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Analysis of Form and Cadence in Musique Concrète via Temporal Elements Robert J. Frank, D.M.A.

In the 60 years since Pierre Schaeffer created the first work of *musique concrete*, there has been great development in the creation of this art form, but little in the analysis and understanding of it. The lack of traditional uses of pitch and meter place analysis of *musique concrete* beyond most existing theories and leave many authors to assert that "It is more important to listen to the specific qualities of each sound than the relationships between events." (Schrader 1982) Although spectral and timbral analysis, extra-musical context, and audio processing techniques certainly influence flow and musicality in a work, every composer of electro-acoustic music also knows that the same techniques can produce unsuccessful works just as well as "good" ones. Great works in the literature have an overarching pacing, flow, and balance in their use of time, contrast, and overall temporal structure, yet little research has been done to identify and analyze these important traits. This led to the author's development of a cognitive system of analysis that identifies "temporal elements" and their function (Frank 1996). Based upon established research in the field of music cognition, this system of analysis focuses not upon process or technique, but the relationships between sonic events themselves within a work.

Foundational to this understanding of temporal elements is the concept of what William James refers to as the "psychological present" (James 1890), a buffer of time up to a general upper limit of 3-4 seconds (Fraise 1978, 1982) during which the mind "chunks" together a group of sounds into a single perceptible unit. This effect is most strong in the range of 100ms-1.8 seconds, forming the range in which metric beats are perceived without further subdivision (London 2004). When a sound or series of sounds extends beyond the psychological present, the mind processes them according to an unconscious schemata of perceptual-motor reactions. Studies have shown that the human mind reacts to the occurrence of a sonic event and then projects forward in time an expectation of what is to come (Mandler 1984). As long as an event continues according to what the mind expects, there is little mental attention required. When something unexpected occurs, such as a change in the sound or pattern, there is a biological reaction signaling that "something has gone wrong." New events will also elicit this signal. Both reactions will bring about psychological conditions which shift the mind's attention to the new or different event, while continuing events will elicit less and less of a reaction (Dowling 1986). This would indicate that unchanging **sustained** sonic events (sound or silence) would form the most stable temporal elements. A series of adjacent sounds that are below the 100ms are not perceived separately, but instead are heard as a single sound (London 2004) forming what might be called a sustaining texture, and may be considered a form of a sustaining element.

Non-sustaining temporal elements are affected by two factors that allow for a projection forward in time of an expectation in the mind: **repetition** and **alignment** to a common, regular pulse. Although exact repetitions form the strongest and most stable form of repetition, highly similar events may also be recognized as repeating, albeit at a slightly less stable level. Alignment to a recurring pulse occurs within a just noticeable difference (JND) of 5-10% of the tempo (Woodrow 1951). Given the possible combinations of these parameters, a catagorization of five basic temporal elements can be defined (Figure 1). Elements in the upper-left quadrant form the most stable elements while those in the lower-right quadrant form the least predictable, and hence least stable elements.



Figure 1: Table of Temporal Elements

Hybrid elements comprised of traits of two adjacent categories and transformational elements that gradually change from one type to another are also possible (Frank 1996).

Since these temporal elements are perceived at a subconscious level, they are often reflective of the subjective choices composers may make while constructing a work, and may help account for why certain works in the literature "just feel right" and others using the same techniques may not. Take for example Pierre Schaeffer's pioneering *Étude aux chemins des fer* (1948). Although his sketches show a clear focus on serial technique and thought, an analysis of temporal elements used in the work reveals a surprisingly recognizable and traditional structure, no doubt influenced by his traditional musical training and background.



Figure 2: Analysis of Temporal Elements in Étude aux chemins des fer

A complete, detailed analysis is presented in a prior publication (Frank 1999) but Schaeffer's form is clearly defined by his symmetrical use of aligned/non-repeating (A/NR) and Aligned/Repeating+Sustained hybrid elements in the Introduction and Coda, pure, clearly defined, contrasting elements in the Exposition, more ambiguous, weaker forms of elements in the Development, and stable yet brief sustained elements as cadential figures between major sections. A cadence in music is generally defined as either a conclusive or inconclusive point of repose, which is exactly what these points of sustained stability provide. Greater meaning and varying senses of conclusiveness is generally thought to be conveyed in the context of these points of repose. When a passage of fulfilled forward projections and expectations (stability) are interrupted, then followed by creative resolutions (Meyer 1953) or a "pleasant surprise" (Berschied 1983) the importance and greater meaning is assigned to that moment. This pattern of "stability – interruption/instability - closing event" is particularly helpful in identifying temporal cadences. In Takemitsu's Water *Music* (1960), there is a nearly perfect example of this one minute from the end of the work (Figure 3). After using predominantly non-aligned/non-repeating elements throughout the work, he employs the following pattern of water drop sounds - one of only two such passages in the entire work: An Aligned/Repeating element is briefly interrupted, followed by a brief similar event (same sounds occurring within the psychological present) which is again interrupted with an even longer pause, then a closing event of two drops (not coincidentally pitched at D and G) forming a conclusive, *musique concrète* equivalent of a common-practice authentic cadence.



Figure 3: Cadence in Water Music

The above examples make use of only single/sequential events and elements. In more complex works, the layering and combinations of various temporal elements can also create clearly perceived temporal cadences. For example, in Vladimir Ussachevsky's *Wireless Fantasy* (1960) a mapping of the relative stability/instability of temporal element usage reveals two points where stable A/R elements are interrupted, then re-stabilized with closing gestures (Figure 4).



Figure 3: Temporal Element Overview and Cadences in Wireless Fantasy

The first cadence precisely coordinates the amplitude peak of a low, sustained element with a melodic cadence in the quoted recording of Wagner's *Parsifal* overture. Then, to close the Wagner quote, the A/R element ends precisely on the beginning of a 2-3 retardation on the closing cadence of that passage, with the resolution of the retardation coordinating with the commencement of the S/A hybrid element used to close the work. In each of these cases, the cadences would have functioned equally well without the additional use of a coordinated use of a common practice musical example, but the combined emphasis leaves no doubt of Ussachevsky's intent to covey the artistic significance of the Wagner excerpt, which was used in the first radio transmission of a musical broadcast (Beaudoin 2007).



Figure 5: Two Temporal Cadences in Wireless Fantasy

The closing passage following the final Wagner quotation also forms an interesting example of a closing temporal cadence. The S/A hybrid element consists of a sinewave-generated set of overtones which begins with a 9.5 second crescendo-decrescendo. At this point there is an interruption via the superimposition of a spark-gap generated Morse code phrase "GN" (the amateur radio abbreviation for "Good Night," a common farewell signal). Ussachevsky then restabilizes with a creatively interesting closing gesture: he removes the lower partials of the sustaining element one by one at a regular interval of just under 2 seconds, only slightly beyond the 1.8 seconds average for perception as an undivided metric beat. This duration places the perception of this element squarely as a hybrid element between a sustained and aligned element. The hybrid nature of this element is further enhanced since there is no new attack but rather the *removal* of a sustaining partial frequency at a regular interval of time. This gives the closing gesture the nature of the final tone ascending into the nothingness of space – a fitting and meaningful conclusion to this work that even Meyer would find to be one of the most "…creative and felicitous resolutions of the disruption" (Dowling pp. 219).

Note: A web site with detailed analyses with animation and sound of these works and copies of other papers can be viewed by selecting the "Temporal Elements" button at: <u>http://www.robertfrankmusic.com</u>

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