An Overview of Spatialised Broadcasting Experiments with a Focus on Radio Art Practices

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This article is an introduction to the specialised area of spatialised broadcasting experiments associated with radio art practices. This subject is investigated primarily from two perspectives: artistic works that explore the dissemination of radio waves (the 'spectrumscape') and the multichannel broadcasting/listening experience. It also discusses some of the history and ideas that form the undercurrents for radio art practice and explores radio art's uses and concepts of spatiality.

1. INTRODUCTION

> If the history of mainstream radio is a suppressed field, the history of experimental radio is utterly repressed. (Weiss 1995)

If 'the history of experimental radio is utterly repressed', then this would indicate that the topic of spatialised broadcasting experiments within radio art practices must be an even more underexplored field. Douglas Kahn has also stated that 'the study of the relationship of sound and radio to the arts is open to a full range of investigation, including the most general' (Kahn 1992: 1). It must be acknowledged that since Weiss and Kahn made these comments in the mid-1990s there has been a growing collection of publications on radio art, but many topics are still left under-represented and this article is presented as an investigation into this expanding field of study.

1.1. Exploring Radio Art

When asked what radio art is, I immediately think of Hildegard Westerkamp's statement that radio art is about the 'pushing of radio boundaries':[1] seemingly amorphous boundaries that shift from practitioner to practitioner (as they challenge our notion of the art form), who themselves are influenced by their national perspectives. What seems to be the commonality is the concept that radio art is art made for or created from the radio medium by artists (regardless of whether we call these artists, composers, sound artists, radio artists, media artists, transmission artists, conceptual artists, etc.). This intrinsic link to the medium of radio is supported by Sabine Breitsameter, who claims that 'radio art is media art – an acoustic media art' (Leonardson 1995); similarly, Leigh Landy – in his book *Understanding the Art of Sound Organization* – writes, '[r]adio art is the use of radio as a medium of art' (Landy 2007: 11).

Focusing on the sound-based elements of radio art Andreas Hagelüken explains that the normal sonic aspects include 'musical structure … noise and field recordings in all colours and … language (not only in its semantic meaning but also in its syntactic and sounding quality)' (as quoted in Black 2005: 1–2). Götz Naleppa (former senior producer of *Klangkunst* at Deutschlandradio Kultur) elaborates:

> taken literally: Radio-Arts must be a sub-term to Soundart, Acoustic Arts etc. These are WIDER terms, because they include sound-installation (in public space not in radio) … sound art for radio [which he calls a sound-composition], is an art form of its own, with its own artistic laws and dramaturgy – simply because it takes place inside the MEDIUM radio … [and has] many sub-forms like soundscape, sound-collage, sound-poetry, musique concrete, noise-music, radio/sound-opera. The difference to other radio-art-forms like radio-play is simple: sound-composition shares with them the same elements: sound, text (voice) and music. But in radio-play text (dialogue) is in the foreground and the other elements SERVE it (often in an illustrative way). And in (radio)sound-composition we have the same elements – but they are EQUAL, they are simply MATERIAL in the hands of the composer. (Quoted in Black 2005: 2)

1.1.1. Exploring Radio Art's Origin

Andreas Hagelüken has argued that '[i]n Germany, unlike other European countries, the terms ''Ars

[1]Hildegard Westerkamp, 2008. Interview by author. Sunderland, UK. September 5.

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Acustica'' and *Radiokunst* (radio art) are closely linked to the history of the *Hörspiel* [radio drama] (and not contemporary music)' (Hagelüken 2006: 90). Hagelüken's assertion is interesting in the fact that it challenges the general misconception that radio art evolved out of the contemporary music practice of *musique concrète* in France. This misconception, as Hagelüken is aware, negates earlier experimental radio work from the German Weimar Republic period (1919–30).

Pierre Schaeffer trained as a radio technician and founded the acoustical experiments studio at the radio station RTF, from which his musical experiments – based on composing using recorded sounds – were first broadcast from Paris on 5 October 1948. This is widely credited as the beginnings of *musique concrète* (Kennedy n.d.). Notably, when DeutschlandRadio's, *Klangkunst* programme celebrated Pierre Schaeffer's work they stated his work 'ist bis heute einer der wichtigsten Meilensteine der Radiokunst' ['remains today one of the most important milestones of the radio art'] (DeutschlandRadio n.d.) and not that radio art originated from *musique concrète*. Dan Lander contributes the general misconceptions surrounding radio art to the 'imposition of a borrowed musical discourse applied to all sound phenomenon' (Lander 1994: 13), and this doesn't take into account Hans Flesch's *Zauberei auf dem Sender* [*Radio Magic*] (Breitsameter 1999). Flesch's acoustic media art work was broadcast on Berlin radio in October 1924 (some 24 years before Schaeffer) and featured 'a cacophony of words, sounds and music … [produced by a fictional] magician who created a wild mix of all sound waves available' (Australian Broadcasting Corporation n.d.). Using his supernatural powers he 'plucked both sound and radio waves from the air to form this unitised work' (Black 2009: 20).

A more direct comparison to *musique concrète*, also in 1924, occurred when Flesch joined forces with Hans Bodenstedt to create a series of experimental cityscape 'sound portraits' (*Hörbilder*) from site-specific location recordings for radio broadcast including *Die Straße* and *Hamburger Hafen*. Bodenstedt states that their idea was that 'an athletic arena, a speaker's podium, classroom, factory, street, ship, zoo .. the whole world offers itself as studio' (Cory 1992: 339) from which to create the new sound-based works.

Using the montages of images associated with silent films as inspiration, Kurt Weill in 1925 conceived of an 'absolute radio' composed from noises, sounds of nature, and 'unheard sounds' (Freire 2003: 69). For Weill this was radio that could develop its own form of autonomous 'radio art' that didn't rely on the 'reproduction of earlier artistic achievements' (Weill 1984). Also from around this same period was the Futurist F.T. Marinetti's audio montage entitled *radio sintesi*.

By 1926 Flesch and Bodenstedt's 'sound portraits' had evolved into larger-scale works with Bodenstedt's *Der Herr der Erde*. Following this in 1928 Flesch commissioned Walter Ruttmann to produce an audio montage entitled *Wochenende*, which 'depicts' the story of a weekend in Berlin (Kahn 1999: 131). Hans Richter states that this work was 'among the outstanding experiments in sound ever made. There was no picture, just sound (which was broadcast) … It is a symphony of sound, speech-fragments and silence' (Richter 1949: 114). What makes this work particularly interesting is that Ruttmann produced not only a sound-based work with movements containing a strong sense of rhythm, but also a musical score for the work (Kunstradio 2004a; Media Art Net n.d.). In 1929, Ruttmann states,

> Alles Hörbare der ganzen Welt wird Material. … nicht nur Rhythmus und Dynamik werden dem Gestaltungswillen dieser neuen Hörkunst dienen, sondern auch der Raum mit der ganzen Skala der durch ihn bedingten Klangverschiedenheiten. Damit ist der Weg offen für eine vollkommen neue akustische Kunst … [*Every audible thing in the whole world becomes material. … not only rhythm and dynamics will serve the creative power of this new audio art, but also space with the complete scale of sonic varieties dependent on the spatial conditions. Thus, everything is open for a completely new acoustic art*…] (Kunstradio 2004a, 2004c).

Evidently there were a number of works created from the equivalent to 'concrète sound objects' well before *musique concrète*, and this raises the questions of to what extent Pierre Schaeffer was aware of this – especially as it is documented that there was an international congress on radio art held in Paris in 1937 (Anderson 2001) – and how much this influenced him. An ongoing challenge for radio art has been its problematic nature that resists clear classification: is it a media-based art-form, is it music or does it pluralistically span both? This may be one of the contributing factors for why radio art lacks presence in many music textbooks (which discuss *musique concrète*).

1.2. Scope and aims

For the purposes of this article I will consider radio art as primarily a media-based art-form and use this as the scope for this investigation into spatialised broadcasting experiments. These experiments will be discussed from two perspectives: artistic works that explore the dissemination of radio waves (the 'spectrumscape') and the multichannel broadcasting/listening experience.

It must be noted that it is not within the scope of this article to explore the artistic practice associated with the transduction of the electro magnetosphere into sound – or what Douglas Kahn has called 'natural radio' (Blamey 2009: 44) – as exemplified by such artists

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as Joyce Hinterding and Alvin Lucier (*Whistlers* and *Sferics*), as these works essentially explore 'natural radio' reception and do not focus on man-made broadcasts (intentional/unintentional). Also, not all artists mentioned in this article identify themselves as radio-art practitioners, but arguably areas of their practice included in this article cross over into the field of radio art practice/theory.
This article aims to:

- assemble a list and to some degree categorise various experimental spatialised radio art works; and
- identify and acknowledge the vigor pertaining to the subject with a focus on radio art practice.

The scope of the article is not to collate a complete compilation of examples of work conducted in this field to date, but to serve as an introduction to this specialised area of practice. This article is a result of the assimilation of available literature chiefly in English that the author has been able to locate to date.

2. EXPOSITION

2.1. Radio as a spatial medium

With the advent of radio and its apparent ability to manifest sounds out of thin air, the medium raised questions to 'the possible limits of human technique and mastery over physical phenomena' (Fisk 1930a: 6). Ernst Fisk in 1930 also predicted 'an even more wonderful age ahead of us; we cannot exhaust the infinite' (Fisk 1930b: 7), and even speculated about the possibility of talking to the dead using the wireless (Fisk 1930c: 5).

The incongruities of audio displacement and dislocation made possible by the radio medium intrigued many people at the time. '[W]ithout distinction or discretion … [it] chucks [music] it into space or land where it has no business to be … into the most impossible places' Hermann Hesse wrote in his 1927 book *Der Steppenwolf* (Hesse 1963: 240). Again, Rudolf Arnheim echoes this sentiment in his 1936 book entitled *Radio*: 'the overlapping of frontiers, the conquest of spatial isolation' (Arnheim 1936: 13–14). Meanwhile, the Italian Futurists prophesied that technology could cancel out space and time, and this seems to be the underlying concept of Filippo Tommaso Marinetti's 1933 radio work *Dramma di distanze* [Drama of Distances]:

> 11 seconds of a military march in Rome
> 11 seconds of a tango dance in Santos
> 11 seconds of Japanese religious music played in Tokyo
> 11 seconds … (Concannon 1990: 167)

This fascination with audio displacement and dislocation (an inevitable fact associated with all audio technology) was later to be categorised by R. Murray Schafer as schizophonia, which he defines as 'the split between an original sound and its electracoustic transmission or reproduction' (Schafer 1994: 90). Further exploring this notion, he states:

> Originally all sounds were originals. They occurred at one time and in one place only. Sounds were then indissolubly tied to the mechanisms that produced them … Every sound was uncounterfeitable, unique. (Schafer 2004: 34)

Schafer coined the term schizophonia in 1969 and deliberately selected 'schizo' (meaning separation or split in Greek) with the intention that there would be connotations with the word schizophrenia. This was to illustrate the 'nervous' quality he wanted to evoke with the word schizophonia (Truax 2001: 134). Although Schafer implies an underlying psychological tension for listeners experiencing schizophonia, in today's world, as Barry Truax points out, listeners make 'sense' of the sonic juxtaposition because of 'conventional acceptance' (i.e. we expect sounds to emanate from speakers) (Truax 2001: 134). Further to this, Jonathan Sterne argues against the distinction between the 'original sound' and its audio reproduction by stressing the cultural nature inherent in listening and exposing the trappings of sonic essentialism. Sterne states that with schizophonia we:

> [a]ssume that sound-reproduction technologies can function as neutral conduits, as instruments rather than substantive parts of social relationships, and that sound-reproduction technologies are ontologically separate from a 'source' that exists prior to and outside its affiliation with technology. Attending to differences between 'sources' and 'copies' divert our attention from processes to products; technology vanishes, leaving its by-product a source and a sound that is separated from it. (Sterne 2003: 21)

While it is not within the scope of this article to debate the critique of the 'original' it is interesting Sterne states that 'reproduction does not really separate copies from originals but instead results in the creation of a distinctive form of originality' (Sterne 2003: 220). It is this notion of the 'distinctive form of originality' which I will also use Schafer's term schizophonia to describe.

When reflecting on the sonic qualities of radio, Schafer wrote: '[a] character in one of Borges' stories dreads mirrors because they multiply men. The same might be said of radios' (Schafer 2004: 35). By using this analogy Schafer is describing the multiplicity of the same simultaneous sound reproduction events dislocated across space that is inherent with wireless broadcasting. Schafer explains:

> Radio extended the outreach of sound to produce greatly expanded profiles [the area in which a sound can be heard], which were remarkable also because they

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> formed interrupted acoustic spaces. Never before had sound disappeared across space to reappear again at a distance. (Schafer 1994: 92)

The idea of schizophonia, the extended interrupted/dislocated acoustic space, the deconstruction of space and the freedom from 'spatial isolation' are themes that emerge time and time again.

2.1.1. Radio Art and Radio Space

Heidi Grundmann (at the time producer of *Kunstradio*, a programme dedicated to radio art on Austrian National Radio, ORF) has indicated that with *Kunstradio* in Austria 'an increasing number of artists, like [Bill] Fontana, consider their radio work as a sculpture, not in the sense of transmitting sound sculptures but rather a declination of [a] sculpture itself ' (Grundmann 1994: 137).

It must be noted that conceptual artists, according to Robert Adrian X, developed the idea of 'electronic space', which emerged from mail art (art which uses the postal system as a medium, which chiefly evolved between the 1950s and the 1990s). Adrian X states '[i]t was mail art, with its notion of a postal space [the integrated amorphous global postal service illuminated with art works in transit] … that made it possible in the first place to develop the idea of works of art in the electronic realm' (Adrian X, 1989: 145). Referring to his telecommunication networked projects Adrian X explains: '[j]ust the fact of turning the machines on and being present in the [electronic] space was the work. What happened with the work was inconsequential, and basically once the machines were off it was gone anyway … and these things referred into radio' (as quoted in Gilfilian 2008: 209).

In the 1990s, artists and conceptual artists such as Gottfried Bechtold and Lawrence Weiner, exploring the notion of 'electronic/digital space', developed the idea of the locations that received the transmission of their radio art (the interrupted/dislocated acoustic space) as a radio sculpture, and that these radio sculptures only existed while the work was being transmitted; further to this, they asserted that any audio recording of the work was only documentation of the radio sculpture (Grundmann n.d.). These and other artists made it possible, according to Grundmann, 'to consider the radio (broadcast) space as a public sculptural space in which music, sound and language are the material of sculptures' (Grundmann 1994: 137).

This idea is further exemplified by *Kunstradio*'s manifesto, entitled 'Toward a Definition of Radio Art' (which was formulated by Robert Adrian X). The manifesto includes: '[r]adio art is not sound art – nor is it music. Radio art is radio … Radio art is composed of sound objects experienced in radio space' and that 'radio space is all the places where radio is heard' (Kunstradio n.d.).

This conceptual notion of 'radio space' as a sonically dislocated/interrupted spatial installation and its creation of an ephemeral 'public sculptural space', is arguably the result of freeing radio art theory from the 'imposition of a borrowed musical discourse', as Lander has identified (Lander 1994: 13).

2.2. The spectrumscape and Hertzian space

Zita Joyce has argued that '[t]he presence of radio waves in a landscape could be described in a similar manner to the presence of sound, framed by R. Murray Schafer as a "soundscape" (1994), … ever-present but [as] invisible as the soundscape' (Joyce 2007: 83–93). This 'spectrumscape' contains all radio frequencies including extremely low frequencies (ELF, 3–30 Hz, directly audible when converted to sound [above ~20Hz], and used for submarine communication) to extremely high frequencies (EHF, 30–300GHz, microwave data links, radio astronomy, amateur radio, remote sensing, advanced weapons systems, advanced security scanning). Joyce considers that the 'concept of radio coverage suggests an idea of spatiality, an area in which particular waves may be received, the presence of a signal' (Joyce 2007: 84).

Anthony Dunne (Professor and Head of Interaction Design at the Royal College of Art) has explored the perceptual dissonance between the spatiality of electromagnetic 'Hertzian space' and the clear boundaries of visual space:

> all electronic objects are a form of radio. If our eyes could see (tune into) energy of a lower frequency these objects would not only appear different but their boundaries would extend much further into space, interpenetrating other objects considered discrete at the frequency of light … (Dunne 1999: 89)

Claiming that we live in an age where 'all space is electronic' (Dunne 1999: 104), Dunne conceived of 'Negative Radio', a space that is free from electromagnetic activity. Dunne's *Faraday Chair* made from glass covered with conductive inks provides 'a new place to dream, away from the constant bombardment of telecomunication and electronic radiation' (RCA n.d.).

2.2.1. Sounding out the spectrumscape spatially within a defined location and specified bandwidth

John Cage has previously discussed the perceptual differences between the now omnipresent man-made electromagnetic activity and listening. Cage states that 'all that radio is … is making available to your ears what was already in the air and available to your ears but you couldn't hear it. In other words, all it is

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making audible something that you are already in. You are bathed in radio waves … This radio simply makes audible something that you thought was inaudible' (Cage 1966).

With his 1951 work *Imaginary Landscape No. 4*, Cage did exactly that, when he made the radio waves within the AM frequency band (520kHz–1,610kHz) audible on 12 radio receivers spatially arranged in the performance space. Originally written as a musical work, the piece was performed by twenty-four operators: one on each radio to control the volume level, the other on each radio to control the frequency it was tuned to.

Although Cage wrote very precise instructions in the score about how the performers should set their radios and change them over time, the spatial arrangements of the radio receivers in the performance space seems to be left to chance.

Sonically this work usually produces a random (as it depends on what is being broadcast at the time), dense stratified texture where the listener is normally able to localise the sound source primarily by time difference cues between the ears (known as the interaural time difference or ITD), as well as amplitude and spectral cues (the sum of which is known as a head-related transfer function or HRTF). The level of reflectivity in the performance space can also significantly affect the listener's spatial perception. If by chance two radio receivers (which are located as to roughly form an equilateral triangle with the listener and which have sufficiently similar tonal characteristics and amplitude) are tuned to the same station then there would also be the possibility of creating a phantom centre image between the two speakers (Rumsey 2001: 21–55).

2.2.2. Sounding out the spectrumscape within a defined location and radio frequency

Microradio Sound Walk by free103point9 (featuring: 31 Down, Matt Bua and Radio Ruido), sounded out the spectrumscape within a defined location and radio frequency by utilising three micro-transmitters (broadcasting on a single FM frequency) installed along a walking path, where participants were invited to wear radio headphone receivers. As the participants 'move farther away from one station and grow closer to the next, the signal they receive will also shift. This sonic progression maps the spatial qualities of the [local] airwaves and provides a tangible example of their ubiquitousness' (free103point9 n.d.).

Each of the three microcasters thematically explored the sense of place and space from different perspectives. 31 Down retransmitted 'local frequencies' (profiling the spectrumscape) by scanning the local airways for radio stations, cell phones, wireless microphones, walkie-talkies, Bluetooth and WIFI signals. Matt Bua investigated 'environmental nature' by using 'contact microphones to wire the Hallwalls environment' (free103point9 n.d.). Radio Ruido considered 'social spaces' that focused on the 'physicality of the performance area, local histories, idiosyncratic voices, audience interaction/play, and storytelling' (free103point9 n.d.).

This abstract multi-perspective spatiality was overlaid upon the gallery space, virtually shutting out the innate soundscape of the space via the use of headphones. Was the intent of the artists to obliterate the gallery soundscape, in a similar sense to Peter Doyle's argument regarding concert music being played in a domestic environment? 'The spatiality of the concert hall was virtually overlaid upon the space of the home; in a sense it obliterated the domestic space' (Doyle 2005: 58). Or was the intent to enhance and augment the perceptual experience for the participants?

Although the participants experienced this work via headphones being broadcast from multiple stations on a single FM frequency, there is no mention in the documentation to whether the transmission was in mono or stereo. If the transmissions were in stereo then a further overlaying of spatiality upon the gallery space could have been achieved via binaural techniques.

Notably, artists at free103point9 prefer to call themselves 'transmission artists' rather than radio-art practitioners.

2.2.3. Binaurally sounding out the localised spectrumscape utilising mobile user interaction

Chrsitina Kubisch's *Electrical Walks* binaurally explore the man-made spectrumscape of cities via her custom-built powered stereo headphones. Kubisch's headphones are hand built by the artist with induction coils (one for [and located near] each ear) which respond to the electromagnetic waves and effectively allows us to hear and localise what Dunne calls the electromagnetic 'Hertzian space' surrounding all electronic objects (which he argues is a form of radio) (Dunne 1999: 89). Kubisch states:

> The perception of everyday reality changes when one listens to the electromagnetic fields; what is accustomed appears in a different context. Sound can transport you to different time areas, sound can transport you through your knowledge of space. Your brain is trying to get together what you hear and see in new ways. Nothing looks the way it sounds. And nothing sounds the way it looks. (Kubisch 2007)

As the user is allowed to move freely through the city spectrumscape, this is an interactive experience which gives the user the opportunity to explore the electromagnetic 'Hertzian space' boundaries of everyday objects such as automated teller machines,

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anti-theft security devices and neon advertising. Because electromagnetic energy travels at the speed of light, localising objects using ITD becomes impossible and listening become slightly disorienting because of the lack of time difference between the ears. Also HRTF is only partially effective for localising objects as the head virtually becomes 'sonically invisible' (i.e., the electromagnetic energy is not blocked by the head the same way that sound is) casting next to no acoustic shadows that are associated with spectral cues. Users are left to explore this 'alien' sonic transduction of the city spectrumscape primarily using amplitude cues between the ears to localise electromagnetic objects in a vacuum devoid of reverberant reflections.

2.2.4. Spatially sounding out human body interference in the spectrumscape within a defined location

Anna Friz states, 'I want to understand radiophonic subjectivity as imminent, partial, resonant, and embodied through an aggregate of body and electronics' (Friz 2008: 101).

Friz's installation work since 2005 has been a 'gradual process of introducing less rather than more stability into' the interactions of radio waves within the space (Friz 2009). Using anywhere from 12 to 75 FM receivers and multiple FM micro-transmitters, Friz creates a spatialised dynamic sonic (radio) static soundscape.

She encourages multipath and harmonic interference between the units by deliberately setting the transmitters to narrowcast on related frequencies. As a result of this technique the receivers emit twitters and oscillations of sound before the 'external sounds' are transmitted. Further to this, she explains that 'since FM operates on line-of-sight broadcast, audience members walking among the radios may interfere with the signal from the transmitter reaching the receiver, causing brief bursts of sound in one or a few of the receivers, and revealing the station or interfrequency static hidden underneath' (Friz 2009).

In addition to this, the volatility of the system is further affected by the construction of the building (in which the array is housed), the time of day and atmospheric conditions.

2.3. Radio art multichannel broadcasting works and listening environment

The following examples were broadcast to a national and/or international audience, as opposed to the two previous works which were narrowcast to a select audience at a specific site.

To contextualise the first two Australian examples I would like to draw on an article entitled 'A Brief Topology of Australian Sound Art and Experimental Broadcasting' by Andrew McLennan; he writes, '[o]ne quality that makes it typically Australian is its need to overcome the tyrannies of distance and isolation, and the impromptu nature of the solution to this problem. This sense of ''making do'' with the materials available still characterises much of the work of sound artists working in Australia today' (McLennan 1994: 303). This is also the paradigm used for the following Australian radiophonic works that dared to explore a heightened sense of audio spatiality.

2.3.1. Multi-mono/stereophonic national simulcast over two discrete AM networks

In 1969 David Ahern was employed by the Australian Broadcasting Commission (later to be re-named the Australian Broadcasting Corporation) to write a work that celebrated the bi-centennial of Captain James Cook's arrival in Australia. Ahern chose to base the radiophonic work on selected passages of Cook's journal and treated the recorded text with various signal processors in an extended live electronic improvisation. As Ahern conceived the work (which he appropriately entitled *Journal*) as a stereophonic experience, this notion presented a problem to the Australian Broadcasting Commission (ABC), who only had AM transmitters at that time. In fact, stereo FM broadcasting would not be introduced in Australia until 1975. Using the paradigm 'of ''making do'' with the materials available' the ABC transmitted *Journal* over two channels on separate AM networks simultaneously.

As it would have been very unlikely that a large percentage of the Australian population would have had two identical AM receivers at the time of transmission, the chances of the audience being able to create a phantom centre image between the speakers would be arguably very slender. Perhaps the *Journal* broadcast is closer to a synchronous multi-mono acoustic media-arts experiment than a stereophonic broadcast? It is hard to imagine the range of bizarre receiver/speaker arrangements that would have been set up across Australia in the various locations and homes. With so many factors to take into consideration, these multiple components of 'radio space' created by this work (as defined by the *Kunstradio*'s manifesto: Kunstradio n.d.) could have ranged from the intended stereophonic setups to spatially pluralistic sound sources, interfacing from various rooms with diverse tonal characteristics. Multiple receivers could also have been tuned to the same AM station to further complicate the listening experience. Perhaps it is more likely that most of the audience listened to the work in incomplete mono, by listening to only one of the AM networks.

Although Ahern's work was before the *Kunstradio* manifesto, Ahern may have shared the same ideology

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when it comes to his radio work. Perhaps he would have agreed that the '[s]ound quality is secondary to conceptual originality … [r]adio is almost always heard combined with other sounds – domestic, traffic, tv, phone calls, playing children etc. [and] [t]he radio artist knows that there is no way to control the experience of a radio work' (Kunstradio n.d.).

2.3.2. Multi-mono/quadrophonic simulcast discretely over one stereo FM network and two mono AM networks

Chris Mann in 1986, again utilising the paradigm 'of "making do" with the materials available' created a work known as the 'Quadrophonic Cocktail'. This time instead of producing a stereophonic work on two AM mono networks, Mann produced a quadrophonic work that was transmitted discretely across one stereo FM network and two AM networks (ABC Fine Music [FM], ABC Metropolitan [AM], and ABC National [AM]). To listen to the full quadrophonic realisation of the work, the audience needed one stereo FM receiver (with two speakers [one for left and one for right]) and two AM receivers (each with one speaker), ideally arranging the four speakers evenly into each corner of a square-shaped room (i.e. one for each corner). Further to this, to experience the full effect of the quadrophonic listening environment, each speaker would need to be set to the same level and the audience would preferably position themselves at the optimum listening position located at the centre of the room.

'Quadrophonic Cocktail' was a specially developed Australia Day celebration broadcast, and sliced together seventeenth- and eighteenth-century texts that alluded to the existence of an undiscovered southern continent (Jonathan Swift's *Gulliver's Travels*, Daniel Defoe's *Robinson Crusoe* and Richard Broome's *The Antipodes*). These three texts were deftly combined with William Dampier's accounts of charting the West Australian coast, and, as McLennan writes, '[t]he audience was invited to "mix your own audio adventure" ' (McLennan 1994: 311).

McLennan's quote indicates that Mann was aware of the lack of control he would have had over all the multiple components of 'radio space' and freely gave the control over to the listener. Of course, the work faced similar audio challenges and conditions to those of Ahern's *Journal*, but this time with an extended frequency range (due to the increased fidelity of the FM broadcast) and with four discrete sound sources.

2.3.3. Broadcasting radio art in 5.1 surround-sound

In September 2004, *Kunstradio*, Österreich 1, the cultural channel of Österreichischen Rundfunks (ORF) in Vienna, Austria transmitted the very first 5.1 surround-sound live-project, entitled *RE-INVENTING RADIO – THE LONG NIGHT OF RADIO-ART*. This project utilised the WorldNet SkyLink system. The *LINE UP*, '5.1 Radio in Europe', article states:

> WorldNet SkyLink [was] designed primarily for the transfer of eight discrete channels of audio (5.1 and a Lt/Rt stereo downmix) over an IP network. This product was originally developed for George Lucas' team at the SkyWalker Ranch in Northern California to enable film directors to approve surround sound mixes from a remote location. Groundbreaking in many ways, the WorldNet SkyLink offered accurate channel phase alignment, the ability to slave to timecode, and either real time transfer using UTP or Store 'n' Forward techniques, plus the use of heavy encryption for secure applications. (Institute of Broadcast Sound 2007: 20)

Table 1. *RE-INVENTING RADIO – THE LONG NIGHT OF RADIO-ART* network

On site:	Vienna, Radiokulturhaus Linz, Ars Electronica Center, SKY Media Loft
On line:	Live Audiostreams, Webcams, Chat Live Streams from Vienna, Linz, Baltimore, Berlin, Hamburg, Kingston, Ont., London, Mexico City, Montréal, New York City, Tokio [sic], Vancouver, Weimar e.a.
On Air:	Live on Österreich 1 (FM, Short Wave, 5.1 via satellite ASTRA). 7: 30 p.m. – 6:00 a.m. CEST (GMT+2)

Conceived by Heidi Grundmann and Elisabeth Zimmermann, *RE-INVENTING RADIO – THE LONG NIGHT OF RADIO-ART* (Kunstradio 2004b) was a live *Kunstradio* event that lasted for more than ten hours and was 'produced collaboratively by artists working in a network of geographically remote nodes (see Table 1)' (Kunstradio 2004c).

The WorldNet SkyLink system was used to connect the Ars Electronica Center venue in Linz to the broadcast centre in Vienna via 3Mbit/s ADSL IP circuits provided by Austria Telecom. The programme from Österreich 1 was then decoded and recoded to the Dolby AC3 format at the Satellite Uplink site for transmission over the Astra satellite. Audience members with a satellite receiver and a 5.1 cinema setup were able to tune into the ASTRA 1 H Satellite, Transponder 117 and scan for a channel called 'OE1 DD'. The audio was delivered to their home cinemas sound systems in 5.1 Dolby Digital format from the multiple sites (the 'Radio Concert Music Hall' in Vienna, 'Ars Electronica Center' in Linz and the 'Sky Medialoft' site) (Petermichl 2004).

2.3.4. Surround-sound 'radio space' listening environments

With the advent of surround-sound radio broadcasting the range of listening environments (which

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constitute the components of 'radio space') have greatly expanded and diversified. It is typical for 5.1 broadcasts to include a stereo mixdown of the same transmission, therefore the diversity of listening environments range from LoFi mono receivers in domestic locations, to HiFi discrete multi-channel environments.

Using HD Radio technology, AM and FM radio stations are able to simulcast within the same channel both digital and analogue audio. The increasing presence of this hybridised digital–analogue signal has sparked a growing trend to integrate surround radio systems into cars; this is exemplified by Lexicon's release of its discrete-surround audio system for the 2009 Hyundai Genesis (Bitstream 2008).

The surround-sound setups for cars hardly conform to the ITU-R BS.775 (ITU 1993) standard when it comes to the optimum listening position (reference listening point), which would perhaps be somewhere between the two front seats or on the hand brake! Of course, we would have to first be able to arrange the speakers successfully on the circumference of an imaginary circle (or employ time delays between the speakers), and apply appropriate angles for a 5.1 speaker installation.

Once again, *Kunstradio*'s manifesto, which includes '[s]ound quality is secondary to conceptual originality … [r]adio is almost always heard combined with other sounds – domestic, traffic, tv, phone calls, playing children etc. [and] [t]he radio artist knows that there is no way to control the experience of a radio work' (Kunstradio n.d.), would be useful for the radio artist.

Perhaps, like Ahern's *Journal* (1969) broadcast, 5.1 radio art broadcasts, with their multitude of various speaker configurations (for each component of 'radio space') are arguably closer to a synchronous multi-mono acoustic media arts work than an ITU-R BS.775 (ITU 1993) broadcast with an optimum listening position. If we start to think of these components of 'radio space' as a multi-mono acoustic media-arts work (and as an element of a larger sound sculpture), then the radio artist needs to consider how this space sonically impacts the audience as they approach and traverse its potentially immersive environment. It can't be assumed that the audience will be listening from the optimum listening position, and instead of seeing this as a weakness maybe this is an opportunity for the radio artist to explore creative uses for the 5.1 broadcast. Considering Stockhausen's *YLEM* (1972), where during the concert 'all 19 players walk off the stage and out of the building, while continuing to play' (Stockhausen 1974) and its resulting spatial extension of the concert hall space, then radio art works could also be thematically developed to interface with, extend and/or challenge our notion of the perimeter for each component of 'radio space'.

2.4. Spatiality and a decentralised broadcasting network

Utilising a decentralised network of about 20 radio organisations (EBU Ars Acustica group), several independent radio stations, artists, artists groups and seven interservers on three continents together challenged the broadcast paradigm with their 1995 networked project entitled *Horizontal Radio*. This vast collective challenged the paradigm by allowing each node over a 24-hour period, as Heidi Grundmann states, to 'participate according to the means they had, according to the art notions they had, according to whatever they wanted to do' (quoted in Bosma 1997). Unlike a syndicated network of stations broadcasting the same material simultaneously (the usual 'vertical' network structure), '[p]articipants at each node … curate[d] their own contribution and the specific on site and/or on air renderings' (Grundmann 2007: 209), which were then in turn fed back into the network. With this type of network and artistic treatment, no two nodes experienced the same collision and/or mix of sound elements.

Utilising this approach, the radio broadcast effectively becomes deconstructed and Schafer's notion of radio that creates 'greatly expanded profiles [the area in which a sound can be heard], … because they formed interrupted acoustic spaces' is complicated by the fact that each node contains a different mix of sound elements from the network. How can we qualify this expanded acoustic profile if it is not essentially the same sound? Perhaps in this case the notion of spatiality relies on the concept of considering 'the radio (broadcast) space as a public sculptural space in which music, sound and language are the material of sculptures' (Grundmann 1994: 137)? But do the sum of the components of 'radio space' with this work create one 'public sculptural space' (perhaps from multiple perspectives) or are many different 'public sculptural spaces' created, which are simply linked and/or related via sound elements from the network? But as each node can choose to do 'whatever they wanted to do' then they could choose not to use any of the material from the network and therefore the framework of the networks could simply be conceptual. So would a conceptual network constitute a link between the 'nodes' to create a 'public sculptural space', a spatial broadcast?

Perhaps Roger Corman's 1959 cult movie *Bucket of Blood* can help answer the question with a quote from beat poet Maxwell H. Brock: 'a sound is a sound unless it's music, a stone is a stone or a sculpture' which seems to imply artistic intent as the distinguishing feature (i.e., if the artist calls it art), as is the case with Marcel Duchamp's 'readymades'

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(in which the simple fact of choosing an ordinary object, placing it, signing it and giving the object a title, makes the object become art, as with a urinal which he entitled *Fountain* in 1917). If we can agree that artistic intent can constitute an art work, it follows that the concept of a 'public sculptural space' with *Horizontal Radio* can allow us to extend the radio-art notion of spatiality to include 'conceptual spatiality', which perhaps we could call 'conspatial broadcasting'.

3. CONCLUSION

While this article is a response to Weiss and Kahn's identified lack of literature pertaining to radio art, this preliminary taxonomy of spatialised broadcasting experiments only offers a glimpse into the range of activities in this creative field. The reviewed examples were investigated primarily from two perspectives: artistic works that explore the dissemination of radio waves (the 'spectrumscape') and the multichannel broadcasting/listening experience. Further to this these perspectives have been broken down into a range of suggested initial categories. It is clear from this article that this topic calls for further research and documentation to gain a more in-depth knowledge of activities conducted in this field. Research in the field of artists exploring the transduction of the electromagnetosphere into sound ('natural radio'), the current developments of internet/digital radio art practices, or relevant mobile/smart phone applications would also be highly valuable to gain a more holistic body of knowledge on this subject.

As there is mounting data to indicate that radio art developed sound-based works some 20 years before *musique concrète* (e.g. Flesch and Bodenstedt's *Die Straße* and *Hamburger Hafen*) and extends into music practice, then this raises issues as to its significance to the development of *musique concrète* and also its significance to musicologists and further research.

The seemingly amorphous boundaries of radio art and the examples presented in this article demonstrate how radio art can be linked across several disciplines via the commonality that radio art is art made for/created from the radio medium by artists. Radio art is an interdisciplinary field of practice and this is an ongoing major factor that impedes radio art from gaining wider recognition. For example, even as with this article the topic of spatialisation may have been of interest to composers and sound artists, but these groups may have had far less of an interest in radio or radio art?

Arguably radio art is closer to a media based artform than a sub-genre of music, but, as stated earlier, radio art can and does pluralistically span both media art and music, which perhaps contributes to radio art's resistance to a clear classification. Even with its problematic classification, radio art is a dynamic art form with existing and evolving theories and practices grounded in a rich history and thus may currently be under-recognised as a fertile field of study within universities globally.

With evolving broadcast technologies, radio art's sound stage and networking possibilities have been further expanded with only budgets, lack of facilities and opportunities to frustrate its development and the creative output from radio-art practitioners. Interestingly, the notion of 'conceptual spatiality' and 'conspatial broadcasting' further complicates the broadcasting paradigm and blurs the amorphous boundaries for this practice.

This article is an introduction (and is by no means an inclusive study) to this specialised area of spatialised broadcasting experiments (with a focus on radio art practices). The article has discussed the historical background related to this subject and explored examples that identify and acknowledge its vigor. While this is by no means an extensive study, it does clearly call for further in-depth investigation into the creatively vibrant topic of radio art.

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