Elemental Chemistry

Textons and a Vision of Space in Acousmatic Music

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Abstract

The electroacoustic work *Elemental Chemistry* was realised as part of the author's research in spatial texture, a subject dealing with the perceived modes of organi*s*ation and patterning among textural morphologies in perceived space. This paper offers an insight into the aesthetic concerns that guided the process of composing this work, while simultaneously introducing some key theoretical aspects of the research.

With Denis Smalley's theoretical framework of space-form (2007) as a point of departure, the research introduces some approaches towards textural scale in spatial percepts of electroacoustic music. This involves the concept of textons, invented in visual texture perception research by experimental psychologist and neuroscientist Béla Julesz (1983). Following the conjecture that spatial aspects of acousmatic music often have a multi-sensory effect on the listening experience, the notion of textons is here extrapolated into the domain of music. Textons can be thought of as the quasi-visual, 'perceptual atoms' of spatial texture and are described here in terms of shapes, locality and propagation through time.

The discussion puts the research topic into the perspective of *Elemental Chemistry* as a work exploring these ideas, and reflects on the degree to which it is successful in doing so.

Elemental Chemistry: Textons and a Vision of Space in Acousmatic Music.

Introduction

I composed the work *Elemental Chemistry* during late 2008 and the early half of 2009. In this paper I discuss the aesthetic intentions, treatment of materials, and the musical processes around which the piece is structured. I also present some aspects of the research that, in one sense, guided the creation of the piece, but, in another sense, emerged out of it. The research is about spatial texture and develops a descriptive theory concerning existing and potential phenomena of space in acousmatic music, using the basics of space-form, developed by Denis Smalley (2007). I will use the piece as a point of departure for introducing the research, and while some of it may be alien for those less acquainted with electroacoustic music, I attempt to make it accessible.

Intentions

The curiosities that guided the creation of *Elemental Chemistry* from the start largely came from an interest in sound environments. These are not only real world phenomena, but can also appear in abstract acousmatic conditions. They impart a different kind of causality in music, which I have termed internal causality[1]: The environment itself may be perceived as an organism which evolves as a result of the collective behaviour of an ecology of morphologies; form and change appear to propagate from within, rather than being instigated by human gesture. I was intrigued to explore field recordings as an avenue for these ideas, and to find out how space can be created and articulated in both abstract and source-referential ways through textural material. As a structural principle in acousmatic music, texture is intrinsically spatial; textures articulate peripheries and presences; texture weaves space as it propagates in time.

Elemental Chemistry explores spatial transformations, which occur in processes where disintegration into noise, or relative disorder, is simultaneously a platform for organisation. These are open states of possibilities, where spectromorphologies spill sound into one another and mutate in a transient flux. Stephen Handel argues that

> 'it is along the continuum between chaos and randomness to order and structure that our perceptual world forms' (Handel 2006, p. 3).

In a sense, the complex and unpredicted interactions in nature and culture are mirrored in our perceptual system. Handel further proposes that perceiving is 'the abstraction of structured energy of the ongoing flux' (2006, p. 4). Acousmatic music is perhaps the ultimate art-form for exploring the ambiguities of perception: left exclusively to auditory stimuli, we are compelled organise a transforming world, and this exploration engages all senses, as, for example, we might visualise and make tactile the sounding. Whereas in the real world we often have a clear idea of the 'where' and 'what' in that which we perceive, the acousmatic world can linger on the boundaries of perceptual organisation; environments are dynamic, they can shift and react in a perceptual chemistry with seemingly infinite possibilities. Space becomes an important percept here; sound creates space as it occupies space; sound becomes your knowledge and experience of gravity, and your view of your surroundings. This ranges from the awareness of a spatial fabric in the most abstract sense, to forms with a more concrete presence.

In this piece, I intentionally sought possibilities of letting the spatial fabric instigate or suggest the temporally directional structures. This has resulted

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in a form evolving spontaneously, as fusions, syntheses and reactions among morphologies are generated in a continuous process.

Source Materials

The point of departure was an abundance of field recordings made during a trip to Greece in the summer of 2008. I had envisioned that I would use these to somehow synthesise the real and the imaginary; there was an idea of 'painting' sound into the environments and abstract them through hyper-accentuation, inverting and obscuring reality so that a new kind of sound world would appear. I was not so interested in anecdotal reference to the source environments, although vestiges would be there, but rather, to instigate a sonic process, absorbing the recordings and building on their features, internalising the materials until the sound substance becomes its own source, as an abstract fluid of sound and space.

In the composition process the field recordings took more of a background role than I initially had expected. The synthesised materials, informed by the recordings, were instead to become the major substance of the piece. A reason might be that common clichés of electroacoustic repertoire, such as water, insects, forests and beaches were difficult to avoid. The spectral properties of a bundle of goat bells provided pitch structures for the synthesised harmonic spectra which were to form a central part of the piece.

The approach to synthesis that I took was largely motivated by the idea of wholes and elements. Harmonic, additive spectra were used partially because they can fuse spectrally, while still covering an area in space, if their partials have individual panoramic distributions. But these can also segment, if granularity or modulation is introduced on individual harmonics. Similarly, noise and aggregated impulses can be distributed in space, and spectrally shaped, to create textures that layer in spectral space and spread in panorama, distance, foreground.

Processes – a continuum of possibilities

The piece can be heard as a continuous, fluctuant polyphony of elemental sonorities, where harmonic spectra of sine-tones, coloured noise and impulses have a presence alongside obscured environmental recordings. These organise in complex spatial configurations, which often evoke natural, source-bonded spaces, while simultaneously having abstract qualities.

The harmonic spectra, one of the distinct sonic features of the piece, undergo alterations in character – between being highly unstable in pitch and dynamics, often with vocal qualities, and having more fixed structures with glassy or metallic resonances. These morphologies combined well with the environmental recordings, having a high transformational potential in the ability to vary continuously between unstable and stable states. Organised in transpositions of the structures found in the aforementioned bell resonances, the harmonic fluctuant sounds became a structural thread. Layered in multiple parallel trajectories, these morphologies could easily interact and multiply in an organic manner, and their spectra would occasionally also combine into melodic traces. The first three-and-a-half minutes of the piece are largely centred on these sounds, spontaneously interacting in undulating pitch modulations and glissandi, but also with a clear presence of resonant, gestural impacts.

Most of the sound structures I worked with had a presence of irregular fluctuation and the idea with this was that they enable several possible directions in which transformational processes may orient themselves. Fluctuations were given a foreground

role on both local and global levels of form, as the non-fixity of textures, gestures and spaces seemed necessary for organic transmutations to occur. This emphasis relates to an interest in the idea of structuring music by degrees of organisation. There are several places in *Elemental Chemistry* where the music seems to organise itself out of a state of relative equilibrium, where random energies suddenly coincide into gestural impacts and transformations. I refer to these as entropic processes: situations where the combined possibilities and energies of several spectromorphological 'systems', mutate into new textures and gestures. Sound example 1 illustrates such a transition of states, near the opening of *Elemental Chemistry*, where the fluctuant harmonic spectra coincide (0:20 into the excerpt) and begin to interact in gestural impacts, undulating pitch modulations and glissandi.

Noise, one of the inescapable features of field recordings, became an important part of the piece. Conceptually, I can see it as an incarnation of the entropy present in all systems – natural, cultural or technological – and as such it is also a common ground among environments. The background noise of recordings could be brought to the foreground by the use of synthesised noise. In *Elemental Chemistry* layers of noise often serve as a spatial adhesive, but also emerges as an environmental feature in itself, occasionally evoking source-bonded phenomena such as rain and waves. It also articulates more abstract spatial transformations, contrasts, spectral layers and gestures. The transitions between opaque textures of white noise, and granular particles, became a recurring characteristic in the sound world. Sound example 2 shows a spatial transformation from the middle of the piece (occurring at 6:59-7:39) where a sustained spectrum is wept away by a dense texture-gesture of coloured noise, igniting a transition towards a quasi-natural environment. The iterated impulses are useful since they can become noise if coagulated, but also meet the harmonic spectra when acquiring resonant tails. When agglomerations (temporal density) occur over short periods of time, swelling gestures emerge, and these recur frequently in *Elemental Chemistry*.

One principle that unites all these different sounds is the periodic and aperiodic iterations and dynamic modulations; these permeate many of the textural elements, whether resonances or particles, and are for me perhaps an abstract mirror image of the sound environments that inspired the piece, where the rhythms of cicadas and crickets had left a strong sonic imprint.

The original field recordings were subverted by the use of filtering and continuously shifting transpositions, and are often not recognisable beyond a sense of environmental presence. Swallowed by abstract textures in a different sound world, a new logic of behaviours, textures and gestures could emerge.

In this variable and mutable music, all sounds are states of processes, rather than discrete objects arranged in a collage. If all sound materials have some basic principles in common, coherence can be maintained in a liberated discourse of form. Here, the spatial texture is always in reaction, creating sudden transformations, or gradual changes; orienting us among landscapes, gestures, quirks and oddities.

Spatial Texture, Space-Form

Spatial texture is a term invented by Denis Smalley to describe the manner in which sounds spread in space and reveal perspective (1997, p. 124). Perhaps we can think of it as 'texture as spatiality[2]', or 'spatiality as texture', and to me it holds great potential as a forming principle of acousmatic music. The first part of my research into spatial

texture concerns low-level activity in space: interactions, which are relevant when there is an implication of magnified, high-resolution sound environment; where we are able to perceive the internal elements of texture. Here I consider scale, not only in terms of time, but also in terms of perspective and spectrum. It is about how our attention is drawn to the inside of something large.

The research is based on the principles of space-form, introduced by Denis Smalley in 2007. There are three main categories of space-form: perspectival space, spectral space and source-bonded space. Smalley defines perspectival space as

> 'the relations of spatial position, movement and scale among spectromorphologies, viewed from the listener's vantage point' (Smalley, 2007, p. 56).

This can be thought of as a localisable space, which calls for an image-oriented listening, beholding the perspectives of an acousmatic 'picture' or surrounding. Spectral space is defined as

> 'the impression of space and spaciousness produced by the occupancy of, and motion within, the range of audible frequencies' (ibid.),

and creates a vertical dimension in music. We may perceive planes, gravity, levitation and other phenomena depending on spectral distributions of sound. Source-bonded space is defined as

> 'the spatial zone and mental image produced by, or inferred from, a sounding source and its cause (if there is one). The space carries with it an image of the activity that produces it' (ibid.).

Source-bonded imagery can often override spectral and perspectival space, when the association to sources become so strong that we forget about spectromorphology.

Smalley describes contiguous and non-contiguous space as two different manifestations of spatial texture (1997, p. 124). Contiguous spatial texture implies that a spectromorphology has a non-fragmented spatial presence, made up of a continuous substance or motion, whereas the non-contiguous texture has multiple elements, which are separated in space, but yet form a whole together as a textural coherence. These are two general ways in which spatial texture articulates an area in perspectival space. If we also consider spectral space we obtain a vertical dimension of perspective, so that high and low may be articulated. Many perspectival phenomena are difficult to isolate from spectral space, which has strong implications on textural orientation and layering in distance and proximity.

Listening to perspectival space often conjures up a quasi-visual percept, as the spatial articulation of panorama, horizon, near and far, can create an almost pictorial image environment. The idea of quasi-visual listening is emphasised in my research, although I am careful to avoid treating it as an analogy; it is not simply a way to describe phenomena by visually-oriented terminology – it is an aspect of listening.

The role of the small elements in texture is dependent on the context. Internal elements are not always perceived: texture can be coagulated to the point where particles are barely audible, or so smooth that there is no reason to speak of elemental sonorities. If on the other hand, we seem to be zoomed into a spatial texture, the internal fabric becomes visible, and we are able to perceive the spatial configurations of elements. I am devising means of describing these elements and their organisation in space and time. Note, however, that this project is not one of developing technical approaches, although such can be implied. Many of the things that some composers might consider 'spatialisation' techniques are here treated as spatial phenomena,

intrinsic to texture and morphology, and thus having musical value.

Textons

I first came across the concept of *Textons* in Albert Bregman's discussion of textures and granularity in *Auditory Scene Analysis* (1990, pp. 116-122). Bregman makes an interesting parallel to the neuroscientist and experimental psychologist Béla Julesz's research on textures in visual perception. Julesz had discovered that visual segregation between textures is dependent on the preconscious processing of perceptual 'atoms', which he termed textons (Julesz and Schumer 1981, p. 595). With the texton theory Julesz showed that preattentive[3] neurological processing can immediately distinguish texture gradients based on conspicuous features among individual elements (Kandel and Wurtz 2000, pp. 502-504). The visual system is able immediately to scan an area and separate regions of textural difference, based on simple local properties such as lines, blobs and orientations (Julesz 1986, p. 246).

Although it has not been proven that auditory textons exist[4] Bregman relates Julesz's textons to the notion of acoustic grains, as would be applicable to granular textures. Going back to spatial texture, my application of textons is sonic, spatial and quasi-visual. Textons are spatial and temporal grains, whose spectromorphology create spatial shapes, and whose aggregate distributions combine and fabricate spatial bodies in motion. Scattered or patterned as motes in space and time, the textons are the lowest-level perceived, morphologies in spatial texture, and have locality in perspectival space, elevation in spectral space, and basic spectromorphological shapes.

Depending on the different ways in which textons are distributed in space, textures have different presences in the acousmatic image. Textons reproduce, or propagate, through time, and we can perceive them as spatial micro-forms in motion or fixity, as part of an animated texture. Local and global spectromorphology in spatial texture hold source-bonded information about the internal matter, external surface and acoustic surroundings of the texture, but also indicate abstract features concerning a texture's presence in spectral and perspectival space.

Texton Shapes

Texton shapes are determined by their spectromorphology, but since they tend to be small, there are limitations to the complexity which may be perceived. Shapes are described through basic parameters, which influence the spatial incarnation of textons. The temporal definition of textons is determined by angularity and graduation of dynamic morphology (this can be a simplified non-technical reference to grain-envelope). Spectral definition is dependent on density and focus of the internal spectral substance of textons, ranging from diffuse, (noise, hiss or inharmonic spectra), to concentrated (harmonic complexes or single tone resonances)[5]. If textons have brief elongation in time, they can be spectrally or dynamically[6] invariant or modulated, in directional (as micro-glissandi), reciprocal, or irregular ways. Such variations can only be simple since textons are the most elemental of sound events in texture. The shapes are not always something that attracts the listener's attention, and can be of marginal importance, depending on context. They do, nevertheless, often have an influence on the global character of the texture.

Texton propagation and filaments

The textons are somewhat like flickering elements which generate spatial texture over time. Propagation is the term I use to describe the way in which they reproduce and evolve in time. Textons can clone themselves and gradually change and move over time, or be slightly different upon each occurrence. A stream of propagating textons alone can form a texture. However, textures formed of multiple such streams, simultaneously distributed in spectral and perspectival space are often more interesting. If the temporal granularity in projections or entities is smoothed out, filaments are formed. I adopt this term from Wishart's notion of 'filament structures', which he discusses with Xenakis' mass-glissandi textures as an example (Wishart 1996, p. 70)[7]. It is an interesting idea that can acquire further potential within spatial texture. Filaments are continuous morphologies and a non-granular cousin of the texton. Although a propagation continuum between textons and filaments was implied above, filaments can appear as separate of textons. Since filaments are smooth in time, they are less accurate in the articulation of locality in perspectival space, but they do often imply infinity and prospective depth, while simultaneously performing a kind of temporal absorption.

Textons and filaments have propagation modes which describe internal change of a propagation over time. Thus, textons may vary in locality, elevation, dynamics and shape over time. The variations may occur at each new texton or at a period of several together, and range from disparate (scattered), intermittent (interrupted trains), patterned (recurrent sequences), fluctuating (irregular)[8], oscillating (regular modulations) or gradual propagations. If nothing changes, the propagation is suspended.

Textons and filaments in Elemental Chemistry

Much of *Elemental Chemistry* is structured around configurations of textons and filaments. For example, in the section from 4:20-5:59 (sound example 3.0), there are several textures where textons occur as transient oscillations or iterative trains. The twitters and the blankets of noise outline the higher boundaries of spectral space, while a faint drone in the bass creates a distal depth. The dynamic variations and panoramic spread of the texture creates a perspectival space. But there is also a strong source-bonded space, in the suggestion of an immersive nature scene, brimming with activity. The dissipating coagulation of particle textons propagate in a gradual fashion, and their sharp, temporal definition articulate a texture in the foreground (see sound example 3.1, isolated from previous excerpt). There are also intermittent, oscillating texton propagations in the twittering sounds. Their graduated oscillatory shapes place them at a distance (sound example 3.2). Intermittent texton propagations also appear in various locations in proximate and distal space, distributed in isolated spectral planes (sound example 3.3). In this section, there are also filament propagations. These intertwine as they wander in spectral and panoramic space, articulating a texture in perspectival space (sound example 3.4).

Multiple, similar texton propagations together can create large, nebular space-forms, where both proximity and distance is clearly perceived. In the section from 10:00-10:43, preceding the main climactic point in *Elemental Chemistry*, one can hear first gradual and then oscillating propagations as rhythmic layers are created in the texture. Simultaneously, grains contract from modulated, elongated shapes to particles, as the temporal density increases (sound example 4). The oscillations are a recurring feature in the

piece. There are similar instances elsewhere in the piece where filaments or textons in oscillation draw out texture and create tension.

Temporal density swells also recur, where textons crunch up and coagulate in gestures or stretched out spatial textures of noise. In the end of the piece, a blanket of noise wipes out all other activity and we are left with layers in proximate[9] and distal[10] space. A gradual dissipation follows, whereby the individual textons gradually emerge from the texture (sound example 5). This is an example of how spectral and perspectival space interacts: the high range washes over us as the mid-range recedes in the distance. The gesture occurs in different contexts at a few different stages in the piece, and is usually preceded by an intensification of energy through rhythmic activity. Here, this is accentuated by the intermittent, cricket-like textons, which also rise in spectral space, and the suspended particle textons in the foreground. The texture-gesture transformation and energy dissipation of the finale is similar to that occurring in sound example 1, halfway through the piece.

Form

Elemental Chemistry does not have an obvious archetypal form, although I think there is a profile of gesture and texture, where accumulations and dissipations of energy creates a satisfactory experience. A sequence of sections emerges, where equilibrial states, environmental characteristics, gestural activity and climactic transformations, are some of the distinguishing features. Gestural impacts and motions help delineating temporal structures in an otherwise continuous texture, where morphologies and spaces gradually change and overlap, making beginnings and ends difficult to determine. We often arrive at points where we are able to identify a new environment, although the route that took us to the present place is not certain. Although this factor can make the perceiving of sequential form difficult, it seems an inevitable result of the malleability of the musical processes involved.

Concluding remarks

I have here attempted to show how *Elemental Chemistry* builds on textural processes, and how these help define the spatiality of the music. Textons and filaments are part of this process and their relative propagations weave relationships in space, which are variable in time. Although much of the terminology relating to these concepts was invented after the completion of the piece, many of the important variables were central to the composition process. Although spatial texture is far from fully explored in *Elemental Chemistry*, I do think that there is potential for structuring music by textonal situations, where form emerges at the thresholds of perceptual organisation. My intention with this project is not only to focus on the low level of texture; it is in the nature of spatial texture that there are always more macroscopic percepts involved, which is something that shall acquire more attention in further research.

As a final note, one aspect of *Elemental Chemistry*, which is less directly related to spatial texture, is the final role of the environmental recordings and the nature references of the piece. Although they took a lesser role than I had expected, what is left in there certainly makes a difference. To me, they are somewhat like inverted traces of the real world, emerging in a less familiar, spatial plasma. In terms of environmental character, I think the piece creates its own universe, where many of the sound structures imitate features of the environments where recordings took place. My hope is that these are manifested as growing threads in the spatial weave, allowing the environment to originate itself.

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[1] I discussed internal causality in more detail in a paper presented in the SSSP 2009 conference (Nyström 2009).

[2] Smalley proposes the word 'spatiality' as 'relating to, or having the character or nature of space' (2010, p. 98).

[3] Julesz describes *preattentive vision* in the following way: 'A system that is parallel (independent of number of elements), acting almost instantaneously, without scrutiny, and covering a large visual field, as in texture discrimination.' (1986, p. 245)

[4] Julesz made some experiments for segmentation of melodic pattern textures in the 1960's, but these did not verify the existence of auditory textons (1995, p. 182).

[5] Definition, concentration, diffuseness and density are terms adopted from Smalley's discussion of spatial perspective in spectromorphology (1997, p. 123).

[6] Spectral and dynamic modulations together can create perspectival, 'three-dimensional' features of textons.

[7] Here, Wishart also indicates the potential held within irregularly evolving filament structures and the relation to Schaeffer's notion of *eccentric* sounds (Chion 1983, p. 146-153).

[8] Fluctuating propagation of filaments is not unlike Wishart's 'unstable morphologies', or 'multiplexes', which 'are coherent in the sense that the overall field of possibilities remains constant but the immediate state of the object is changing in a continuous fashion' (Wishart 1996, p. 95).

[9] Proximate space is defined as 'the area of perspectival space closest to the listener's vantage point in a particular listening context' (Smalley 2007, p. 56).

[10] Distal space is defined as, 'the area of perspectival space farthest from the listener's vantage point in a particular listening context' (Smalley 2007, p. 55).