
Reflections on sound image design in electroacoustic music

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The capacity for electroacoustic music to project and manipulate sonic images is now acknowledged as a cornerstone of the medium's aesthetic potential. The notion of imagery may be used in a range of ways, reflecting electroacoustic music's potential to present sound 'documents' re-contextualised from real-world experience, as well as to project more abstract entities in which the concept of an image may give coherent form to fantastical constructs, frequently driven by the transforming and distortive effects of signal processing. This paper investigates the practical application of these distinctions in electroacoustic music, largely through reflective discussion of the author's own working methods, and evaluates ways in which the aesthetic effects of signal processing can influence the nature and construction of sound images. Within this, Denis Smalley's concept of the indicative field is used as a conceptual tool for the characterisation and analysis of the affective dimensions of sound image construction and manipulation.

1. INTRODUCTION

The last two decades have seen increasing acknowledgement and awareness of the role of imagery in electroacoustic music. In many ways this may be seen as a response to the way sound recording has facilitated the direct capture of materials both in and out of the studio, and as a tool for conceptualising a means of integrating these with processes of sound transformation and manipulation. The notion of an underlying continuum of realism and abstraction has therefore become a core source of meaning in electroacoustic music (Young 1994), particularly in acousmatic music, which is the primary focus of this paper. The concept of the sound image is more than simply one of presenting 'realistic' or literal 'torn from reality' field recordings – though of course these are important aspects of the practice. Imagery may be more generally regarded as part of the response mechanism that listeners may bring to sounds of uncertain or abstract origin – the imagination's response to that which is fantastical or remote from known physical sources. Sound image is, therefore, a term used to define both the associative and referential aspects of sound, including recognition of realistic objects and actions as well as illusory figures and forms associated with

electroacoustically transformed or re-shaped sound materials.¹

Even in the face of Pierre Schaeffer's rigorously conceived theoretical foundation for the phenomenologically reduced sound object at the centre of electroacoustical thinking and processes (Schaeffer 1966), examples of composers exploiting the dualism of sonic structure and referential meaning are found early on in the development of electroacoustic repertoire.² The roots are of course acknowledged in Schaeffer's writing, his discussion of four 'modes' of listening acknowledges the pairings of ordinary and specialised, natural and cultural listening,³ but it is fair to say that the previous twenty years of electroacoustic music practice have seen more widespread acknowledgement and application of this pragmatic stance: that sound has strong potential to evoke its real-world origins and that this has a potential structural role in the genre. I say pragmatic because of course much material for electroacoustic composition is environmentally sourced, and these sounds tend to carry for us reference to their original contexts. Issues of terminology have been crucial in the evolution of this perspective on the genre, to the extent that some composers have avoided the term 'music' in favour of others such as 'sonic art'. In one sense this can be taken as an imperative to launch the genre from a new basis. For example, the term 'sound image' was used by New Zealand composer Douglas Lilburn in his 1965 acousmatic work, *The Return*, a setting of a text of the same name by Alistair Campbell, thereby circumventing questions of 'music' and focusing on the use of sound as an evocative reflection on a metaphorical

¹Antonio Damasio's concept of *image* is a touchstone here, which he defines as '... mental patterns with a structure built with the tokens of each of the sensory modalities – visual, auditory, olfactory, gustatory, somatosensory' (Damasio 2000: 318).

²Notably Luc Ferrari (see Warburton 1998).

³Schaeffer (1966: 112ff). The irony in some of Schaeffer's early compositional work is that limited signal processing methods and the assumed imposition of a 'state' of reduced listening (*ibid.*: 270) means that from an aesthetic viewpoint many of the works in the 1948 *Études de bruit* still project quite literal sound images, described by Emmerson (1986: 18) as '... two conflicting arguments: the more abstract musical discourse ... of interacting sounds and their patterns, and the almost cinematic stream of images of real objects being hit, scraped and otherwise set in motion'.

text.⁴ Now, for many composers, electroacoustic music offers the potential to develop an holistic approach to sound and its creative manipulation in the sense that the use of digital resources to effect extensive mutation and transformation of sounds can be ‘grounded’ by making allusion to the events whose significance is recognised as already existing in the real world, something known, directly or vicariously, independent of the compositional context in which it is used.⁵

2. THEORY, PRACTICE AND CLAIMING THE GENRE

There is a strong symbiotic relationship between theory and practice in this area. Influential writing by composers such as Trevor Wishart (1994, 1996),⁶ Denis Smalley (1992, 1993, 1997), Simon Emmerson (1986) and Barry Truax (1984, 1996), plus many others committed to articulating the nature of their listening and decision-making processes and environments, has contributed to this.⁷ In creative practice the ubiquity of affordable, high-quality portable recording equipment has given tremendous impetus to the way the genre has flourished, since collection of sound sources can be carried out habitually and inconspicuously,⁸ allowing the recording process to be regarded as a means of reflection on experience, a kind of memory-tool and simply as an end in itself in the form of phonography. A further significant factor is almost certainly the availability and use of portable recording equipment by domestic users – the phenomenon (or the magic?) of familiar sounds recorded and played back is commonplace and understood at a fundamental level as a process with expressive potential. A clear thread that unities much of the compositional, theoretical and speculative research in electroacoustic music is that the complexity of electroacoustic materials brings us back to a form of natural, one might say ‘common sense’

listening which calls on us to re-evaluate the traditionally encapsulated, rarefied nature of musical listening in terms of what we know from external contexts. Jean Petitot has described it in this way:

One of the most striking things about acousmatic music such as that of François Bayle – apart from its specifically aesthetic and artistic qualities – is its wealth of morphological components. ... it includes forms, figurative salience, clear and fuzzy contours, attacks and fronts, not to mention deformation, stretching, mixing, stability and instability, rupture, discontinuity, harmonic clouds, crumbling and deviation of figures and so on. (Petitot 1989: 171–2)

The imagery of this description is telling, and in this sense electroacoustic music offers a way to investigate artistically the nature of listening itself. Pete Stollery for instance describes his work as ‘music where there exists an interplay between the original “meaning” of sounds and sounds existing purely as sound, divorced from their physical origins. ... this is achieved by the juxtaposition of real (familiar) and unreal (unfamiliar) sounds to create surreal landscapes’,⁹ while Robert Normandeau claims ‘esthetical criteria whereby he creates a “cinema for the ear” in which “meaning” as well as “sound” become elements that elaborate his works’.¹⁰ And drawing in reference to the impact of the World Soundscape Project’s substantial influence on electroacoustic music, Jonty Harrison has written:

My acousmatic journey seems to take me down a wide road. One side of the street has a sign saying ‘rue Schaeffer’ – here the preoccupation is with abstracting musical data from sound objects (‘objets sonores’), without reference to their provenance in any anecdotal way... The name on the other side of the road is hard to read, but I am sure that ‘Schafer Street’ – where natural sound is used precisely ‘because’ of its provenance, and where signification does not reside in the ‘purely’ musical (whatever that is) – cannot be more than a block away. (Harrison 2000)¹¹

These stances are reflected in the literature of electroacoustic music where a galvanising idea to have emerged is that because we have the potential to bring sound ‘in’ to a work through recording, shifted in context but ‘untranslated’ as an acoustical signal, we may seek strategies to incorporate referential meaning at more than one level. This is crucial because it means that when we recognise, say, the sound of water in an electroacoustic work, we have the capacity to listen not just at a detailed level to the way the liquid is flowing, lapping or otherwise responding to being activated, but also at a

⁴Campbell’s text, which in Lilburn’s work is presented as a straightforward narration, is an imaginative and visionary expression of his own land – meeting with mist and sea and inhabited by ‘gods of the middle world’ – the evocation of which is inverted into that of a ‘drowned Dionysus’, symbolic of a rejection of European mythology in favour of those of his native roots. As an historical aside on the criticism of work of this genre, Lilburn’s *The Return* was critically reviewed by Robin Maconie in 1968 by means of unfavourable comparison with Stockhausen’s *Gesang der Jünglinge*, particularly berating *The Return*’s content as ‘evocative rather than meaningful’ and as ‘full of literalisms’ (Maconie 1968).
⁵Denis Smalley (1992: 542) has applied Linda Hutcheon’s term ‘transcontextuality’ to articulate the potential for this transference of association and reference.

⁶*On Sonic Art* was originally published in 1985 articulating, amongst other things, Wishart’s notion of the sonic landscape, setting out a theory for the integration of sound source recognition as a structural consideration in electroacoustic music.

⁷As examples: Saariaho (1987), Keane (1989), Barrett (1999), Fischman (1999), Rudy (2001) and Westerkamp (2002).

⁸See, for example, DeLaurenti, <http://www.delaurenti.net/writing.htm#safari>. An historical perspective on this is offered through Luc Ferrari’s practice in Warburton (1998).

⁹<http://www.petestollery.com/> (accessed 31 August 2006).

¹⁰http://www.electrocd.com/bio.e/normandeau_ro.html (accessed 31 August 2006).

¹¹Schafer’s *The Tuning of the World* (Schafer 1977) was the major seminal expression of soundscape studies extended and enveloped by Barry Truax as a theoretical foundation for electroacoustic music.

higher level in which more generalisable images of water will form. These levels of awareness then have consequences for structure at a purely morphological level as a perceived source of generic gestural pattern (shaped by the fact that it is expressed *through* the material in question) or as a more global expression of environmental setting or a specific place, perhaps. Each of these levels correlate with those expressed by Stollery, Normandeau and Harrison above – the intrinsically morphological aspects of sound set against its potential for narrative and evocation of environment. Yet the notion of imagery in electroacoustic music is also relevant to contexts situated somewhere between these polarities. Across a range of situations it includes more complex potentials for cross-modal association and connotation as well as allusion to very specific physical events. Schneider and Godøy (2001) have surveyed, from a generically musical perspective, the manifold nature of imagery as a term. More specifically, Godøy (2001) considers resonance and excitation as cognitively separable components in the formation of musical imagery, based on experiential knowledge and projections of bodily empathy. In doing so he elaborates on a triangular model (vision, action and audition) of cross-modality in sketching the possible corroborative sources of sound imagery as a way of drawing meanings from the corporeal and physical dimensions of music.¹² These notions of resonance and excitation are not far removed from Trevor Wishart's considerations of imposed and intrinsic morphology (Wishart 1996) which represent an attempt to clarify ways in which natural resonant properties of, say, a cymbal, are psychologically distinct from our perceptions of performance gesture or, more generically, perceptions of the motivating energies that actually enable us to hear its sound.¹³

These perspectives on sonic imagery highlight the perceptual distinction between 'realistic' sound images, those understood as tangibly from life, and those more connotative sounds whose imagery is not phonographic but might stimulate feelings of known actions and objects. This framework for imagery, then, is a core aspect of the potential of acousmatic music. A poetic dimension is afforded by the removal of visual sources since, in representational terms, acousmatic sounds become partial objects – potentially evocative of their sources, yet at the same time introducing ambiguities, potentially impressionistic and requiring active imaginative input to effect reconstruction of a scene or resolve contradictions of context. Trevor Wishart's outline of 'object-space relationships' (Wishart 1996: 146) aims to summarise these perspective as a set of interlocking

shifts in associations and interactions between sounds and their settings. A further significant attempt to form a general framework for understanding sonic imagery is found in Denis Smalley's discussion of indicative fields (Smalley 1992), a set of nine generalised models of physical and mental structures embracing experiential models drawn from sounding and non-sounding contexts, namely: gesture, utterance, behaviour, energy and motion, object/substance, environment, vision, space. As a way of locating bases of sonic imagery, their relevance is clear. For example, in terms of the object/substance field, Smalley points to categories of 'material-like qualities – stone, glass, ceramics, woods, metals skins, etc.' or the 'thingness' implied by certain sound types. In Godøy's terms this is supported by the unifying physical sense of resonance when he affirms: 'knowledge of resonant features often also includes notions of what we would call "source coherence", meaning the identification of a source across variant instances of excitation ...' (Godøy 2001: 245).¹⁴

As a key to analytical terminology, Smalley's indicative fields are powerful, since they are precise enough to have descriptive value, but malleable enough to have relevance to the way composers and listeners might form images of the materials from their differing perspectives.¹⁵ They also cover overlapping and intersecting criteria, which allow them to function as components of indicative networks (Smalley 1992: 521). For example, the visual field may be relevant to the way an environmental field is projected, which may also call on the recognition of objects and substances as elements in the discourse. At a broader level, interpretations of formal organisation may also arise directly from the way we infer meaning through indicative relationships. For instance, a sequence of distinct environmentally defined fields may as a whole carry a message about the spatial field¹⁶ as a way of articulating movement through spaces of different dimensions and scales relative to each other, or to the nature of our perceived immersion in them. There is difficulty in being categorical about sound imagery – it tends toward the interpretative and personal, since it effectively points toward the way sound may initiate cross-modal associations, reflecting the experience of the listener and even a willingness to engage with, say, field recordings as a source of something presented as 'musical'. While the discussion that follows focuses on acousmatic works, many more questions of indicative

¹⁴McAdams (1993) uses the term 'transformational invariants'.

¹⁵The validity of these ideas nevertheless requires a strong element of consent from listeners as to their applicability in given situations. Smalley makes this claim on the basis of 'experiences of decision-making during the compositional process, and on assessing the reactions and interpretations of listeners to electroacoustic music in both teaching and concert contexts over a number of years' (Smalley 1992: 521).

¹⁶Smalley's discussion of space as an indicative field is in itself multi-dimensional and too extensive to fully discuss here.

¹²Bodily empathy for physical motion was a strong motivation for the sculptural work of the avant-garde artist Len Lye, who integrated sound as a consequence of the action of his kinetic sculptures (Lye 1984).

¹³Wishart in fact acknowledges the basis of this idea in the [Schaefferian] concept of sound typology (Wishart 1996: 177).

content and their integration and context are relevant to the staged presence of instruments in electroacoustic contexts. As an example, in a work such as Cort Lippe's *Music for Hi-Hat and Computer* (1998), the transformations of the cymbal sounds take us into spectromorphological and indicative territory that transcends the physical nature of the instrument. Yet, in performance, a reading of the tremendous range of sonic apparitions that form is inseparable from the physical presence of the instrument itself and the immediacy of the performer's engagement in producing the sounds that trigger the work (and there is something acutely interesting about that particular instrument in this sort of interactive situation, since it is free-standing, rather sculptural, and constantly subject to the performers approaches to it).

3. PROJECTING IMAGES

In themselves, sound images are often fragile constructs. Because of the complexity and intersecting nature of their origins, the composer's and the listener's visions may be difficult to align with complete congruence. While a complete one-to-one mapping of composerly 'intent' (and composers are often not always rigorously calculating in intent!) and listener response may not even be desirable, the overlapping and multi-dimensional perspectives on sound imagery offered by these indicative fields present a clear strategy for projecting intent and handling materials at multiple levels¹⁷. And in any artistic context where multiple levels of structure, signification and process are able to function, the potential to draw the observer/listener in as an active participant in the experience offered them may be a vehicle toward enriching the value of the work. For example, in Francis Dhomont's *Phonurgie* (1998), a transition occurs at 4'48" that projects a densely textured but recognisable image of closely microphoned flapping birds' wings. In the context of the work at that point, which has been constructed of many impulsive resonant pitched gestures and textures emerging out of them, such a coherently realistic sound functions not just as a transition to a new morphological field but introduces a strong shift in indicative terms. That is to say, the perceived level of proximity to known physicality is transformed – even if the 'bird' image were not agreed upon by listeners, the clarity and scale of the sound, the sharpness of the attacks and the naturalistic motion represent an apparent 'surfacing' out of a world of more abstract causality. Formally, therefore, its function is not just a contrasting morphological 'theme', but to affirm long-range, indicatively based motion. It tells us that the piece is not just about the structure of the sounds, but about how we might conceive and project our own imaginative presence

within it. Whilst a 'meaning' is available at the level of that juxtaposition alone, a more conclusive meaning (why have we been projected into this new 'environment?') is ambiguous ... open. The overriding meaning is the powerful nature of the transition itself and the realisation that this kind of indicative shift is *possible*.

One final underlining of that point is this: composers with a professed intent to exploit referential meaning and spectromorphological structure (cf. Stollery, Normandeau and Harrison above) may use these distinctions as a way to steer a musical argument, as a device allowing indicative fields and networks to be tangibly formed by making movement through and across them something dynamic and conspicuous. One other dimension to this argument, deserving of further research, but outside the scope of this paper, is the relationship of studio-based compositional practice to the aural imagination. While the real and the imaginary are often cited as generators of musical aims and processes, and are tangible once actually heard, the extent to which these can or cannot be conceived and formed within a composerly 'inner ear' (that is, outside the concrete conditions of the studio) may give further insight into the precise nature of the genre from the perspective of the listener who has not the privilege of knowing the provenance and processes that lead to the final emanation of the work. In short, can music that aims to exploit the true, physically experiential totality of sound – referential and abstract – and that facilitates the production of radically new aural constructs, itself be imagined?

4. IMAGERY AND TRANSFORMATION

The second part of this essay is devoted to a discussion of some potential uses of sound imagery in the context of the audio transformation tools available in electroacoustic music. These are based mostly on my own creative practice, but are presented here with reference to the notion of indicative fields and networks.

While much of the discussion of electroacoustic composition technique is associated with the direct effects of signal processing on the dynamic morphology and spectral structure of sound *per se* (for instance the manipulation of amplitude envelopes, spectral contour, partial structure, perceived pitch or spatial setting), the effects of sound transformation on imagery are perhaps less well discussed. Three perspectives on this are identified:

- (1) The potential via signal processing to stimulate alterations to our perception of sound image. This includes the way a listener might interpret the physical nature and behaviour of sound sources.
- (2) The potential for transformation processes to offer a means to mediate between purely 'spectromorphologically' based and 'referential' discourse

¹⁷See Schneider and Godøy (2001: 14) for further discussion.

carrying with them the potential for hybrid sound designs in which sound identities may interact with and influence each other.

- (3) The capacity of a sound image to function as a structural catalyst and formal anchor.

4.1. 'Altered' images

Sound images have the potential to function thematically, as a generative source informing spectromorphological development and transformation,¹⁸ but signal processing may also transform the indicative nature of materials. This may be because the processing technique/s applied have an inherently strong transformational morphology of their own (Young 2002), or because latent characteristics of the sound take on a new indicative significance for the ear. Cross-synthesis techniques in general have this capacity to fuse together indicative properties of sounds in the creation of hybrid sound images. But even technologically straightforward intervention in the nature of the physical signals may lead to the formation of expanded, enhanced or entirely new images. For example, the call of a New Zealand native bird, a tui, is subjected to straightforward pitch shifting of one and two octaves downwards, respectively, after the original sample in Sound Example 1 (on Volume 12's *Organised Sound DVD*).

Clearly the elongation of the sound's morphology and the lowering of its formant structure results in a shift in perceived source. What we gain is not just a 'larger' tui with a deeper voice, but a more human-sounding ululation. The above small example is representative of the way in which sound transformations can radically affect the way a course can be plotted through indicative suggestion in electroacoustic music. Indeed, because the effects of transformation cannot necessarily be accurately predicted (both because of the 'unlocking' of structural characteristics of the signal and the vagaries of processing artefacts), processes of discovery, revelation and the pursuit of satisfying pathways through indicative networks are one of the defining characteristics of the creative process in the medium.

Sound images can often be quickly created by selection of a salient sonic characteristic of a sound event that is likely to be rapidly recognised,¹⁹ and tight juxtapositions of sound image 'seeds' can then also form concentratedly expressed 'flips' of image, such as in

Sound Example 2 from the opening of *Coriolis Effect* (2002) by James Paul Sain.

My own work *Inner* (1995) attempts to exploit this principle with the initial presentation of a single, gasping sharp intake of breath bracketed by silence, and with no wider context suggested – the sound image is clear, but devoid of a broader frame of reference. This I considered to be a gesturally strong way to open the work whose core 'theme' is the sound and associated feeling of human breath. Subsequent treatments and developments of material in the work are designed to reflect the indicative nature of this opening gesture. For example, in the next moments of the work, the sound given in Sound Example 3 is a slowly 'released' noise band, suggestive of but not realistically akin to the exhalation of breath. Short inhalation fragments are also used to bring the listener rapidly back to a sense of this sound source in the midst of more abstract materials (and therefore to the thematic seed of the work) (Sound Example 4).

New dimensions on the sensation of inhalation/exhalation are created in a number of ways, including the 'fracturing' of a constant 'in-out' breathing morphology through the use of an envelope substitution technique in which a sound with irregular dynamic profile re-energises the breathing sound. The breathing image remains intact, yet is given a surreal rhythmic contour (Sound Example 5).

This process of reshaping one sound with the dynamic characteristics of another is explored extensively in *Inner*. I have described the general nature of this process as an interaction between an idio-morphology (the sound whose spectral content is retained) and an exo-morphology (the sound whose profile is used as the imposed dynamic template) (Young 2002). Where desirable, the two participating sounds can, of course be mixed together, or layers of exo-morphologically reshaped variants can be multiplexed, and so on.²⁰ A principal value of this way of thinking about indicative relationships between materials is that it offers a way to re-inject materials into a work in an organically cross-referential way; experimenting with shaping and mixing of components can allow a developing context for a sound which is heard 'through' the dynamic filter of other sounds. One technical dimension of this process is that variations in the window size in which the envelope of the exo-morphology is analysed and reapplied can influence the extent to which recognisable characteristics of the idio-morphology are projected. Longer windows (above *ca* 100 ms) allow more morphological micro-variation of the original to be preserved (some of which may be important to recognition of the source) whilst shorter ones (down to 10 ms) will create much

¹⁸Smalley (1993) uses the term 'source bonding' to describe the way a sound may be heard as related to an originating sound source. Source bonding may be relevant to sounds heard in the work, or to sounds known from outside the work, but inferred by, for example, spectromorphological or behavioural relatedness.

¹⁹It is a well-recognised psychoacoustical phenomenon that the onset component of a sound frequently contains crucial information used by the ear to interpret sound sources.

²⁰For example, in my work *Allting Runt Omkring* (1998), sounds processed with synchronised envelope substitution of this kind were dispersed amongst the eight loudspeakers.

tighter correlation between sources and may render the idio-morphology less inherently recognisable.²¹

4.2. Sound-image and sound vs image

One of the challenges in working with the construction and manipulation of sound images lies in the dualism of the indicative scope of sound (such as reference, connotation and analogy) and the scope for spectromorphological design. As I have argued, these dimensions are not mutually exclusive and are deeply interdependent, but from a composer's perspective the potential to 'tilt' emphasis in one direction or another is a touchstone of compositional technique. The indicative and the spectromorphological aspects of sound and sound design bring their own kinds of richness to music. Nature provides many examples of sounds that tend to stimulate sheer sonic-aesthetic pleasure, and well as offering metaphorically rich sources of reference – no wonder that water has been a frequently used sound source in acousmatic music! But this dualism of the sensual-functional in sound is allied to the indicative and the spectromorphological, since it can operate in each of those areas. Sensitivity to the way an emphasis within each of them may be manipulated is an important tool in steering a course through the way indicative attributes of material may shift with signal processing and to the way materials are chosen from, say, a myriad of transformational variants of an initial sound.

My work *Tongue* (2001) is based on recordings of tongue twisters in a variety of languages, with the intention of investigating the patterns and structures inherent in this linguistic phenomenon. The material offered interest not just because of the engaging sonic properties of the sounds, but because of the inherently absurd meanings of tongue twisters themselves: here sound and the difficulty of execution governs semantic sense. Four participants provided material for the work in Japanese, Swedish, Spanish and Mandarin (including one in Sichuan dialect). Sound Example 6 contains the Swedish and one of several Japanese tongue twisters used.

In keeping with the rhythmic structuring of these materials, a very straightforward but structurally fundamental processing step with some of the material was the separation of consonant attacks and other transient noise elements simply by editing out vowel sound components, effectively producing abstracted rhythmic attack 'skeletons', as in Sound Example 7 derived from the previous Japanese tongue twister.

²¹In accord with principles of vocoding, the most satisfactory results in terms of a balance between retention of recognisable characteristics and dramatic reshaping of a sound is achieved where a relatively continuous sound has a more discontinuous or dynamically variable morphology imposed on it.

Examples like this provided a way to manipulate the rhythmic essence of the material whilst drawing back from the full vocal image of the original material. A key transformational technique used to engage with this idea is that of waveset interleaving. A waveset is defined as a section of a waveform defined by three zero crossings, departing from the situation of the sine wave in which the three zero crossings define the period (Wishart 1994). Most natural sounds, of course, do not have periodic structures defined by three zero crossings, and those comprising noise are aperiodic. Interleaving clusters of wavesets present possibilities for sound design quite different to those of 'normal' granular means where the grain size remains constant, imposing a periodic structure (and therefore often a pitched artefact) onto the processed material.

In Sound Example 8, the rhythmic skeletons of the Japanese and Swedish tongue twisters are interleaved in groups of 150 alternating wavesets. These rhythmic patterns then significantly inform the work's development at a rhythmic level, whilst frequently remaining indicative of utterance (Sound Example 9). Layers of reference can be exploited in this kind of indicative/morphological interplay, for example in the section from *Tongue* given in Sound Example 10, where the Japanese speaker is projected as wholly 'present' amidst a scattering of consonants, stuck in a series of attempts to articulate one of her tongue twisters.

In the work *Virtual* (1997), a central idea was to attempt to relate environmental images of air movement – the wind and its action – to a more body-centred concept of human breath.²² Statement of this intention was made at the outset of the work by presenting a strong gestural statement, an accelerando morphology, of rich noise, but which has embedded in its makeup discernibly human breath formants. Following the initial dense, visceral phrase, a very 'open' space is presented with the intention that this should be indicative of a more environmental setting (Sound Example 11). The human scale of things is hinted at in another way by mixing with wind-noise-like turbulent sounds of creeping through foliage and over branches (Sound Example 12).

A more general sense of play with the 'reality' of an open environment recorded was also experimented with in developing the work. Wind is an illusory phenomenon, since it is itself invisible, but its *effects* are audible and visible. Its representation in sound image terms is therefore available, and perhaps enhanced, by being expressed through many different interactions with objects. Sound Example 13 presents two sounds files in succession, the first a recording of wind noise in a forest of tall pine trees, the second an 'enhancement' of this,

²²An overriding image for me at the time was the anthropomorphic representation of the four winds as humanoids blowing across the globe from the four points of the compass.

mixing with other enveloped-correlated noise sounds including breath-derived material. This kind of layering process was used extensively in the work (and in many others of mine) and arose from the simple observation that the movement of wind in the first unprocessed sample has two distinct dimensions, the distant noise of wind in trees, and the close-up action of wind directly across the microphone – an image indicative of spatial immensity and intimacy in one sound. Spatial perspective of this kind can assist listeners' identification with pertinent indicative fields by virtue of the way it may encourage them to psychologically situate themselves relative to the image of physical scale, depth and proximity that is projected.²³

A broad concept of imagery is at the heart of *Trace* (2003), using alto saxophone samples recorded with the Swedish saxophone virtuoso Jörgen Pettersson. The starting point here was a set of multiphonics drawn from Kientzy (1982) initially as a catalyst for harmonic and spectral development. However, Pettersson improvised many other sounds for me, which provided a range of material that more generally sketched sound images of the instrument – the breath and fingers, different ways of exciting noise and resonance from the 'tube', blending his own voice with the sounds and so forth. In this one example from the material used in *Trace* (Sound Example 14), the source sound was a series of slap tongue resonances, ordinary in its scalar pattern, but containing a number of timbral components. A transformation used to enrich this sound and develop its embryonic qualities was a granulation-based time stretch and pitch shift. As the grains get further apart, the periodic artefact they generate produces a downward pitch curve that overlaps with the upward pitch motion of the source (which is in fact a latent acoustical feature of the original). By generating additional elements of spectromorphological detail, the sound is tilted away from its original physicality, taking on more of the semblance of something 'liquid' (though at approximately one third of the way into the gesture the formant structure briefly intersects with something more akin to a 'real' saxophone).

4.3. Sound image and structure

In *Pythagoras's Curtain* (2001) my aim was to investigate the expression of tactility as something audible, using a range of mundane sounds reflecting the action of the hands at close range: hand claps, writing with chalk on a blackboard, knocking on doors, handling paper, balloons, splashing water, rubbing a crystal glass, and many others. At one level most of these sounds have clear object/substance indicative

qualities. The hands set in motion the objects and present 'play' or 'action' through the intrinsic sonorous qualities of those objects. But there is also a spatial field at work in terms of the intimacy and scale of the sounds themselves, most of which are heard as though the ear were placed very close to the sound source, which of course is exactly what was done with the microphone. In this sense the image of cognate sounds projecting objects set in motion or manipulated by hand is intended as a grounding device. So while the sound sources represent a disparate range of morphologies, the tactile presence and intimate focus could be regarded as a thread of indicative coherence.

One way the tactile motivations of these source sounds was explored was through the waveset interleaving technique described above. With impulse-based sounds this was a way to preserve indications of the tactile and object/substance nature of the sources whilst projecting a semblance of imaginary play between them.²⁴

The next two examples show an initial sound source, hand claps interleaved with water splashes, introducing a causal relationship between the two timbres (Sound Example 15). In the next example, the morphology imposed by interleaving groups of forty wave-sets of two sounds (a rubbed balloon and a tapped crystal glass) generates the percept of more attack-like iterations between them. This produces the image of a very ambiguous causal energy/sounding object relationship, reinforced by very general correlations between the two spectra (Sound Example 16). Ambiguity of a spatial nature is presented in the next examples with a single sound event of knocking on a door which was recorded simultaneously with two pairs of close-up and distant microphones, then waveset interleaved to construct a hybrid image in the nature of a mixed dry/reverberant spatially ambiguous soundfield (Sound Example 17).

What these examples attempt to show is that related referential sounds – in this case centred on the generative sound image of tactility – can support progressions through other kinds of indicative field. At one level this has the capacity to give longer-range structural potential to that image. More generally, there is potential for generalised characteristics of sound identities to have a more broadly inferred influence over the shaping of musical materials at a connotative and/or behavioural level. Where this can be established, the grounding influence of a sound image can be sustained across long-range formal planes.

My work *Liquid Sky* (1998) was composed in order to explore the sound imagery of rain. Numerous field recordings were made in springtime in Vancouver, which readily provided the source material (!), a process which involved focusing on the varying sonic effects of

²³It is worth noting that the term 'stereophonic' is derived from the Greek for 'solid', a reminder that this form of reproduction alone marked an advance toward more successful representation of sound as a physically etched and tangible image.

²⁴With the sounds in this work, typical number of wavesets of two source sounds interleaved ranged between 30 and 250.

rain falling in different objects – leaves, puddles, glass, shingle and pieces of garbage. The simple, and admittedly obvious, observation that the sound of rain is dependent on its interaction with physical bodies was developed using the envelope substitution technique described above, shown in the next few examples. I was looking for a way to develop an image of rain on an exaggerated atmospheric level, whilst retaining a sense of the details of its liquid nature. In these examples, two separate processes are carried out with a raw recording of rain falling from guttering. Firstly, it is time stretched through granulation and pitch shifting, taking the sound well away from any sense of the original source and introducing phase anomalies that are indicative of a much larger spatial setting (Sound Example 18). The original is then subject to envelope substitution, with a very variable dynamic profile imposed, giving it a new energy but retaining the sense of close-up droplets (Sound example 19). These two are then mixed to create a composite sound that is both ‘immense’ and ‘intimate’ in micro detail. The resulting range of scale in space and presence becomes a level to make shifts in emphasis across the structure as a whole (Sound example 20).

Studio recordings were also made of closely microphoned water droplets in order to enhance the scope for varying the perspective and focus on sounds generally indicative of water and its behaviour. In this short sequence of examples a single mono recording of a water droplet is granulated (mostly to create a stereophonic presence for the sound), then pitch shifted downwards by an octave and time stretched by a factor of 2.5. In this sequence, the sound begins to take on an almost vowel-like quality, offering the potential to shift the indicative implications of the material (Sound Example 21).

As the sound is time stretched, the small natural ‘grains’ in the decay of the sound are clearly made more active, with the potential to assume energy rather than simply be a consequence of its release, leading to the creation of more extended textures and gestures of this kind, thereby becoming a catalyst for both musical statement and continuation and a motivating energy supporting structural motion (Sound Example 22).

The real and the imaginary can be woven seamlessly in electroacoustic sound imagery. In this further example from *Liquid Sky*, two separate layers of liquid-sourced material are brought together in developing the sound image of a liquid of unusual viscosity. Though the two layers of sound are timbrally distinct they indicate a similar genre of fluid behaviour, and this is underlined by the coordination of the components to have simultaneous peaks at certain points, implying a related causality (Sound Example 23).

Broadly the work is marked by a transition from noisy spectra to pitched ones imposed through resonant filtering techniques. In this final example, a contributory sound file to *Liquid Sky*, a drifting resonant spectrum and high-frequency ‘droplets’ suggest a dream-like

abstraction of the behaviour of water. In the final context of the work this is emphasised by a shift back to more direct realism of falling rain (Sound Example 24).

In these ways the interaction of source sounds and processing techniques facilitate shifts in the indicative implications of the material. The concept of the sound image is a unifier across different indicative fields: the projection of the material (water), its behaviour (liquid motions, ‘granular’ rain, the ‘impact’ of water droplets).

5. SUMMARY

In electroacoustic music, we find that use of natural and everyday sounds and recognition of their sources can generate meaning through their potential to relate to indicative fields. Sound recording and reproduction equipment is essentially a transparent packaging (transportation) system, which invites us to find meaning in the process of recognising sounds, since we can be drawn into narratives and projections of sound events that may be real, surreal, or completely hypothetical. A key way of giving form to this idea is through the notion of the sound image, a conceptual tool which unites those sounds which are distinctly referential and those with a remote relationship to reality, allowing them to be investigated for the properties of presence and physicality they project, either alone or through associations and networks contrived for them. The integration of these sonic polarities is one of the most innovative and defining features of the genre. The act of ‘imaging’ in this broad sense can allow the composer to conceive structural relationships and transformational pathways that call on indicative relationships in consideration of factors such as the materiality of sound, spatial presence, colour, balance, inflection or the sense of tension and its release. Understanding the potentials and effects of transformational processes is surely a crucial ingredient in working toward a fuller understanding of electroacoustic sound imagery, since by so doing indicative relationships can be mediated and transfigured. Indeed the dynamics of sound in constant flux may allow us to conceive some transformations as images of constructive, destructive and shaping forces. A crucial force in the aesthetics and practice of electroacoustic music is, then, its fundamental ability to negotiate this synthesis of illusion and veracity, abstraction and reality, stemming inevitably from our propensity for fantasy, symbol-making and the finding of sheer enjoyment in the senses.

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