ARTISTS AND SCIENTISTS WORKING

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1 INTRODUCTION

This paper relates to the experiences of a visual artist and acoustician working together in the field of public engagement. Public engagement is playing an increasingly important role in the work of both artists and scientists, especially those engaged in research and indeed many grant awarding bodies now see this as an essential element of any research programme. Our experiences mainly relate to two public engagement exhibitions SOUND and COAST, funded by EPSRC as part of their public engagement programme and on which we have both had a major involvement.

The title of this paper may in itself be contradictory as it is only in relatively recent years that the more traditional field of scholarship has been separated into discrete art and science compartments into which scholars have been segregated. University departments such as Natural Philosophy have been changed into Physics departments (Edinburgh University did this in the early 1970's) and the breadth of disciplines covered has been narrowed. Similarly schools of art have been sectioned into fine art, design and architecture. Scholars in early times usually took a wider perspective. The ancient Greek scholar Pythagoras (560-480 BC) for example related the "golden section" (the ratio of the slant height to the distance from the centre to the edge in a pyramid) to the proportions of the human figure. More directly in the field of acoustics he studied which notes sounded pleasantly together using what we now call a monochord and worked out the frequency ratios of the string lengths, thus discovering the principles of harmonics and what later led on to Fourier analysis. Leonardo Da Vinci (Italy 1452 – 1519) is probably the most notable example or a rounded scholar. In modern terms we would probably have to classify him as a combination of artist, scientist and engineer.

Although universities have gone down the route of separating academics and students into narrow compartments, in fact this is not really imbedded into their charters. At Edinburgh University for example the stated mission is to "provide an outstanding education environment, supporting study across a broad range of academic disciplines and serving the major professions" and "Enhance the scientific and cultural vision of society as well as its economic well being". In educating science students it is becoming increasingly accepted that the creative element is important, in addition to problem solving. An example here are the group projects which have recently been introduced into the fourth year physics course at The University of Edinburgh. In one of these the students opted to perform Michael Frayn's play "Copenhagen" which represents a fictional account of a mysterious meeting which took place in 1941 between two of the greatest physicists of the 20th century, the German Werner Heisenberg and the Dane Niels Bohr. This year one group is studying noise in the environment and its impact on the community.

2 SIMILARITIES BETWEEN SONIC AND VISUAL IMAGERY

Flicking through the pages of "The Musicians Guide to Acoustics" [1] and other books on acoustics one can not help but notice the similarities between sound and vision and these are frequently used as a vehicle for integrating projects which have an artistic element. There are also fundamental differences of course which are equally important.

The most obvious similarity is that both sound and light can be represented as waves with a given spectral distribution of frequencies and wavelengths. The term "rainbow of sound" conjures up a

visual picture of how sound frequencies are distributed over the spectrum. Also the spectrogram is often used to give a moving picture of the changing sound spectrum. This has been used on a number of occasions in the SOUND exhibition as an interactive exhibit. Audible sound waves have a very broad range of frequencies i.e. 20 Hz to 20 kHz, almost 10 octaves, whereas visible light waves only cover a range of approximately 4 to 7 . 10^{-14} Hz, a factor of less that two (an octave) between the lowest and the highest. One of the audience at our recent café scientifique presentation in Stockport asked what would happen if the visible spectrum was equally as wide as the sound spectrum; would we then generate visible harmonics?

Another interesting analogy is in the way in which we construct images in three dimensions. Human beings have two eyes and two ears separated by not too different amounts in the horizontal plane. Slight differences in the images formed by the two eyes give us stereoscopic vision and allow us to estimate the distance of different objects in our visual landscape. In a similar way, if we close our eyes we hear the direction from which different sounds are coming e.g. whether someone speaking to us is to our left or right hand side. We can't take the analogy too far though because our ears use quite different mechanisms from our eyes to estimate distance. This was discovered by Lord Rayleigh (1842 – 1919) who produced his Duplex theory to show how the brain used both time difference and sound level differences to obtain direction clues. More recent studies, using for example Head Related Transfer Functions, have extended Rayleigh's early ideas to give us a very full understanding of how the brain interprets the sonic landscape. Auditory spatial awareness has been the subject of many recent texts e.g. "Space speaks, are you listening" [2].

If we look further into the question we find that there are many more analogies between sound and vision. For example the question of how sounds are masked by others of different frequency is quite closely related to the visual counterpart of different colours being in close proximity. Even the quantum nature of light has an analogy in very low pressure acoustics.

3 SOUND EXHIBITION

Increased levels of sound in the environment seem to be one of the inevitable consequences of technological advance and change our milieu in diverse ways. The problem is particularly pertinent in large industrial cities and is seen as a major problem for the emerging economies of the east which are undergoing such rapid industrial development. SOUND is an exhibition of two-dimensional art works and installations inspired by some of the often conflicting issues that arise and the research that is going on to try to combat them. To give but one example, renewable energy sources are seen as a way of reducing carbon emissions into the atmosphere but opponents to wind turbines cite the noise they produce as being a problem and often oppose the construction of wind farms on these grounds. More generally though the exhibition seeks to question the barriers sometimes set up to delineate art from science.

The first thing to say about the contents of the exhibition is that it is continually evolving but in essence it is made up of a number of paintings set in a soundscape.. It opened in a fairly small way in the Scottish Parliament in 2006 and was expanded to show at the larger Dynamic Earth venue in Edinburgh. From there it went the Glasgow Science Centre, the London Metropolitan University, the Centre for Contemporary Arts in Glasgow and the Waterfront Gallery in Belfast (under the name LOUDER NOW). The wide range of venues reflects the fact that we want to display in public spaces where the material will be seen by a broad cross section of the general public.

The soundscapes for the exhibition are in the form of what might be termed "musique concrete" i.e a type of sound collage made up of sound files recorded from the real world and sometimes manipulated acoustically. Examples of recorded sounds are traffic noise, aeroplanes, underground trains, motorcycles and factories. Generally speaking we have recorded these monophonically and used either the Protools of Cubase editing programs to generate surround sound in something resembling 5.1 configuration. In a few cases the constraints of the venue have meant that we have

had to work in stereo and on one occasion letting the visitors hear the sounds through earphones.

Fig 1 Paintings from the Waterfront exhibition in Belfast.

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4 COAST EXHIBITION

The COAST exhibition has been running for longer that SOUND and relates to the problems of pollution and erosion around the Scottish coastline. For the last year it has been showing in Denmark, at the Natural History Museum in Aarhus, the North Sea Centre in Hirtshals and Denmark's Aquarium in Copenhagen. Before that it showed at a number of venues in the UK and also at the National Bank Cultural Centre Thessaloniki and the Goulandris Centre in Athens. Like the SOUND exhibition it has attracted very large numbers of visitors.

The introduction of a soundscape into the COAST exhibition is a relatively recent innovation. On the grounds that the coastal environment is important for wildlife in the sea as well as well as humans, a number of the component sounds were recorded underwater with a hydrophone. An example is the sound from a rising bubble under water, shown in Fig. 2. Small bubbles in water have a natural frequency of vibration which give rise to pitched sounds with frequency dependent on bubble size. Fish sounds were obtained by courtesy of the Marine Laboratories in Aberdeen.
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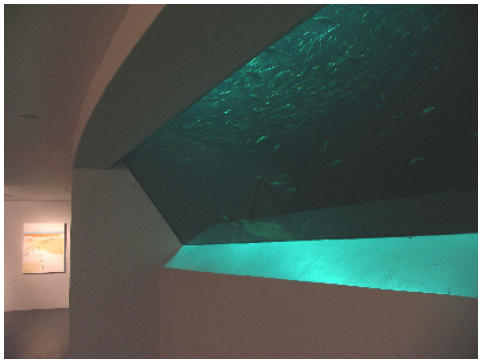
The first venue where a soundscape was tried was the North Sea Centre in Hirtshals in northern Denmark. Here the gallery is in the basement and the walls on one side are actually the glass walls at the bottom of their large aquarium; one of the largest in Europe. The paintings were displayed on the other walls and illuminated so that they showed up in the rather dim light. Entering into the gallery down a staircase gave a very atmospheric effect and highlighted the relationship between the environments above and below the waves. Some idea of this is given by the pictures in Fig 2.



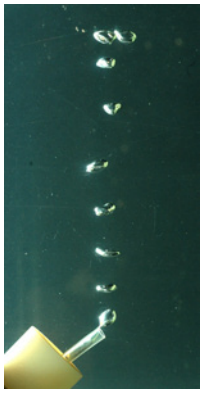


Fig 2 Left: the underground gallery
Right: a sequence of rising bubbles in water used in the soundscape

5 SYNERGY

Working as an artist and scientist together has been an opportunity to create exhibitions that are distinctive and engaging for the general public. From the point of view of the artist, scientific and technological innovations offer new possibilities for artistic expression whilst for the scientist the artistic element opens up a whole new arena for exploration. A feature of the two exhibitions discussed here is that they are both concerned with the environment where there are conflicting views relating to health, preservation, economics and visual beauty. Some of these are more relevant to the scientist and others to the artist but working in combination the two can create synergy.

6 FUTURE IDEAS AND VENUES

The fact that the exhibitions are continually evolving is crucial to their continued existence. At each showing of an exhibition it is important for the artist to come up with new ideas in order to maintain the interest of the visitors and the press as well as the creators.

The next showing of SOUND will be at the national Physical Laboratory in Teddington where paintings will be displayed in their anechoic and reverberation rooms together with soundscapes. In order to test out the idea a pilot exhibition was set up in the School of Physics at Edinburgh University and shown to an invited audience. Visitors to the exhibition first entered the reverberation room, shown in Fig 3. Here the soundscape was made up of a more-or-less continuous sequence of sounds which came at you from all directions. A single painting surrounded the whole room so the visitor was entirely surrounded by sounds and visual images. From the reverberation room you went directly into the anechoic room where the sound level was contrastingly low. The soundscape here was made up from discrete and widely separated sounds which appeared to come from prescribed directions, in between the sections of complete silence. Here small paintings were spaced at intervals round the room. Visitors found the experience quite dramatic and in some cases disturbing.

One other venue where the exhibition has shown recently was in the Floating Gallery at the Falkirk Wheel. The Falkirk Wheel is a major feat of modern engineering and attracts huge numbers of visitors. The Floating Gallery is in effect a barge moored near the entrance to the wheel. This gave the opportunity to further explore the use of a single surround image (Figure 3).

3 Left: the reverberation room
Right: the Floating Gallery at the Falkirk Wheel.

7 REFERENCES

1. Murray Campbell and Clive Greated “The Musician’s Guide to Acoustics” Dent 1987
2. Barry Blesser and Lida-Ruth Salter “Space speaks, are you listening” MIT Press 2007