

Analysis, Performance, and Images of Musical Sound: Surfaces, Cyclical Relationships, and the Musical Work

John Latartara and Michael Gardiner

Introduction

It is not a question of junking these concepts, nor do we have the means to do so. Doubtless it is more necessary, from within semiology, to transform concepts, to displace them, to turn them against their presuppositions, to reinscribe them in other chains, and little by little to modify the terrain of our work and thereby produce new configurations. (Derrida 1981:24)

Following Derrida, in this paper we hope to reinscribe the familiar musicological concepts of analysis and performance, drawing them into new relationships, in order to turn them against their presuppositions and produce new configurations. Through an exploration of analysis, performance, and images of musical sound, these new configurations highlight surface details and offer an alternative approach to previous analysis and performance paradigms, leading to a reformulation of the concept of the musical “work.”

The relationship between analysis and performance has posed challenging questions for musicologists, theorists, and performers, generating some of the most thought-provoking discussions in the literature. The endeavors of analysis and performance are closely related, yet historically they have employed different methods and participated in different traditions. Nicholas Cook writes, “I would like to counterpose not so much the analyst and the performer but rather the ‘writing’ and the ‘performing’ musician, or, more precisely, music as writing and music as performance” (1999:250). For the most part, analysts write about notated music, whereas performers play or sing music. While not inherently negative, these differences of activity have contributed to the chasm that often exists between music analysis and performance. For the most part, musical conclusions in analytical articles are based upon score analyses, leaving performers’ interpretations entirely out of the discussion. Rarely do analytical articles base their musical conclusions on performance analyses, unless that is the specific intent of the article.¹

In order to focus our argument we define “analysis” as the methodological activity of analyzing a score as practiced in most Western art music analytical journals published today. Likewise, while the concept of musical

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performance can encompass improvisation and physical gesture, we take “performance” to mean the Western art music performance tradition, as practiced today, of score interpretation. Although both definitions are admittedly limited, they represent typical approaches and activities within both fields.²

Why should the fields of analysis and performance be brought closer together, and how would this benefit musicologists, theorists, and performers? The simple answer is that both analysis and performance are mutually supportive endeavors that broaden our musical understanding in different but related ways. A more profound reason for bringing analysis and performance closer is that doing so can expand our understanding of the musical “work.” Although a problematic term and concept, a musical “work” is generally defined within the Western art music tradition as having an identity based upon a score that is used for performance interpretation and having a fixed beginning and ending (see Talbot 2000:169–70). This score-based view of the musical work has exacerbated the gap between analysis and performance by drawing sharp lines between score and interpretation, and we claim that images of musical sound generated through spectrography can provide the tools to bring these fields together. The three main points we highlight are: (1) analysis and performance have had troubled relationships in musicological literature, (2) images of musical sound (spectrographs) can bring novel perspectives to analysis and performance, and (3) these novel perspectives can be used to generate a different, non-score-based conception of the musical work.

We begin with an introduction to current analysis and performance research, after which we proceed to a discussion of images of musical sound, spectrographs, and the musical surface. We then compare two performances each of C. P. E. Bach’s *Fantasia in C Minor*, W. 63, no. 6, and Beethoven’s “*Hammerklavier*” Sonata, op. 106, movement 1, to demonstrate the value of spectrographic images in rendering visible and comprehensible the musical surface. Our analyses highlight and compare surface details between two different performances, as well as between performance and score. In the next section we discuss the new cyclical paradigm that can be formed connecting score, performance, and spectrograph, and we show how this offers an alternative to previous analysis and performance paradigms and to widely accepted notions of the musical work. Finally, drawing upon our discussion of spectrographs and musical models, we propose a new theory of the musical work as dynamic and in constant flux.

Analysis and Performance

Recently a growing number of publications have specifically addressed both analysis and performance. Cook points out that in the field of music theory, “Wallace Berry’s book *Musical Structure and Performance* [1989] . . . marked the emergence of ‘analysis and performance’ as a recognized sub-discipline within music theory” (1999:239). Drawing on Seeger (1977:168–81), Rink (2002:37) provides a useful framework to separate analysis and performance literature into two types. The first approach he calls “prescriptive,” which involves the analysis of a score prior to, and perhaps as the basis for, a performance. The second he calls “descriptive,” which involves the analysis of an actual performance.³

Prescriptive performance analyses using more traditional analytical methodologies have included those by Schenker (2002), Cone (1968), Narmour (1988), Berry (1989), and Schachter (1994). All of these studies have emphasized that score analysis, within a theoretical framework, can lead to more insightful performances. Berry exemplifies this view when he writes that his *Musical Structure and Performance* is “about the systematic, rational examination of music toward demonstrable insights into structure as immanent meaning, and thence to concrete, pragmatic issues of tempo and articulation reflected in the myriad, subtle details of execution” (1989: ix). From this prescriptive mode, the interaction between analysis and performance is a one-way process, moving from analysis *to* performance.

Descriptive performance analyses attempt to reverse this one-way flow by beginning with the performance instead of the score. In relation to Western art music, this approach was initially developed in the field of music psychology and has, for the most part, concentrated on the musical elements of time, dynamics, and articulation. Gabrielsson (1999:523–50) provides a summary of descriptive performance analysis research that he separates into two eras: the early and the contemporary. The early era begins with the dynamic and articulation studies for piano by Binet and Courtier (1895) and continues to the 1940s, and the contemporary era begins with the work of Bengtsson, Gabrielsson, and Thorsen (1969) on timing and dynamics and continues to the present.

A number of recent studies specifically attempt to bridge the chasm between score analysis and performance analysis. Cogan (1984) analyzes performances using spectrographs of musical recordings from a variety of eras and cultures. He also analyzes different performances of the same piece and uses spectrographic images as corroborating evidence for a theory of tone color. Schmalfeldt (1985) attempts to bridge the analysis and performance gap by creating a dialogue between analyst and performer

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(herself in both cases) that highlights how each perspective might move the other toward a better understanding of a Beethoven Bagatelle. Both Folio (1993:2) and Rink (2002:39) attempt analyses using more unorthodox approaches aimed specifically at performers. Folio uses the concepts of drama, narrative, and plot to analyze Bartók's *Contrasts*, and Rink provides a list of methods, including tempo and dynamic graphing, that can be used to guide performances. Lester (1995) draws relations between score analysis and performance, and Clarke (1995) creates links between score and performance using theories of musical expression. Finally, Goodman (2002) and Johnson (2002) analyze performance aspects of time, tempo, and dynamics by matching and comparing these elements with the score. Johnson also uses a "spectrogram" to analyze vocal vibrato.

While musicologists and music theorists have only recently turned attention to these analysis and performance issues, ethnomusicologists have actively investigated these connections since the late nineteenth century. As Stock bluntly states, "much ethnomusicology is intimately concerned with issues of musical performance; some of it even refers quite explicitly to the Western art music tradition. But neither Rink nor Dunsby makes any mention of this large body of published research. Ethnomusicology is effectively 'written out' of the history of music research" (1997:43). Largely through the need for transcriptions of non-notated music, ethnomusicology has from its inception been grappling with performance issues in relation to analysis, notation, structure, culture, and meaning (Ellingson 1992), providing an important additional contribution to the analysis and performance literature.

Images of Musical Sound, Spectrographs, and the Musical Surface

"Images of musical sound" refers to performance images created automatically by some kind of machine or device. The history of sound imaging has been directly dependent upon advances in electronic and computer technology. The earliest studies to take full advantage of new technologies for musical analysis were by ethnomusicologists. These methods date back to the early twentieth century with the studies of Pliny Earle Goddard (1906), Densmore (1918), and Metfessel (1928) (see Ellingson 1992). These early devices automatically transcribed fundamental frequency content, which could then be translated into musical notation by hand. Perhaps the most famous of these devices was the "melograph" developed by Charles Seeger (1951), which revealed not only pitch, but also amplitude and overtones from a live or recorded performance. With dramatic advances in technol-

ogy and computer speed in recent decades, the spectrograph replaced the melograph and emerged as one of the more powerful and useful ways to image sound.

Spectrographs, also called spectrograms or sonograms, represent sound as a two-dimensional image, showing pitch on the vertical axis, time on the horizontal axis, and dynamics using shading or color. Spectrographs, therefore, provide pictures of actual musical performances that show the entire sonic signal, including the fundamental, overtones, and complex noise-like sounds (for example, attack noise from piano hammers). A spectrograph is a static visual model of music, derived from the temporal process of performance.⁴ Unlike a score, which in the Western art music tradition is mostly prescriptive, a spectrograph is descriptive, providing a detailed visual picture of a specific performance. Although both are visual representations of a work, the benefits of comparing the score and the spectrograph lies in their functional differences, not their similarities. We analyze spectrographic images to reveal similarities and differences between not only score and performance, but also between different performances. Our analytic observations, consequently, are based upon both the score and performances.

Spectrographs were developed and initially used at Bell Laboratories in the 1940s and 1950s to study the language sounds of speech (Potter 1945, Fletcher 1953, Potter, Kopp, and Kopp 1966). Some of the earliest spectrographs of Western musical performance are Potter's (1945) image of a tenor with orchestra, and Winckel's (1960) "sonogram" image of a passage from Beethoven's Symphony no. 8. Cogan (1984) was the first to publish a book-length study devoted entirely to the analysis of music through the use of spectrographic technology. More recent studies that utilize spectrographs for the analysis of musical performance in both Western and non-Western traditions include Huang (1998a, 1998b), Cogan (1998, 1999), Leech-Wilkinson (2003), and Latartara (2004, 2005).

There is a critical distinction between the spectrographic image and musical hearing. Spectrographs provide a visual representation of a physical sound signal, while musical hearing is a human perception involving both the physical and the psychophysical. For example, a spectrograph may show a fundamental pitch at 262 Hz with many overtones, all with a strong intensity, and vertical bands of complex noise-like frequencies at the onset. These various details, however, would be perceived by a listener as the single pitch C4 played loudly on a piano. This is why spectrographs can be so useful for performance comparisons. In addition to hearing that one performer plays a certain passage differently than another performer, we can examine precise differences in the performances' overtone structures,

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complex noise-like onset sounds, and dynamics. Being able to analyze and discuss quantitative measures of frequencies and intensities provides valuable information for the analyst that is not available to the same level of precision from listening, and therefore allows for more detailed analytical comparison of different performances.

In addition, through their detailed representations of the musical “surface,” spectrographs facilitate an analytical approach that reflects postmodern insights into meaning and interpretation.⁵ Postmodern critics often stress surface over depth, representation over reality, arguing that analysis does not uncover underlying truths but rather multiplies surface effects. In one of the classics of postmodernism, *Simulacra and Simulation* (1994), Baudrillard discusses the idea of surface and depth in relation to the religious “image” and the deeper meaning that image represents. In defining the differences between “representation” and “simulation,” he sets up a series of successive phases that reconceptualize the relationship between image and deeper meaning:

Such would be the successive stages of the image:
it is the reflection of a profound reality;
it masks and denatures a profound reality;
it masks the absence of a profound reality;
it has no relation to any reality whatsoever: it is its own pure
simulacrum. (1994:6)

Baudrillard argues that the conceptual space of representative meaning has been flattened, eliminating the connections between signifier (image) and what is being signified (deeper meaning). An image no longer stands for something else—something more profound—but rather stands for what it is on the surface, the image itself. In a similar fashion spectrographs can be used to examine musical surfaces. If we replace the word “image” with musical “score,” Baudrillard’s successive phases gradually flatten out deeper, hierarchical analytical meanings in favor of the musical surface—the score or performance without reduction. The score, and thereby the performance, can be thought of as not reflecting or hiding a deeper analytical meaning but merely existing on the surface as itself. This does not mean that musical surfaces are meaningless, but rather that meanings may proliferate independent of deeper musical structures. Spectrographs facilitate analysis of the musical surface by creating a static picture of the surface details of a musical performance, which can then be examined.⁶

This process of examining musical surfaces has become increasingly popular for both composers and music analysts. Stockhausen’s concept of “Moment-Form,” for example, can be viewed as a concern with the surface:

When certain characteristics remain constant for a while—in musical terms, when sounds occupy a particular region, a certain register, or stay within a certain dynamic, or maintain a certain average speed—then a moment is going on . . . and when these characteristics all of a sudden change, a new moment begins. (1989:63)

Rather than reducing musical details, Stockhausen describes the musical surface to develop his theory of the moment. Studies by Kramer, who analyzes Mozart's *Divertimento in E \flat , K. 563* (1995:26–32), and Fink, who draws long-range connections without underlying hierarchical levels (1999), both explore the idea of the musical surface. In one of his analyses, Fink shows long-range linear connections in the Credo of Beethoven's *Missa Solemnis*, op. 123, created through duration and register. Fink writes,

[the connection] does not assign some pitches to a “deeper” level of structure; nor does it say anything about the intervening music. It is simply a consequence of the surface fact that these are the *only sustained choral notes in the extreme (above g²) soprano register during that 178-bar stretch of music*. (1999:112)

While this approach is certainly a useful way to challenge hierarchical analytic approaches, our methodology is somewhat different. Rather than scanning only the score for surface connections, we are interested in highlighting specific surface details from both the score and multiple performances of the same piece in order to reveal connections and oppositions that exist between score and performance.

While it is true that spectrographs grew out of the scientific and structural linguistic fields, the visualization of musical sound need not dictate a structuralist approach. An approach that considers score, multiple performances, and spectrograph can multiply both the amount and kind of information available to the analyst. We agree with Cook when he argues, “a musicology of performance really demands the integration of sound, word, and image achievable through current hypermedia technology” (2001:13). The following analyses, therefore, seek to increase the possibilities and complexities of analysis and performance relations.

Performances and Analyses

C. P. E. Bach's *Fantasia in C Minor, Opening Passage*

C. P. E. Bach's *Fantasia in C Minor*, W. 63, no. 6, provides a good example for spectrographic performance analysis, both in terms of performance practice and instrumental choice. With its improvisational character and unmeasured

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Example 1: Beginning of Bach's Fantasia in C Minor.

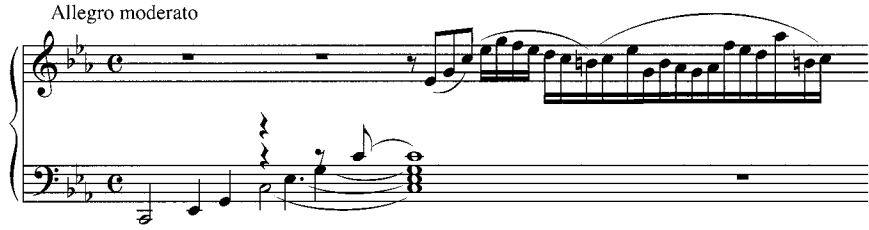


Figure 1a: Spectrograph of beginning of fantasia played on a clavichord by Benson.

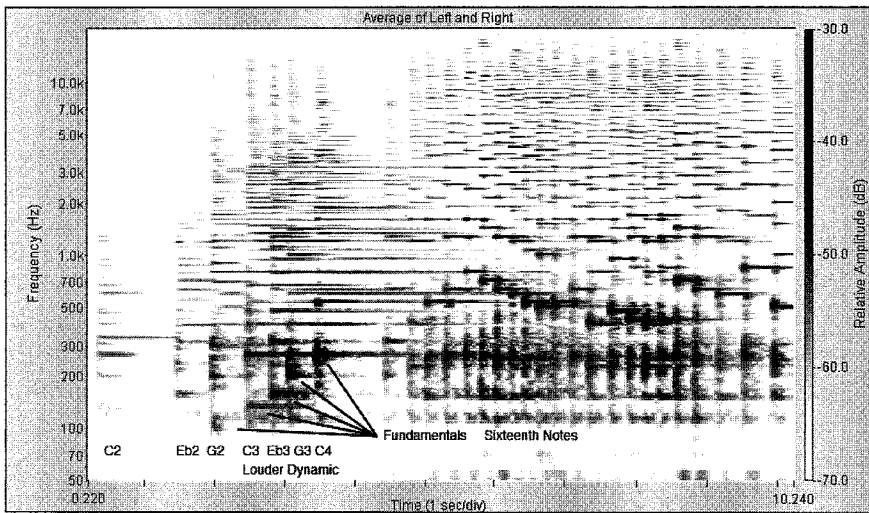
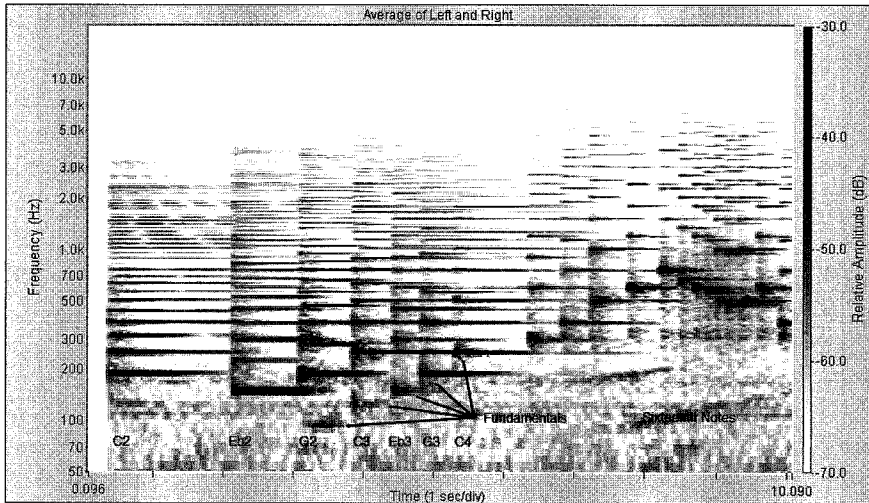


Figure 1b: Spectrograph of beginning of fantasia played on a fortepiano by Garvey.



beginning and ending sections, the fantasia offered Bach a way to “practice the declamatory [speech-like] style, and move audaciously from one affect to another” (Bach 1949:153).⁷ We will analyze the opening passage played by two different performers on two different instruments. Joan Benson (1993) uses a clavichord and Evelyn Garvey (1988) uses a fortepiano, and these instrumental choices have radical consequences for the sound and perception of the performances.

Example 1 shows the score for the beginning of the fantasia, and figure 1a shows a spectrograph of this beginning played on a clavichord by Benson.⁸ At the bottom of the spectrograph the corresponding fundamental pitch is shown, as well as the sixteenth note passage.⁹ If we focus on just the opening arpeggio, a number of characteristics regarding performance and instrumental sound emerge. As shown by figure 1a, a dramatic spectral expansion occurs, both through the rise in register and an increase in dynamics. The opening C Minor arpeggio begins quietly on C2, but gradually gets louder as it moves upwards to C4. This is seen as a change from predominantly grey to black and as an increase in upper partials, moving from a narrow spectral range on C2, with upper partials reaching only 1.5 kHz, to a wide, complex spectrum on C4 with upper partials reaching as high as 18 kHz. Moving from C2 to C4 can be perceived as a shift from darker sounds to brighter sounds. In general, lower, less intense sounds, which show fewer overtones, are often perceived and described as darker, and higher more intense sounds, which show more overtones, are often perceived and described as brighter (see Cogan 1984:1–19). These terms, however, are not absolute and are used relatively with each piece being analyzed. As the piece rises into registers 4 and 5 and increases in dynamics during the sixteenth-note passage, upper partials extend to 20 kHz, the limit of human hearing. Also, as the dynamics and attack density increase, complex noise-like sounds, caused by attack sounds and appearing as vertical bands of grey, emerge underneath the fundamentals. This extended upper partial range and complex spectra underneath the fundamentals corresponds with an even brighter, more complex sound. As heard in the performance and shown by the image, this opening gesture (from C2 to the sixteenth-note passage) projects a vivid spectral expansion and sonic shift from a darker and simpler sound to one that is brighter and more complex.

In addition, articulation plays a crucial role in the shaping of this opening. The first three pitches, C2, E \flat 2, and G2, are isolated from one another, with little overlap between partials. The remaining four pitches in the bass clef, seen as longer grey horizontal lines, are sustained into one another, creating a denser harmonic sound. The overall sound of this clavichord performance is spectrally varied and bright, achieved through instrument choice, dynamics, and articulation.

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Figure 1b shows a spectrograph of the same Fantasia in C Minor opening passage, played on a fortepiano by Garvey. For the opening C Minor arpeggio, the fortepiano maintains a relatively constant dynamic level, shown by the consistent shades of grey and black, and displays less spectral difference, shown by the steady upper partial peak between 3–5 kHz. There is a subtle crescendo to C3 followed by a decrescendo to C4, shown by a very slight increase and decrease in upper partials. Compared with the clavichord, the fortepiano performance is characterized by a narrower spectral range with upper partials reaching only as high as 5 kHz, reflecting a darker sound with much less dynamic contrast. Even during the beginning of the sixteenth-note passage, the upper partials barely rise above 5 kHz. Also, Garvey's fortepiano is tuned one half-step lower than Benson's clavichord, another factor in the darker sound.¹⁰ Similar to the clavichord, but more constant, the fortepiano projects complex noise-like sound between partials and below the fundamentals. Some of these noise-like grey bands between 50–100 Hz, however, are caused by ambient hiss from the auditorium recording. (Benson's clavichord performance was recorded in a studio.)

In addition, Garvey's opening articulation is also different from Benson's. Rather than waiting until C3, Garvey sustains each pitch into one another, starting right at the beginning with C2. The overall sound of this fortepiano performance is dark and spectrally static, achieved through instrument choice, dynamics, and articulation.

Looking more closely at Bach's score in example 1, the notation reveals important subtleties.¹¹ For this opening passage, Bach provides no dynamic indications in the score, but does express a specific articulation. Beginning on C3 in the bass voice, using the "French manner" of notation, the left hand splits into four separate voices, each sustained by a slur (Bach 1949:155). Bach notates the move up from C2 to C3 as part of a single voice, whereas the ascent from C3 to C4 is part of a multi-voice texture. While both performances articulate this difference, they do so in different ways. Benson, playing the clavichord, carefully isolates C2, E2, and G2, and then increases the dynamic on C3, while sustaining the remaining pitches, E♭3, G3, and C4. Although the fortepiano does not isolate the opening three pitches, Garvey does create a subtle crescendo that peaks exactly on C3 just before a decrescendo, highlighting the initiation of the multi-voice texture. Also, both performers speed up when playing the arpeggio from C3 to C4. Therefore, while each performer, through instrument choice and performance execution, interprets this opening passage differently, both interpretations demonstrate a remarkable sensitivity to the surface details of Bach's score.

Beethoven's "Hammerklavier" Sonata op. 106, movement 1:
Thematic Transformations

While Benson and Garvey chose to perform on different instruments, Russell Sherman (2000) and Wilhelm Kempff (1965) both perform the first movement of Beethoven's "Hammerklavier" sonata on a modern grand piano.¹² The following analysis explores three occurrences of the opening theme, beginning from the eighth-note anacrusis to the second beat of m. 4, showing how Sherman and Kempff articulate different and even opposing approaches to the material. These differences are largely determined by the way each performer interprets Beethoven's pedal, rest, and dynamic indications. Example 2 shows the opening theme mm. 1–4, and figure 2 shows a spectrograph of both Sherman and Kempff playing these opening bars.

As shown by figure 2, Sherman keeps the pedal depressed throughout the passage, resulting in a continuous spectral band with a strengthening of the upper partials in the second half of the phrase. Since F3 is prominent in the left hand in both halves of the phrase, the bottom of figure 2 shows an unchanging, continuous band. Unlike Sherman, Kempff lifts the pedal between the two halves of the phrase, highlighting the notated rests in m. 2 and creating a division in the sound. Kempff's decision to lift the pedal to perform the notated rests can be viewed as a foreshadowing of more radical divisions to come. Whereas Sherman's opening is unified in its spectrum, Kempff immediately creates division. Sherman's execution unifies the tonality, dynamic level, pedal marking, wide registration, and homophonic texture, only to be transformed in its subsequent appearances. Kempff's divided opening promises future thematic transformation.

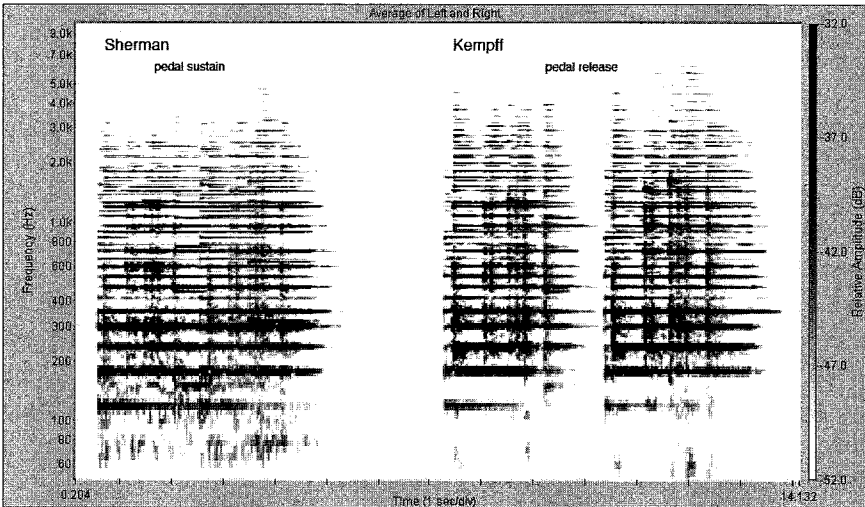
Example 3 shows the thematic appearance at mm. 34–38, and figure 3 shows a spectrograph of Sherman and Kempff playing mm. 34–38. In this next appearance, the theme is harmonically divided in two, the first half sounding a B \flat Major triad, the second a D Major triad. One effect of this tonal shift is that the material is made unstable, opening up possible trajectories of development. The pedal is rearticulated to highlight the movement to this new tonality. Once again, however, Sherman and Kempff make different interpretive decisions. Sherman chooses to sustain the B \flat material through the notated rests, whereas Kempff chooses to highlight these rests. As in the opening, Sherman emphasizes unity of material by sustaining the sound, whereas Kempff emphasizes division by stopping the sound. Although this version contains a tonal division, spectrally this section has a similar profile as the opening, owing to common dynamics, density, and smooth voice-leading with common tones F and D in the outer voices. In both parts, there is a wide spectrum with a static fundamental and identical rhythmic punctuation.

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Example 2: “Hammerklavier” theme mm. 1–4.



Figure 2: Spectrograph of Sherman and Kempff playing mm. 1–4.

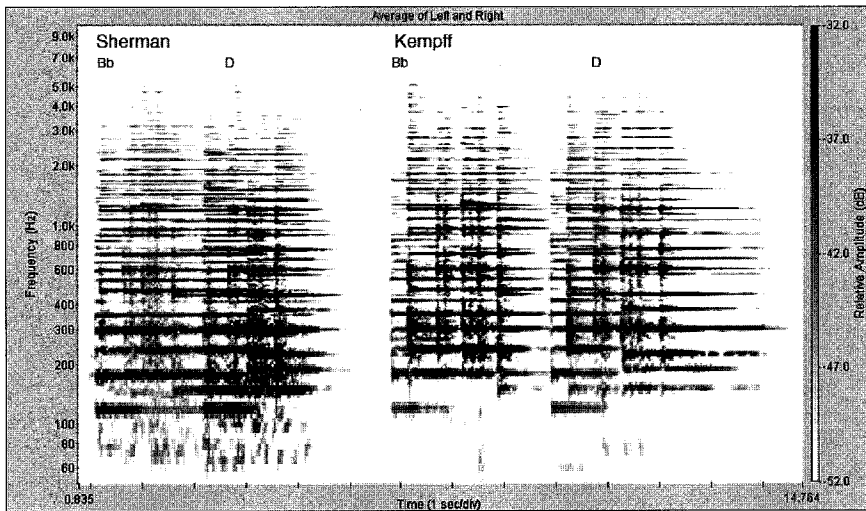


Example 4 shows the theme at mm. 385–89, and figure 4 shows Sherman and Kempff playing mm. 385–89. Although this texture continues until the end of the movement, for ease of comparison example 4 and figure 4 end at m. 389. The right hand maintains the original thematic texture, while the left hand plays a written-out eighth-note trill, an important element of this movement, creating two very different surface textures. This material is also vertically distinct, as the lowest and highest pitches of the phrase are separated by four octaves. Unlike the previous versions of the theme, this time the score alternates between soft and loud dynamic levels. Looking at figure 4, we can see that Sherman and Kempff have very different ideas on how to shape this transformed theme. Compared to Sherman, Kempff achieves far greater contrast between the soft and loud dynamics, as shown by the upper

Example 3: “Hammerklavier” theme mm. 34–38.



Figure 3: Spectrograph of Sherman and Kempff playing mm. 34–38.



partial peak on each *forte* dynamic. Whereas both performers begin with an upper partial peak of about 600 Hz, Sherman’s first *forte* dynamic extends to 2 kHz, but Kempff’s extends to 4 kHz. Overall, Sherman’s performance of this passage could be characterized as more unified, whereas Kempff’s emphasizes dynamic contrast.

These surface analyses using spectrographic images highlight the diversity of approaches performers take when confronted with a score. Benson and Garvey, through their instrument choice and manipulation of the surface details, construct the fantasia’s opening in divergent ways. Benson’s performance is varied, while Garvey’s is unified. Likewise, Sherman and Kempff approach the intricacies and transformations of the opening “Hammerklavier” theme differently. Sherman consistently emphasizes unity

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Example 4: "Hammerklavier" theme mm. 385–89.

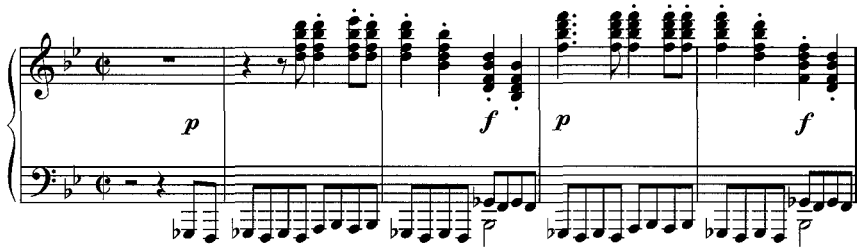
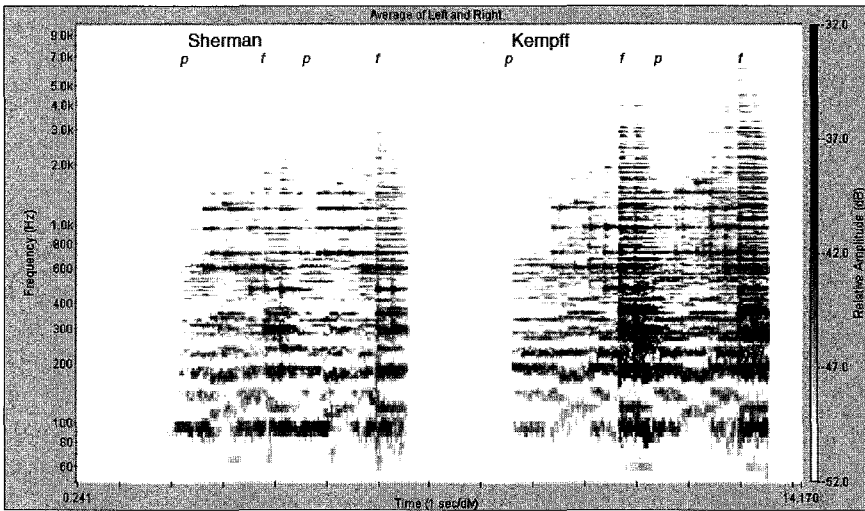


Figure 4: Spectrograph of Sherman and Kempff playing mm. 385–89.



and similarity, and Kempff consistently emphasizes division and contrast. The spectrographic image highlights these surface performance details.

Cyclical Relationships and Models of the Musical Work

Much of the analysis and performance literature has moved either from score analysis to performance or from performance to score analysis. By adding the spectrographic image to this analytical process, an alternative to the bi-directionality from score to performance, or performance to score, is offered. The addition of the spectrograph to the score and performance paradigm can be thought of as forming a cyclical relationship, connecting all three to one another. The score has a prescriptive relationship to the performance, a performance is used to create a descriptive spectrograph,

and a spectrograph is a static visualization of a work, like a score, but with a descriptive relationship to the performance. In addition, a score could be created from a spectrograph by transcribing the fundamental frequencies into notated pitches and transcribing distances between attack points into notated rhythms. Seen in this way, the score becomes a reduction of a spectrograph; only fundamental frequencies are shown and rhythmic nuances in performance are quantized away in favor of simpler ratios.

The crucial juncture in these relationships is between score and spectrograph. The spectrographic image allows the analyst to move directly from score to analysis of a performance without necessarily hearing the performance. For instance, many readers of this paper may not have access to these specific performances, but detailed analytical discussion of each performance remains possible. The analytical discussions can include not only generalized comments about dynamics and articulation, but also specific frequency and decibel content. Each aspect of the performance discussed can also be seen by the reader in the spectrographic image. Music analysis has primarily focused on the score—a prescriptive map or blueprint of the piece. Because the spectrographs in our analyses were created from performances, we are able to explore an individual performance with the same care and precision as we would a traditional score. Just as we visually analyze the notation of each score, we may also visually analyze each spectrographic performance image. The relationship that these images have to our aural perception of the performance will, of course, change depending on the image and on the way we hear the piece.

These new cyclical relations between score, performance, and spectrograph, however, must be further explored in order to achieve a more thorough reorientation of the bi-directional analysis and performance paradigm. While the gap between analytical writing and performing music exists, the underlying *reason* for this gap must still be confronted. The polarity between analysis and performance arose, we believe, from the different understandings each field has developed regarding the musical “work.” Analytical literature has, for the most part, consistently used the score as the primary source for understanding the musical work. Of course, analysts are certainly influenced by different performances, but few published musical analyses grant equal (or more) value to performances as to the score in coming to their analytic conclusions. The score frequently becomes the sole location of analytical inquiry, so discussion of the musical work often becomes discussion of the score.¹³ Performers (in the Western art music tradition) also begin with the score and may have specific and insightful analytical understandings, but their performance activities transform musical understanding and conclusions into the sonic realm. Elements not specifically indicated in the score often take on primary importance:

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articulation, phrasing, pedaling, and rubato. The performance becomes the generator for analytical inquiry, and discussion of the musical work often becomes discussion of a performance. We view these tendencies as somewhat misguided and would argue that the score-based ontology of the musical work, with a fixed beginning and end, is an illusion.

Many postmodern writers have already explored the idea of the work in this way. In his essay, *What is an Author?*, the philosopher Michel Foucault writes:

What is a work? What is the curious unity which we designate as the work? Of what elements is it composed? . . . A theory of the work does not exist, and the empirical task of those who naively undertake the editing of works suffers in the absence of such a theory. (1998:207)

As musicologists, theorists, ethnomusicologists, and performers, it is crucial to recognize that we do not yet have a consistent theory of the musical work. Depending upon who writes the book, article, review, or liner notes, the definition of the musical work shifts, transforms, and mutates to fit the needs of the author. A number of relatively recent publications do attempt to define the musical work, or at least to problematize the issue.

Lydia Goehr's study, *The Imaginary Museum of Musical Works* (1992), critically examines the idea of "the work" in a musical context. Through examination of period treatises, letters, and contracts, Goehr details conceptual differences between the musical work before and after 1800. She views the period around 1800 as an axis point in European history where the modern musical "work-concept" was formed.

The purported autonomy of the fine arts, guaranteed by their placement in museums, raised particularly interesting problems for music . . . As it entered the world of fine arts, music had to find a plastic equivalent commodity, a valuable and permanently existing product, that could be treated in the same way as the objects of the already respectable fine arts. Music would have to find an object that could be divorced from everyday contexts, form part of a collection of works of art, and be contemplated purely aesthetically . . . The object was called "the work." (1992:173-74)

Goehr, therefore, situates the formation of the work-concept around 1800 because of a shift in the understanding of art and music as "objects" of beauty and transcendence. Furthermore, she details the shift of the composer's status from lowly servant to respected (idolized) artist, and also the concept of "Werktreue": a hierarchy in which performers and performances were subservient to the composer and their work. Just as museums collected and displayed artists' works, so too musicians began to collect and display musicians' works that exist only in an "imaginary museum of musical works."

More recently, others have questioned Goehr's conclusions. White (1997) offers evidence from the writings of Johann Fux and J. S. Bach to demonstrate the existence of a work concept prior to 1800. As White writes about Fux's *Gradus ad Parnassum*, "Put plainly, the *Gradus* derives its authority and sense of purpose from the achievement and independent existence of individual art works" (1997:101).

Talbot (2000) investigates the idea of "composer-centeredness," showing how before 1800 Western art music culture emphasized genre, and how after 1800 it emphasized the composer. He views Goehr's work-concept as a by-product of a "composer-concept," concluding that "musical works enter their imaginary museum only because composers have already entered their imaginary Pantheon" (2000:186). Strohm (2000) takes issue with both Goehr and Talbot, discussing, among other things, the idea that music with social function does not necessarily hinder the formation of a work-concept, and he provides evidence of a Renaissance work-concept through a quote by Tinctoris. Strohm goes on to criticize Talbot, giving specific examples of "composer-centeredness" before 1800, and cites the wide circulation of printed and written music of the sixteenth and seventeenth centuries by famous composers as examples of composer-centeredness. Finally, Perkins argues that the "work-concept" was well formed by the fifteenth and sixteenth centuries due to

the statements of theorists and other writers of the period; the evidence of the sources; the development of new instrumental genres; the corrections of detail made in manuscripts of the period; the stop-press changes made by printers of music in the course of a run; and the anecdotal evidence . . . concerning the attitudes of both the composer and contemporaneous commentators towards the music ascribed to Josquin. (2003:41)¹⁴

Regardless of when and how the work-concept developed, each of the formations identified by these authors depends on a score-based, object-oriented concept of the musical work that still exists for most classical musicians and listeners today. We may disagree over what edition (Urtext or Schnabel) or performance (Sherman or Kempff) is preferred, but few would fail to identify Beethoven's "Hammerklavier" sonata as a musical work. Problems, paradoxes, and incompatibilities arising between analysis and performance can be directly traced to our current modes of thought within this musical work concept. Borrowing again from postmodern theory, the concept of the *model* in relation to the surface can be helpful in reconceptualizing the musical work.

Postmodern writers have challenged the notion that an image or model reflects some deeper reality, and they describe a conceptual framework in which there is no deeper reality but only the surface. Baudrillard (1994)

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describes what he calls “the vertigo of interpretation” created by the many (endless) series of possible models existing on the surface that can be used to reflect a work. It can be said that the model does not represent a deeper reality but actually *creates* the real, or what is taken to be the real. Models are no longer a double of a real; rather, they mark “the generation by models of a real without origin or reality: a hyperreal” (1994:1). The real only exists through the lens of the model and is therefore generated by the model. This flattening out of conceptual space increases complexity by allowing corroborating and opposing models to coexist on the same plane. If the model generates its own reality, there is no deeper absolute truth with which each model must correspond. Corroborating and opposing models are equally valid because each forms its own reality. To return to the musical work, it too only exists through models. A Schenkerian model locates certain contrapuntal and linear qualities regarded as inherent and which form the reality of the work. A set theory model locates intervallic supersets from which subsets are derived; neo-Riemannian theory, narrative theory, statistical analysis, and contour theory each have their own specific analytical focus that generates possible realities of the work. Performance and performance analysis have their models as well. Epstein (1995) uses durational analyses of recordings that precisely measure accelerations and decelerations in tempo, while a spectrograph models a performance’s frequency, intensity, and duration in a graphical format. Each model creates the work, or it could be said, creates a series that extends the boundaries of a work to infinity.

In our framework, models of score, performance, and spectrograph generate the musical work, which exists only through the models themselves. The cyclical relationship formed between score, performance, and spectrograph generates multiple models of the work that exist within the same flat conceptual plane. These models may corroborate (performances that closely follow the score and spectrographs that follow a performance) or oppose (contrasting performances and different score editions) one another, but all three are valid within the analytical surface. Because there is no authoritative score, performance, or analytical approach with which all of these models of the work must correspond, opposition created through a variety of interpretations becomes acceptable. As a physical description of a performance, the spectrographic image is a particularly useful tool that applies the idea of a Baudrillardian conceptual surface to the physical surface of the musical sound. This provides an answer to the question posed at the beginning of this essay: why should we try to bridge the fields of analysis and performance? Bringing analysis and performance closer together allows us to dismantle the false notion that the musical work resides in either domain. Analysis and performance both generate their own models of the work, and neither has precedence over the other.

A Reformulation of the Musical Work

As stated above, each model creates the work, or, it could be said, creates a series that extends the boundaries of a work to infinity. In other words, if the model generates the work, infinite models would generate infinite versions or series of the work. This expanding series of possible states of the work resulting from a multitude of models can be compared with the philosopher Gilles Deleuze's (1993:59–75) notion of “compossible” and “impossible” states of affairs. Deleuze defines “compossibles” as “the totality of converging series that constitute the world,” while “impossibles” are “the series that diverge, and from then on belong to two possible worlds” (1993:60). Compossibles refer to the singular result (single model) from all possible variables, and impossibles refer to all of the variables (infinite models) that are possible but did not occur.

Referring back to the analysis section of this essay, an example of a compossible single model would be the merging possibilities that constituted a particular performance: Kempff's playing of Beethoven's “Hammerklavier,” recorded on a particular piano, in a particular studio, with a particular microphone, mixing console, etc. It is important to emphasize that all choices made throughout the recording process are themselves performance decisions, similar to those a conductor might make in sculpting the sound of an orchestra. The choice of what kind of microphone to use for the recording is equally as important as what type of keyboard to play. But the possibilities do not end at that point. When the listener adjusts the equalization on their home stereo, listens on an mp3 player or to a radio station that compresses the sound files of the Kempff recording to boost the signal, these actions and decisions also effect changes in the performance as perceived phenomenologically by the listener. All these possibilities intersect to form a single performance and a single model of the work.

The impossible models would therefore consist of the various permutations of choices not selected for the singular performance just described. The fact of their non-selection in no way negates their possibility; Kempff could have performed on a Yamaha piano rather than on a Steinway, or the session could have been recorded in a different room or hall using a different microphone. As shown by the amount of low frequency hiss in the fortepiano recording by Garvey, these decisions are crucial and have noticeable sonic consequences. Thus, all the instruments, microphones, mixers, and stereos that could have been used in the creation of a performance, but were not, have become the basis of a series of possible models.¹⁵ Each mode of analysis, whether Schenkerian, neo-Reimanian, or spectral, becomes a merging series of infinite possibilities to form a single model. With this convergence in mind, what are the connections between infinite possible

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models and the concept of the musical work? What type of musical work is actually being created?

To answer these questions it is necessary to reformulate the concept of the musical work beyond the stable boundaries that score-based orientations, Urtext editions, individual performances, or singular analyses sometimes appear to demarcate. Philosopher of science Gilbert Simondon elaborates such a principle using the term “metastability,” a state of constant becoming and transformation caused by the tension between corroborating and/or opposing models. Simondon writes that “the idea of ‘metastable equilibrium’ had not been recognized . . . In order to define metastability, it is necessary to introduce the notion of the potential residing in a given system” (1992:301–2).

While each score, analysis, and performance generates a single model, the tension among all possible models (potentials coexisting on the same flat conceptual plane) produces a constantly evolving set of relations resulting in what could be called a metastable musical work. The metastable musical work exists within the potentials of all possible analyses and performances, models that may corroborate and even oppose one another. Furthermore, these potentials for the work exist not only synchronically, but also diachronically. The work scans ahead to further possible states through the potential of future models, and it scans back before its existence to locate traces of itself in previous scores, performances, and analyses. Its boundaries form a porous membrane with the future and past inviting perpetual transformations. This ontological fluidity is the reason why the idea of a stable work proves to be so unsatisfactory at this stage of philosophical and musicological inquiry. A stable musical work is a dead system with no potentials, whereas a metastable musical work is fluid, filled with infinite potentials. Through the cyclical relations of score, performance, and spectrograph, interacting with one another on the surface, the metastable musical work exists in constant flux and emerges as a dynamic, mobile system that is affected by the decisions of musicologists, theorists, and performers alike.

Conclusion

The recent trend in analysis and performance research is encouraging, with such a large number and variety of studies being published that attempt to bring these domains closer together. Images of musical sound, and spectrographs in particular, can be a useful tool in this ongoing project of exploring the relationships between analysis and performance. Spectrographs can be used to generate an alternative to the prevailing dialectic between score analysis and performance, where score, performance, and spectrograph are

reconceptualized within a cyclical relationship on a flat conceptual plane. The relationship between score and spectrograph is especially powerful because it allows for the analysis of a performance without the need to hear it first; a specific performance can be visually analyzed in the same way that a score is analyzed. This reorientation, however, demands closer scrutiny, which leads to a reformulation of the musical work. The model (whether score, performance, or spectrograph) does not describe but actually generates the musical work, so neither analysis nor performance maintains “Urtext” dominance over the other.

This reorientation of the musical work does not come without risk. If the musical work is a constantly shifting system, generated and defined by the chosen model, the ensuing quagmire of relativism might negate any meaningful analysis or performance. Are we to accept as valid any analysis or performance no matter how much it deviates from accepted norms, including different pitches that appear in no manuscript or edition, or performances that completely alter the notated dynamic structure? Our answer is no. Although these potential models exist, it is the prerogative of each analyst and performer to accept those models of the work that best generate the most useful understandings. The constantly transforming musical work is defined and redefined by which models we choose to accept. These choices are performance decisions, no different than the ones that Benson, Garvey, Sherman, or Kempff might make in rejecting and accepting specific models that generate the musical work. So, while the cyclical relationship between score, performance, and spectrograph and the reconceptualization of the musical work forge closer links between analysis and performance, it is even more critical that we make careful readings of each analysis and performance to decide which models are the most meaningful.

Finally, we might ask, to what extent does culture influence and frame our understanding of the musical work, and where are the borders that demarcate the work's beginning(s) and ending(s)? The answers to these questions lie in the potential of research committed to exploring new methodologies, new technologies, and new relationships, which forge increasingly close ties between analysis and performance, and between analyst and performer.

Notes

We would like to thank James MacKay, Alan Spurgeon, and Kevin Swinden for their helpful suggestions on earlier drafts, which greatly improved the essay.

1. For instance, while Spicer (1996), Morgan (2000), and Siciliano (2005), all provide new and valuable analytical insight, they do so from conclusions based entirely upon scores. Of course, one may argue that the focus of these articles is not performance related, but that is precisely our point: unless overtly stated as a main goal, performance analysis and discussion

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are most often ignored in the analytical literature of Western art music. This absence calls into question the value performance has in generating useful analytical information.

2. We do not mean to suggest that analysts are not sensitive to performance issues, or that performers lack analytical insight. Many analysts are also performers, and performers also analyze, whether they choose to write anything down in a formal way or not. Our definitions are merely meant to reflect the activity in the literature.

3. According to Seeger prescriptive notation is like “a blueprint of how a specific piece of music shall be made to sound,” and descriptive notation is “a report of how a specific performance of any music actually did sound” (1977:168).

4. The creation of a visual image from a temporal process could also be viewed as helping to create a musical “object.” For a lucid discussion of musical objects see Butterfield (2002).

5. A profusion and variety of studies in recent years explore the relationships between musicology and postmodernism, including L. Kramer (1995), J. Kramer (1999), Horton (2001), Lochhead and Auner (2002), Nercessian (2002), Dell’Antonio (2004), and Yang (2006).

6. Indeed, there is the danger that spectrographs can provide too much surface information, overshadowing any practical or perceptual value. As Jairazbhoy warns in relation to Seeger’s melograph, “[the melograph] presented a profusion of visual data, involving tolerances much finer than the ear can distinguish, thus creating a new series of problems for the interpreter” (1977:264). The spectrographic image is always only a possible visualization of a musical performance that can be subtly or radically altered upon software settings.

7. C. P. E. Bach’s *Fantasia in C Minor* was set to text by friend and poet Heinrich Wilhelm von Gerstenberg. For an interesting discussion of this setting, as well as Bach’s attitude toward the interconnections of music and text, see Helm (1972).

8. All spectrographs were made from CD recordings, rendered as .wav files (44.1 sampling rate, 16 bit depth) on a computer using Soundtechnology software. The horizontal axis represents time, read from left to right, and the vertical axis represents frequency, moving from low (bottom) to high (top). Softer sounds are lighter grey and louder sounds are dark grey to black. It is important to note that spectral differences between recordings and live performances are much less significant than those between different performances (see Cogan 1984:15).

9. Notice that the fundamentals of the opening two pitches, C2 and E2, are not physically present, but are perceived through the presence of the upper partials. The typical explanation for this is that it is the difference between partials that causes fundamental pitch perception.

10. Both Benson and Garvey use equal temperament tuning, but elsewhere different temperaments, such as mean-tone tuning, would also affect the overtone structure and therefore the spectrographic image. Spectral differences due to temperament could result in different musical conclusions depending upon the analytic focus.

11. With the scores of C. P. E. Bach it is, perhaps, even more crucial to pay close attention to every subtle nuance. As Darbellay has noted “C. P. E. Bach’s musical notation far exceeds in precision and thoroughness everything before it and much in the notations of later composers” (1988:61).

12. Both Rosen (2002) and Taub (2002) make useful comments regarding the performance of Beethoven’s “*Hammerklavier*,” op. 106, movement 1. Rosen makes an interesting connection between instrumental timbre and Beethoven’s metronome mark (138) by noting the “lighter character” if played on a period instrument, thereby making the tempo more plausible. Taub notes the intertextual incorporation of a Baroque form (Fugue) into the first movement as well as the division of the first eight measures into two parts. He does not mention, however, the

division(s) of the first four bars, a point crucial to our analysis. Friedmann's (1978) analysis is an attempt to fit motivic material from op. 106 into a unified framework of set theory, on local and tonal levels. Although Rosen's and Taub's writing reflect a performer's mindset, they do not mention any individual performer's interpretations other than their own.

13. Score-based analytic habits can also be seen infiltrating "aural" analyses. Trombley (1995) develops a graphic nomenclature for showing a work's structure based entirely on aural analysis. Trombley never mentions a single recording in the article that deviates from the score in any way. As he states, "Indeed, one of the problems of aural analysis is that we are at the mercy of the performance, which, as in the present case, could vary" (1995:101). For Trombley, the fact that different performances could vary is a "problem" that interferes with the prescriptive correspondence between score and performance.

14. In addition, we would also mention the pioneering work of Roman Ingarden writing in the early twentieth century. In his book *The Work of Music and the Problem of Its Identity*, Ingarden comes to the conclusion that the musical work is an intentional object of a higher order. He says the work is like "an ideal boundary . . . [that] remains one and the same in contrast to the many concretions in specific performances" (1986:119). In Ingarden's conception, the work is still singular and remains untouched and unblemished by its many performances. Furthermore, although the work is riddled with "gaps or areas of indeterminateness," Ingarden concludes that "both the fixed and the open elements have been conceived by the composer as fully defined and fixed" (1986:116). For us, however, the fluidity of performance points to a fluidity of the work, which cannot be resolved by a singular "intentional object of a higher order."

15. Schenker is particularly sensitive to these issues: "Once a performance does take place, one must realize that thereby new elements are added to a complete work of art: the nature of the instrument that is being played; properties of the hall, the room, the audience; the mood of the performer, technique, et cetera" (2002:3).

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