

Aural feedback, Vocal technique, and Creativity

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Introduction

This research contributes to an ongoing investigation into the instinctive nature of singing. Related projects involve: action research with children who are encouraged to reflect on the developing capacities of their own and each others' voices; experimental research with adults and children designed to illuminate parallels between singing ability and other aspects of extended oracy (modes of controlled whistling; tongue-clicks); trialling of pedagogical strategies for developing intuitive vocal responses and 'musical thinking'; and a wide-ranging literature review drawing on research in animal behaviour, human evolution, communication theory and cognitive psychology.

Aims of the project

While this project builds on extensive use over some ten years of digital echo-delay in composing and music teaching (Bannan and Pimley 1989) its current focus arose out of the development of a Children's Choir as a research laboratory at the University of Reading. Composing and the devising of musical games were already regular activities of the Children's Choir from its formation in Autumn 1994. The sessions incorporating the Acoustic Mirror took place during March 1997 and allowed observation and subsequent analysis of videoed sessions. The aims were to evaluate the effect of the employment of the Acoustic Mirror on the children's listening, creative responses, attention and enjoyment of sessions; and to arrive at preliminary conclusions which would give rise to more focused research questions which could be investigated experimentally.

The background to the project

Using the Acoustic Mirror is like working with a controllable echo which the user can set at any duration from the barely discernible 0.125 of a second to 32 seconds. Equipment of this kind is commonly available in broadcasting and film studios for the generation of sound effects, and represents the digital continuation of studio techniques formerly carried out using loops of tape on reel-to-reel recorders: a history recalled by the use of the term 'loop' for a section of recycled recording. In using the Acoustic Mirror with child and adult singers, the intention was not to place

them in a *hi-tech*, scientific environment remote from their previous experience, but rather to elicit responses which are as old as humanity itself. As the video film of musical behaviour made with a student in the arches of Brunel's railway bridge over the River Thames at Maidenhead shows, you do not need digital technology to encounter echo and reverberation. In the parabolic arch of the span which crosses the river, sharp sounds (clapping and staccato singing) can be heard repeating several times, decaying rapidly from a strong initial echo. In the adjoining 'Saxon' arch of the span created for the canal horses to pass, a reverberation time of some 6 seconds encourages the singing of legato lines which coalesce into harmony. The assumption was made throughout the trialling and experimentation with the Acoustic Mirror that the heightened listening and creative responses it elicited owed more to this atavistic feature of response to an acoustic environment than they did to its attractiveness as a modern technology.

If one approaches the phenomenon of singing from an evolutionary perspective, the aural, respiratory and productive potential for vocal communication represent adaptations to the environment which have promoted the survival of the human species. In this respect, human responses to acoustic properties constitute a field ripe for research: buildings, resonators, masks and megaphones have all been developed over the centuries and in widespread cultures to increase the carrying power and presence of the voice. But to explain the effect on an individual performer of this form of acoustic empowerment is not straightforward. One hypothesis would be that such responses are locked into the early stages whereby oral communication developed in the human species. In Hockett's influential analysis (1960) of animal communication, two of his 13 design features stand out as of evolutionary significance for singing: the 'rapid fading' of signalling in the auditory domain compared to that by visual or olfactory signs; and the capacity for 'displacement', shared with dancing bees, to refer to objects absent in either space or time. In Hockett's explanation of the selective advantage of 'rapid fading', we have perhaps a clue to one of the purposes of music - the celebration of survival. For once the social benefits and capacity to inform conferred by communication outweighed the likelihood that a predator would locate its human dinner through intercepting vocal signals, the opportunity existed for the safe, if still bold and reckless, exercise of vocalisation. Such security would be afforded by caves and dwellings whose acoustic properties literally amplified response to them. Zahavi's 'handicap theory' (in Diamond, 1991) would explain human vocalisation as a kind of necessary bravado: a display which might otherwise involve cost becomes beneficial when it is read by a potential predator as an honest claim of superiority. Working with the Acoustic Mirror suggests that subjects relish transcending the transitory nature of normal auditory communication. Users leave their mark in an oral "Kilroy was here". The equipment confers an experience which would otherwise require seeking out acoustic spaces in which echo and reverberation can be obtained. This 'anthropological hypothesis' further suggests that working with the Acoustic Mirror might illustrate how performers develop social representations of these environmental effects into the structure of their music-making: how, say, harmony and counterpoint might have evolved.

The development of resonant singing and speaking could itself be seen as an internalisation of these properties of acoustic extension. The child with a 'natural voice' hits upon through experiment or mimicry the most efficient use of his or her vocal organ. If the acquisition of oracy is instinctive and universal, why do only some individuals achieve this? If one sees the environmental and social conditions in

which oracy develops as providing an 'innate releasing mechanism' (Tinbergen 1951) whereby vocal performance is elicited in some individuals but inhibited in others, it may be possible to account for their different rates and qualities of vocal development and propose pedagogical strategies which develop the potential for singing of all. The 'anthropological hypothesis' may explain why some individuals will report only feeling confident to sing in groups, while others admit only to singing when at their most solitary and 'secure' in the lavatory or bathroom. In observing subjects' use of the Acoustic Mirror, one can consider how the experience helps them trust their instinctive vocal responses in a manner which transcends inhibition through providing an enhanced and supportive feedback of their own vocal output. There is a superficial similarity in this to the experience of *karaoke*. But the differences otherwise could not be more marked. Where *karaoke* makes users the slave of existing musical material and role-models (Walker 1994), experience of the Acoustic Mirror provides potent means of unlocking the user's own creativity, and does so through aural representation of the user's own recognisable voice. The 'feedback loop' does not involve loss of self, but a supportive promotion of aural self-image.

Musical analysis of the content of user's individual and group responses to the Acoustic Mirror suggests the presence of archetypes evident in our capacity for creative productivity. The periodicity of the digital echo certainly provides structural coherence in which such techniques as *call* and *response*, *hocket* and *canon* are freely re-invented. Grainger's theories of musical archetypes explored in *Blacking* (1987), examined alongside Hockett's design-features for communication and the research of Scherer (1992) into common acoustic features of animals' sound-making responses to emotional states, illuminate the possibility that significant characteristics of musical generation, varied as they are between and within cultures, parallel aural/oral phenomena which arise from acoustic experience. Such a view finds support in recent analysis of the aesthetics and technical means of digital composition. (Wishart, 1994). Similarly, the surviving importance of animal mimicry in the song literature of widespread cultures offers clues to the means by which the vocal capacities of individuals and societies may have developed.

Developments in linguistic psychology have proposed the creative nature of voice acquisition (Locke 1993; Pinker 1994). While it has long been common to refer metaphorically to the 'voice' of a particular composer, the analogy is usefully reversed if we consider the acquisition of a voice as a compositional process. Research needs to be initiated in this field: work with the Acoustic Mirror at least requires that users compose in order to develop their voices.

An important feature of recent approaches to language acquisition is the assumption of originality of personal language use. What Locke (1996) refers to as 'generativity' defines the capacity conferred on users of a linguistic system for the construction of unique and original utterances. Music educators (Paynter & Aston 1970, Wishart 1979) long ago drew attention to the potential for the same originality in singing, as well as the implications for classroom vocal development associated with such a view. However, widespread pedagogical acceptance of a child-centred, creative approach to singing development encounters traditional Western practice inhibited by social constraints and the weight of a tradition of conformist community singing. By contrast, spontaneous and original participation in group singing is common in the practice of African and Polynesian societies where such conformity is not required and individuality of contribution to performance is valued (Blacking

1987, Campbell 1991). Using the Acoustic Mirror can elicit coherent vocal behaviour in a similar manner.

Methodology

Sessions using the Acoustic Mirror were carried out with members of a children's choir. Observations of subjects' behaviour and responses were made at an initial, unrecorded session. Three subsequent sessions were recorded on video. These were subsequently analysed with respect to:

- changes in subject behaviour when using the Acoustic Mirror compared to recorded examples of standard choir sessions
- the musical responses of subjects in group tasks
- the musical responses of subjects in individual tasks
- the musical responses of subjects in individual tasks which led to group performance
- what subjects' musical responses demonstrate about their listening

The Equipment

The Acoustic Mirror system comprises a Lexicon JamMan digital sampling echo/delay unit accessed through a mixer with two (of up to six available) microphone inputs and two speaker outputs. Digital sampling amounts to tapeless recording: up to 32 seconds' duration of material can be stored in the unit's memory and recalled in various ways. The JamMan has the potential for: immediate playback, retrograde playback, looping (between one repetition and infinite repetition divided logarithmically on a 16-point scale), and multiple layering of loops in real-time. Looping is achieved in Echo Mode.

Echo functions provide tools for both the performer and the composer. Music conceived for tape-delay by composers such as Stockhausen, Reich, Ferneyhough and Gehlhaar can be securely realised using this equipment. Other JamMan functions include Sample Mode, which can be used in voice and instrumental teaching and practice routines to provide tapeless playback. Sample Mode also allows the reversal of the signal, which can prove helpful in, for instance, the diagnosis of technical problems with legato and evenness of tone. Retrograde play also gives rise to the potential for analysing how we perceive tuning according to the direction of musical flow. Comparing forward and reverse examples leads one to recognise the extent to which pitches are retuned between their attack and release as a result of performers' responses to feedback. The potential for studio analysis of performance of Sample Mode and Retrograde play remains to be investigated. This article confines itself to responses to Echo Mode.

Informal trials: experimenting with my own voice and musical abilities

Before introducing the use of the Acoustic Mirror to performing groups, I carried out extensive practice sessions and trials on my own. There were two purposes to this: to learn how to 'trouble-shoot' with the equipment so as to avoid

frustrating and time-consuming technical problems during participatory sessions; and to acquire a sense of what the subjects would be likely to experience, and a means of devising simple explanations of what subjects had to do to in order to initiate work with the system. A laminated 'how to' sheet was provided in case users felt ready to take control of the technical side (this has yet to happen).

My 'solo' trials, which I replicated with the help of university students and colleagues, consisted of: rhythm games, in which the aim is to divide, by hand-clapping, an echo-period into eight equal durations - a task which becomes extremely difficult as the period is extended; and the creation of harmonic textures based on pitched vocal sounds. Such textures comprised staccato sounds; legato sounds coalescing into chords; and a combination of both. My own expertise with the system has developed to the point at which a recognizable scat version of Pachelbel's *Canon* can be sampled line by line in real time.

Diary entries, first session of Children's Choir with Acoustic Mirror

In order not to overload subjects' tolerance of novel experience, the first session with the Acoustic Mirror was not videoed. However, an immediate diary entry was made of the content of the session:

Session 1

Wednesday Feb. 19th (unrecorded trial)

The equipment was trialled without demonstration: its potential as a recording/echoing device was described, and the children were all recorded contributing to two cumulative textures:

- i) single, short sounds on a 2" loop
- ii) sustained sounds on a 6" loop.

Concentration was at a very high level, and everyone contributed appropriately to both tasks, without misunderstandings or 'accidents'. The release of tension when I faded the mike at the completion of the first task was quite unexpected: about a full minute of unbridled laughter, all in very good humour but unstoppable (and unstopped). The same again after the second task, only less so. Immediately there were suggestions as to how the equipment could be employed: the 'structural' or 'generative' properties spurred ideas in 7 or so children straight away. I encouraged them to remember them or write them down; think about them during the next two weeks, and come back ready to try them out next time we use the equipment.

The 'release of tension' experience suggests an entirely new line of enquiry: the relationships between creativity, performance, emotion and reflection. This was no simple 'letting off steam', but a shared response to the novelty and excitement of the performing phase. c.f Wordsworth 'emotion recollected in tranquillity' - is this link experienced in reverse by performers? Responses from parents suggested that the session had been much enjoyed, and that the equipment had captured the children's imagination. Not bad for a 10-minute basic introduction.

Similar informal trial, same day, with adult members of Reading Barbershop Club

As a 'one-off', the Acoustic Mirror was also employed in a voice-training session with adult male Barbershoppers. Responses to the equipment and same two tasks very much paralleled the children's experience, suggesting that, in terms of the 'anthropological hypothesis' for the effects of the Acoustic Mirror, it is a potent device for releasing inhibitions through accessing 'the child within'.

Video analysis of children's musical responses to the use of the Acoustic Mirror

(Videos of rehearsal sessions on March 5th and 12th and an informal show of work to parents on March 19th)

Observations on video examples:

1. excerpt of children creating a texture from short sounds (whole class)
2. excerpt of children creating a texture from sustained sounds (whole class)
3. excerpt of children devising their own generative principles:
 - a) group composition (group of 4 sing bird-song music by Child L)
 - b) individual performance (Child H sings her own multi-layered piece)

The whole-class texture comprised of short sounds sampled within a three-second period whose boundaries were defined by a sharp tongue-click I laid down in advance. One child declined the opportunity to contribute (though she joined in subsequent tasks). Subjects had little difficulty locating 'space' into which to project their sounds. Many took the opportunity to differentiate their sounds clearly, which made subsequent identification easier; indeed, there was little evidence of subjects copying each other - influence tended to be by motivation to contrast with, rather than to parallel, previous sounds. As a test of listening, subjects were asked to locate their sound in the texture and join in again: in order to demonstrate their success in doing so, the volume of the playback was faded out and then back in again. The texture of the live version was convincingly similar to the serially sampled one.

The whole-class texture comprising of sustained sounds was sampled within an eight-second period whose boundaries were defined by the material the subjects provided themselves. This prevented their responses being guided by material of my choice (though clearly the nature of the resulting texture drew heavily on the potential of the first sampled melody). A variety of responses ensued, including counter-melodies, drones, and attempts to underpin the texture with low material or transcend it with high and sharp sounds. Many of the contributions suggested identification with the opportunity provided by the cumulative nature of the material. It proved harder to replicate the effect of the texture through live modelling and the withdrawal of the sampled version: the difficulty of co-ordinating rhythms within the extended period confirmed the implications of the solo-clapping trials, though subjects had no inhibitions about maintaining the pitch and timbre of their independent contributions.

In group discussion after the first session with the Acoustic Mirror, subjects were encouraged to devise tasks of their own which could lead to group performances employing the system. Many were keen to make immediate suggestions, but since the session had to terminate, they were asked to write down instructions at home and bring them back the following week. Two responses to this task were

recorded. In the first, four children chosen by the composer (Child L) for their ability to mimic specific bird calls laid down their samples so as to create a repeating texture. This response demonstrated the clear understanding of a 10-year-old subject of the basic potential of the system. The second response, conceived by Child H, a 12-year-old with previous experience of composing, is more sophisticated. With the aim of producing a chaotic atmosphere on the theme of *Clocks* to which she wanted the whole class to respond, she had notated in rudimentary fashion six elements: the sound of a small domestic chime; the peal of Big Ben; the ticking rhythm of two tongue-clicks of different pitch and timbre; the regular tapping of toe-caps on the floor; a scat version of the March from Kodaly's *Hary Janos*; and a scat version of Grieg's *In the hall of the mountain king*. In order to make sense of her ideas, Child H was sampled performing all six elements herself, and the loop thus created was treated as a 'wildtrack' onto which members of the class added their own choice from the six elements provided. What impressed was Child H's initial boldness in performance, especially in view of the pitched elements (Big Ben and the two Classical excerpts). Others in the class responded well to this stimulus, and the chaotic, nostalgic-nightmare quality of the result owed much to the fresh and enthusiastic vocalisation which it gave rise to.

Conclusions

Foremost among the issues raised in this project is the role of listening in the use of the Acoustic Mirror. The rapt attention of subjects during sampling contrasts significantly with behaviour in conventional rehearsal periods also captured on video, and most dramatically with the outbursts of relieving laughter which usually followed the fading of the microphone. Observation of the video on fast-forward shows subjects to remain more still and focused, with less leg-crossing and shifting of balance.

Of more interest is subjects' creative and vocal response to the opportunities presented by the Acoustic Mirror. These can be analysed according to observations of the relationship between aural and oral processing: subject's *Perception* and *Production*. Critical features which link these phenomena are: timing; pitching; timbral choices.

Noticeable with respect to subjects' **timing** of responses is that the use of the system overcame the tendency in improvisation for events all to happen together. The regular repetition afforded by sampled echo created a security which permitted subjects to find unoccupied acoustic space in which to contribute their sounds. That such rhythmic relationships could, to some extent, be retained even when the sample was faded out suggests that children have a more developed and instinctive sense of rhythmic implication, of the relationship between event and context, than notated 'children's music' and conventional pedagogy would indicate.

Similarly in their **pitching** subjects demonstrated an innate feeling for combining different tones, often seeking particularly low or high ranges in order to extend a texture. In Child H's performance and the vocal response of other members of the group, we can hear fearless renditions of pitched material despite the Ivesian tonal clutter.

Subjects were not told that all material had to be original, yet with regard to **timbral choices** they clearly sought to avoid duplicating the sounds others had

already made. This implies a sophisticated capacity to recall and sort vocal material according to timbral quality, a feature which could be exploited more in creative work in which concern for pitch and rhythm tends to dominate. The implications of this capacity for developing vocal flexibility should not go unremarked.

The social and emotional considerations of the project are also of interest, especially as they relate to creative tasks carried out by the Children's Choir prior to their introduction to the Acoustic Mirror. Considerable attention had been paid to the question of feedback within the group as it affects, for instance, the development of secure pitching. Since the choir is unauditioned, ingenuity is required to ensure that poor pitchers who join swiftly acquire greater confidence and flexibility so as not so stand out or feel exposed. Many of the Choir's routines involve providing members with a different quality of feedback to that which they are used to perceiving from their own voices. Exercises may involve the use of animal mimicry, glove puppets, imitation of cartoon characters and the exploration of the sound-associations of emotional states, such as turning a scream into a sigh. This variation of feedback is essential if the cenesthetic sensation associated with a child's vocalisation is to be extended: a healthy and productive balance needs to be maintained between "hey, that's my voice!" and "that doesn't sound (feel) like me". In its different way, the Acoustic Mirror provides a complimentary 'alternative feedback' whose properties extend vocal self-knowledge in an enjoyable and unthreatening manner.

Beyond this feature of personal vocal development lies the collaborative and game-playing social interaction which the Acoustic Mirror can promote. Subjects participated in activities of educational value which were not presented as 'problem-solving' or even 'opportunities for self-expression', though both processes became evident in subjects' responses. Group work was coloured by a greater than usual degree of mutual dependency, trust and respect: no behaviour in any of the sessions resulted in the samples having to be terminated as a result of inappropriate responses or lack of self-control. In this respect, there were noticeable differences in the outcomes of performance tasks between standard rehearsal situations and those which employed the Acoustic Mirror.

The pedagogical implications of the project are by no means confined to supporting the use of digital echo/delay. For instance, subjects' response to the system as an acoustic phenomenon underlines the need for school singing to be carried out in supportive room-acoustics, and for children to experience reverberation and echo elsewhere if no suitable room exists at school. There are implications here for school design, where open-plan classrooms tend to be acoustically deadened to cut down on sound levels. As a means of promoting child-centred modes of creative learning, use of the system has consequences for vocal development in preserving and extending the link between the voice as instrument and its employment as self-expression. Teaching methods can be developed which relate ownership of the material of the artwork (the composition) to ownership of the means of The University of Calgary production (the voice). Such an approach contrasts markedly with the conventional children's choir/class-singing model.

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