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New Modality: Sonic Magnification

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There have been many attempts to rationalise the potentially diverse nature of electroacoustic music. What has often been used to define the music has been concerned with the medium (electronic) or media (tape, computer) and the type or range of source material. These preoccupations have acted as a smokescreen, obscuring and hindering aesthetic discourse. With the huge expansion and development of electronic music it has been difficult to stand back an objectively observe the current state of affairs. This paper takes an alternative view of the evolution of acousmatic music and the result of Schaefferian and post-Schaefferian theories.

Throughout history the term mode and modality have had varying and often conflicting definitions. What essentially defines the concept of modality is the repetition of patterns. These may be a group of pitches, resonances (the recurrence of a particular frequency) or rhythmic motives that are organised hierarchically. Over the last fifty years composers working in the field of acousmatic music have gravitated towards modal composition. An explanation for this gravitation is offered through the idea of sonic magnification: the fragmentation of sound events and their augmentation through compositional techniques. As well as discussing the term modal in the context of acousmatic music, other contributing stylistic factors are considered. These include spectral focus, sound objects as modes, duration and pitch perception and the use of noise and non-pitched material. Consequently, the latter part of the twentieth century has not only produced a new form of music, being electronic, but a completely new style of modal composition.

A fundamental problem facing an acousmatic composer is how to extend the duration of a sound. 'Sound events' and 'sound objects' are in themselves self-contained units with their own internal timbral relationship. Michel Chion defines a sound object as: " … a perceived sound unity, whose intrinsic qualities, its colour, its dimensions, are considered independently of any signification it might convey".[1] Different methods and approaches have been adopted to assist the integration of such sounds into a compositional language: for example, typomorphology and spectromorphology. As Smalley states, spectromorphology is primarily concerned with a music that focuses on timbre rather

[1] Michel Chion, *La Musique Electroacoustique,* col. Que sais-je (P.U.F., Paris, 1982), p. 55.

than the note.[2] However, historically the concept of the note provided a core building block for musical composition. To expand material a composer could ask an instrumentalist to simply elongate or repeat a note. In acousmatic terms recorded sound is abstracted from its causality, divorced from physicality. Consequently, arranging recorded sounds into the context of an acousmatic composition raises the issue how to elongate material. If a sound object is a discrete unit, then how can it be molded into a coherent composition?

In the paper, "Introspectiveness and the Source", the author discussed various ideas behind the fascination with internal elements of sound.[3] This interest in inner worlds would seem part of an ongoing process in music that has been influenced by scientific development. For example, Antony van Leeuwenhoek's (1632-1723) work with the microscope brought to life whole new worlds. In a letter to the Royal Society of London he described micro-organisms in fresh water:

> The motion of most of them in the water was so swift, and so various, upwards, downwards, and roundabout, that I admit I could not but wonder at it. I judge that some of these little creatures were above a thousand times smaller than the smallest ones which I have hitherto seen on the rind of cheese, wheaten flour, mold and the like.[4]

The development of the science of acoustics has also had a significant impact on music. Rayleigh's *Theory of Sound* (1877) had a huge influence on the way in which sound was perceived.[5] Such developments can be seen as a contributing to the preoccupation with microscopic sound worlds. The computer has also aided the observation of sounds on microscopic levels. For example, the terms partial, sample, grain, and transient all suggest a microscopic component of a sound. These terms too are part of the vocabulary of the acousmatic composer. An extract from Trevor Wishart's *Audible Design* further illustrates this point:

> Samples are akin to the quarks of subatomic particle theory, essential to the existence of matter … The first significant object from a musical point of view is a shape made out of samples, and in particular a wavecycle (a single wavelength of a sound). These may be regarded as the atomic units of sound.[6]

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[2] Denis Smalley, ADefining Timbre - Refining Timbre,≅ *Contemporary Music Review*, 10:2, p. 37. ATimbre is concerned with the temporal unfolding and shaping of sound spectra, in other words with *spectromorphology*.≅

[3] John Richards, "Introspectiveness and the Source," Presented at the 32nd Royal Musical Association Research Students' Conference, 1998 and the 2nd Sonic Arts Conference, Huddersfield, 1999

[4] Antony van Leeuwenhoek

[5] Rayleigh

[6] Trevor Wishart, *Audible Design* (Orpheus the Pantomime Ltd, 1994), pp.16 –17.

All sound is temporal; therefore, the 'magnification' of sound not only alters its perceptual 'size', but also its duration.

Certain techniques arose in music concrete and acousmatic composition that addressed the issue of extending the duration of sound objects and events. These can generally be defined as augmentation or time-stretching techniques. Perhaps the most immediate technique to be employed was tape vary-speed. This technique enabled the slowing down and downward transposition of sound. Pierre Schaeffer experimented with variable tape speeds in *Cinq études de bruits* (1948). Other tape techniques, for example, brassage, enabled blank segments to be inserted between sound fragments to perceptibly extend the duration of a sound. The computer has also assisted augmentation of sounds. To take the principle of brassage a stage further, granular reconstruction, breaking a sound into even smaller segments, or to the point of a grain, has been made possible by the computer. Barry Truax's *Basilica*, Trevor Wishart's *Tongues of Fire* and Nick Fells' *riversongs* all illustrate the augmentation of material through brassage and granulation techniques. However, perhaps the most influential technique has been spectral time-stretching. Trevor Wishart in *Audible Design* discusses time-stretching techniques in detail: He states:

> A sustained sound with stable spectrum and no distinctive onset characteristics may be analysed to produce a (window) frequency-domain representation. We can then resynthesize the sound, using each window to generate a longer duration (phase vocoding). The resultant sound appears longer but retains its pitch and spectral characteristics. Of all the techniques … this is by far the best for pure time-stretching …[7]

Despite a focus throughout the twentieth century on timbre and noise-based composition, and new approaches and methods to accommodate the sound material, pitch and its perception are still fundamental parameters in music. The process of sonic magnification has indirectly affected pitch and its perception in acousmatic composition. Pitch is a psychoacoustic phenomenon. Its perception is influenced by, not only duration, but, for example, loudness and timbre. Various experiments have been undertaken concerning the critical duration for pitch perception. Licklider (1951) and Gulick (1971) have both explored the diminution of pitch perception as duration is decreased. Licklider found that when the duration of a pure tone is no longer than approximately three milliseconds it is heard as a click. Variations of pitch perception based on duration are also influenced by frequency. The lower the frequency the more time is needed for a pure tone to be perceived. This is due to the number of cycles per second of a particular waveform. This would seem self-explanatory, for example, if a listener hears a pure tone with very few or incomplete waveform cycles, then the ability to perceive a pitch will obviously be affected. Perhaps what is more interesting psychologically in music is the affect of extending the duration of pitches.

[7] Wishart, p. 89

Sonic magnification invariably leads, not only to expanding the duration of a sound object or event, but also to the creation of long drawn-out, or 'static' pitches. There would seem a critical point in tonal music whereby certain durations of pitch undermine the concept of keys and their progressions. It is not just the note or pitch that is heard, but the progression or transition from one note to another, the sequence of pitches. The longer a listener dwells on one particular pitch or groups of pitches, the more difficult it is to retain the concept of a sequence: the listener is taken from one discrete pitch centre to another.

The fundamental is also at the heart of defining a key or particular tonality; and it is the lower frequency material in an acousmatic composition that draws the listener into the perception of a pitch centre.

The term modality has been avoided up to this point, and for good reason. It has been widely used throughout musical history and has had numerous applications. The term mode derives from the Latin *modus*: measure. An early use of the term defined the relationship between the note values *longa* and *brevis*. In modern times, mode has become defined as a particular scale, a generalised tune, or a combination of the two inherent in a specific music culture. Winnington-Ingram in *Mode in Ancient Greek Music* writes:

> Mode is essentially a question of the internal relationships of notes within a scale, especially of the predominance of one of them over the others as a tonic, its predominance being established in any or all of a number of ways: e.g., frequency recurrence, its appearance in a prominent position as the first note or the last, the delaying of its expected occurrence by some kind of embellishment.[8]

This definition of mode, the predominance of a particular pitch, would seem pertinent to the issues already discussed. Perhaps it is foolish to try and pin one particular meaning on the term and explore its relationship to acousmatic music. What is more pertinent is the ubiquitous use of the term, and its use as a method of classification.

As already discussed a sound object can be viewed as a discrete sonic unit. Such an object can comprise of a very complex hierarchy of timbres. If a sound is approached spectromorphologically or is 'magnified', then the relationships between the timbral elements become clearer. A sound object may be viewed as having an inner acoustic structure, where certain elements are more dominant than others. The more a sound object is magnified, the greater the accentuation of pitch. Clicks and glitches begin to adopt certain resonances and pitches. Through sonic magnification the internal harmonic content of sound object becomes perceptible. There are many parameters that characterise a particular sound object, for example, frequency, amplitude envelope, or loudness; however, a sound object's frequency characteristics are integral in the way in which the sound is perceived. From this premise a sound object may be clearly perceived as a form of mode: a discrete rhythmic and harmonic set. It is the repetition or strength of certain

[8] Winnington-Ingram, *Mode in Greek Music* (Cambridge, 1936), p.2.

harmonic partials that create a form of modality. There would also seem no reason why the term ‘mode’ could not be used to define non-pitched material, noise. If a noise source is stretched, or transposed downward for example, then the listener will be able to more clearly detect pitched elements. A noise source thus moves towards pitch through sonic magnification.

The first movement of Denis Smalley’s *Névé* illustrates modality. A frequency analysis of the composition reveals a clear fundamental of circa 55 Hz (A). This pitch is also represented in octaves throughout the lower register. The duration of *Névé* is 4:41, of which at least three quarters of the composition (3:30) revolves around a fundamental of A. Other frequency which dominate, particularly in the section from 1:53 – 3:03, are 520 Hz and 150 Hz (C and E flat). To summarise, a mode seems to exist that comprises of the pitches A, C and E flat. The interplay throughout the composition between the fundamental A and the tri-tone, E flat, is undoubtedly a key feature of the work. Not only is the pitch A prominent throughout, but it also adopts a structural role. The composition begins with a fundamental of A, develops through the pitches of C and E flat and resolves back to the fundamental. The long drawn-out pitches and textures suggest that the source material has been ‘magnified’. Very faint traces of artefacts produced by aliasing also hint at the use of phase vocoding and time-stretching techniques. Timbraly the composition is characterised by ‘breathy’ transients, a detail also exaggerated by sonic magnification.

As Smalley remarked that composing with and ‘within’ timbre can only be realised in acousmatic composition, it is not surprising that musical genres that have a timbral focus gravitate towards modality. Indian classical music, the gamelan, and modal jazz are just three examples. Acousmatic composition is not about scales or necessarily pitch sets, but is tied to the idea of the sound object as a mode, with its subtle timbral hierarchies, resonances and rhythmic motifs. This paper is concerned with pitch, its perception, duration and frequency of occurrence; and techniques in acousmatic composition that have driven a compositional style towards a new form of modality.