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Making the Inaudible Audible: Strategies and Disagreements

The study of environmental sound highlights the limitations of human perception. Sonification and audification predominantly use scientific methods that favor transformation of sound to the sweet spot in the middle of our hearing range. This approach overlooks the different perceptual effects of high and low, loud and soft, fast and slow sounds. It is my contention that in our interpretation of how to make inaudible sound audible, we must consider the strengths and limits of human hearing and listening.

The work of acoustic ecology focuses on listening to emphasise an awareness of the overall soundscape (Schafer 1977). This is usually limited to areas where it directly affects human presence, and it is largely because underwater and ultrasonic are inaudible to us that we are unaware of the impact of anthropogenic over biotic and abiotic sounds. Acoustic levels underwater are unregulated, and given that sound is essential to marine life, the impact of additional sounds is having considerable consequences. (Stocker 2002, Slabbekoorn 2010)

Sounds can be inaudible or unperceivable to us in different ways. The basic parameters are sounds that lie out of our frequency range (above 20,000 hz and below 20 hz), beyond our amplitude sensitivity (either too quiet or loud), and of a time frame that may be imperceptible to us (too fast or slow). To compare the scientific to musical terminologies: frequency/pitch, amplitude/volume, and time/rhythm or form. In what ways can these sounds be folded into our relatively narrow perceptual bandwidth?

Scientists and composers, limited to discipline-specific methodologies, are driven by different motivations and priorities in the analysis and use of sound. As a result approaches to making the inaudible audible generally fall into two camps of analytically strict systems or more intuitive translations. Can

scientists, musicians and artists learn from each other in this relatively new area? To what extent do we question the “ostensible neutrality of these listening technologies” (Kahn 1999; 200), given that listening is both personal and contextual? (LaBelle 2007) When making the inaudible audible, what happens if we consider not simply what we hear, but how we listen?

I identify two distinct but overlapping approaches to making the inaudible audible: audification by scaling existing vibratory signals into human hearing range; and sonification of data by translation and mapping onto a choice of sounds. Audification uses the existing signal as its basis, while sonification requires compositional strategies of mapping data (non-vibratory information) onto sounds. Another common strategy is visualisation where sound is represented graphically depicting the parameters of frequency and amplitude over time. The analysis of humpback whale sounds (Payne and McVay 1971) demanded visualising the sound waves to reveal recognisable patterns, now called ‘songs’, which are too slow to recognise by ear.

Alvin Lucier’s work can be said to be making the inaudible audible or at times visual in space (Lucier 1995; 152). In “Music for Solo Performer: for enormously amplified brain waves and percussion” (1965) EEG electrodes on the performer’s head translate alpha waves into electrical signals which are amplified, but not frequency shifted, so they remain below our hearing range at between 8 to 12 hertz. These are made audible by using the loudspeakers to physically activate percussion instruments placed throughout the space. This early piece combines audification of existing signals and sonification of those signals into sounds.

In “Listening To What I Cannot Hear” (2009), composer David Dunn lowers the overall frequency of ultrasonic recordings of bats and household appliances, to make us audibly aware of sounds we create but cannot usually hear. Dunn and scientist Crutchfield’s groundbreaking environmental work highlights sound as the key to a series of feedback loops relating climate change to drought stressed trees to bark beetle infestation. By placing Dunn’s custom-made microphones in infested trees and amplifying the results, this example of audification has advanced scientific research. (Dunn and Crutchfield 2009)

Even when we can hear sound, it does not mean that we can understand it. Music offers profound insights into listening and making sense of previously inaudible sound. Underwater bio-acoustic scientist Michel Andre called on Senegalese drum master Arona N’Daye Rose to help interpret possible rhythmic structures in sperm whale echo-location clicks. From the apparent cacophony, Rose rapidly deduced the number of whales in the group, a conclusion that took the scientific team six months to determine. (Andre and Kamminga 2000)

Sonification needs to take into account our physical abilities, including how clearly and quickly we can perceive changes and patterns. In *Sun Run Sun* I explored the sonification of live GPS navigation data, listening to the satellites moving in and out of focus overhead while walking through the environment. In a continuation of Lucier and Dunn’s work, this sonification provokes

an aesthetic rather than practical response. When there is no change in data, 'silent spots' emerge, and this draws ones attention back to the immediate environment (Dekker 2009). These projects illustrate that the choice of sounds we use in sonification, and the choice of scaling factor in audification, will inevitably affect what we hear and ultimately how we interpret it.

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