SoundEffects
An Interdisciplinary Journal of Sound and Sound Experience

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Soundscape and perception

reconfiguring the acoustic environment for experimental purpose

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SoundEffects | vol. 1 | no. 1 | 2011 issn 1904-500X

Abstract

This paper explores practice-led research into soundscape awareness and perception. I will commence by outlining an installation-based approach that combines field recordings and software control to create a mediated soundscape. This soundscape is broadcast at the same location where the field recordings were made, and is received using wireless headphones. The objective is to create new and unexpected relationships between familiar aspects of the acoustic environment in order to encourage focussed listening and activate perceptual learning mechanisms.

Primary research material derived from participant comments and questionnaires is considered in relationship to the theoretical positions of soundscape studies, acoustic communication, ecological acoustics and psychology.

This enquiry provides corroborating evidence for, and unifies, a disparate group of previously documented phenomena concerning soundscape awareness. In addition, observations concerning disorientation, uncanny sensations and the awareness of coincidental interactions between recorded sound and real-time visual elements suggest a direction for future research.

This paper explores practice-led research that uses mobile listening technology and environmental field recordings to reveal perceptual, cognitive and attitudinal phenomena associated with soundscape awareness and engagement. Participant comments, qualitative feedback from questionnaires and invigilator observations are considered in relationship to the theoretical positions and methodological approaches of soundscape studies, acoustic communication, ecological acoustics and psychology. The initial objective of the enquiry is the development of a new research paradigm capable of advancing the use of sound installation as a method for soundscape enquiry. The longer-term goal is to create a better understanding of human engagement with sound, environment and place that can be generalised beyond the initial installation experience.

I will commence by outlining the installation strategy that uses participant experience of superimposed, mediated site-specific sound as research material. The combination of field recording, performative phonography, composition, software control and a text-score approach to orchestration will be outlined as a methodological development of soundwalking practice. Research material from a series of events is discussed in relation to a set of themes they propose.

This enquiry provides corroborating evidence for, and unifies, a disparate group of previously documented phenomena concerning the interaction between cognition and soundscape: the ability to identify sounds when separated from the source; the construction of meaning through the combination of perceptual information and learned experience; an ability to locate sounds in space as an aid to navigation; the role played by rhythm and repetition in aural perception and the identification

issn 1904-500X

of different utterance patterns for establishing relationships to place. In addition, emerging evidence, concerning disorientation, uncanny sensations and the awareness of coincidence, proposes new knowledge concerning perceptual awareness and learning and a direction for future research.

1. Installation concept

The inspiration for this enquiry into perception and engagement with the soundscape was an installation, *The Sounding Shore*, which I produced for the Whitstable Biennale in Kent, on the English coast in June 2008. The installation was designed for a public art event, and a research outcome was not initially anticipated. However, the conceptual framework for the project was grounded in a soundscape studies research paradigm I was exploring in the context of a master's degree in studio-based composition at Goldsmiths College, University of London. The field recordings used in the work were made in the area local to the proposed installation site (the beach/foreshore immediately opposite Keems Yard), and the sonic materials were identified, classified and edited with reference to R. Murray Schafer's concepts of *keynote sounds*, *sound signals* and *soundmarks* (Schafer, 1994, pp. 9-10). Twenty short stereo sound files were identified which represented the 'acoustic highlights' of the location. For example, the sounds of waves, walking on shingle, the clink of glasses outside the local pub, an ice cream van and children's voices. These were loaded into a Max/MSP patch designed to randomly trigger sounds as isolated events or as unpredictable combinations, to create an alternative environmental soundtrack for the location. The patch created a 'cut and splice' aesthetic featuring hard cuts between sounds, unlikely juxtapositions and improbable spatial combinations. The objective was to create a sound environment with a clear relationship to place, but which was adequately different from quotidian experience to encourage a heightened awareness of individual soundscape events, unconscious perceptual mechanism and related behaviours. It was proposed that this altered perspective might encourage new forms of perceptual learning and adaption, while providing a point of reflection back towards the spatial relationships and content of everyday sonic encounters.

A wireless headphone network was used in order to isolate participants from the location's quotidian soundscape. While complete isolation was the initial objective, an element of spill from the environment was found to be inevitable. However, the interaction between the work and the environment proved an unexpected advantage, as it created the illusion of direct connectivity between the installation, the acoustic space, objects and people. This compounded the degree of confusion already established by the sourcing of sonic materials, challenging participants to identify 'real' and 'virtual' sounds. A research potential was identified in the range and richness of comments that followed from the experience.

issn 1904-500X

2. Research design

A conceptual framework was developed as a response to the theories and methodologies of soundscape studies, acoustic communication and acoustic ecology. This established an appropriate research paradigm in which listening as a focused activity and the exploration of a metaphorical 'listening path' as expressed through the development of compositional practice, coexist as compatible research trajectories. Following a review of phonographic techniques and the creative practices of artists including Bill Fontana, Janet Cardiff, Luc Ferrari, Christina Kubisch, Jennie Savage, Dallas Simpson and Hildegard Westerkamp, the approach to installation developed for *The Sounding Shore* was adopted as a method within a staged research process. The questions driving the enquiry at this stage were:

> What form of creative sound-installation practice will offer a meaningful art/aesthetic experience at the same time as revealing useful and insightful information about perceptual and cognitive functions?
>
> What perceptual and cognitive functions are revealed by this practice-led enquiry?
>
> How does existing theory support or challenge the research outcomes?

This focus served to delimit the disciplinary and methodological scope of the research while encouraging a wide range of observations for the purpose of identifying areas where gaps in knowledge might exist. A series of iterations of the installation, exploring different sonic materials and locations, was proposed, along with the sampling of participant experience using questionnaires and recorded comments. Due to practical considerations regarding the recruiting of participants, on-campus locations were identified to coincide with university conferences engaging with sound and environment issues. Public art events were also targeted. This strategy provided two participant demographics: sound specialists and a general listening public, as well as a range of urban, sub-urban and coastal/leisure locations. The research design focused on qualitative approaches for the initial stages, with the objective of generating quantitative data to investigate specific observations as the research evolved. During the period 2009-2011 installation took place during:

- *Sound, Sight, Space and Play* conference, De Montfort University, Leicester (June 2010). One two-hour session. Location type: city centre campus.
- *Whitstable Biennale*, Kent (June 2010). Two two-hour sessions on separate Saturdays during the biennale month. Location type: sea front and beach.
- *Sounding Out 5* conference, Bournemouth University (September 2010). Two two-hour sessions on consecutive days. Location type: Talbot Campus suburban).

issn 1904-500X

Participants at De Montfort University, Leicester, June 2010

Equipment setup and participants, Whitstable Biennale, June 2010

issn 1904-500X

Non site-specific listening. Wolverhampton University installation, July 2010

Participants, AudioLab symposium, West Bay, Dorset, March 2011

issn 1904-500X

- *AudioLab 11.1 Language of Place* symposium, West Bay, Dorset (March 2011). Two two-hour sessions. Location type: sea front and harbour.

An additional installation at *Space: the Real and the Abstract*, a conference at the University of Wolverhampton in July 2010, was used to present the audio programmes from *Sound, Sight, Space and Play* and the *Whitstable Biennale* in an indoor environment – to explore a more profound separation of sound from space. At the time of writing a further installation is planned as part of the *SPR Phonography Colloquium* at Goldsmiths College, University of London (July 2011). Installation sound files can be downloaded from http://www.marcusleadley.com/OS-MP3-files/.

During the installation programme significant improvements were made to both recording and delivery mechanisms to improve the sound quality and acoustic detail of the experience.

2.1 Sound recording

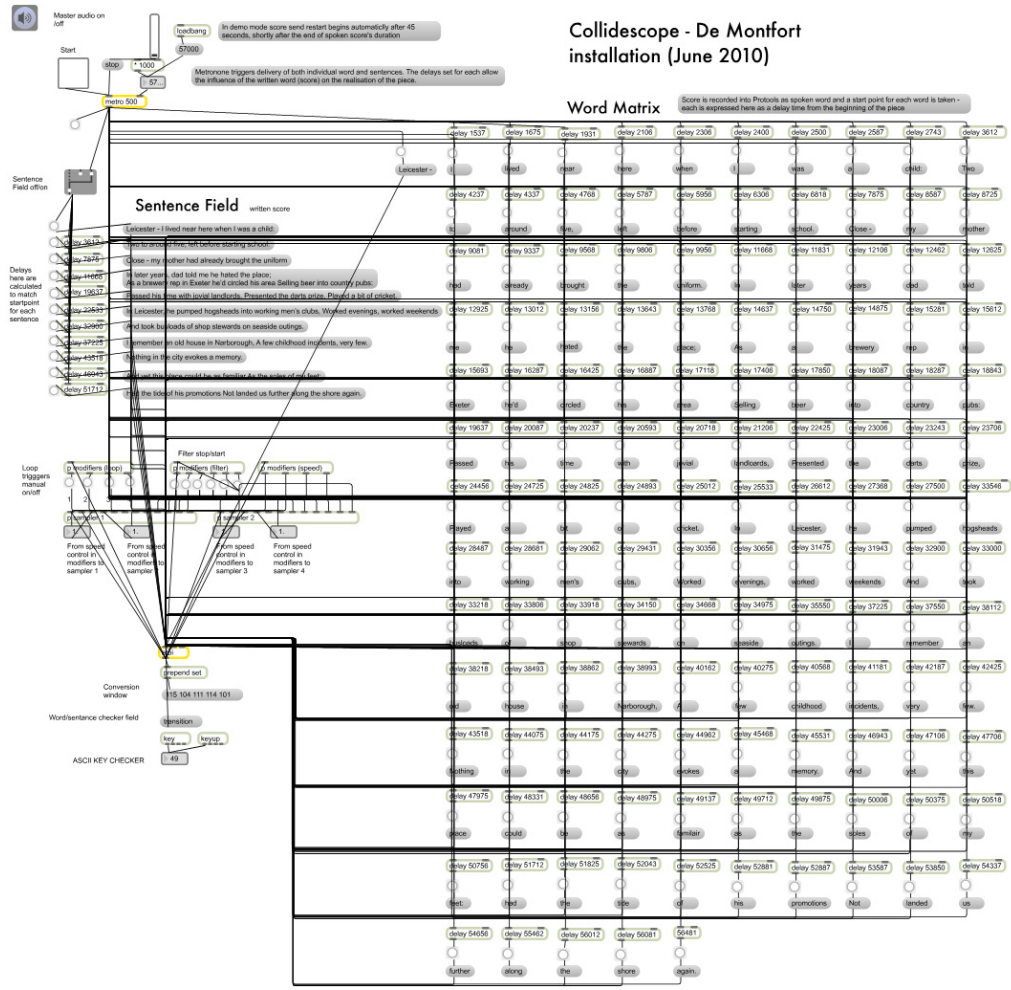
Materials for the first biennale installation were recorded using a Sony minidisk recorder and a consumer grade Sony ECM-DS70P microphone. The recording unit was upgraded to a Roland R44 and subsequently to a Sound Devices 702. Testing of different recording techniques and a study of film sound production led to the adoption of a multi-microphone approach, featuring a Rode NT4 for capturing stereo ambiences and a Rode NTG3 for monophonic sources. In addition, a set of Sound Man binaural microphones was found extremely useful for capturing motion events. An exploratory recording protocol based on the observational techniques of listening walks (Schafer, 1994, p. 212) evolved in which a site was explored in three stages, each accompanied by a different microphone set up. Performative interventions with the landscape were also recorded in order to 'sound' environmental features. Recorded materials were edited using Pro Tools. It was during early experiments with layered material that the combination of standard X/Y stereo, binaural and monophonic recordings was observed as providing a realistic approximation of natural soundfield dispersion (near, mid and far field characteristics with occasional binaural interjections creating a degree of pseudo surround) for headphone listening.

2.2 Max/MSP development

The original patch offered four-voice polyphony and access to twenty sound files. The acoustic management of layers was achieved by close attention to sound editing, selection and bank loading during preproduction. The number of sound file players was increased to five, and the file storage capacity to thirty. The additional

issn 1904-500X

file locations were for monophonic recordings, and an automated pan function was introduced to change placement locations in the stereo field.
Modifications were also made to the timing mechanism responsible for triggering files. Initially, a metronome was used in combination with a number of random number generators. However, this proved rather mechanical. As the installation's wireless technology facilitated mobile listening, it enabled participants to explore



Installation Max/MSP patch (De Montfort installation) showing text score and timing trigger implementation grid

the physical landscape and the superimposed soundscape simultaneously. An analogy was observed between the installation and soundwalking practice. With reference to Schafer's original soundwalking brief for, "an exploration of the sound-

issn 1904-500X

scape of a given area using a score as a guide" (Schafer, 1994, p. 213), the use of a text score to orchestrate the playback process was considered. A system was devised that used the timings of key words in the looped performance of a short text to trigger sounds. File choice continued to be initiated by stochastic principles; however, files were arranged in themed patch libraries. The first classification devised was to differentiate between 'people' (sounds of human actions, voices, motions) and 'places' (environmental atmospheres, machine sounds, natural phenomena). This was further developed to account for *keynote sounds*, *sound signals* and *soundmarks.* As the interrogation of narrative was not a research goal, the verbal content of the score was not included in the installation sound. However, the score initiated a cyclic character with a loose, rhythmic aspect that gave the montage a more naturalistic feel. The first test score was a set of instructions with an ocean-oriented theme:

Whitstable Biennale 2008:
Proceed as if passing rapidly through water at great depth.
Be aware of the force which is required to do this.
Consider the role of gravity in your ascent to the surface.
Consider the nature of that which you may pass in your journey to the surface.
You have a choice to make when you break the surface: remain in this liminal zone or allow the energy of your ascent to carry you on rapidly to great height.
How is this choice of transition to be characterised?

Subsequent scores were developed with specific installations in mind. I had a degree of personal past history with three of the installation sites and the scores drew on these early experiences:

Leicester installation:
I lived near here when I was a child:
Two to around five, left before starting school.
Close – my mother had already brought the uniform.
In later years, dad told me he hated the place;
As a brewery rep in Exeter he'd circled his area
Selling beer into country pubs:
Passed his time with jovial landlords,
Presented the darts prize,
Played a bit of cricket.
In Leicester, he pumped hogsheads into working men's clubs,
Worked evenings, worked weekends
And took busloads of shop stewards on seaside outings.

issn 1904-500X

I remember an old house in Narborough,
A few childhood incidents, very few.
Nothing in the city evokes a memory.
And yet this place could be as familiar
As the soles of my feet:
Had the tide of his promotions
Not landed us further along the shore again.

Whitstable Biennale 2010:
I practiced here in the early 80s.
Alex could sing like Bono – but – we made
More money busking Beatles songs.
More than pumping gas on a Sunday.
Or working at the chipboard factory:
Gotta love that 20p coin.

I'd drive over from Herne Bay for parties:
Intimate, run down little houses packed with life.
Narrow gardens overgrow, a distant sound of surf.
Purple Hipsters in the kitchen,
Red Squares on the stairs,
And the late-night scent of Rothmans
Hanging in the air.

Bournemouth installation:
My mother tells a story of how, shortly after the war
She and her friend Jean would take holidays in Bournemouth.
A week here, a week there – always staying at the same guesthouse.
It was run by a woman whose husband was a classical musician,
And he did not like his wife running this business.
On one occasion he placed an ancient gramophone with a massive horn
By their door – and began playing music in the middle of the night.
On another, they returned to find the curtains torn down and the furniture overturned.

And yet they kept returning –
In cheerful anticipation of such unpredictable behaviour;
Seemingly, it added spice to the seaside adventure.

issn 1904-500X

2.3 Headphone system

This was upgraded from a domestic Sony unit with three headsets to a Schenzen Go-On system with fifteen sets of headphones and improved transmission capabilities. This upgrade offered a major improvement in sound quality, allowing more participants to explore the location more easily. This significantly enhanced the experience and the impact of the work on perception.

3. Outcomes and observations

I invigilated each installation in order to observe participant behaviour and to engage in conversation. These interactions were recorded so that anecdotal feedback could be considered within the framework of research. Questionnaires were also given to participants: twenty-seven completed forms were returned from Leicester; nine from Whitstable; thirteen from Wolverhampton and seven from Bournemouth. Data was not collected at the West Bay event, but participant observations were made.

While events were conducted in different locations with different participants and sonic materials, certain trends in participant observations can be identified as common to all locations. I have chosen to present these grouped in relation to the themes they suggest. For anecdotal comments where quotes are given, P: (participant). Where my own comments are relevant, these are prefixed with I: (interviewer).

Looking at the comments of the different participant groups – conference attending student/sound practitioners and a general public-art audience – some general trends need documenting. Overall, comments regarding perception of sounds in the environment were similar, displaying a mixture of emotional and intellectual content. Members of the first group were more likely to enquire about technical aspects, intent, compositional practice and comment on the sound quality. However, both groups were interested in the software/technology. The participants at the public events tended to stay with the experience for less time, expressed humour in relation to the 'surreal' aspect of the work, identified familiar sounds and relayed anecdotes about other listening experiences. They were less likely to fill in questionnaires, so direct engagement was a more appropriate approach.

3.1 Sound and sequence identification

Questionnaire feedback from Leicester, Whitstable and Bournemouth installations concerning sound sources, soundscape events and populations evidences the extraordinary level of detail contemporary humans can extract for audio content.

issn 1904-500X

The absence of visual correlation is no impediment to identification if sounds have become familiar due to their assimilation into a cognitive framework – which Eric Clarke identifies as being informed by an ongoing and essentially passive process of perceptual learning (see Clarke, 2005, pp. 23-24). James Gibson observes that objects have *affordances* (Gibson, 1966, pp. 284-6): a constellation of meanings and values, which are embedded in cognition through prior association, and become associated with the sounds they make. Affordances vary from person to person due to prior associations and experience. Drawing on Gibson's work, Clarke pursues the idea that objects also have *invariant properties* and exhibit specific behaviours that remain constant through natural processes of sonic transformation (Clarke, 2005, pp. 32-6). Perception tracks these continuities through time to derive subtle shades of meaning in unfolding events. Clark argues that invariance is the underlying reason why we perceive environmental sound as a relatively stable phenomenon. The influence of event sequence and the invariant characteristics of objects/sounds can be identified where participants correctly identify processes and behaviours. For example, 'car passing', 'moving plate', 'heavy traffic', 'rain on roof', 'stopping bus', 'aggressive small dog being walked'.

In addressing the perception of environmental sounds and sequences Albert Bregman's work on auditory scene analysis also becomes relevant. He suggests that unpacking complex audio streams into identifiable sub-patterns is achieved through parsing operations similar to those that determine linguistic grammar, syntax and semantics. Bottom up processing (based on the correspondence of present perceptions to cognitive models of past auditory phenomena) constructs a feature set that can be mapped to stored meaning. Top down processing (an intellectual process of reference and extrapolation) combines expectations, rules and patterns to provide interpretations (see Bregman, 1994, pp. 397-411).

The identification of specific, familiar sounds was only evidenced during the Whitstable installation:

> P1: "The Harmonica Marcus, was that that little dapper old man wandering up the high street?"
> I: "Yes."
>
> P2: "You've been in the chip shop n'all!"
>
> P3: "Where do they play the harmonica? In the pub? Was that a train?"
> I: "No someone dragging a trolley past."
> "I can hear the sound of people sitting outside that pub rattling glasses."
> I: "That was inside the pub."
> P3: "Oh is it? – Any chance of people walking along with their boats?"

issn 1904-500X

Unlike the situation at the university conferences, significant numbers of people at the Whitstable installation were local to the area. As a consequence, we have the identification of the soundmarks that Schafer identifies as, "specially regarded or noticed by the people of that community" (1994, p. 275).

3.2 Repetition and rhythm

The majority of comments from Leicester and Whitstable indicate an awareness of sounds repeating. The rate of reporting drops for the Bournemouth event and it is reasonable to identify this as a consequence of software development that included access to a greater number of sound files. Comments focus on the sounds that participants found memorable, intriguing or annoying. This proclivity for pattern and content awareness generally supports the role of repetition in perpetual learning observed by Clarke (2005), as a mechanism that creates a resonance between perceiver and environment. Bregman (1994) also identifies the role of repetition in learning. This, I observe, operates along a temporal axis ranging from pitch recognition (high frequency repetition experienced as integrated stream) to the perceptually distinct patterning of rhythm and language.

Participants' awareness of rhythm is harder to characterise; even direct questioning delivered ambiguous results. It appears that the term rhythm has developed a near ubiquitous cultural association with music. Consequently, people responded to questions by identifying incidents of songs of performances in the recordings. The number of percussive sounds was increased for the Bournemouth installation and people commented on the rhythms that were arbitrarily created. Prominent environmental rhythms, such as waves on a beach or the thrum of traffic, were identified in conversation, but this awareness needed to be teased out. This suggests that the awareness of rhythm in nature operates predominantly at an instinctual, habitual level. The importance of rhythm to both orientation and learning processes is supported by Roland Barthes (1991) and Henri Lefebvre (2004) who both observe that its study is integral to an understanding of time and the everyday. Equally, Jean-Luc Nancy (2007, p. 17) highlights the importance of rhythm as that which separates the stroke of the present from linear time, giving time its time – facilitating the folding and unfolding which represents an aspect of the taking place of a 'self' (the opening).

3.3 Sound and meaning

In order to pursue the relationship between aural perception and the meanings associated with sounds, it is necessary to differentiate between processes of hearing and listening. Roland Barthes suggests, "Hearing is a physiological phenomenon;

issn 1904-500X

listening is a psychological act" (Barthes, 1991, p. 245). There is broad agreement that hearing is a passive activity (see Eisler and Adorno, 2004, p. 74; VanDerveer, 1979, p. 2; Oliveros, 2005, p. 7; Truax, 1984, pp.14-6). Listening, on the other hand, is a complex cognitive process located at the interstices between hearing and comprehension. Barthes proposes three forms of listening: 'alert listening', which is the base-line model selected by evolution for its contribution to survival and orientation; 'deciphering', which is the beginning of human listening and is focused on the identification of signs; and an 'entirely modern' form that is engaged with the flow of significance. Barry Truax creates a similar delineation between basic processes – 'listening in readiness', where familiar sounds can be processed in the background without conscious attention, and 'listening in search', which represent the focused search for detail and information (Truax, 1984, pp. 19-21). Jean-Luc Nancy makes the observation that 'to hear' is the search for sense (a bird, a plane) and 'to listen' is always an inclination towards meaning and that which is, "not immediately accessible" (Nancy, 2007, p. 7). Steven Connor echoes a similar sentiment: "We ask of sound 'What was that?', meaning 'Who was that?', or 'Where was that?', we do not naturally ask of an image, 'What sound does that make?'" (Connor, 1997, p. 213). Nancy identifies meaning as the sum of many references. He also suggests that sound itself is a reference, because the sound that is heard is the resounding of a vibration transmitted from elsewhere; sound "spreads in space, where it resounds while still resounding in me" (Nancy, 2007, p. 7). Thus, he concludes that sound and meaning share the space of a referral.

Anecdotal feedback evidences behaviours linked to baseline alert listening: physical reactions to 'virtual' sound cues such as moving out of the way of an object perceived to be in close proximity. Questionnaire returns provided more specific information:

> Q: Did you find yourself looking around for the source of a sound?
> Bournemouth: 4 of 7 participants = 57%
> Leicester: 19 of 27 participants = 70.3%
> Whitstable: 8 of 9 participants = 88.8%

The Wolverhampton questionnaire also reveals incidence of a physical response to sound cues during acousmatic listening:

> Whitstable: 5 of 13 participants = 38.4%
> Leicester: 7 of 13 participants = 53.8%

Further investigation with larger sample populations may reveal listening trends and degrees of effect related to specific types of location and between acousmatic and on-site listening.

issn 1904-500X

Further support for a variety of listening practices can be observed in participant comments that suggest an awareness of perceptual change in relation to the 'before' and 'after' experience of the installation, as these comments from Whitstable highlight:

> P4: "Ah! I suppose when you're walking along there's lots of sounds you hear but go through one ear and out the other. Like those jet skies or boats going past. You'll be walking and you can hear them in the background but you're not really taking 'em in. It's just an everyday background you will always hear."

> P5: "I am really conscious of people talking and birds singing now – when you're wandering around you just get on with your thing – but it's there."

These comments suggest a form of background passive audition; the term 'through one ear and out the other' is a colloquial description of the functionality underlying 'listening in readiness' or 'alert listening'. The progression of listening to a heightened form ('deciphering', 'listening in search' or 'modern listening') is encapsulated in the following quotes from Bournemouth:

> P6: "I've had similar experiences before but it's always amazing; it's exercising a part of your mind that you don't normally work with – the juxtaposition of sound."

> P7: "It reminds me of when I used to do a lot of landscape painting so I'd go somewhere and be like all day with my paint and my easel and when I'd leave at the end of the day my senses were heightened. This was like a visual clarity. It's new to me to have that going on with my ears in a really kind of cool way."

In terms of a residual perceptual legacy, following the experience of edited, superimposed soundscape material, the Leicester installation delivered the following observation:

> P8: "It's a different feeling when you take them [headphones] off – when you get used to that sound. That's an interesting one."

3.4 Soundscape and mood

Participant comment P8 also proposes the intriguing notion that different perceptual states may have different 'feelings', in the same way that emotional moods are observed as having degrees of positive or negative valance. Equally, it may be possible to suggest that mood is influenced by perceptual state and vice versa. Further art-based sound experiments might be devised to interrogate this.

Interrogating anecdotal information concerning the effect of the installation audio on participant mood in Wolverhampton suggests it had a greater influence than during the site-specific presentations. Many participants indicated some level

issn 1904-500X

of influence, and their comments are generally supportive of commonly held views concerning the characters of each location:

> Coastal: 'relaxed', 'relief', 'excited', 'change of pace', 'happier', 'calmed'.
> Urban: 'loneliness', 'irritation', 'relaxed', 'anxious'.

The role of utterance in the soundscape is identified as a significant source of information relating to population mood in all feedback. For example, 'group of women chatting friendly', 'young male – informative', 'group of teenagers greeting each other', 'man and woman friendly, laughing – crossing into street' and 'man/woman in a hurry – aggressive'. Languages and accents are also identified in utterance content and this provides community related information. However, this does not always accurately inform the listener's perspective; several Leicester participants cited non-local accents as the reason why they believed the installation sound was recorded in south London.

3.5 Soundscape and schizophonia

The suggestion in comment P8, that participants get 'used to' the altered soundscape, evidences the adaptive character of aural perception and the habituation Truax observes in relation to the normalisation of 'schizophonia'. Schafer suggests that prior to the invention of sound recording and broadcast technologies all sound was connected to one time and one place only and attributable to a physical cause (Schafer, 1994, p. 90). He suggests the term 'schizophonia' for the separation of sound from source, proposing it as a "nervous word ... I wanted it to convey a sense of aberration and drama" (ibid., p. 91). Sound reproducing technologies, "create a synthetic soundscape in which natural sounds are becoming increasingly unnatural while machine made substitutes are providing the operating signals directing modern life" (ibid.). The installation method of this enquiry exists at the interstices between contemporary mobile listening, soundscape composition and the re-presentation of environmental sounds as electroacoustic intervention. It delivers a highly schitziphonic experience. "The challenge of the schizophonic situation for the listener is to make sense out of the juxtaposition of two different contexts. In many cases, the 'sense' becomes conventional acceptance" (Truax, 1984, p. 121).

3.6 Disorientation

Trevor Wishart notes that disorientation is the likely outcome when a link between aural content, landscape and source cannot be identified, "This sense of disorientation produced in some listeners by the impact of electronic sounds was the basis of the early use of electronic sound materials for science fiction productions" (Wishart,

issn 1904-500X

2003, p. 44). Film also provides us with examples where the superimposition of environmental sound can create an extreme sense of dislocation. For example, in the film *Elephant* by Gus Van Sant (see Jordan, 2007), where Hildegard Westerkamp's soundscape composition *Beneath the Forest Floor* is incorporated into the sound design of the school shooting scene. This enquiry proposes that the superimposition of recorded environmental sound during the installation has a similar effect and that this mobile listening experience is substantially different to listening to music 'on the move'. Connor (1997, p. 211) observes that the personal stereo does not remove the user from the environment but deepens the experience of the body in relation to a new inner soundtrack. He suggests it is not an inwardly focused experience; it promotes a mode of attention focused towards the non-auditory aspects of the environments one passes through. The effect of listening to environmental recordings appears to reverse this paradigm: it heightens the awareness of the environment's auditory aspects. For example, from Leicester we have:

> P9: "I felt like disorientation – people were behind me – but not while I was doing the questionnaire because I was too concentrated so I stopped doing it and started going around. There was a girl who I thought was talking to me but there was no one. I got confused with space from behind because this is the best configurement [*sic*]. This space is going into your space when you are walking around – not sitting down because you're kind of distracted ..."

Another observation here is the way in which focusing on a task and/or sitting down reduces the impact of the perceptually challenging audio. Further research concerning sound, orientation, balance and coordination might yield interesting results. This correlation between movement and disorientation is echoed by another comment from the same installation:

> P10: "I walked down there and a cyclist came towards me but I heard the sound of a car and thought 'oh I don't like this – I want to go and sit down.'"

Participants in Whitstable made more general comments concerning their experience of disorientation:

> P11: "It's nice but it's a bit disorientating. You don't normally have headphones to listen to it."

> P12: "When I put them [headphones] on here and there was the harmonica player I really thought there was someone there."

One participant at Bournemouth made the following insightful comment concerning his experience of disorientation:

> P13: "All very odd. Knowing all that was intentional I was not expecting too much because I knew what it was all about. But then you see for yourself and then you

issn 1904-500X

> think about the building work, which is actually over your right shoulder nevertheless. It's very, very intriguing. It's very difficult to relate the noise to something that is here around – there are no cars, there is no building work. As soon as you stop rationalising about it, it is completely ... it is there."

Comment P13 also proposes the necessity for a 'letting go' into the installation experience and the need for the suspension of disbelief. This has obvious adaptive advantages over attempts to rationalise, control and respond; the quicker a situation is identified as non-threatening, the sooner it can be assimilated. This is robust evidence for the adaptive nature of human perception and the relative ease with which the contemporary schizophonic soundscape may be processed.

The ambiguity between recorded and live sound during the Bournemouth event is clearly identified as a principle cause of disorientation:

> P14: "... to be in the place at the same time is really strange. Where you kick it up then the loud stuff that's happening now kind of comes in as an under voice and it's a little more convincing. The ambiguity is there because you can't tell if you're stuck in it."

> P15: "I enjoyed that a lot – I also enjoyed the bleeding effect. I kept trying to check out what I was hearing was in the headphones or just right next to me."

Also from Whitstable:

> P16: "It's quite weird to work out this [recording] and what's around you."

This observation supports the connection between listening and an orientation towards meaning; where there is an inconsistency between events or spatial relationships it immediately leads to heightened attention.

3.7 Uncanny sensations

The experience of uncanny sensations is not reported in the anecdotal feedback. However, questionnaire returns indicate:

> Q: "Did you experience an uncanny sensation?"
> Leicester: 7 of 27 participants = 26%
> Whitstable: 4 of 9 participants = 44.4%
> Bournemouth: 5 of 7 participants = 71.4%

In the Wolverhampton questionnaire, which sampled participant experience of none site-specific sound, we observe the following outcomes for uncanny sensations:

> Leicester audio programme: 3 of 13 participants = 23%
> Whitstable audio programme: 5 of 13 participants = 38.4%

issn 1904-500X

While it is impossible to make any meaningful extrapolation from these percentages, as the sample populations are too small, they do evidence the experience of uncanny sensations in relation to the installation. They also gesture at the possibility of differing levels of affect under different conditions, which suggests a future investigation of uncanny sensations in different acoustic environments as a valuable research exercise.

In his 1919 essay *Das Unheimliche* Sigmund Freud (1959, pp. 372-95) suggests that things that are lifelike – waxworks, dolls and automaton – anything that gestures towards the mysterious animation of things 'undead' – are potent triggers for uncanny sensations. Involuntary repetition is also highlighted as a cause. One only has to think of animated billboards and the plethora of technologies that appear to speak in order to locate incidents of the contemporary uncanny. However, as Truax' comments concerning schizophonia in section 3.4 suggest, we are habituated to expect such events and broadly desensitised. Marc Falkenberg contests Freud's assertion that the uncanny is principally the outcome of familiar, but repressed, unconscious content (see Falkenberg, 2005, p. 20). He suggests Freud overstates this position in order to refute the observations of Ernst Jentsch that the uncanny is "... comprehensible if a correlation 'new/foreign/hostile' corresponds to the psychical association of 'old/known/familiar.' In the former case, the emergence of sensations of uncertainty is quite natural, and one's lack of orientation will then easily be able to take on the shading of the uncanny; in the latter case, disorientation remains concealed for as long as the confusion of 'known/self-evident' does not enter the consciousness of the individual" (1995, pp. 6-18. Originally published 1906). Following this argument, uncanny sensations are the outcome of a particular manifestation of uncertainty. Confusion concerning 'known/self evident' sounds leads to disorientation, while confusion about 'new/foreign/hostile' content leads to uncanny impressions. The layering and mediation of sounds during the installation create familiar and unfamiliar sonic experiences and participants' comments support Jentsch's observations concerning the triggering of both disorientation and uncanny responses.

3.8 Coincidence

An awareness of coincidence is one of the most intriguing outcomes of the anecdotal feedback from all sound installations. Comments evidence a keenness to discuss the outcomes of arbitrary interactions between auditory and visual phenomena. The Bournemouth installation reveals:

> P17: "It's very nice when there are steps – you see people with all their shoes and they are synchronising with the steps. It's a nice mixture. The most interesting is when there are some sounds of outside mixing up with the recording."

issn 1904-500X

> P18: "Some really fascinating moments. When there was, I think, this suitcase [being dragged]. Exactly on the moment when it came, there was a woman with a child [in a pushchair], which was a very similar sound."
>
> P19: "So listening to voices that are inside when you are outside, and exactly in the moment there was a group of people who came next to me also talking, and this was very fascinating."
>
> P20: "I really like that. Funny how things happen. There are those feet marks that are on the [steps] – just down there – I stood on those and as soon as I stood on them the sound cut – what's the chances of that happening!"

The aesthetic outcomes of coincidence are further highlighted as part of the appeal – as this comment from Leicester suggests:

> P21: "I walked out to the street to see how it would sound out there and it was interesting in the tunnel, the archway. That was probably the most effective place, because you had the traffic going by behind you and the recording of traffic in front. The two merged quite well."

However, the attraction of a pleasing aesthetic cannot fully explain the reason why perception should be 'fine tuned' to the awareness of coincidence. Thomas Griffiths and Joshua Tenenbaum (2001, pp. 370-375) observe that there are often major inconsistencies between the general awareness of the potential for events to coincide and the actual statistical probability – with occurrence often being far more likely than anticipated. Following on from Persi Diaconis' and Fredrick Mosteller's definition of coincidence as "...a surprising concurrence of events, perceived as meaningfully related, with no apparent causal connection" (1989, p. 853), what participants are not identifying is that the installation itself is the causal connection, and that the probability of an interaction between sounds recorded at a location and objects and events at the same location is relatively high. Raymond Nickerson observes that it is the surprise element that makes coincidence memorable and it remains surprising only until the cause is identified (see Nickerson 2004, p. 86). Diaconis and Mosteller also observe that,

> What we perceive as coincidence and what we neglect as not notable depends on what we are sensitive to. Some research suggests that previous experience gives us hooks for identifying coincidences. Multiple events emphasize themselves, and without them we would have no coincidences to recognize. The classical studies of remembering remind us that frequency, recency, intensity, familiarity and relevance of experience strengthens recall and recognition. (1989, p. 859)

This suggests that what we are observing, in a proclivity for coincidence-awareness, is the operation of an important mechanism embedded within the perceptual learning process.

issn 1904-500X

4. Conclusion

In this paper I have explored soundscape awareness and engagement through a focus on participant listening experience in the mediated sound environment of site-specific installation. Where appropriate, theory and practical research have been integrated to provide a focused assessment of the enquiry's main research questions:

> What form of creative sound-installation practice will offer a meaningful art/aesthetic experience at the same time as revealing useful and insightful information about perceptual and cognitive functions?
>
> What perceptual and cognitive functions are revealed by this practice-led enquiry?
>
> How does existing theory support or challenge the research outcomes?

The achievement of the first objective has been outlined in the strategy that combines environmental sound recording with montage and composition techniques under the direction of a text score. As a mobile listening experience this has been proposed as a development of soundwalking methodology into a controllable, mediated electroacoustic intervention with landscape. By reconfiguring the quotidian soundscape in the same environment where sonic materials were recorded, the installation breaks the direct connection between sounds, objects and events – yet a degree of tentative, site-related connectivity remains which captivates and intrigues perception. Perceptual adoptions, listening awarenesses and cognitive processes regarding the relationship between sound, meaning and orientation are revealed in comments and questionnaires.

The consideration of installation research outcomes suggests that the invariant properties of objects and the cognitive network of object affordances are central to the process of extracting information from recorded as well as live sound. The role of sound in navigating space is evidenced by the variety of physical responses in relation to audio cues. A connection between the utterance content of different locations and the participant's sense of place and wellbeing can be observed in comments concerning population mood and demographics. Disorientation or uncanny sensations are identified as the consequences of confusing, unfamiliar or manipulated sound. It is proposed that when observed in participant responses, these sensations become indicators of a heightened schizophonic experience. Coincidence-awareness is identified as a potential mechanism operating within perceptual learning for the purpose of pattern recognition and awareness.

issn 1904-500X

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