yet conventional theoretical analysis rarely explores the topic of color or the means by which this is achieved. Today, the advanced sonographic technology provides tremendous insight into the composer’s intentions and leads us into a new era of research, that of spectral analysis.

The first attempt to understand color as vital to musical analysis began in 1974, when Robert Cogan and Pozzi Escot embarked on formulating an objective theory of sound. “Sonic design,” they said “is the coordination of many seemingly diverse elements of sound into a single discernible compositional entity”2 and the four interweaving elements are space, language, time and color. Equally important, sound color appears in close connection to the other three elements of sonic design, deriving its function from these relationships.

Sonic design originates within acoustical space. From slow sound vibrations to fast high pitch frequencies lies the spectral medium of composition. Though the human ear has the capability of only hearing frequencies between 16 cps (C0) to 25,000 (above C10)3, musical space offers an inestimable number of possible sonorous combinations. It is within this vast universe that composers initiate sound and music occurs. Register, shape, line and motion are all variable compositional elements dependent on the available space. Utilizing their means, the composer-designer creates an overall spatial experience unique to a particular composition. Therefore, no two pieces of music can share spatial identity, rather each emerges as an exclusive entity in limited space.

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1 The present research pertains to a more comprehensive study, namely from my dissertation with Boston University, entitled “Tracing the enhancement of sonorities in Beethoven’s sonatas.” The findings shared in this paper particularly reflect on the relationship between space and color in two of Beethoven’s piano works.
3 Cogan and Escot, Sonic Design, 16.
This paper will examine the sonorous pictures of two whole movements of Beethoven sonatas, the first movement of op. 2 #1 and the first movement of op. 57, the “Appassionata.” The movements appear as complete sonorous entities unveiling within musical space. Keeping in mind that they were written 10 years apart, for very different instruments, the research concentrates on specifically revealing the relationship between space and color in both of these works.

Beethoven’s Walter fortepiano, associated with op. 2 #1, offered him a pitch range of 1,353cps (F1-43.6cps to F6-1,396.9cps). The Erard on the other hand, associated with op. 57, increased that range to 2,049.4cps (F1-43.6cps to C7-2,093cps). When sitting down at the piano to compose, Beethoven did not only have to deal with a specific physical compass, but most importantly, with a limited audible space. Unaware of the odds, modern day pianists exploit a musical space of 4,158.5cps (A0-27.5cps to C8-4,186cps) in performing pieces intended for half of this space.

Recognizing that in addition to pitch frequency the timbral colors specific to the medium at hand re-define musical space as an area of coloristic instigation, only period instruments recordings will be used for this research. The Viennese and the Stossmechanik mechanisms will then be allowed to speak for themselves.

**Symmetrical inception**

Upon listening to the *Allegro* from piano sonata op. 2 #1 performed by Malcolm Bilson on a Walter copy by Paul McNulty, the audience cannot help but respond to the emotional angst emanated from the first Manheim rocket of the movement to the terminal chordal sonority. Attaching the light key-weight Walter piano with its boosted physical speed to the performance of this first movement directs the player into a frantic trance. The music itself seems to emanate
endless drive and the performer’s task is to keep up with it. But what exactly causes this extensive anxiety?

Appendix 1 displays a two-dimensional picture of the Allegro of op. 2 #1, clearly illustrating music’s movement in space. On one hand, the vertical axis shows pitch usage accompanied by partials distribution, whereas the horizontal one displays the progression of sound in time and reveals larger shapes formations. In addition, color content defines energy levels, dynamic intensity and register tone quality.

Considering the overall layout of this movement, one first observes uniformity in register distribution. Registers 3, 4 and 5 represent locations of primary activity. In the exposition (example 1), if one note escapes these middle registers, it is immediately counteracted by a figuration on the other side of the spectrum and then the music returns inwardly to the middle ground. Register 4 acts as the middle axis within the entire available space and, not coincidentally, middle C commences this sonata. Remembering Beethoven’s F1-F6 piano, the middle C sound marks the center of the audible medium at hand. The composition surges outwardly from this central point and, as the hands depart, a symmetry of great proportions grows on the vertical level. This contrary motion of sounds leads to a climactic reach of simultaneous wave crest and trough at the end of the exposition. Though Beethoven places the individual sounds three and a half octaves apart and respectively, four and a half octaves apart, the colorful partials generated by the heavy low bass activate the entire spectrum in between. In addition, the extreme F6 in \( f \) produces even higher harmonics, presenting a broad overall sonority that not only fills the instrumental medium at hand, but also surpasses it. All in all, the wide band here encompasses about 5,000 Herz of audible space.

But the expansive waves rapidly cascade within towards the middle registral axis. Indeed,
what makes the end of the exposition so dramatic rests not only on the extremities of the spectrum being achieved at the same time, but also on the incredible diminution of space and energy in the consecutive measures. From 5,000 Hz of sound to a thin band of 1,500 Hz, the listener is left in a state of continuous anticipation, anxious for greater sonorities and lively contrast. One last ff chordal sonority reaches to Eb 6 stimulating the highest partial yet attained. As a whole, this evenly distributed energy dilutes over the next four beats into the soft uniform chordal rendition of the new tonality, Ab major.

The beginning of the development’s spectograph (example 2) displays a similar contour to that of the exposition. But in this section, the concept of evolvement eventually alters the usage of space itself. Escaping the balancing middle ground of the instrument, the music enthusiastically reaches towards more remote registers. In particular, there seems to arise a gravitational force at the bottom of the spectrum, pulling the entire commotion towards register 1. As the left hand smoothly drops, the entire alignment shifts down and registers 2, 3 and 4 epitomize the new focal point of activity. It is interesting to note that despite this dimensional fall, the coloristic spectrum, rather than fading away, glows exceedingly with bright overtones, reaching the 5,000 Hz mark again, this time as the upshot of enriched textures in lower registers and sf attacks. Extensively used in the exposition, the familiar envelope shape of rising and descending sonorities is therefore set aside in favor of one extended block of sonorities. Space itself not only evolves on the vertical axis of sonorous partials, but also on the horizontal axis of time. This prolonged resource of sonority extended over horizontal parameters implies a successful development of audible space in time.

Concluding the section, a C major chord inclusive of C4, recalls the centrality of the available space. Ingeniously, this sound points to the verticality of the audible medium at hand,
but in addition, its placement, right in the middle of the movement, evokes the unfolding of horizontal space throughout the movement.

Soon, another shift in register configuration occurs. Contrary to the previous measures, the music now strives to reach higher heights and, consecutively exploring the upper side of the spectrum, registers 3, 4, 5 and 6 impose supremacy. Insistently, F6 resounds four times in this section, but its frailty leads to diminished sonority, rather than intensified energy. When attempting to counter-act the low range of the Walter piano, register 6 remains powerless and cannot help but succumb in *decrescendo* to the darker coloristic nature of the bass. Once again, a pedal point on middle C in *pp* exposes its spatial importance by continuing to carry on the energy of the piece (example 3). The ultimate transformation of registral activity emerges in the next few measures, above the subtle descent in the bass. For the first time in the movement, the music advances through register leaps, found in the right hand. Though all the registers have already been explored in this movement, Beethoven has always proceeded in a gradual manner. Suddenly, the frantic jumps seem to expand the available space and, accompanied by the *crescendo* marking, they create an incredible anxiety. In the midst of this anticipation, the recapitulation takes its course and provides tremendous satisfaction through familiar sound combinations and cautious register motion.

The recapitulation displays a spectograph almost identical to that of the exposition (example 3). The music flows smoothly reestablishing the gradual symmetry of sound envelope. Six measures of intense chordal sonorities in *ff* conclude the *Allegro*, rigorously putting an end to linearity in this movement (example 4). The energy reaches once again the 5,000 Hz mark and the last f minor chord, presented in both hands in close position, symmetrically covers registers 2, 3, 4, and 5, and centrally surrounds middle C.
The overall picture of this movement reveals Beethoven’s genius and his deep understanding of the Walter instrument. On a medium of limited resonance, he finds ways of diversifying the coloristic substance, creating an atmosphere of perpetual motion and anxiety. Knowing the spatial boundaries, Beethoven commences by establishing a solid middle ground. Usually, he keeps the hands only one or two octaves apart. The linear, envelope shape sonorities bring about the continuous audible rise and fall of the music targeting a general frequency ceiling between the 2,000-4,500 Hz range. Climaxes reaching the 6,000 Hz mark grow out of the abandon of the middle register, when lines start departing from each other and from the central axis. They do so simultaneously, in contrary motion. Bearing in mind the dryness of the early Viennese piano, no attempt of exploring monophonic lines is ever considered. As they diverge, the hands lead to a juxtaposition of delicate higher sounds and robust lower ones, activating a wide band of colorful overtones in between. The effect is that of symmetrical unity. When outer registers finally disclose their timbre, they still wrap around the center of the keyboard, making use of its richness. On the horizontal level, the centrality of space is celebrated through the extended block of vigorous sonorities in the development section. Comparably, middle C stands at the intersection of these two perpendicular axes and a symmetry of incredible proportions defines this movement.

*Tragic contrast*

Sonata op. 2 #1 not only serves as a springboard for the upcoming works in the genre, but also gives a glimpse of Beethoven’s creativity in utilizing the sonorous space of a particular piano. 10 years later, he proceeds in writing the “Appassionata” for quite a different instrument than the Walter. This time, the Erard’s physical space of 5 ½ octaves offers higher resonances as well as fresh sounds produced by the English-action mechanism.
Listening to the *Allegro assai* of op. 57, the audience embarks on a ride of unexpected contrasts. Occasional mysterious atmospheres oppose eccentric outbursts of sonority and sweet peaceful dispositions give way to violent conquests. All these temperamental changes happening over a steady ongoing pulse place the listener in a frantic emotional state. Good’s assertion proves true here, “beginning with Beethoven, the romantics wrote music differently, bringing emotions out to overt, sometimes excessive expression.”

Glancing over the spectograph of this movement played by John Khouri on a 1801 Broadwood (very similar to Beethoven’s own Erard), one perceives these emotional stages as cleverly treatments of the available musical space.

The overall picture of this movement displays quite a different coloristic layout than the *Allegro* of op. 2 #1 (appendix 2). Symmetry and envelope shape sonorities are laid aside in favor of a spontaneous approach characterized by constant changes in sound appearance within space. In the exposition (example 5), the opening punctuated low-energy figurations emerge as the result of strict parallelism between the hands. Spaced exactly two octaves apart, the two voices play in unison in *pp* for two and a half measures. Though the human ear (or the spectograph) cannot perceive the fundamental of the low notes, the overtones close the gap between the right and the left hand, seemingly exposing the top voice’s notes as stronger partials of the lower voice.

But this parallel motion stirs up opposing ideas in a context of musical contrasts. Abruptly one encounters the first fiery upshot of energy resulting from a downward zig-zag arpeggiation. Then follow three peaks formed through the means of upward chordal sonorities. These short yet powerful outbreaks reach the 7,000 Herz mark and present an evenly distributed intensity never imagined in the first sonata. By launching them in the midst of quiet 1,000 to

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4 Good, *Giraffes, Black Dragons, and Other Pianos*, 119.
2,000 Herz material, Beethoven introduces the emblematic feature of this movement, tragedy expressed by outstanding contrast.

Falling pedal points lead into the second theme presented in parallel octaves and accompanied by rich broken octaves. Linearity makes its way on the visual representation as well. From Fb 6 to Bb 1, four and a half registers elegantly display their unique spectra. As the sound drops, the overtones reduce, yet the richness of the fundamentals enhance. Strict yet rapid contrary motion also adds to the collection of visual signs. As several fundamentals generate multiple overtones that overlap, they create high-energy acoustic beats and stunning coloristic combinations in the lower half of the sonorous range. The exposition concludes with yet another contrasting motion, a soaring tremolo in register 6 reverberating over a slow descending arpeggio. Departing from each other, the hands end up 5 octaves apart in \textit{pp}. The elevated sound of Ab 6 disappears as a reflection of the unperceived Ab 1 on the other side of the spectrum. Though broadly defined, musical space appears hollow in the middle. As the few overtones fade away over the next three beats, space itself seems to dissolve. The listener might be inclined to believe that Beethoven has arrived to a peaceful destination, free of passionate contrasts and diverging ideas. But this reflection proves only temporary.

What truly maintains the tremendous energy in this movement is the incessant register shift on a large scale. No particular octave of the piano takes priority over the others. The depth, middle and height of musical space are all explored in a fairly short time. In between, the music floats around from register to register, refusing to let the ear accommodate to one specific sonority or range color.

The development’s spectograph (example 6) appears even more striking to the eye in comparison to that of the exposition. Though it begins by outlining the same punctuated
sonorities as in the exposition, it abandons the short high-energy outbreaks in favor of prolonged colorful chunks of ardent resonances. Register shifts as long as contrary motion happen at a continuous fast rate. Space here seems to be stretched and then condensed as an accordion from a narrow band of approximately 700 Herz to 7,000. The hands cross each other three times in the process. Touching the crests and the troughs at the same time in \textit{f}, they successfully expose the spatial grandeur of the instrumental medium at hand.

But as though attempting to weaken the tension, Beethoven inserts a lengthy pedal point on Ab 3, contracting space to one horizontal procession. Jumping thirds in the right hand keep the momentum going, activating blue and red patches of sound above this pedal point of up to 4,000 Herz. Nevertheless, compared to the upcoming section of the development, this solitary pedal point brings about stability in space.

Through visual analysis of this last part of the development section, one experiences an illusion of ever rising fireworks that eventually explode at the top of the spectra and at once succumb to the opposing low periphery in preparation for the recapitulation’s arrival. Conceived out of uprising sequences of the second theme, the incredible climax gains intensity when the right hand proves powerless of exceeding the highest register of the piano. As the left hand approaches, the top voice frantically screams its ever-shortening motif, as if loosing breath. Fascinatingly, sonorous space broadens underneath the bass line, regardless of the overtones shrinking above it. The luminous area subsequently becomes the ideal location for forceful reprisal. A \textit{ff} triple pedal point of alternating 16ths triggers a wide band noise of 9,000 Herz. Beethoven remembers the insistent four-note motif from the exposition and, to boost the audible chaos, decides to violently toss it around the tremolo, from register 2 to register 5. Whereas register shift had so far appeared in a gradual manner, no trace of controlled placement remains
here. The earsplitting reverberation represents the utmost goal. Sound richness transpires through vivid red scrapes on the spectograph. The intense high partials restate the instrument’s sonorous projection. Considering its highest pure pitch at around 2,100 Herz, this massive block of overtones surpasses the piano’s physical means by more than 4 times. In the midst of this turmoil, one recalls Beethoven’s dissatisfaction with the publisher’s nickname for the piece. “The term ‘appassionata,’” Charles Rosen objects, “does not render the tragic character of the work, evident at once with the opening page.”

The recapitulation follows in a faithful manner (example 7). As it concludes with another tremolo effect, for a moment, the five-octave gap between F1 and F6 evokes space emptiness, just like in the exposition. But rather than letting the sounds float and disappear in the abyss, Beethoven retains the transcendental sonority of the tremolo and proceeds to further improvisation.

The following section (example 8) is often labeled as part of a long coda, but its sequential material and unprecedented improvisational character reveal a concerto-like cadenza in its own right. Starting with familiar motifs, the performer transitions into virtuosic displays of raging arpeggiated figurations. On the spectograph, these bring back uprising colorful resonances, helped by the ff dynamic marking and long pedal indications. Zig-zag minute articulations generate quivering partials, giving the impression of uprising uncertainty. On a small spatial scale, this perpetual movement compels the ear to perceive motion quickly and process the abundance of coloristic change at a very fast rate. On a large spatial scale, however, linearity proves the most dramatic motion yet. As the fundamental gradually rises from Bb 1 to Db 4, the anxiety level escalates with every step. The top voice reaches Bb 6 and threatens to

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5 Charles Rosen, Beethoven’s Piano Sonatas: A Short Companion (Yale University Press, 2002), 192.
6 See Rosen, Beethoven’s Piano Sonatas, 195 and Taub, Playing the Beethoven, 172.
surpass the physical means of the compass again. All in all, six different registers anticipate a climactic experience.

The event occurs when cascading arpeggiations reverse the overall upward motion of the cadenza. Brilliant sonorities of rapid descents followed by ample crests translate into audible and visual explosions of great intensity. Each group of two measures explores registers 6, 5, 4, 3 and 2 back and forth. It is in this setting that both C2 and C7 (the highest note on Beethoven’s piano) are played simultaneously encompassing a wide distance of 2,000 Herz.

The sweeping arpeggios striving for the 7th register, then hovering over registers 6, 5, 4, 3, 2 and nervously rushing all the way back, leave both performer and listener breathless. One last rollercoaster looses momentum and, exhausted, finds no strength to return to the top. On the spectograph, space visibly condenses from 6,000 to 600 Herz. The pp, ritardando and diminuendo indications drastically erase the colorful violence previously encountered on the graph. A sense of desolate questioning and heartbreaking renunciation settles in for just a few moments.

But an impulsive ff gesture interrupts the deplorable atmosphere by outwardly throwing the arms towards the edges of the keyboard where F1 and F6 are simultaneously played one last time. Helped by the additional notes within the chord, the aggressive figuration shoots above the 7,000 Herz mark, displaying evenly distributed energy that surpasses the compass. Indeed, here it appears that Beethoven reveals additional space, space he had been saving for this very special moment of outrageous fervency. This striking event commences the true Coda. Although the subito p and the immediate contrary jumps to register 4 attempt to reduce this powerful outbreak’s impact, the remainder of the coda expands outwardly in intensity. Beethoven applies sf signs and amplified dynamics to the rapid exchange of material between hands. This spatial
alternation stimulates a wide-band of electrifying frequencies. Aggressive expression leads to incredible richness exhibited as vibrant burgundy fundamentals in the lower half of the spectograph and dazzling indigo overtones in the upper half. Yet this raging anguish evaporates in a matter of seconds. Accompanied by a shaky tremolo in the center of the piano, one last arpeggio rises to reach F6, but then succumbs under the long lasting reverberation of F1 and the held pedal. The ppp marking, never before used in the piano sonatas, aids this transition from outburst to peace, from sound to silence, and from broad space to nothingness.

If “the handwriting in the [Appassionata’s] autograph manuscript betray the emotional turmoil of the piece,” the visual representation of its performance displays an ongoing spatial struggle. From the gloomy low fundamentals to the soaring eruptions of powerful overtones, space does not merely represent the localized parameter in which these events take place; but rather, it becomes the very element responsible for shaping the drama in audible contrast. Low/high dramatic surprises in the exposition, and later in the recapitulation, are substituted by prolonged areas of fiery activity attaining constant peaks of 6,000-7,000 Herz in the development and coda sections. The cadenza, on the other hand, exhibits flashy fireworks that seem to stretch space and exceed the audible means of the Erard.

Beethoven sets no specific boundaries between the hands here. They proceed either in parallel, contrary, or zig-zag motion, sometimes courageously crossing each other to enhance the drama. The entire compass belongs to the imagination. Quick register shifts make it impossible for the ear to accommodate to a specific timbre, hence the continuous element of surprise. On numerous occasions in this movement Beethoven gives the impression of additional range extensions. The high seems to make room for higher and the low drops to even lower depths. Consequently, incredible gaps between peripheral registers result in diverse colorful illustrations.

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7 Rosen, Beethoven’s Piano Sonatas, 192.
Sometimes the complete spectra is stimulated, reflecting an evenly-distributed sonorous upshot. Other times, the higher pitch appears as a contained overtone of the lower one. In yet other cases, the physical gap translates into an audible one, validating an inward hollow area and redefining space as a region of activity rather than a previously set frame. When activity stops, space itself seems to evaporate.

**Conclusion**

Whereas in the *Allegro* of op. 2 #1 Beethoven had produced anxiety through symmetrical departure from the middle ground, in the first movement of the “Appassionata” he causes tragedy through extreme audible contrast. Definitely inspired by the richer sonorous medium of the Erard, he delights in using a variety of visual signs. Beethoven treats space and color in an enhanced way in the “Appassionata,” taking full advantage of the enlarged physical space but also, on a smaller scale, he uses the intricacies of minute motions to project diversity of color. Indeed, both the coloristic potential and space itself seem to evolve compared to op. 2 #1. The outcome presents itself extremely compelling and, just like Robert Cogan and Escot Pozzi, one comes to the conclusion that “the essence of musical power derives from the inventive use of whatever space is available.”

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APPENDIX 1 - op. 2 #1 *Allegro*

Example 1 - Exposition

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8 Ibid, 17.
Example 2 - Development

Example 3 - Retransition/Recapitulation
Example 4 - Coda

APPENDIX 2 - op. 57 Allegro assai
Example 6 - Development

Example 7 - Recapitulation
Example 8 - Cadenza/Coda