Sorting out the Strata

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ABSTRACT: Many 20 th century compositions appear to present different coexisting layers of musical activity. Auditory scene analysis can help explain how the composer achieves and manipulates these illusions. Excerpts from works by Ligeti, Messiaen, Stravinsky, and Varese show a variety of ways in which elements such as onset asynchrony, register, timbre, and rhythmic dissonance promote fusion or segregation of the musical material in the listener's perception. The nature, behaviour, and interaction of the layers can then be more clearly articulated for further analysis. It is argued that, since the model of auditory scene analysis evolved to explain our parsing of complex real-world environments, the sophistication and complexity of these musical works can provide an interesting field for comparison, where the effect of various factors in combination create clear segregation, textural effects, or ambiguity depending on the context, often without the use of tonal hierarchies. The potential (and difficulties) for ranking the salience of different elements is discussed, and the potential impact of research into click migration, information theory, memory codification, and particularly auditory imagery on music analysis is also mentioned.

Some suggested readings: Albert Bregman, Auditory Scene Analysis (1990), especially pp. ? ; Rolf Inge Godøy, "Knowledge in Music Theory by Shapes of Musical Objects and Sound-Producing Actions" in Music, Gestalt, and Computing, ed. Marc Leman (Berlin: Springer-Verlag, 1997); Stephen McAdams, "Spectral Fusion and the Creation of Auditory Images" in M.Clynes (ed.) Music, Mind, and Brain (New York: Plenum, 1982); Stephen McAdams, "Music: A Science of the Mind?", Contemporary Music Review 2 (1987), esp. pp. 38-44; Rosemary Mountain, "Time and Texture", ex tempore VII/1 (1994), especially pp. ?; Rosemary Mountain, "Composition: my laboratory for auditory perception research"in GenPsy, 3/4, 241-254, Rome (1999); James K. Wright and Albert Bregman "Auditory stream segregation and the control of dissonance in polyphonic music", Contemporary Music Review 2/1 (1987).

Sorting out the Strata talk

Varèse's Amériques: a counterpoint of textures

Aspects of structural organization in Varèse's work Amériques are studied through the application of auditory perception guidelines to reveal the segregation and manipulation of layers throughout the work. The presentation explores the techniques used by the composer to control dynamic tension throughout the piece, and simultaneously demonstrates the potential of the tools used for the analysis.

Most of the orchestral works of Varèse, like those of Messiaen, Ives, early Stravinsky, etc., create the illusion of various independent layers or blocks of sound, juxtaposed and superimposed. It is

argued that the treatment of the blocks and layers of sound is a major feature of the style, and that therefore it is essential to develop tools for examining their manipulation.

The organization of a multi-layered passage can be viewed as a type of counterpoint, with entire textures or melody-and-accompaniment passages replacing single melodic lines. In the same way, it is often important to appreciate that vertical configurations in a given measure may be of secondary importance to horizontal configurations.

In order to distinguish one "layer" from another, it becomes necessary to examine the properties which make one group of sounds appear to belong together, while at the same time being differentiated from other sounds in the same passage. Bregman's work in auditory scene analysis and McAdams' adaptation of these general principles to the specific context of music have been a great help to the author in developing appropriate analytical tools. More recent writings such as those by Godøy reveal the importance of more subtle components relating to the perception of character in a musical gesture, beyond the basic issues of pitch, duration, and timbre.

Auditory streaming and fusion are two poles of perception: in auditory streaming, the ear/mind has great difficulty hearing two sequences of notes as belonging together, whereas in fusion they are difficult to segregate. When two layers of music are heard, factors that tend towards fusion unite the sounds of each layer, while factors that tend towards streaming maintain the separation between layers. Amériques provides excellent examples of Varèse's creation of tension and release patterns through a controlled blurring of boundaries: two layers, for example, may slowly fuse into one or split into three. In another technique, the introduction of a strongly contrasting third layer or block of sound into a two-layer passage seems to suggest the fusion of the other two in retrospect, bringing into focus the role that memory plays in listening to music. Ostinato is a useful device in that it can be easily perceived as a separate layer without adding excessive information.

The opening minute and a half of Amériques (Examples 1a, b, and c) provides examples of the roles of onset asynchrony, timbre, and melodic shape in promoting the impression of three distinct independent ideas (mm. 1-4), which are soon fused by the uniform tempo modulation (mm. 5-7), their interruption by a highly contrasted block of gestures (m. 8) and their reappearance in a similar combination (mm. 9-10, 19). The same passage also shows the use of rhythmic consonance as a factor of fusion (m. 2, harps, mm. 10-11, brass) while in a different context (percussion, mm.9-10), its absence does not provoke segregation. This curiosity is examined.

By understanding the factors which promote segregation or fusion, and then studying the score (with reference to aural evidence as much as possible) it becomes relatively easy to untangle the various components of the complex designs created in Amériques and similar works. Once the layers and textures are identified, they can also be described in terms of their properties and characteristics: pitch collections, textural density, rhythmic elements, dynamic profile, etc. Subsequently, large-scale formal structure can be sketched out with reference to the number of simultaneous layers, the rate and degree of change between successive sections, and the "porosity" of the layers and their interaction.

It is argued that the degree of subtlety employed by Varèse in his manipulation of the interaction of the various layers in Amériques confirms the value of this analytical approach. Various passages from the score are presented as examples of the different types of treatment he employed to create structures with a high degree of complexity and nuance. It is suggested that this

means of organization was an appropriate substitute for the harmonic and metric hierarchies that had traditionally shaped musical structures.

The emphasis on the correlation between auditory perception and the analysis of the score is suggested as additional recommendation of the approach. The ease with which this method can be learned has been verified by the author over three years of teaching it the context of undergraduate upper-level analysis courses; the respect which the students gained for the composers in question (Messiaen, Varèse, and Stravinsky) seemed to confirm the validity of the experiment.

The presentation will survey the relevance of factors such as rhythmic dissonance, onset asynchrony, tempo, melodic shape, register and timbre towards the perception of fusion or segregation of sonic configurations. A comparison of two audio recordings of the first few measures of the work will emphasize the relevance of understanding the composer's procedures to the performers' appropriate portrayal of the design.

SORTING OUT THE STRATA: Auditory Scene Analysis Applied

The proposal argues that the methods and concepts of auditory scene analysis (as articulated by Bregman et al) have good potential for aiding in the analysis of 20th-century multi-strata works due to their aim of explaining how we are likely to group together or segregate diverse auditory information. However, since most of the research has been carried out by psychologists, often using simple melodic fragments and harmonic contexts, it is suggested that an examination of complex musical works by musicians is fundamental to further development of the model.

It is shown that the breadth of the scene analysis approach permits an easy integration of various aspects of Gestalt-based theories of grouping, timbral and textural studies, and the investigation of rhythmic/metric dissonance which have already been addressed by theorists in music analysis.. The presentation demonstrates the analytical potential by a detailed examination of the opening of Varèse's Amériques, with cursory reference to short passages from Stravinsky's Rite of Spring and Petrushka.

Summary of methodology

A brief introduction describes why research in perception and cognition are of particular value to those studying non-pitch-based organization, which may be inadequately expressed by notation without some intermediary interpretation.

A basic description of auditory scene analysis is provided, with clarification of the various musical elements which are said to promote segregation in a complex auditory environment (including tonality, register, timbre, dynamic contour, spatial location, etc). The range of possibilities is described: clear or obscure distinction between strata; static or changing relationship between superimposed strata; abrupt change or gradual dissolving between juxtaposed strata. Musical examples of various of these possibilities are drawn from the opening (first 1 ½ minutes) of Varèse's Amériques.

The difficulty of specifying which elements are most influential in promoting fusion or fission is acknowledged, but tentative suggestions are made of ranking, based on reasons of perception,

musical training of listeners, and conventions. The role of rhythmic dissonance in enhancing segregation is shown to be greatly influenced by the specific level at which the dissonance is perceived. Counter-influences are examined, such as stylistic expectations and immediate context.

Ramifications of studying entire works from the perspective of auditory scene analysis are examined: these include the possibility of studying large-scale structure in terms of the (changing) number of strata involved and the (changing) degree of clarity of segregation.

Results of research into click migration, information theory and memory codification are shown as extremely relevant to understanding the perceptual consequences of listening to two layers of musical material simultaneously. It is shown that simultaneously-sounding notes may not be heard as simultaneous, and that this can have important ramifications for analysis.

The relative ease of applying auditory scene analysis to complex works, and the relevance of the results to the understanding of the work's structure are claimed as sufficient reason to continue this type of analysis. It is suggested that the results not only provide an understanding of our perception of the work, but also suggest the motives for certain decisions on the part of the composer, made in order to convey the impression of two or more layers of distinct but coexisting musical material. It is further argued that the means by which the composer manipulates the strata form a potentially recognizable aspect of his/her characteristic style.

1. Albert S. Bregman, Auditory Scene Analysis: The Perceptual Organization of Sound (Cambridge: MIT Press, 1990); Stephen McAdams, "Music: a science of the mind?" Contemporary Music Review 2 (1987).

2. Leonard B. Meyer, Emotion and Meaning in Music (Chicago: Univ. of Chicago Press, 1956), James Tenney, Meta+Hodos & META Meta+Hodos (Oakland: Frog Peak Press, 1988); John Sloboda, The Musical Mind (Oxford: Clarendon Press, 1985); Eugene Narmour, The Analysis and Cognition of Basic Melodic Structures (Chicago: Univ. of Chicago Press, 1990).

3. Pierre Schaeffer, Traité des objets musicaux (Paris: Éditions du Seuil, 1966); Trevor Wishart, On Sonic Art (rev. ed.), ed. Simon Emmerson (Amsterdam: Harwood, 1996); Rolf Inge Godøy, "Knowledge in Music Theory by Shapes of Musical Objects and Sound-Producing Actions," Music, Gestalt, and Computing, ed. Marc Leman (Berlin: Springer-Verlag, 1997); John MacKay, "On the Perception of Density and Stratification in Granular Sonic Textues," Interface 13/14 (1984); Rosemary Mountain, "Time and Texture: Lutoslawski's Concerto for Orchestra and Ligeti's Chamber Concerto," ex tempore VII/1 (1994).

4. Maury Yeston, The Stratification of Musical Rhythm (New Haven: Yale University Press, 1976) and Harald Krebs, "Some Extensions of the Concepts of Metrical Consonance and Dissonance," Journal of Music Theory 31 (1987).

5. A.H.Gregory, "Perception of clicks in music," Perception & Psychophysics 24 (1978); Roisin L. Ash, "Click Migration and Segmentation in Gaelic Melodies," Proceedings of the 3rd Triennial ESCOM Conference (1997); Abraham Moles, Information Theory and Esthetic Perception, trans. Joel E. Cohen (Urbana: University of Illinois Press, 1966); Candace Brower, "Memory and the Perception of Rhythm," Music Theory Spectrum 15/1 (1993).