Space-form and the acousmatic image

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The analytical discussion of acousmatic music can benefit from being based on spatial concepts, and this article aims to provide a framework for investigation. A personal experience of soundscape listening is the starting point, and uncovers basic ideas relating to the disposition and behaviour of sounding content, and listening strategy. This enables the opening out of the discussion to include source-bonded sounds in general, giving particular consideration to how experience of sense modes other than the aural are implicated in our understanding of space, and in acousmatic listening. Attention then shifts to a source-bonded spatial model based on the production of space by the gestural activity of music performance, prior to focusing in more detail on acousmatic music, initially by delving into spectral space, where ideas about gravitation and diagonal forces are germane. This leads to concepts central to the structuring of perspectival space in relation to the vantage point of the listener. The final section considers a methodology for space-form investigation.

1. INTRODUCTION

Acousmatic music is the only sonic medium that concentrates on space and spatial experience as aesthetically central. Although there has been much of value written about spatial attributes and the role of space, mainly by composers, the thinking is somewhat scattered, and as yet there is no substantial, unified text on the topic, nor any solid framework which might provide a reasonably secure basis for investigating space. This essay seeks to begin to provide such a framework, and to offer a sense of direction for future study.

Firstly, I set out the experiential basis on which our understanding of space resides, since this is necessary if we are to be able to identify how acousmatic music relates to spatial experience in general. Then I move on to discuss ways of defining spatial forms, through source bonding approaches, through the composition of spectral space, and the creation of perspective, taking into consideration that the effectiveness of spatial conceptions depends on the vantage point of the listener. Spatial forms add up to space-form, and my main purpose is to propose that analytical investigation of acousmatic music focused on space-form is a way of integrating the multiple facets of the acousmatic image. A space-form approach is different from other methodologies in that it places time at the service of space.

While I concentrate on acousmatic music, there is much that can be taken over to other electroacoustic music genres which possess an acousmatic component, and since I also discuss the conventional model of 'performed space', it should be possible for others to extend what I have to say to investigate live and interactive genres.

Focusing on space as the key, integrating element requires a reorientation of listening priorities and attentions: in my experience we are not that used to listening out for spatial attributes, for spatial forms, and space-form, partly because there is so much else to listen out for. But perhaps this is also because we are not sure what space really is, in sonic terms, or that we lack a sufficiently comprehensive bundle of concepts to talk about it, or that we think it tangential rather than central.

I start by discussing a personal listening experience.

2. ORBIEU SOUNDSCAPE

It's after 9 p.m. Late June. Night is closing in. I am sitting near a first-floor window in a house on the edge of a village in the south of France. The house is one in a variegated row, set on the quay of the Orbieu River. A road passes along the quay in front of the house – only the odd vehicle at this time of day – and on the other side of the road, high, shade-providing plane trees planted in 1900, line the quay. Almost immediately on the other side of the trees' trunks is a low stone wall, and then a drop of about twenty feet to the river. A gap between two of the trees affords me a view of the river, and the landscape beyond. The river flows and laps nonchalantly (at this time of year) directly towards the house (always audible from inside), turning left to continue along the quay; the stone wall and height of the quay hide from view the stretch of the river flowing parallel to the quayside. The river has broadened its domain as it approaches the quay from the distance, creating an extensive stony riverbed to the left (dry for most of the year), dotted with plant clumps nearer the water's edge. On the right of the river approach are some allotments,

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sleeping at this time of day. My vantage point is nigh perfect. Sitting by the window I don't see the road or any other houses, just the river and the landscape, the only sign of obvious human intervention being the, more or less, cultivated allotments. At its closest visible point the river lies at about forty-five degrees below me.

In the dusk, sounds of day and night mingle. I lean on the windowsill and put my head outside to let my ears enter the outdoors space. My listening space is bounded by the house walls, now to each side just behind my ears. The conditions are acousmatic: I may be able to make out the lie and shapes of things but cannot see the sources of any of the sounds I hear. There are four, longer-term sounding participants – the river, frogs, cicadas, swifts.

The river's sound is a permanent texture – a generalised ground (as opposed to a figure). Its space spreads over a central area of the sonic image. Because it moves towards me its textural resolution offers both more generalised, distant features (flow), and closer detail (lapping in the shallows). Despite the distance from my vantage point I can focus on a certain degree of micro-detail if I am attentive, but I am less interested in this habitual sound right now, and I tend to background it.

Over to the left of the river (and the sonic image), close to the water, among stones and plant clumps, is the frogs' territory – a *zoned space*.[1] We can also regard this, in ecological terms, as a *signal space*.[2] Furthermore, the collective practice of near-field call communication makes this a type of *behavioural space*. Spectromorphological[3] similarity, married to an appropriate proximity of the inhabitants, creates the relationship between zone, signal and behaviour. The frog calls are short, repeated units, whose polyphonic layering shifts. There are not so many individuals as to create a congested texture, and some have more distinctive spectromorphological identities than others, as well as a more relaxed rate of repetition. Some are fairly loud, no doubt amplified a little through reflection off the stones and the river wall, adding a slight resonance to the zone's identity. They are not easy to localise precisely without listening effort (just a few too many individuals to keep track of). I am more aware of the dispersal of the zone's texture, with some more soloistic individuals standing out in relief (not really a chorus); knowing that these frogs do not move, I regard the texture as an array of fixed spatial points.

There was a curious intervention in the frog texture – a singular event that appeared related to the loudest frog calls, in terms of morphology and timbre. Hidden from view, below the river side of the wall (where there is some vegetation down towards the water), came two crow-like cries, the first to the left, and a short time later the second to the right. Why, I don't know. Was it one bird displaced in space, or two birds signalling each other? Reflecting off the wall, the sound projected out towards the frogs, seeming temporarily to expand, and add elevation to, the frogs' zone.

Cicadas, residues of the sinking daylight, sound in the two plane trees framing my river view; they inhabit their own spatial zone, which starts not that far above my vantage point, but around twenty or so feet away. These are the sounds closest to me, occupying the most *proximate space*[4] of the sound image, but not close enough for me to feel as if they are approaching my *personal space*. The iterative, but also granular noise-bands, coagulate, oscillating in wave-like fashion between the trees, creating a continuity in space, almost as if I had composed them to cover and balance the space between two tree-loudspeakers. (Mind you, these trees are over forty feet tall.) I know that the cicadas do not move, and I therefore regard the perceived collective rhythm of the spatial movement as the result of the relative time-shifts emitted by multiple fixed sources. Loud though the cicadas may be, their occupancy of spectral space does not mask any of the other sounds. However, I need to blot them out of consciousness, treating them as a proximate ground, in order to concentrate on the more variable frogs.

Air-bound, above and stretching out beyond the plane tree to the right, is the swifts' zone, their high-frequency calls delineating the canopy of the soundscape's space. At this time of day they have confined their space to a limited, higher zone, rather than practise, over a wider and sometimes proximate space, their rapid swooping approach contours to catch insects, at which they are very adept. (They could pass within a few feet of me outside the window.) This is another example of signal/behavioural space, but this time the sources are mobile, though it is impossible to tell how far successive calls are separate source instances, or the utterance of a same individual displaced in space: I assume a mixture. I cannot see the swifts' spatial texture but the *perspectival space*[5] created by the calls makes me imagine I can see it in action. The morphology of the calls, if one quickly focuses on an individual shape, approaches the

[1]New terms representing key concepts appear in italics when initially introduced.

[2]Slabbekoorn, in Marler and Slabbekoorn (2004) discusses birds' space; this idea is applicable to other living beings, and can be applied to textures in acousmatic music, where sources are not 'living' or identifiable. We might also interpret an instrumental musical context that has repeated call- or response-like elements in a similar way. See also Wallin (1991).

[3]Spectromorphology is 'the interaction between sound spectra (spectro-) and the ways they change and are shaped in time (-morphology)' (Smalley 1997).

[4]I use the term 'proximate' to designate space nearest to the listener, and 'distal' for space furthest from the listener. The relationship between proximate and distal space creates depth of image.

[5]Perspectival space – the relations of spatial position, movement and scale, viewed from the listener's vantage point – is the subject of Section 8.

graduated continuant archetype;[6] the slight pitch dip seems to express the birds' physical contour drift, and this impression is enhanced by the grouping of multiple calls. This is an elevated *distal space*, where the distance between me and them, their known and deduced mobility, and the close similarity among the call-signals, combine to form a collective behaviour, a spatial texture with free-drifting internal motion. This contrasts with the frogs' rhythmic polyphony of grounded, sometimes individualistic, fixed point-sources. For a moment I wonder what would happen to the swifts' space were I to record it and bring it indoors for loudspeaker listening. The recorded image could not reproduce the spatial elevation, but I would nevertheless deduce it: in acousmatic music actual spatial localisation is not essential to create elevation. Aerial cues can be interpreted from morphological features set in spectral space (spectromorphology), the behaviour of texture, and the spectral resolution of the sound that informs me about relative distance. Of course there is also strong source bonding[7] involved: I recognise the swifts' calls as flight calls. So doing away with the actual elevation will have no effect on my diagnosis of elevation. Identified sources carry their space with them.

There were two more singular sonic events, caused by passing cars. Each of these outlined a *vectorial space*.[8] The first, approached from the right, creating an extension of the *panoramic space*,[9] passed along the quay, then turned left about 250 feet away, moving out of earshot into the village. It had emerged from distal space at the extreme right of the image, and in journeying past my vantage point, turned out to be the most proximate of all the sounds. Its vector was articulated through changes in spectral quality, and its graduated-continuant morphology was the most extended of the soundscape. Some time later the second car approached, its sound emerging relatively rapidly from the village at the spot where the other car had turned, 250 feet away, but instead of coming along the quay, it continued straight on over the only bridge in the area, heading off into the landscape. This vector extended the left of the panorama, fading gradually into the reaches of distal space. The first car is an example of the *vectorial wipe*, a sound travelling across proximate space, that wipes out, in this case only temporarily, the ongoing distal image behind it.

Unlike water, frogs, cicadas or swifts, the cars represent cultural artefacts and human presence, possibly to be regarded as intrusions in the 'natural' environment, but for me they fulfilled a welcome quasi-compositional function: each created a different distal-proximate vector, extending lateral space in both directions, the second car extending into deeper distal space, and the first drawing proximate space forward.

3. HOLISTIC SPACE AND SPACE-FORM

By now the perspectival and spectral space of this soundscape had, to my mind, become as satisfying and fully formed as it could be, and I could arrive at an holistic view. This holistic space comprised an array of zoned spaces. I could regard the frog-river-crow zone as a *nested space* (spaces within a space) in which three adjacent sub-zones combine to create a riverbed zone, invested with a slight elevation due to the crow event; the cicada, swift and riverbed zones are independent of each other. The two cars taken together (forgetting that they happened at different times), meet to describe a vector that delineates the peripheral border of the whole. Three of the zones – the frogs, cicadas and swifts – are behavioural, signal spaces, each differentiated from the other by its spectromorphological structure and perspectival site.[10] The river itself, through its central placement, its permanence, and the generality of its oblivious textural flow, anchors and grounds the holistic space, yet in relation to the figural interest of other zones it is inevitably backgrounded. The swifts, in elevated space, act as the river's foil.

A listener needs time to progress from an initial listening encounter with the soundscape to a state of engaging actively and fully in scanning and exploring the spectromorphological and spatial properties on offer. I cannot listen to everything simultaneously and need to devote attention to each of the zones in turn, accumulating a global view, which emerges over time. Note that in my account of the soundscape I used the present tense to describe the longer-term, ongoing activity and space, as if they embody a certain permanence, even though, in fact, the swifts' presence was relatively brief, the cicadas stopped once it became darker, and the frogs went on into the night; the river is still sounding as you read this. I chose to discuss passing events in the past tense, as completed actions, thereby recognising their more compressed temporality. I did not state how long I listened, and this is not important: I listened as long as I could, or needed to.

Possibly the most important strategy in arriving at an holistic view of the space-form of this experience is that I disregard temporal evolution: I can collapse the whole

[6]A graduated continuant is a morphology that enters gradually, faded in without attack (though this could happen quite rapidly), and exits in the same fashion; see Smalley (1997: 112–13).

[7]Source bonding is 'the natural tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or associated origins' (Smalley 1997: 110).

[8]The space traversed by the trajectory of a sound.

[9]The breadth of frontal space, extending to the limits of the listener's peripheral view.

[10]The behaviour of the sounding identities of the zones accords with the gestalt grouping principles of similarity, proximity in space and/or time, continuity, organisation, context, belongingness and common fate as discussed in Handel (2006: 377–81) and Bregman (1990: 196–203)

experience into a present moment, and that is largely how it rests in my memory. The temporal disposition of, and relations among, sounds serve to articulate and shape spectral and perspectival space, but even though my perception of sound is the product of time, I ultimately sideline time's formative role. So space can be more significant than time, or at least we can profit by starting with the idea that time can be placed at the service of space rather than the reverse. Time becomes space.

4. SOURCE-BONDED SPACES

Henri Lefebvre, in his classic book *The Production of Space*, originally published in 1974, underlines that space is

> … neither a mere 'frame', after the fashion of the frame of a painting, nor a form or container of a virtually neutral kind, designed simply to receive whatever is poured into it. Space is a social morphology: it is to lived experience what form itself is to the living organism, and just as intimately bound up with function and structure. (Lefebvre 1991: 93)

While Lefebvre hardly ever mentions music/sound, what he has to say draws attention to attributes central to sonic arts. In particular, space is concerned with energy and its release, energy which '*has* to be deployed in space' (my italics) (*ibid.*: 12), and physical space 'has no "reality" without the energy that is deployed in it: energy modifies space or generates a new space' (*ibid.*: 177). This is precisely how spectromorphologies, however directly or marginally source-bonded, function with regard to space in acousmatic music.

Sounds in general, and source-bonded sounds in particular, therefore carry their space with them – they are space-bearers. Imagine that I had recorded the Orbieu soundscape in stereo, and listened to it over loudspeakers. Despite the squashing of panoramic space, despite the disappearance of the elevation of the image (including my elevated vantage point), and despite the consequent compression of holistic space and the blurring of the zonal spaces, and despite the reduced textural resolution of the behavioural spaces, I would still be able to infer the zones and elevation,[11] and the nature of the behaviour/signal spaces: the holistic structure would be preserved. Although I will intuitively pick up various cues of position in space, particularly the relationship between proximate and distal space, these cues are not the prime space-bearers. It is the behaviour of the source-causes themselves that transmits the main spatial information.[12] I know from experience about the spectromorphologies created by frogs, rivers, cicadas, birds and cars, and how they behave, but it is not so much that they act in an already existing space. Rather, they produce space through their action. These spaces did not exist before the source-causes created them. Source-causes produce space.

Source-bonded spaces are significant in the context of any acousmatic musical work, not just in those works where clearly defined source bonding occurs, but also in musical contexts where I imagine or even invent possible source bonds based on my interpretation of behavioural space. For example, as we discovered with the Orbieu soundscape, the natural environment can provide us with a model capable of assuming variegated guises that can be carried over into acousmatic music. This could be taken fairly literally in that the soundscape itself might be the subject of acousmatic experience (though transferral to a recorded format is never a literal act). On the other hand, the kinds of spatial forms and organisation found in the natural environment could be taken on by spectromorphologies whose surface identity might appear tangential in source-cause terms. The idea of source-bonded space is never entirely absent.

4.1. Source-bonded spaces – nature and culture

Source-bonded spaces cover a variety of contexts occupying the territory between nature and culture. The purest type of natural-based domain focuses on source-causes where one is not aware of human intervention, and the Orbieu example, despite the car presence, indicates ways in which nature-based spatial forms are structured. In the cultural domain human activity produces source-causes, either intentionally, as with music-making and purposeful sound-play, or unintentionally, where the sounds produced are by-products of human activity. Spaces produced by human activity I refer to as *enacted spaces*, and they can be divided into two primary types – *utterance spaces*, which are articulated by vocal sound, and *agential spaces*, where space is produced by human movement and (inter)action with objects, surfaces, substances, and built structures; we can also include human intervention in the landscape. In Section 6 I shall be discussing one type of agential space in some detail – *performed space*, which is concerned with intentional sound-making and musical activity.

[11] Source-bonding and spectromorphology may not be the only factor at work here: the perception of (virtual) elevation can be deduced from the existence of quarter-octave frequency peaks between 7 and 9 kHz (Blauert 1997: 310–12); 7 kHz is about four octaves above A440 Hz. However, in recorded sound this effect is extremely fragile.

[12] In listening to a mono recording from a small radio, with an earpiece in one ear only, I will find that proximate-distal information is preserved. However, panoramic space, technically is not. But I reconstitute panoramic space: I imagine an orchestra, or a recording of the natural environment, as occupying panoramic space. This is most likely due not only to source bonding, but also to the variety and multiplicity of sources, their proximate/distal resolution, and the shifting textural resolution of the image detected over time, the whole implying a certain panoramic distribution.

I do not intend to elaborate a complete repertory of enacted spaces, all of which are articulated by the scope of the behaviour perceived in them: they are essentially behavioural spaces. However, there are two kinds of space produced by culture that are linked to the enacted spaces and the agential, but sometimes only indirectly. Both are concerned with technology. The first comprises sound-emitting machines, mechanisms, and technologically based systems of various sizes and scales, including not only sources concerned with transport and manufacturing but also work and entertainment – computers and game systems, for example. Although all these are human creations, and although they may sometimes be triggered or controlled by human agency, they can emit sound independently of us, thereby, in part at least, producing their own space. We can call these *mechanised spaces*, and they can be nested in broader enacted spaces.

The second kind of space overlaps with the first but suggests, and transmits to us, spaces from beyond our immediate enacted space. This is *mediatic space*, which comprises an amalgam of spaces associated with communications and mass media, as represented in sound by radio and the telephone, and sonic aspects of film and television. Included are utterance spaces, such as the interview, the voiceover, DJ styles, the disembodied voice (bathed in reverberation); transformations which signify distance, like the kinds of spectral crunching one hears when sound quality is poor; and the catalogue stretches to include mediatic genres like commercials, and communicational signals like ringtones. Mediatic space creates not so much a direct spatial form, but an image of spaces and places, events, distances, which impinge on, and form part of the spaces within which we act.

Taken together, utterance and agential spaces, mechanised and mediatic spaces, produce the sounding cultural domain.

5. TRANSMODAL PERCEPTION

Although acousmatic music may be received via a single sensory mode, this does not mean that the other senses lie dormant; in fact they spill over into sonic experience. Our sense of texture is learned through vision and touch as well as sound; our experience of the physical act of sound making involves both touch and proprioception;[13] spectral motion, and the movement and distribution of sounds in space relate to our own experience of physical motion and cultural and natural environments.[14] All these sense modes embody underlying spatial attributes: texture has space, gesture operates in spaces integrated into the gestural task, cultural and natural scenes are spatial, the highs and lows and motions of sound spectra evoke space. But sense experiences are also rooted in the physical and spatial entity of the human body, which is always at the focal centre of perception – as utterer, initiator and gestural agent, peripatetic participant, observer and auditor. Transmodal linking occurs automatically when the sonic materials seem to evoke what we imagine to be the experience of the world outside the music, and in acousmatic listening (not just acousmatic music) transmodal responses occur even though these senses are not directly activated in order only to listen. In listening to acousmatic music, rather than suffering some kind of sensory deprivation, I am led spontaneously to contemplate the, possibly unique or unfamiliar, virtual transmodal richness afforded by the aesthetic configurations of the music.

Acousmatic composers are instinctively aware of transmodal connections. Michel Chion, for example, commenting on everyday causal listening, writes that 'the sounds which we hear are connected by us to our intellectual knowledge of context, to vision and the voluminous representation of sonic causes, and to our general sensory experience' (Chion 1998: 113). Sound, for him, is 'trans-sensorial', and it would be a mistake 'to think that all that is auditory is only auditory' and a mistake to regard the senses as self-contained entities (*ibid.*: 57). He draws attention to rhythm as fundamentally trans-sensorial due to its corporeal basis (proprioception), and to the omnipresence of rhythm, including visual rhythm; texture and the internal grain of texture are regarded as trans-sensorial, along with space, which is 'not something visual', being 'constructed as much by the experience of moving around in space in order to touch things'; 'looking functions partly in a haptic manner, like touching at a distance'.[15]

My own writing emphasises the proprioceptive properties borne by the gestures of sound making (Smalley 1997). When we recognise that a sound has been created by human gesture we can identify in detail the type of physical energy and touch that instigated and propagated the sound, and in acousmatic music we connect spontaneously with any vestiges of gesture we may detect, even when the sound (either the source, or aspects of the cause) is not 'real' or does not seem entirely plausible. It is as if we were instantaneously re-enacting and following the progress of the liveness of the sound, the presence of its creation. That we are listening to something which is 'recorded' seems not to detract from the semblance of liveness communicated.

The transmodal nature of perception is highlighted in a number of recent, more scientifically and philosophically oriented writings which build on the ecological

[13]Proprioception involves the tensing and relaxing of muscles in relation to all types of body movement.

[14]I use the word 'movement' when referring to changes in spatial location. 'Motion' is used in a conceptual sense (for example, types of motion), which includes the idea of spectral space, where actual physical motion is not involved.

[15]My translations, from French.

approach to perception initiated by Gibson. John G. Neuhoff (2004: 255–6) observes that 'perceptual modalities' clearly interact and that in a natural environment 'distinct sources of auditory and visual information are integrated seamlessly to form a unified representation of external space that guides navigation'.[16] He goes on to explain the relative contributions to navigation provided by the visual and auditory systems, and kinaesthetic senses, and how discrepancies are sorted out, with vision in particular dominating in such situations: '… vision can dominate even proprioceptive judgements' (*ibid.*: 258). He refers to research which suggests that interaction between auditory and visual perception takes place at the cellular level of the central nervous system, and to research which documents sensory interaction taking place in various areas of the brain, in particular the neurons in the superior colliculi, which as well as carrying out their sensory coordinating function, are 'tuned to specific auditory localisation cues [that] provide a basis for a map of auditory space'.[17]

Stephen Handel, writing about the relationship between auditory and visual perception, regards the act of looking or listening as a creative process of constructing objects – the appearance of things, 'and things exist in space and time simultaneously' (Handel 2006: 4–5). He notes that 'the usual distinction that vision gives us objects and audition gives us events is a trap. It misleads us into thinking about vision as a spatial sense and about audition as a temporal sense' (*ibid.*: 5). The working of the transmodal perceptual process comprises the convergence of interacting parallel and serial mechanisms which occur at several neural locations, and auditory and visual information, more often than not, represent the same activity or event. Perhaps it is not surprising, therefore, that acousmatic music can be a quasi-visual, as much as an aural, experience – that visual and sounding space are not easily disengaged from each other.

For Alva Noë, 'to perceive you must be in possession of sensori-motor body skill' (Noë 2004: 11). Sensori-motor skills embody the sense of movement, of position, of touch, indeed all things proprioceptive, and visual and aural skills become integrated with body skills. Moreover, 'perceptual experience, in whatever modality, acquires spatial content thanks to the perceiver's knowledge of the way sensory stimulation depends on movement' (*ibid.*: 117). Very often we cannot directly perceive all aspects of what is presented to us. 'Experiential content is itself virtual', in that, for example, even unseen or hidden attributes can be accessed by activating expectations based on previous sensori-motor experience (*ibid.*: 67). When I see a three-dimensional object, front on, I do not see the whole, and I deduce what I might expect to perceive were I to move differently in relation to the object, or it in relation to me, revealing the far side, its shape, its volume. This object therefore becomes three-dimensional, regardless of whether or not it actually is (*ibid.*: 119).

If I carry this idea over into acousmatic music perception, such perceptual virtuality looms even larger. From sound alone I can constitute in my imagination the layout and activity of a scene; or the shape of a spectromorphological event (however 'abstract') as its spectral space moves in relation to me; or the apparent size, dimensions and texture of an object. This is indeed a 'vision' where the auditory sense calls on the companion senses to participate in the enactment of spatial experience. But since I cannot call on all my senses to participate *directly*, thereby corroborating, if they can, what my mind and ear think they hear, the identity of sources and their spaces is often bound to be uncertain to a degree. This will be particularly so if the composer consciously courts ambiguity, or rather, does not wish to tie down the listening imagination to known sources and everyday experience of space.

Noë emphasises that there can be no clear-cut distinction between one's perceptual awareness and thought awareness, an idea important for understanding space-form, which although gathered in time, can be contemplated outside the time of listening. I can, for example, think about the Orbieu soundscape now, without perceiving it: '… thought and experience are, in important ways, continuous' (*ibid.*: 118).

So, the Orbieu soundscape is there, awaiting my enquiry. When I perceive it purely aurally I can access aspects of its sonic presence, but my understanding of what I hear is not just a matter of hearing but of my knowledge of being able to act in the soundscape, being physically able to be in it; know birds as live, three-dimensional beings that fly; feel the wind; look at, touch and enter water (how could I know that water flows from its sound alone?); walk around and climb a tree; travel in a car; move out of the house into the landscape: my stationary vantage point is therefore hardly stationary at all. Similarly, an acousmatic musical work has the potential to harness my enactment, my spatial enactment.

6. ACOUSMATIC SPACE-FORM: A WORKING DEFINITION

Understanding the transmodal potential of acousmatic perception leads us to a more comprehensive view of what space-form might be.

Space-form in acousmatic music is an aesthetically created 'environment' which structures transmodal perceptual contingencies through source-bondings and spectromorphological relations. Further, it integrates

[16]Neuhoff refers to research by Auerbach & Sperling (1974); Welch and Aarren (1980). He also states: 'Evidence for this unified spatial representation comes from both behavioral and neurophysiological studies'.

[17]'The superior colliculi are symmetrical structures at the top of the brainstem'.

attributes particular to musical culture and tradition (like pitch and rhythm, for example). Acousmatic space-form inhabits domains somewhere between space as lived and enacted, and the spaces afforded through spectromorphological contemplation – by the perceived and imagined configurations of spectral and perspectival space.

7. ENACTED SPACE – PERFORMED SPACE

The idea of enactment, besides being central to transmodal means of perceiving and understanding space, is central to sounding spaces created by human activity – *enacted spaces*, and its two sub-categories, *utterance space* and *agential space*. I wish to concentrate on a particular manifestation of the latter – *performed space*, mainly from the point of view of instrumental music, although the same ideas, with little adaptation, can also be applied to intentional sound-making in general, as well as utterance space. A primary reason for focusing on agential space is that it expands the natural environment model, but also because sound-making, instruments, and music as an already composed artefact, feature as materials in acousmatic music: this gives us a different slant on source-bonding.

Performed space is gesturally rooted. A human agent, using the sense of touch, or an implement, applies energy to a sounding body, producing spectromorphologies. Alternatively, internal physical energy generated from inside the human body can be applied to an external sounding body, like a wind instrument. Needless to say, our perception of such agential enactment is transmodal, particularly emphasising the proprioceptive energy and action necessary for sound production and control, which is vividly transmitted by acousmatic spectromorphologies.

Edward Hall in his classic book *The Hidden Dimension*, first published in 1966, proposed a proxemic[18] classification of distances based on social situations, categorising space relative to the human participants into four zones – the intimate, the personal, the social, and the public. He regards our perception of space as 'dynamic' in that it is concerned with actions which we can think of as occurring in 'a series of expanding and contracting fields' (Hall 1990: 115). The intimate zone is concerned with activities as contrasted as love making and contact sports. Such close proximity can be positive, or negative, since we can feel threatened by unsolicited or unexpected proximity. The second zone – the personal – operates within arm's length (four feet at maximum), at the limit of possible physical contact. The social zone, which covers a distance from about four to twelve feet, is more impersonal – the zone of office and business transactions, casual socialising, and domestic contexts where one can engage with, or disengage from, others at will. The public zone, which conveys a certain detachment from involvement, covers distances from twelve to about twenty-five feet; over this distance our ability to resolve visual detail (facial expression) dissolves, we need to raise our voices to communicate across this space, and we can decide or not to approach, or to take evasive action should anything untoward occur (*ibid.*: 116–29).

In performed space in instrumental music we can identify mixtures of Hall's four zones at work, producing three spaces – gestural, ensemble, and arena space; gestural space is nested in ensemble space, and ensemble space is in turn nested within arena space.

7.1. Gestural space

Gestural space is the intimate space of individual performer and instrument. Performance gesture produces and defines a spatial zone within *reachable space*, the space being activated by the nature of causal gesture moving through that space in relation to the instrumental source, the whole event being united in the resulting spectromorphology. The temporal unfolding of energy therefore articulates a spatial zone. Performed events are source-bonded, so under acousmatic conditions (as with a recording) spectromorphologies are the carriers of enacted, agential space.

Sounding body and performance gesture are physically indissolubly linked in intimate space. String, and some wind performers are entwined with their instrument, in some cases in types of characteristic embrace, whereas other performer-instrument spaces are more prosthetic. Percussion and keyboard instruments, however, often require intimate space to be extended to the personal, at the limits of reachable space, and the performer may need to move position in order to maintain contact with the sounding body.

However, as a watching listener I do not need physically to approach the source in order to perceive the intimacy of gestural space; I do not need to inhabit Hall's intimate zone or the personal, arm's-length zone, or even the social zone, although in the social zone, within a range of seven to twelve feet, we are approaching what might, in terms of a musical source, be regarded physically as a fairly intimate encounter. When we perceive music, the idea of intimacy can be more bound up with what we deduce from visual and aural observation of proprioception as it relates to resultant spectromorphologies. Even though we may be perceiving at a distance from the source, we are nevertheless able to decode the degree of intimacy of gestural space through visual and aural observation of proprioception. Therefore, despite my listening distance from musical source-cause I can still, mentally, be drawn in close: the sound reaches out to me. So the idea of intimate space as represented by gestural space in

[18]'Proxemics' refers to the role of spatial factors in human relations and communications.

music is rather different from the intimate space of everyday human relations.

Nevertheless, in live performance conditions my perception of the sounding intimacy of gestural space is not preserved over any distance. My need for a certain proximity to the source of the music depends on the musical genre. In listening to classical music live I prefer to be relatively close to a string quartet but further away for an orchestra, closer for a baroque flute than I need be for a Boehm flute. Too close and spectral detail is too much in the face, and one begins to separate components of sound which should be more blended; too far away and spectral subtlety and refinement decrease, and my immediate engagement is in danger of dissipating. I need to be at a right distance to feel involved in energetic passages, and at the same time be able to contemplate subtleties of expression.

A gestural space never exists alone: there is always some kind of context, and that leads us to consider ensemble space and arena space.

7.2. Ensemble space

Ensemble space, within which individual gestural spaces are nested, is the personal and social space among performers: a group of performers produces a collective performed space. This is revealed both visually (seeing proprioception at work, and knowing how it works) and in the music (hearing proprioception at work). In duos or small ensembles the space is more personal, even if this may extend slightly beyond Hall's measured norm. A large ensemble may be made up of separate or nested internal zones of greater or lesser complexity, which change and adapt depending on the composition of the music. Individual gestural spaces may stay within family groupings or communicate across the space with other individuals or families. Sound can bind spatial zones when like behaviour creates a sonic contiguity where we cannot separately identify individuals, as with a violin section, for example.[19] In ensemble space we witness the fabric of the music in the process of articulation – the synchronisation of a collective gesture, collaboration or competition within texture, and exchanges of materials. As far as the watching listener is concerned this is a transmodal perceptual experience, though enacted within a rather stylised framework compared with other cultural environments, or the natural environment.

Ensemble space can always be thought of in terms of behavioural space, and sometimes in terms of signal space, and is related to the kinds of behaviour, signal and nested spaces represented in the Orbieu soundscape. The ensemble is also articulated in a panoramic space of greater or lesser breadth, with a certain distal extension. Sources may be regarded physically as fixed points, and this will be emphasised in smaller groups. However, in larger ensembles physical fixity is offset by the spatial movement of musical materials within the panorama: the spectormorphologies themselves are dispersed or move, rather than the sources or causes. We should not forget that musical materials also 'move' in spectral space (or in the notes of pitch space in the case of tonal music), that the spectral and the perspectival work together, and that a sense of perspective, particularly distal space, can be created spectrally.[20]

7.3. Arena space

Arena space is the whole public space inhabited by both performers and listeners.[21] An audience may be conscious of the personal and social spaces within its own zone, and certain kinds of audiences (rock concerts, clubs), through their behaviour, may seek to enhance personal and social contexts.

For our acousmatic purposes the most important aspect is that we perceive arena space as an acoustic setting, as a bounded and enclosed space produced by the nesting of gestural and ensemble spaces within it. Whatever the type of cultural context in which music is performed, it is music itself which is charged with linking gestural, ensemble, and arena space, and in a 'good' performance this relationship is more than a mere link: the three spaces become integrated, despite any physical separation of ensemble space and the audience in the wider arena.[22] The ultimate purpose of performance is to transmit music from gestural/ensemble space to be perceived in arena space.

7.4. The recorded image of performed space

The senses of hearing and vision are both active in gestural, ensemble and arena space; proprioception is

[19]We prefer not to see a violinist whose bowing is wrongly at odds with the group, and we do not like to hear an individual 'standing out'.

[20]As we know, it is only in the twentieth century that articulation of perspective becomes a significant compositional value. Composers have explored the potential of orchestral spatial texture, sometimes with considerable success. It is not my purpose to investigate this area here. For further study, see Maria Anne Hartley (1998).

[21]I borrow the arena idea from Emmerson (1998), but for convenience I am using it to represent all sizes of performance space, whether chamber sized, a concert hall, or a larger arena in the case of rock concerts.

[22]Davidson (1997: 222–3) reports that 'the body movements of the performers inform the audience about their musical intention', and further suggests that 'in live or video performance viewing, audiences can enhance their understanding of a musical performance by observing the performer's movements'. Such proprioceptive connections can unite gestural/ensemble and arena space even more closely. I am less concerned, here, with body demeanours that might create ambient ethos (e.g. an image of contemplation), or convey something of phrase-shaping and musical character, than with physical actions which initiate, shape, and elide or link spectromorphologies, particularly since I am ultimately interested in what is deduced about spatial enactment under acousmatic conditions. I also ignore the potential effect of a conductor's activity on perception.

the focus of perception in gestural and ensemble space, and is transmitted both aurally (spectromorphologically) and visually (energised enactment in gestural and social space) within arena space. Our transmodal knowledge, activated by spectromorphological energies, makes sure that performed space can be received, even in a recording, where the liaisons among these three spaces are preserved, but in a purely aural form. The details of particular visual and proprioceptive information may be veiled, although generically preserved via spectromorphologies.

Issues relating to the viable proximity of the listener to musical sound sources in a live performance context were raised in discussing gestural space. In the process of recording music, spectromorphologies performed in one space are captured in such a way that they can be transferred to another space to be listened to acousmatically.[23] In a stereo recording, a significant and necessary transformation is that the musical 'image' must be shrunk to fit the real space between the pair of loudspeakers. But decisions have also to be made about the appropriate presence of gestural and ensemble space as well as the relations between them: that is the challenge presented to producer and sound engineer. It is no surprise that for those who wish to engage in a concentrated musical experience, a viable recorded musical image (let us set aside the issue of particular musical interpretations) is able to offer a better image of gestural and ensemble space than an unsatisfactory live image. And now, with the 5.1 format, whatever its defects for audio alone, the relations among gestural, ensemble, and arena space have to be rethought. These kinds of issues are very relevant to acousmatic composers, who do not work in isolation from the medium or formats which they have taken on as their own.

7.5. Mediatised performed space

Mediatised performance is the product of mass media or of media technology, as with televised, audio or video recordings (Auslander 1999: 55). I adopt the term *mediatised performed space*[24] to identify a particular genre of performance space within which the transmission of gestural/ensemble spaces is mediated by technology. With popular or rock music concerts or open-air musical events, where relative distance between gestural space and further boundaries of the arena can be so extended that aural and visual contact are lost, the video image is able to zoom in on the intimate and personal spaces of performance, thereby transporting a mediatised intimacy to the remote perceiver.[25]

[23]I cannot here consider the differences between listening over loudspeakers and the binaural image on headphones.

[24]Not to be confused with mediatic space.

[25]This is also the case with televised performance of any musical genre, and may also be a role of video in multimedia performances.

Microphones and loudspeakers enable the amplification and projection of sound within arena space, so that an extrovert and gesturally extravagant, or a more introvert and gesturally discrete, performance can thereby hope to achieve more acceptable impact or intimacy. The microphone is able to capture the intimacy of gestural and utterance space, whose detailed qualities could otherwise not be conveyed,[26] and in super-public arena spaces technology can cure the deficiencies in what would otherwise be a performance space which could not fulfil its primary communicative function.[27]

7.6. Microphone space

Mediatised performed space makes us aware of microphone space, particularly where changes in vocal behaviour are specifically articulated to take advantage of the microphone's mediating potential; intimate crooning, and the capture of breath in the voice spring to mind.

The acousmatic composer takes advantage of this special kind of intimate performed space when creating sound sources in front of a microphone. The recorded sound produced, further transformed or not, is destined to be used as material in an acousmatic work, and the intention, in preparing the sounds for use, is to magnify sonic properties already perceived through close listening. Microphone space becomes source-bonded when decoded by listeners familiar with the process and the type of material and gestural causality being recorded. This may or may not be musically desirable. Sometimes, when I decode the image of someone 'playing' with source-bonded material in front of a microphone, I find it an intruding, rather than enhancing, experience. Microphone space is a primary compositional tool for creating proximate spaces which beam to us small and microscopic presences and details of spectral space. As such it will be recognised if source-bonded magnification seems to be taking place. However, microphone space can also appear to be emulated when a seemingly magnified sound or texture is identified due to the detail of its spectral resolution in relation to morphology; with such textures, or microtextures, behaviour space will also make a contribution.

7.7. Performed space in the acousmatic image

The listener's transmodal perception of performed space is quite different from the kind of spatial context exemplified by the Orbieu soundscape because performed space is founded on agential space, which is

[26]We need to recognise that popular music is primarily vococentric.

[27]Hall identified a close phase of public distance of between twelve and twenty-five feet, and a far phase anything beyond that. Public distance he regarded as being 'well outside the circle of involvement' (Hall 1990: 123).

centred on the human body as cause, and in some cases as source as well (wind instruments). At the focal centre of perception, I am able to track the production of gestural space due to my direct previous experience of gesture in sound-making, whether this be in purely 'musical' contexts or not. In acousmatic music, if I identify the source-bonded, spectromorphological presence of the intimate and social spaces of gestural space, my attitude to the image immediately changes, and my view of the accumulating space-form will consequently also undergo change.

Performed gestural space does not require a 'natural' or feasible performance acoustic in order to convey its indigenous intimate or personal space. I can decode gestural space regardless of whether I hear an acoustic around the sound, regardless of whether the image is mono or stereo, whether it is distal or proximate, or whether it is with me in the same arena or in another 'room' altogether. In acousmatic music, gestural space, unlike *in situ* performance, need not necessarily produce its own arena, and may be contextualised in spaces which differ considerably from an habitual arena. The possibility of detaching gesture (and ensemble) from arena, facilitates a freedom of transcontextual and semiotic play.[28]

On the other hand, the cultural wedding of gestural and ensemble spaces to a particular arena-type, to the extent that they are invariably regarded as associated, can automatically invoke a specific type of arena almost regardless of any contradictory influences. Such is the case with the organ, and with choral church music.

In public performances where instruments and acousmatic sound are combined, there can be a duality of play between the arena space produced *in situ* by gestural/ensemble space, and 'arenas' of otherness created by the interaction of, or contrast between, gestural/ensemble space and the spatial contexts carried by acousmatic sounds. Microphone space is normally in evidence, not just purely for balance reasons, or to convey magnified spectromorphologies and intimate gestural space, but also to mediate between *in situ* gestural space and the acousmatic fabric transmitted only by loudspeakers: microphone mediation aids compatibility, even if sometimes it may barely be apparent. In recordings of pieces which combine *in situ* performance with the acousmatic, arena identities can change, so that, for example, the *in situ* arena disappears, to be masked by, or absorbed into, the total acousmatic fabric. So a recorded version can create a very different spatial identity for the same piece.

In the CD recording of my *Clarinet Threads*, for example, the relationship between gestural space and performed space arenas is different compared with any *in situ* performance. In the recording, the *in situ* performed space arena is intentionally (as well as inevitably) weakened, while the implications of imagined, acousmatically created 'arenas' or environments are enhanced. These changes in perceived space arise from the ambiguous source-bonding of some of the clarinet sounds, and from the ways in which the clarinet is integrated into the texture, particularly once spectral space is no longer so grounded by seeing the performer.[29] Thus the focal relations between the acousmatic and the non-acousmatic are reconfigured when one no longer sees, and the clarinet becomes more of a 'thread'.

Taking on Hall's general idea of a dynamic of expanding and contracting intimate, personal, social and public spaces, and initially applying it to sounding performed space, has enabled us to discover ways in which the production of musical space may both correspond to, and differ from, everyday spatial life. A similar space-bearing process occurs with a variety of types of agential events, not just with intentional agency, but also in contexts where sound is the unintended by-product of cultural activity, in work, play, domestic action, and so on. Unintended agency covers a wide variety of potentially less 'clean', culturally enacted events or scenes, which may mix many sound-types, including utterance. And the environmental and the cultural may merge; gestural spaces will still exist, but within a framework of social or collective spaces (rather than a musical, ensemble space), and behavioural spaces, set in 'arenas' – outdoors or indoors, domestic or public, urban or rural. Starting from the base of a somewhat formalised performed space, and combining this with what was discovered in the Orbieu soundscape, we can therefore expand out to take account of a wider variety of enacted spaces.

8. SPECTRAL SPACE

Sounds occupy areas of spectral space. Each piece of music will have its upper and lower boundaries within which spectromorphologies act – in narrow bands, concentrated knots, masses, layers, extended spreads, dispersed clouds; they may remain stable or evolve over time, moving through ranges and registers with greater or less energy and alacrity, smoothly or by step or in leaps, in an orderly or erratic manner.

The word 'spectrum' is used to refer to the internal components which make up sound, whether we actually hear these components or not, and the term 'spectral design' indicates that the composer may create a spectrum from scratch or may reconfigure the spectral components of an existing sound; 'spectrum' is often aligned with the notion of timbre, or sound quality. In addition, composers know that spectral design factors are at work in the creation of distal and proximate

[28]I think, for example, of the flying instruments in Jean-Claude Risset's *Songes*, or *Espaces Resonants*. For a commentary on space in *Songes* see Emmerson (1998).

[29]This is discussed in Emmerson (1998).

space, which is a perspectival dimension, created partly through changes in, and control of, spectral quality. For example, our normal experience of the movement of a sound from distal to proximate space involves a change in the spectral resolution (and the dynamic level) of the sound. Although I may design or change spectra to create distal or proximate impressions, this is heard by the listener as actual changes in spatial position or movement in space. All this is not what the concept of spectral space is about here. Put crudely, spectral space is concerned with space and spaciousness in the vertical dimension – up, down, height, depth, along with infill and clearing.[30]

8.1. Tonal pitch space

Spectral space exists in all music, but is more commonly known in the guise of pitch space, as in tonal vocal and instrumental music. I regard tonal pitch space as a subset of spectral space because it is founded on a particular subdivision of spectral space into incremental steps that are deployed in intervallic combinations, and we are able to discriminate clearly the different interstices that result. The concept of spectral space is not based on any *a priori* subdivision, and admits total freedom of motion without restriction on spectral type: a note is a specific type of spectrum.

However, motion in tonal pitch space is an important conditioning factor, and many of the types of motion we may encounter in acousmatic music are related to our experience of pitch space in the pre-acousmatic repertory. Consider, for example, the piano figurations in Debussy, where contour, shapes, and velocities are projected, tumble or turn in pitch space: here we become very aware of the spatial dimension that pitch combinations afford. François Delalande (1989) conducted a study of Debussy's prelude, *La terrasse des audiences au clair de lune*, which sought to reveal the listening behaviour of a small number of experienced music listeners. The listeners were not that successful in trying to pin down the musical materials or units, in order to arrive at a global view of their structural unfolding through time,[31] and some were concerned at their lack of success in applying such an analytical approach through listening alone. However, for my purposes it is salutary that in their accounts, the listeners highlighted spectral space attributes, though these are intermingled with attributes that might be regarded as belonging to perspectival space.[32] Delalande uncovers the following list, which is based on placement in, and motion through, pitch space, also taking harmonic factors into consideration: transparency of texture, approaching and distancing, 'planes of presence', unveiling, a zoom effect, thickening of melodic line, widening of pitch range; up and down directionality, which includes falls and double falls, upward melodic staircase configurations, poles of attraction, and the feeling of weight.

8.2. Gravitation

These references to fall, poles of attraction, and weight suggest the idea of gravitation[33] in spectral space. It is François Bayle who first called attention to gravitation in the acousmatic image. It belongs to what he calls the 'static archetypes', which define the 'landscape and its population', and include ideas of horizon, temperature, climate. Baylean archetypes, which also include dynamic and position archetypes, are concerned with bases on which existence is founded (Bayle 1993: 76). Stéphane Roy, in his analysis of Bayle's *Ombres blanches* (White Shadows) further elaborates on the tendency within pitch and spectral space for events to be attracted from higher to lower registers, generating implications within musical structure. The assumption is that, generally, more spectral effort is needed to maintain a higher registral location (Roy 1998: 174). The idea of attraction towards stability in lower regions is prevalent in tonal music, as found in the predominance of arch-shaped melodies,[34] and the notion of cadence (a word derived from the Latin verb for 'fall') and its association with tension released. Not, though, that all cadences involve descent. In addition, we are used to devices of descent, such as the suspension and suspension chains, associated with the release of tension through the resolution of dissonance.

8.3. Gravitation: diagonal forces and planes

As is to be expected, spectral space in acousmatic music does exhibit gravitational tendencies. I prefer to think of spectral space in terms of diagonal forces, where motion

[30] In *Spectormorphology: explaining sound-shapes* (1997), I discussed types of spectra based on the continuum between note and noise, set out a basic reference bank of motion and growth processes, and indicated some ways in which spectral space is filled out. This section elaborates on a number of these ideas in greater detail.

[31] This is what Delalande refers to as a taxonomic listening behaviour, which he recognises as somewhat 'artificial'; taxonomic listening is likely to operate simultaneously alongside other the types of listening behaviour referred to in note 32. See Delalande (1998).

[32] Delalande situates the attributes I list under figurativist listening behaviour (metaphors, or narratives of action) and empathic listening behaviour (forces and tensions expressed as feelings).

[33] In English there is some overlap between 'gravity' and 'gravitation'. The Concise Oxford defines gravity as 'the force that attracts a body to the centre of the earth or other celestial body', whereas gravitation is, more generally, 'a force of attraction between any particle of matter in the universe to any other'.

[34] David Huron tells us, based on a study of about 10,000 phrases from 6,000 European folksongs, that convex phrases (up/down) accounted for 40 per cent of those analysed, while a further 50 per cent were either ascending or descending phrases; however, an ascending phrase is often followed by a descending phrase, but the statistical possibility of the reverse occurring is no better than chance (Huron 2006: 86).

is attracted towards, or leaves, a region that acts as a horizontal plane.[35] I use the more general word 'region' because a plane can take on a variety of spectral guises, ranging from a pitch to something more expansive, but it needs to be locatable in spectral space, relative to its surroundings. A plane represents relative stability, whereas diagonal forces store up tension, particularly in departing from the horizontal. The movement, *Géologie sonore* (Sounding Geology), from Bernard Parmegiani's *De Natura Sonorum*,[36] provides a clear example. The movement starts with a grounding in a bass drone, rooted by the interval of a fifth; this is joined by a thin, high plane, which, with the bass, sets a stable spectral space frame; the expected infill process, articulated through the cumulative spectral pressures and surges of successive entries of different densities, creates diagonal forces in both directions, but with a growing upward tendency. Tension is stored up and prolonged, but the spectral space is eventually fairly rapidly cleared, as if the diagonal forces have given way, leaving us with the rooted, bass plane. Here we encounter a classic case of the repose of the horizontal planar setting, and of the resistance and effort of diagonal forces, ultimately neutralised, though seemingly of their own volition. The example lasts 4′34″, but a gravitationally based process could be relatively brief – a gesture, a phrase – or we could take a broader view of gravitational tendencies over the stretch of a longer piece, seeing how they differ, play out, and balance each other.

A horizontal plane does not have to occupy a region lower than the diagonal forces which defer to or contest it, does not have to act as the runway from which stored tension takes off, does not have to be a sustained, continuant morphology, and can be merely hinted at or touched on: its role is to act as an orientational reference point. In the *Géologie sonore* example the attempt to offset the gravitational influence of the bass drone did not start in the bass region, and the 'return' to the bass plane was not a return in the sense that spectral motion ultimately headed towards the bass. It is easy to conjure up a number of alternative scenarios. For example, imagine an initial plane that turns out to be situated in the midst of Parmegiani's diagonal forces, a plane which is only briefly stated at the outset, but is superseded by a different, either higher or lower, thicker plane emerging at the end.

8.4. Gravitation: implied planes and levitation

A plane can be implied rather than actually exist. The case of continuing, sustained, unidirectional motion (glissandi) is instructive. A descent, depending on its energy and velocity, invites an analogy with downward drift or fall, seemingly attracted towards a lower region. If it disappears from view we might imagine it continuing out of sight or earshot: there is no need for it to reach a grounded position for us to recognise its gravitational tendency, and no need for a plane to be explicitly expressed. An ascending, disappearing spectral motion may embody similar implications, but there is a significant difference, because a continuing ascent can also appear to be distancing itself, moving into spatial infinity. As human beings we may remain grounded, but air and sky appear boundless. This indicates that implications of distal and proximate space can be carried by spectral space alone. Maybe we assume that lower spectral regions are more weighty, and closer to us. These days this is emphasised in the physicality of sub-bass loudspeaker vibrations and the ways in which such frequency areas can be blurred in perspectival space, compared with the greater clarity and potential for clearer localisation of higher spectral regions.

I do not go along with the real-world idea that effort, and therefore spectral effort, is necessary to reach higher spectral space regions. For example, the high plane at the outset of *Géologie sonore* simply emerges in its region; it does not climb or make any effort to get there, although there is a certain minor pitch tension within the narrow sound-band; eventually it might be regarded as being pulled into the diagonal forces, but by that time we are not paying attention to its future because there is too much else going on.

Ascending spectromorphologies can rise effortlessly, as if light enough to be supported on air. There is a significant difference in the spectral energy and the type of morphology required to project an object into spectral space, compared with the energy necessary to support and maintain a spectromorphology in a higher region. When a more forced upward projection occurs this energetic impetus is not necessarily invested in the projected spectromorphology itself, but in a coincident or preceding object that launches the projection. When levitation in spectral space occurs, we have the impression that sound floats free of gravitational forces. Any planes achieved through levitation, as well as regions which just appear on high, can act as (anti)gravitational attractors, or alternative attractors if they manage to establish a horizontal reference-point. While levitation processes are more readily associated with upper spectral regions they can exist lower down in

[35] I take the idea of diagonal forces from David Slawson's book on the design principles and aesthetic values of Japanese gardens, where he outlines the principle of the three forces – the diagonal force whose dynamic quality connects the horizontal force, which involves movement along the ground plane parallel to the horizon, to the vertical force 'that comes into play when we … look up at the sky or when we move our bodies in opposition to the force of gravity' (Slawson 1987: 97).

[36] From a perspectival point of view the intended geological image is one of flight over a terrain whose strata surface. Although one can just about imagine oneself looking down from above, the high-low view of a frontal, panoramic, spectral space is bound to persist.

spectral space: it is a matter of a relative lack of spectral energy and affording sufficient time for the process to occur with ease.

8.5. The presence of space

High sustained, continuant morphologies can indicate to me not a morphology acting in space, but rather an aeriform presence, a means of suggesting space itself rather than anything which moves in it, something possibly atemporal, as if time is becalmed. Continuant spectromorphologies in general can produce this idea of spatial presence, creating, for example, the idea of periphery or horizon, like a sketch which, with a few lines and smudges, produces space but no identifiable content. The spectral planes at the opening of my *Valley Flow* give this impression, even as they partly fill out the space, and one initial, brief, low morphological push is enough to hint at a deep, spectral boundary. It is not until the first approach process occurs that a more material, source-bonded content intrudes. So I may discriminate, though not always with certainty, between spectromorphologies that seem more to be space itself, and more defined forms that inhabit spectral space.

8.6. Scale in spectral space

When diagonal forces expand and diverge, or contract and converge, the scale of spectral space itself expands and contracts.[37] Gravitation is not only to do with regions of attraction and planes of reference but is also linked to the expanse of spectral space outlined, filled or cleared by diagonal force activity. The ideas of gravitation and scale are therefore complementary. A process of expansion/divergence (or contraction/convergence) can occur through simultaneous motion in both directions, but this does not have to be coordinated, and more extended processes can involve chains of successive or overlapping motions, which could be deflected or interrupted as they evolve over longer durations. Spectral expansion and divergence make us aware of the extent of the intervening spectral space, which may remain empty or become occupied. It is not only the directional behaviour of the diagonal forces which stores up and dissolves tension, but also the revealing and filling of voids, shaped by the actions of diagonal forces.

In the *Géologie sonore* example, the initial spectral gap, in its emptiness, already suggests a certain scale, and perhaps it also embodies a latent tension because, since it is at the start of a movement, we do not expect it to remain stable. The fleshing out of the intervening space makes us more aware of the actual extent of the expanse. Moreover, we take notice of the spectral scale of the infilling spectromorphologies themselves, and the room for manoeuvre available to them as they compete and give way to each other.

Gravitational tendencies and spectral scale are very much at the heart of my *Base Metals*, where the components of metallic resonances are configured and reconfigured, with tonal pitch playing an orientating role.[38] The listener can become particularly conscious of this aspect of spectral space once the ear is led away from the source-bonded attacks of sounds into contemplating the progress of spectral continuities.

An expansion/divergence form occurs in the closing stages of *Resounding*.[39] It starts with the final statement of a tonal chord progression which simultaneously ascends and descends, with emphasis on depth; this process hollows out an empty volume (as contrary-motion, tonal chord progressions do), which may be barely perceived at this stage, but emptiness is subsequently made evident by clearing the texture which has gone before, by initiating a process of levitation which moves towards an upper region, and by introducing a brief, sustained, organ-like pedal-point, reminding us of the lowest bass region. Here, scale, the relatively gentle gravitational pull of the bass, and the invitation of levitation, come together. We then leave the bass, and end in levitated spectral space.

Changes of scale in spectral space are often aligned with changes in perspective – with the processes of approach/recession, and ouverture/enclosure, to be discussed in the section on perspectival space. However, we need to be reminded that spectral space in itself produces space, without any need for actual spatial movement of sound, save for its projection into the arena within which we listen.

8.7. Source bonding influences

Although there can be no acousmatic music without spectral space, we are not always aware of how spectral factors contribute to our sense of space. This is particularly so with strongly source-bonded images, where the vertical dimension is more likely to blend, in our minds, with the merging or nesting of source-bonded spaces. In strongly source-bonded contexts the mind does not spontaneously separate out information about spectral boundaries, gravitation, diagonal forces, and changes of scale, or the spectral makeup of

[37] Stéphane Roy's concept of accumulation/dispersion – an uninterrupted, linear, goal-oriented process concerned with increasing and/or decreasing density – involves changes in spectral space scale (Roy 2003: 347), as does the Schaefferian idea of accumulation, which is concerned with disordered microsound density (see Chion 1983: 137).

[38] I am not referring to the tonal system, where the metaphors of distance (from a home key) and attraction (towards a home key) are thought of as 'spatial' (See Lerdahl 2001). I am concerned with note centres acting as planes in the vertical dimension of pitch/spectral space.

[39] It is hoped that *Resounding* (2004), and its companion work, *Ringing Down the Sun* (2002), will be released on DVD-audio in 2007.

participating spectromorphologies, even if these are, in fact, primary spatial carriers. The opening few minutes of my *Empty Vessels* are a case in point. Here, specific source-bonded sounds are used not only because they create an environmental space but also because they produce spectral space. Diagonal forces and gravitational elements are at work, whether these were 'discovered' in my environmental recordings (birds, the passing aeroplane, insects), or specifically introduced – one horizontal contour, one ascending contour, at least two descending contours, and a bass undulation underneath the second plane vector, deepening the space. Source-bonded and perspectival aspects are more immediate because they are more 'real', whereas thinking spectrally requires a certain level of abstraction. As with the Orbieu soundscape, the listener is more likely to be interested in behaviour spaces and the perspectival space produced by their activity rather than in an abstracted spectral space. Conversely, in *Base Metals*, which I referred to in discussing the scale of spectral space, the intertwining of pitch and timbre, and extended, detailed development of spectral components calls attention to a spectral space less encumbered by source associations.

With all this in mind we move on to the seemingly more tangible topic of perspectival space.

9. PERSPECTIVAL SPACE

In visual art 'perspective' refers to the representation of three-dimensional forms on a two-dimensional surface so as to articulate the relations of position, volume of occupancy, and distance, as observed from a vantage point. We also use the term in reference to the visual world generally, in which case the movement of forms can be regarded as an additional articulator. Relative position, size and movement produce a sense of scale in the relations among forms, and a sense of the scale of the articulated space as a whole.[40]

I define the 'perspectival space' of the acousmatic image as the relations of position, movement and scale among spectromorphologies, viewed from the listener's vantage point. I say 'viewed' because although the acousmatic image may be invisible, one can also, depending on the nature of the spectromorphologies and their contextual relations, locate and track their positions in a quasi-visual manner. This is no doubt due to the habitual transmodal collaboration between the visual and aural sense in everyday experience. Using the adjective 'perspectival' to qualify 'space' may seem tautological, but I need to differentiate the perspectival attitude to space from other approaches, like that of spectral space, for example.

[40]I have purposely used the word 'scale' in relation to both spectral and perspectival space. This indicates that together they create a sense of scale.

With perspectival space there is a kind of contract between me, the viewer, and what is viewed. That my perceptions are rooted in me as a physical and spatial being means that all I perceive is 'sized up', located, and put into perspective in relation to the human scale – in relation to *egocentric space*.[41] For example, gestural and ensemble space, and environmental zones and what happens within them, although they may exist independently of me, only make sense in relation to egocentric space.

Perspectival space can be regarded as the flux in relations among three views – *prospective space*, *panoramic space* and *circumspace*. Prospective space is the frontal image, which extends laterally to create a panoramic space within the range of vision; circumspace – space around the listener – extends panoramic space to encompass the listener, with the possibility of approaching or passing over egocentric space from all directions. Simple stereo listening is concerned with prospective space, whose panoramic dimension will be broader or narrower depending on the site of the listener's egocentric space. Surround-sound formats, and concert diffusion systems enable the extension of prospective space into circumspace.

Since perspectival space is concerned with relations over time, it is a higher-level formal concept. As I listened to the Orbieu soundscape I accumulated perspectival information from combining the zones of signal/behavioural space, and their partial nesting, as they produced the relations among panoramic, proximate, distal, and vectorial space. With performed space, perspective results from the accumulation of gestural, ensemble and arena space. A similar cumulative process occurs in listening to acousmatic music, as content and contexts pass by, but since the music is a composed aesthetic product, I may expect perspectival space to reveal relational oddities, contradictions, imagined possibilities and impossibilities, new amalgams and views. Above all, acousmatic music can offer multiple viewpoints, and variable image resolutions and scales, arising from combinatorial adventure. However, since I am in the world, my worldly experience of perspective always resides with me as the point of reference.

Because the making of perspectival space arises from a cumulative blend of numerous sonic attributes and compositional techniques, it is not something that the composer can design from scratch, or totally control along the way. Rather, perspective emerges or is discovered, guided as this process might be by some

[41]Noë borrows the term 'egocentric space' from Evans, G., *The Varieties of Reference*, Oxford University Press, 1982. It is 'a kind of *behavioural* space, that is, a space defined by ways of moving and behavioural degrees of freedom' (Noë 2004: 87). Egocentric space is mobile in practice. I shall eventually tackle the idea of the mobile listener, but for the present I am regarding the listener's position as fixed.

underlying concept: I cannot force spectromorphologies to adopt perspectival roles incompatible with their spectral shaping and character. Certain types of spectromorphology are better suited for particular perspectival roles. Think, for example, of the type of sound which might provide a deep, peripheral horizon, or which might best describe a spatial volute. And one quickly finds that the mixing of sounds can just as easily undermine perspective as create it. The constraints are manifold.

9.1. Prospective space

My use of the adjective 'prospective' is derived from the notion of 'prospect', a view of landscape that implies a vantage point from where one looks forwards, scanning and exploring the scene to take in the identity and proportional relations of the shapes observed, and the dimensions, extent and depth of the image.[42] Not that the acousmatic image is invariably one which evokes landscape, but at its most extensive the collaboration between perspectival and spectral space generates an imagined environmental scale, and sometimes something even more 'cosmic'. The analogy of the prospect seems an apt way to represent the basic perspectival space of the stereo image (whether related to interior or exterior spaces), and of broader panoramas and deeper distal images afforded by diffusion over larger loudspeaker arrays in public listening contexts.

9.2. Prospective space: approach and recession

The prospective space of the stereo image is centred, though this centre may be implied rather than be marked by an actual sound. The image recedes towards a distal centre (which might be a spread rather than a point), or moves outwards, either away from a proximate centre into distal space, or alternatively, outwards and forwards from a distal centre towards a more proximate space. My view of prospective space over time results from a process of 'reading' a series of relations of recession and approach as they cover space from the periphery inwards, and from the proximate centre outwards. Such relations can be articulated by varieties of types of movement contiguous in space, or not; by dynamic and spectral processes of emergence and disappearance; by contrasted, fixed placements of different spectromorphologies; and by displacements and shifts among like or unlike spectromorphologies.

[42]The idea of the prospect is central to the grand park designs associated with the eighteenth-century English country house, and is also evident in landscape art. Nature was not taken as is, but could be shaped, and appreciating a prospect was an aesthetic experience where taste was applied, whether with regard to an actual landscape or to an idealised or imagined one (Brewer 1997).

9.3. Prospective space: ouverture and enclosure

Relations of recession and approach may also be associated with processes of opening out the perspective, and closing it in, possibly achieving a state of enclosure. These processes I shall call *ouverture* and *enclosure*. At one extreme, a process of enclosure implies filling prospective space to the extent that the distal periphery will be absent or masked; there will be an emphasis on proximate space, which may be aided by an impression of magnification in the texture of the image; panoramic space will attain maximum extension (within the limits of the stereo image); spectral space will become relatively congested or compacted, and a feeling of enclosure may be enhanced due to source bonding factors. The more egocentric space seems to be overwhelmed, and the more that sound attempts to approach personal space, the greater the feeling of enclosure. At an opposite extreme, a process of ouverture, whether sudden or gradual, will be initiated by the total or partial erasure of elements within proximate space, permitting the view to expand into distal space, possibly paralleled by an impression of panoramic extension, thereby creating a more open or transparent view which no longer threatens egocentric space.

Particular types of morphology can facilitate the process of ouverture and the emergence of space-form. For example, at the beginning of my *Empty Vessels* a distal environmental prospect emerges out of the resonance of a metallic attack-resonance morphology. The attack, which creates only a moment of proximate space, initiates the resonance into which the image naturally recedes, focusing on the internal spectral properties of the sounding body, from which a distal natural environmental emerges. The perspectival space shifts from the vibrations inside an object to an open, outdoors space, which then expands upwards into elevated space due to the source-bonded influence of birds and a passing aeroplane. The view is further enhanced by the momentary presence of insect microsounds, suggesting a more intimate, proximate elevation. This process of ouverture announces the holistic space of the piece, with its boundaries of proximate, panoramic, distal and elevated space, which emanate from an initial enclosed spatial image.

There are typical compositional devices whereby relatively rapid (en)closure or ouverture can be realised. One is the *proximate vectorial wipe*, a version of which was created by the car vector in the Orbieu soundscape. (An attacking event could perform a similar service; I could call that a *blocking attack*.) What follows from a wipe could be the restoration of the previous perspective (as with the Orbieu example), a shift in perspective, or a continuation of the vector thereby masking permanently the further reaches of perspectival space; in other words, there are three possible consequences of a

vectorial wipe – restoration, shift, and prolongation. On the other hand, the rupturing of an ongoing proximate space can open up a distal view, which if then closed up, would create a *distal interpolation*. With prolongation of a proximate vector, and with distal interpolation, what was previously viewed or momentarily glimpsed might be understood as continuing, thereby leaving in the mind a residue of a fuller, ongoing perspectival space. Assumptions of this kind are related to experiences of occlusion in visual perception and environmental observation.

The related processes of recession and approach, emergence and disappearance, and enclosure and ouverture, are examples of how spectral space, source bonding and perspectival space interact to contribute to our feelings about spatial situations. Note that feelings evoked do not require the situation of a full physical enclosure of egocentric space, and can be carried only by prospective space, given the right conditions. This highlights the particular importance of prospective space to us.

9.4. Prospective space and the pictorial image

I am struck by the correlation between the prospective space of the stereo image and perspective in painting, particularly in relation to the period when artificial perspective emerged in Western art during the fifteenth century.[43] It was Leon Battista Alberti in his treatise of 1435 – *Della Pittura* – who wrote of creating an 'open window' by first drawing the rectangle within which the painting would be elaborated, of establishing a 'centric' point, of how 'successive transverse qualities visually change to an almost infinite distance', and of the 'determined relationship' necessary to make painted objects appear as real objects (Alberti 1991: 54–6). For me, the perspectival space of the stereo acousmatic image is inescapably visual and physical (regardless of the 'reality' of the spectromorphologies perceived), the speakers frequently evoking the convention of a window frame[44] through which I observe the receding distal horizon, and between which the most proximate events are active, sometimes projecting themselves towards or into egocentric space. In creating the receding distal image we even work, as did painters using artificial perspective, with a kind of spatial foreshortening, where the play of spectromorphologies in the panorama of proximate-distal recession can imply a horizon well beyond the space actually occupied by the sound. This impression is aided by the way in which spectral space is used.

The perspectival space of the prospective acousmatic image may sometimes simulate or emulate the natural, but more often it is a synthetic construct, whether created by design or through the evolving consequences of combining sounds. The perspective of the acousmatic image has evolved its own conventions.

9.5. Prospective space and the fixed vantage point

I am struck, too, that the ideal distance of viewer from painting in the fifteenth and early sixteenth centuries is very similar to the ideal distance of listener from the edge of stereo prospective space: a certain relationship between egocentric and prospective space is expected. John White tells us that in a high proportion of instances the ideal distance of the viewer from the painting was either equal to, or one-and-half times, the width of the painting (White 1987: 192–7),[45] the explanation probably being 'in part the psychological effect of the artist's own distance from his work while creating it' (*ibid.*: 194), but also due to the need to create clarity of relational resolution between surface design and receding image. Moreover, adopting this advised vantage point brings a sense of immediacy and inclusion to the viewer. Of course, regardless of the ideal, viewers will adopt different vantage points. In addition, there are viewing contexts where the adoption of the ideal vantage point is impossible, as, for example, with frescoes in churches.

This all sounds very familiar to the acousmatic composer, whose creation of perspectival space will be affected by listening vantage point. In testing the ideal vantage point I listened to a variety of stereo pieces, and found that, on average, for perceiving close detail a ratio of 1:1 between the distance between the left and right speaker, and the distance from the centre of the loudspeaker image to my vantage point, was good for close detail, and also aided the feeling of enclosure. In many cases 1:1.5 (slightly further away) provided a better sense of spatial contiguity, although with this higher ratio one can begin to feel a little too distant from some images. Beyond that one feels more definitely 'out of the picture'. A ratio of 1:0.75 is useful for close monitoring purposes during composition. The notion of the ideal vantage point is liable to take a considerable battering when a piece has to cope with the multiple vantage points and excessive distance ratios of public listening contexts. The composer has the difficult task of coming to terms with how perspectival relations so carefully conceived in idealised conditions, will be undermined, given quite different relations between prospective and egocentric space, and how in these

[43]See White (1987) for an account of perspective in the 'pictorial space' in the fifteenth and early sixteenth centuries. Artificial perspective in painting was a mathematically controlled construct based on reality, rather than a pure, 'natural' model, and its rules might be applied in whole or in part.

[44]Even if we can, these days, successfully subvert that frame within certain limits, one is nevertheless aware of the two speakers as boundary markers.

[45]White refers to Masaccio, Donatello, and Ghiberti, but also to artists where the viewing distance is less.

circumstances the hold of the image over the listener might be retained.

9.6. Circumspace

A new term is necessary to represent perspectives that encompass the listener. I do not wish, for example, to rely on a term like 'surround sound', which some associate with particular recorded formats. Since the composition and delivery of perspectives which attempt to extend prospective and panoramic space can vary considerably, we need a word which is not format-bound, which can cover all existing formats and loudspeaker installations used for their delivery, and which can continue to be used as formats and installations change and evolve. 'Circumspace', which incorporates the Latin preposition for 'around' or 'about' as a prefix, seems appropriate to represent the aesthetic notion of relations of position, movement and scale in this, the most comprehensive type of perspectival space.[46]

Full circumspace physically subsumes egocentric space, locating the listener within a field of sensations. There is the potential to encroach on personal space, to penetrate egocentric space, although as yet this can only be realised under very controlled conditions. It is more usual for the image to pass over and around the listener than for spectromorphologies to loom so closely that personal space is really breached. While circumspace is able to offer a spatial experience that is more 'environmental' in terms of the quasi-reality of multi-directional sound, this does not necessarily mean that it is superior to prospective space. The production of space is not accomplished purely by placing sounds and making them move, as if this were some kind of technical process which can be applied separately from all other aspects of image creation, but relies on the relations between spectromorphologies, source-bonding, spectral space and perspectival space. The composer has seriously to consider how prospective space relates to full circumspace, and how spectromorphologies might be suitably deployed, remembering that proximate-distal and panoramic dimensions tend to retain greater significance for the listener due to the customary forward orientation of the visual field.

In circumspace, processes of recession and approach, enclosure and ouverture, and emergence and disappearance, can be expanded; zoned spaces and the simultaneity of spaces can be multiplied into a more flexible polyphonic perspective; vectors can become more effective and varied; spatial texture can become more complex. The image can be raised in height (loudspeaker placement permitting), with the possibility of elevating only the higher regions of spectral space. The use of sub-bass speakers extends the depth of the sound, adding a subterranean dimension in the lowest register of spectral space. Thus circumspace is not just concerned with the horizontal, but also the vertical plane.

9.7. Circumspectral spaces

How spectral space in itself is distributed contributes to the sensation of height, depth, and spatial scale and volume. I can create a more vivid sense of the physical volume of space by creating what I shall call *circumspectral spaces*, where the spectral space of what is perceived as a coherent or unified morphology is split and distributed spatially. In my music, for example, circumspectral approaches have been particularly effective in imparting spatial volume to attack-resonance spectromorphologies, both to the attack phase and to prolonged, fluctuating, resonance-based forms, giving the impression that the listener is inside the resonance.[47] Imbuing the image with circumspectral elements enables greater flexibility in the use of perspectival shifts to create spatial forms that seem to turn in three dimensions.

9.8. Circumspace: the three delivery modes

With circumspace the varied formats and modes of delivery over loudspeaker systems affect, for better or worse, the reception of spatial forms and space-form. In the home, the delivery of circumspace is as yet relatively undeveloped (acousmatic music, and music recordings in 5.1 format are growing), whereas in concert, listening formats and loudspeaker systems are so diverse.

In public listening contexts I identify three basic delivery modes in relation to format.[48] The first is the *enacted mode*, where perspectival space, although fixed in the format of the (stereo) composition, is actively diffused, expanded and rearticulated in real time through relative changes in loudspeaker sound levels.[49] The composed perspectival space may be expanded in all directions, going so far as to create a circumspace not directly present in the composition itself, but which might be implied in the stereo acousmatic image, and

[46] Lotis uses the term 'ambiophony' to define 'the global perception of the surrounding sonic environment' – a 'diffused ambience' (Lotis 2003: 258). I have also come across 'periphony', but I can't remember where. 'Surround sound' is too closely associated with the idea of specific formats, rather than to any broader concept of space that surrounds.

[47] *Resounding*, in particular.

[48] I define the three modes here without discussing their merits or limitations, since that would also require a consideration of the merits and limitations of formats, all of which lies outside my agenda.

[49] One can think of the enacted mode of delivery as a type of enacted space. However, unlike the performed space of instrumental music, the relation between gestural space and the production of sound is not comparable since spectromorphologies are not directly articulated. Thus the effect of gestural space in the enacted mode is largely indecipherable for the listener. It is a kind of covert enactment.

invite elaboration. Moreover, enactment is a requirement in order to try and achieve a viable relationship between perspectival space and the multiple egocentric spaces occupied by the audience.

The second mode is the *fixed mode*, where perspectival space is fully integrated into the format of the composition, and is delivered circumspatially with no significant re-articulation.[50] The third is the *automated mode*, where automated processes and systems are used to deliver the sound. This mode is often more associated with live and interactive performance systems where it is integrated into the sound processing. At its most elementary, the automated mode merely distributes the sound among loudspeakers with limited, or no, attention to recession of the image. Thus perspectival space can lose aspects of its third dimension, although this may not be that disturbing if gestural space and other aspects of performed space are evident in the production of spectormorphologies. Such can be the case when conventional instrumental spectromorphologies are distributed, or where gesture-sensing interfaces offer significant agential activity thereby directly appealing to transmodal perception. The three delivery modes can be mixed, and frequently are. For example, with purely acousmatic music, various permutations of fixity and enactment are viable, and in live/interactive performance all three modes can operate.

10. VANTAGE POINT SHIFTS

The fragility of the bond between the music and egocentric space haunts this whole discussion. In the case of the Orbieu soundscape I was the solitary listener, and I had found a viable, ideal, vantage point. Elsewhere there has been an imagined me, or a surrogate me, or possibly that generalised, hypothetical listener who always creeps in as an extension of the writer. In discussing gestural space, mediatised performed space, and the prospective space of the acousmatic image, attention was given to the viability of the proximity of the listener's vantage point. With acousmatic music the vividness of the perspectival space in relation to egocentric space is always going to be important if the listener is to have a sense of involvement, but the composer can never be sure that the listener's egocentric space will be ideally chosen, and in public contexts there may be no choice. The larger the space the more wayward can be the reception of the acousmatic image.

The listener's vantage point and orientation may be *fixed*, *variable* or *peripatetic*. A fixed, forward orientation, looking towards prospective space, is the most common in concert situations and attentive private listening, allowing for some head movement to take in a wider panorama. But there can be freedom from fixity, depending on context. For example, if I am listening alone in circumspace, image permitting, I like to take up different vantage points. Initially, with my own compositions,[51] this is to test various off-centre listening positions, but in the end I find that varying the vantage point offers me viable alternative views, and repeated listening facilitates an accumulation of different views of the same piece. A favourite position is between the back speakers; this creates an extended panoramic space and a fuller, deeper prospective space. Circumspace is thereby marginalised as proximate space recedes, but as a result of my moving back, a new proximate space opens to view in the volume of the grander prospect now before me. Moreover, although I am on the very edge of this space, in my imagination I can project myself into it. But the dimensions of the listening space are never so large that I feel too far 'out of the picture'.

In more public listening, without seating and with not too many listeners, variable orientation can work if a viable prospective image is there to meet me as I turn or move, shifting my egocentric space. Prospective space therefore needs to be pivotable to a degree. The account of listening to my own music, above, does not permit unfettered variable orientation, but listeners, given freedom of movement with not too many clashes over egocentric space, could soon find vantage points of interest. For variable orientation to become relatively free, there needs to be a sufficient variety of zoning, or possibly a polyphony of spaces, or on the other hand a certain multidirectional consistency, so that the perspectival space of the work tends towards what might be expected of an installation.

One particular type of circumspace positively invites variable orientation. This is *immersive space*, where the spectral and perspectival space is amply filled, surrounding egocentric space, where the pull of any one direction does not dominate too much, and where the listener gains from adopting, and is encouraged to adopt, different vantage points.[52]

In other listening contexts of variable orientation, like those associated with installations or site-specific events, senses other than the aural can be more directly engaged, possibly combined with elements of performed space and mixtures of media, thereby freeing aural elements from continuous, concentrated scrutiny; under such circumstances the listener can be more forgiving of

[50]This is the case with my two six-channel works, *Ringing Down the Sun* and *Resounding*, although in larger spaces the number of loudspeakers will need to be increased, and their relative levels carefully controlled, in order to ensure spatial contiguity in the image.

[51]*Ringing Down the Sun* and *Resounding*.

[52]An example is Robert Normandeau's *StrinGDberg*, which makes use of circumspectral techniques to create a fully contiguous, but varying, holistic space. With regard to the sixteen-track concert version, Normandeau has spoken of the 'changing perception according to proximity to the speaker', and of giving the listener the 'opportunity to walk into the work' (talk at City University, 15 March 2006). The reader is invited to consider the relations between perspectival and spectral space in the 5.1 version, compared with the stereo version.

the acousmatic image. In fully peripatetic contexts, where the listener can move between listening spaces, egocentric space is at its most mobile, and the listener, given so much freedom of movement is hopefully able to become more sensitive to the interdependence of egocentric space and the acousmatic image.

11. CONTAINMENT AND TRANSCENDENCE

In previous writing about acousmatic music I have differentiated between the composed space – space in all its facets as composed into the image; and the listening space – the space in which the music is heard (Smalley 1991).[53] This nesting of composed space within the listening space affects how the composed image is experienced. The acousmatic image changes not only according to mode of delivery, and to that fragile relationship between egocentric and perspectival space, but also in relation to the dimensions of the listening space.

In performed space, gestural and ensemble space are nested in arena space, and the music is grounded due to the physical placement of the performers. A recording of instrumental or vocal music carries with it an image of arena space.[54] But with acousmatic music in public contexts, the spatial image can liberate itself from the physical presence of the listening space – it can escape its arena. In domestic listening to acousmatic music, unlike listening to a recording of instrumental and vocal music, there is no arena carried over. I can best express the psychology of this relationship between composed and listening space by referring to containment within, and transcendence of, the confines of the listening space. Containment and transcendence are experiential qualities associated with the image, and can be regarded as a companion concept to enclosure/ouverture.

A circumspatial or purely prospective image that suggests 'environmental' dimensions, through whatever combination of spectral, source-bonded and perspectival means, is liable psychologically to transcend the boundaries of the listening space. This is because, firstly, we know that environment is more expansive than any concert hall or domestic setting, secondly, because the suggestion of the openness of environmental space tends to eradicate consciousness of boundary walls, and thirdly because transmodal perception transports our imagination into environmental settings. In a large listening space an environmental-type image will partly live and move in the atmosphere of that space, but how far spatial forms are liable to settle into the arena space of public listening and how far they may seem to transcend that space, depend very much on the combined influences of the feel of the space (including lighting), the mode and skill of delivery, listening attitude, and of course, musical language. In a domestic setting, however, because the listening space is so much smaller, the walls will dissolve more readily.

The acousmatic image of an indoor acoustic space is already in itself bounded and contained. With the acousmatic image of a larger acoustic, like that of a cathedral, or where the dosage of reverberation is unrealistically excessive, transcendence of the larger listening space becomes viable, but acousmatic acoustic spaces smaller than that of the listening space will appear contained within it – rooms within a room. In a domestic setting, however, the image of smaller acousmatic acoustic spaces will easily transcend the listening space, maybe giving the impression of a companion room, or spaces beyond the house.

Sometimes in acousmatic works I am struck by an unfortunate contradiction between an image whose content, in terms of source-bonding and/or spectral space, tells me that it should be unbounded, while reverberation added by the composer, particularly if it is all-pervasive, tells me that the space is contained. I need to be convinced that such intervention in potential transcendence is logical within the context of the image. Not that there is inevitably a clear distinction between the bounded and the unbounded, between the kinds of acoustic reflections that might be heard out-of-doors and those architecturally contained. Forests, to cite one example, have their reflections.

The conditions of reception of spatial attributes and qualities are always going to be important if the listener is to have a sense of involvement. It matters whether the image can reach out to me, draw me in, or transport me to other places and spaces. This is not dependent on the musical language alone, but on how, and if, the acousmatic image survives the rough and tumble of its cohabitation with me in egocentric space.

12. INVESTIGATING SPACE-FORM

In 'Spectromorphology: explaining sound shapes', I left the discussion of space until last because it was so 'bound up with spectromophological content': we needed to know about spectromorphology before we were in a position to understand space. And I invented the term 'spatiomorphology' to highlight, conceptually, the special concentration on spatial properties afforded by acousmatic music, stating that space, formed through spectromorphological activity, becomes a new type of source bonding (Smalley 1997: 122). I still adhere to this view, and it is feasible to continue to use

[53]French composers, following Chion (1991: 50–4), refer to the composed space as 'internal space' and the listening space as 'external space'.

[54]The recorded arena space is, in a sense, 'composed' by the recording engineer. With popular music recordings, arena space can be entirely an acousmatic construction, even though some kind of feasible arena space is in some way being referenced. With recordings of contemporary instrumental music which play on spectral space, we can experience a liberation from grounding as long as we can sideline gestural and ensemble space. This is more likely to be feasible when instrumental source identity is ambiguous or masked, and where instruments act collectively in masses or mobile textures.

'spatiomorphology' to capture this idea. However, space as expanded in this article has become more complex. Readers will also realise that I have adopted a more integrated 'ecological' approach, which is only fitting since we cannot separate space itself from what produces it, nor from our experience of space in nature and culture. But possibly the most significant shift in my thinking is that rather than being the final frontier of investigation, space should now move to centre stage to become the focal point of analysis of, or commentary on, acousmatic music.

I am no longer happy with relying primarily on an investigative process that elaborates a taxonomy of spectromorphologies, and then proceeds to try and work out how they are related and act over time. Such a methodology is based on inherited traditional assumptions handed down from tonal music – that we uncover building blocks of musical materials (themes, motives), and attentively follow their transformations and development, arriving at a view of how material progress creates the dynamic tensions of temporal experience. I am not suggesting that we throw overboard this traditional method, as it can yield perfectly valid insights particularly with regard to time experienced over various stretches of duration. In any case, many spatial forms are temporal, dynamic processes in spectral and perspectival space. Moreover, following spatial forms – their patterns and habits, progress and succession – gives rise, in the mind of the listener, to expectations about continuity, change, or rupture: an implicative process is involved. This indicates the nature of the close liaison between space and time.

A study based on space-form proceeds from a higher level of structure. What I do is, arising from a first or second listening, note down the main attributes and spatial forms, based on the ideas I have discussed in this article. I can then arrive fairly quickly at a view of the space(s) and attributes at work. Often this kind of diagnosis will coincide with some of the temporal divisions of the work, which is only logical since when space changes, so often will temporal structures, but not always. I can then dig down into details of the spaces, which will involve investigating how time articulates spaces, and how my view of spaces may evolve, adapt or change over time. However, with a spatial approach I am no longer duty bound to arrive at a convenient and complete temporal segmentation at a variety of levels, and often this is not viable. Many acousmatic works resist segmentation because they are not built on firm identities and consistent hierarchies, but on multifaceted typologies that so readily change guise and merge with others, defying morphological boundaries and resisting categorical labelling. I implied, in discussing the Orbieu soundscape (admittedly a fairly simple case study), that it is possible, having completed a listening act, to 'collapse' the temporal dimension into a spatial view, somewhat sidelining the temporal evolution that enabled space to emerge. It is often feasible to produce a succinct, holistic view that encapsulates the essentials of the space-form of an acousmatic work.

I recognise three main space-form processes, which can be intermingled. The first is the 'journey', a more traditional 'narrative' approach where one is aware of passing between spaces. A second process adopts changing views of the same space; on balance the listener takes an holistic view.[55] A third process is occupied with multiple spaces, mixed materials, possibly intercuttings, dislocations, and impressions of simultaneous spaces, although the final view could well be an holistic one.

We can also recognise a difference between what I shall call the *naturalist* work, and the *interventionist* work. At one extreme, a naturalist work unfolds as if 'natural', with few seams and ruptures, and a logic of passage; there is a certain transparency in the way things proceed, above all in the care with mixing. With the interventionist approach the composer's hand is in evidence, and the stamp of the technology and techniques is apparent in the kind of material and the way it is manipulated, whereas in the naturalist work there will be some attempt to hide techniques, and avoid exposing technological signifiers.

Of course space-form can only be found rewarding if it has taken on a significant formative role in the music, and this is not the case with every acousmatic work: we have to pick and choose. One thing I have discovered is that listening out for space-form refreshes my listening, and allows me to re-evaluate the repertory. I revisited a much-respected work from the past, which is now rather taken for granted – Luc Ferrari's *Presque rien no.1* – to find out if a space-form approach would offer anything different. I was surprised to find that it is bristling with spatial forms, which do not arise just as a natural consequence of the recorded material, but from the ways in which the composer has used the spatial forms. There are vectors, vectorial wipes, processes of ouverture/enclosure, zones and zone shifts, simultaneous/superimposed spaces, voices as behaviour spaces, gestural/agential spaces, one curious example of performed space, a striking example of (en)closure (the cicadas), and a careful consideration of the relations between distal, proximate and panoramic space and how these should be placed over time. This piece is a good place to start in exploring space-form because it yields its spatial forms and space-form so willingly. But I also found that in listening to a wide range of acousmatic music to try out my ideas, I discovered that starting from a space-form approach led me to the essentials of the musical form, and enabled me, through comparative observations, to discover stylistic traits and forming processes both within a body of work by the same composer, but also shared across composers. A

[55]My *Empty Vessels* is an example.

significant virtue of making space the centre of attention is that this facilitates an integration of diverse approaches to the acousmatic image: we can use spatial concepts to investigate soundscapes, source-bonded approaches, and more 'abstract' or 'abstracted approaches', celebrating the unique richness of the only aesthetic medium that can truly explore sonic space.

But above all, acousmatic space-form is centred on us, not only as receivers and perceivers, but also as producers and inhabitants of space.

GLOSSARY

Agential space	A space articulated by human (inter)action with objects, surfaces, substances, and built structures, etc. Combines with utterance space to create enacted space.
Approach/recession	Typical relational processes in perspectival space, concerned with shifts and movement between proximate and distal space, and/or between periphery and proximate centre. Associated with ouverture/enclosure.
Arena space	A sub-category of performed space – the whole public space inhabited by performers and listeners, within which gestural space and ensemble space are nested.
Automated mode of delivery	Where automated processes and systems are used to deliver perspectival space in public listening.
Behavioural space	A zone of perspectival space produced by the interaction of sounds which, spectromorphologically and texturally, indicate collaborative, group identity. See also 'signal space'.
Circumspace	In perspectival space – the extension of prospective and panoramic space so that sound can move around the listener and through or across egocentric space.
Circumspectral space	The spatial distribution or splitting up of the spectral space of what is perceived as a coherent or unified spectromorphology.
Containment/transcendence	How far the acousmatic image appears bounded within the physical confines of the listening space, and how far the image appears to transcend such confines.
Diagonal forces	The motion of spectral energy towards or away from a spectral region which acts as a plane. Planes can be expressed or implied. See 'gravitation'.
Distal space	The area of perspectival space farthest from the listener's vantage point in a particular listening context.
Distal interpolation	A temporary rupture in ongoing proximate space thereby permitting access to a distal view.
Egocentric space	The personal space (within arm's reach) surrounding the listener.
Elevated space	A high zone in perspectival space. Not to be confused with 'levitation'.
Enacted mode of delivery	The active diffusion of perspectival space in public listening.
Enacted space	Space produced by human activity – a space within which humans 'act'. See also 'agential space' and 'utterance space'.
Ensemble space	A sub-category of performed space – the collective space within which gestural spaces are nested. Can be thought of as a type of behavioural space.
Fixed mode of delivery	Where the delivery of perspectival space is integrated into the format of the composition, and is not further diffused via the enacted mode of delivery.
Gestural space	The intimate or personal, source-bonded zone, produced by the energy of causal gesture moving through space, as with performer and instrument, or agent and sound-making apparatus.
Gravitation	The attraction towards lower or higher regions of spectral space. See 'diagonal forces'.
Holistic space	An analytical stance, realised by mentally amalgamating an array of spatial forms into a unified spatial view.
Immersive space	The filling of spectral and perspectival space in circumspace so that the listener feels immersed in the image.
Lateral space	The extension of panoramic space towards the rear of the listener.
Levitation	A relatively effortless ascent in spectral space.
Mechanised space	A source-bonded space produced by sound-emitting machines, mechanisms and technologically based systems, independently of human activity. Can participate in enacted spaces.
Mediatic space	An amalgam of spaces associated with communications and mass media, creating an image of spaces, places, distances, events, etc.
Mediatised performed space	A type of arena space within which the transmission of gestural/ensemble space is mediated by technology (microphone, loudspeakers, video) in order to preserve the intimacy of gestural space.
Microphone space	A performed gestural or utterance space where intimacy of the image is magnified. Used for creating proximate and intimate spaces in the acousmatic image.
Nested space	In perspectival space – the embracing of one space within another.
Ouverture/enclosure	Typical relational processes in perspectival space, concerned with the opening up of spatial view by ceasing proximate activity, and the (en)closing of space through introducing proximate activity which masks or cuts off any distal image. Associated with approach/recession.
Panoramic space	The breadth of prospective space extending to the limits of the listener's peripheral view.

Performed space	Spaces produced by intentional sound-making, as in musical performance. See 'gestural space', 'ensemble space', and 'arena space'.
Perspectival space	The relations of spatial position, movement and scale among spectromorphologies, viewed from the listener's vantage point.
Prospective space	In perspectival space – the frontal image, which extends laterally to create panoramic space.
Proximate space	The area of perspectival space closest to the listener's vantage point in a particular listening context.
Signal space	A type of behavioural space produced by the signal calls of the participants, either to communicate with each other, or to communicate their presence to other inhabitants. See also 'behavioural space'.
Source-bonded space	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.
Space-form	An approach to musical form, and its analysis, which privileges space as the primary articulator. Time acts in the service of space.
Spatial form	A smaller or larger spectromorphology or musical passage (but not necessarily an identifiable 'unit') that may be analysed according to its various perceived spatial attributes. Space-form is made up of spatial forms.
Spectral space	The impression of space and spaciousness produced by occupancy of, and motion within, the range of audible frequencies.
Tonal pitch space	The subdivision of spectral space into incremental steps that are deployed in intervallic combinations – a sub-category of spectral space.
Transmodal perception	The interaction and interdependence of various sense modalities.
Utterance space	A space produced by vocal sound. This may be an intimate, personal, or social space, and in communicational contexts can also be regarded as a behavioural space. Combines with 'agential space' to create 'enacted space'.
Vantage point	The position from where the listener views perspectival space, and perceives and receives the acousmatic image. The vantage point may be fixed, variable or peripatetic.
Vectorial space	The space traversed by the trajectory of a sound, whether beyond or around the listener, or crossing through egocentric space.

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