Confronting the Transition: Improving Quality of Life for the Elderly with an Interactive Multisensory Environment–A Case Study

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Abstract. Continuing developments in medical science are leading to a general increase in length of life. These have been accompanied by an increase in disabilities and diseases associated with ageing and the quality of life for the old and older old can be seen often to decline progressively. An interactive multisensory environment (*i*MUSE) has been developed, together with a particular methodology - vibroacoustic sound therapy – (VAST), to offer the possibility of amelioration for some of these conditions with the aim of providing the opportunity for an improvement of well-being for some elderly and older old people. This paper describes the development of this environment, its modus operandi, and concludes with a case study of an elderly frail man who provides a model for the application of *i*MUSE in care homes for the elderly frail and mentally infirm.

Keywords: elderly well being, successful ageing, multi sensory, vibroacoustic sound therapy.

1 Introduction

Across the developed world, people are living longer and life expectancy is set to continue increasing for the foreseeable future.

> *'According to the Office for National Statistics, life expectancy in the UK increased by 2.2 years during the last decade, but healthy-life expectancy increased by only 0.6 years. Death is currently preceded by about 10 years of chronic disease or disability, and this is increasing. Government health targets are contributing to this disaster by insistently targeting causes of death instead of chronic disease. This problem is one of the largest of the 21st century. If we do nothing about it, it will swallow up our health service, then our economy, and eventually ourselves. We must do something urgently to help the older old – before we join them'. [1]*

Care homes have to be run with fairly strict routines. Breakfast, lunch, tea, dinner structure the day of residents and often there are not many other meaningful or chosen activities in-between the meals. Residents feel a lack of meaning and control over their

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lives, which leads to increasing dependency, lack of initiative, lethargy and depression. VAST and *i*MUSE have been specifically developed to provide a means of recovering, re-developing or retaining a sense of identity and agency through aesthetically based activities for interactive expression, communication, spontaneity and fun.

2 Conditions

Initially Vibroacoustic Sound Therapy (VAST) was developed for children with profound and multiple learning difficulties (PMLD) [2]. Following this a pilot project with the elderly was run for twelve months in 1997-8 to see whether there was potential for improving quality of life for the elderly frail and mentally infirm. Results were positive and further research and development has culminated in the development of an *i*nteractive MUltiSensory Environment (*i*MUSE), [3] within which a number of techniques have been developed and combined, resulting in a methodology – Vibroacoustic Sound Therapy [4]. The approach has been developed with elderly people with a range of conditions often associated with ageing, including stress, anxiety, depression, dementia, rheumatism and arthritis, cancer, stroke and (advanced) Alzheimer's.

3 Environment

Providing multisensory feedback for an action such as vocalization or hand movement can lead to powerful enhancement of experience. The *i*Muse environment evolved experimenting with combinations of real-time audio, tactile and visual feedback for action. When sound is created by a participant it can be heard, felt as vibration and 'seen' as changing graphical patterns.

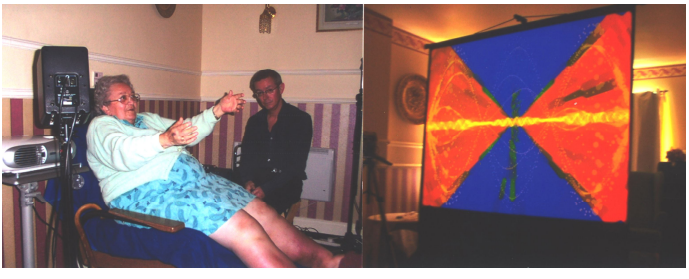

Fig. 1. A resident creating graphic displays from sound generated by hand/arm movements

The VAST room in a care home setting has a Soundchair set with two loudspeakers placed in front of the chair at around ear height. A 1.50 x1m projection screen is placed approximately two meters away from the chair. The room lighting level is kept generally quite low so that projected images are clear and distraction kept to a minimum. A Soundbeam sensor (see below) is placed beside the Soundchair. A Soundbeam controller unit, computer, sound mixer and projector are not normally visible to the participant, and these are controlled by the facilitator.

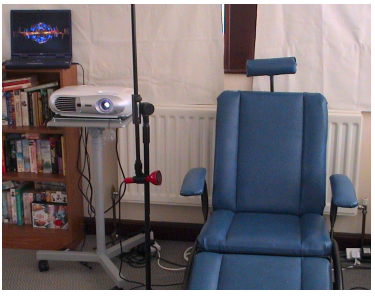

Fig. 2. The Soundchair, Soundbeam sensor, projector and computer

The Soundchair has acoustic chambers containing loudspeakers. There are three chambers corresponding to the areas of the upper body, seat and legs, a little like a three-part sun lounger. When sitting in this chair, any sound which is heard within the environment is heard and felt simultaneously in the back, seat and legs of the participant. This can reinforce the cause and effect experience and motivate further action and involvement from the participant.

The Soundbeam [5] is an unltrasonic distance sensor which is used for gestural capture. The sensor emits an ultrasonic beam. Any movement within this beam is registered by the device and converted into MIDI code, which subsequently can be used to generate any sound created in turn by a computer-based synthesizer or sampler. Large flowing movements, such as the sweep of an arm, or small movements, such as the flick of an eyelid, can be given expressive potential in this context, so enabling people with varying levels of physical disability the possibility for expression and control through movement. As any movement immediately generates a sound which corresponds to the speed and amount of the gesture, there is clear cause and effect – there is no apparent latency in the system and because the participant is sitting in a chair the field of movement is limited and therefore can easily be captured by the gesture sensor.

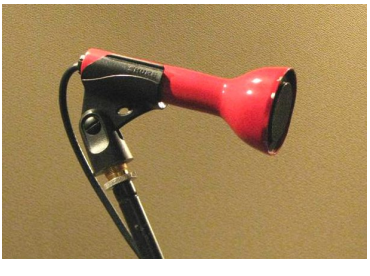

Fig. 3. The Soundbeam ultrasonic sensor

The visual output is generated in three ways: multi-coloured graphical patterns are generated from sounds made in the session using G-Force software [6]. Change of pattern shape and colour are mapped to change in pitch and amplitude of the sound, giving an immediate and intuitive sense of control. Arkaos VJ Midi software [7] is

used to display pre-prepared sequences of images which can be customized for each individual. Signals (notes) from the Soundbeam change which picture is projected, and pictures can be merged and faded into each other in different ways. A third visual output is used, also utilizing Arkaos. In this, a camera is focused on the participant, and hand, arm and head movements form the basis of the projected image, which appears as a moving kaleidoscopic pattern. The colour of participant's clothing forms the colours of the projected kaleidoscope, and the feeling of control by the participant is enhanced, often resulting in intense immersion in the activity.

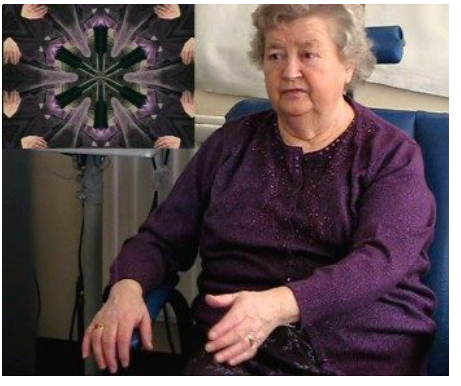

Fig. 4. Camera-based kaleidoscopic moving image from the participant's movements

The facilitator interacts with a participant in order to optimise the *i*MUSE environment according to individual preferences by adapting modes of inter-sensory mapping as well as types of sounds and colour schemes. On a technical level this involves operating the sound processor and Soundbeam settings and adjusting the various projection variables throughout the session.

The environment is a particular aesthetic, one in which the participant can explore and experience in a synaesthetic domain, and one in which there is no behaviour pattern more appropriate than another – everyone can find their own, most effective way of 'playing the environment'. The whole approach is dependent on technology, but is not technology led. The technology merely provides the tools, [8]. As pointed out by Strick [9]

> *'In digital media, .. music and visual art are truly united, not only by the experiencing subject, the listener/viewer, but by the artist. They are created out of the same stuff, bits of electronic information, infinitely interchangeable. ..the aspiration to novel experience created by the compounding of sensation and association has never been more possible'.*

The technology itself has to be used in a particular way, and the tools for *i*MUSE have been chosen carefully to be as open-ended as possible both in terms of operation and application. How the interaction is managed between the participant and facilitator is crucial, with the technology being as non-intrusive and as hidden from this as far as is possible.

4 Interactive Techniques

A Person-centred approach [10, 11] determines the nature of the interaction between participant and facilitator. Some interactive techniques which have been developed in VAST are reflected in the Intensive Interaction methods developed by Nind & Hewett [12].

The focus in VAST is always on the participant being active and as far as possible sharing control of any activity, and all the activities are designed to be intrinsically rewarding and motivating. The facilitator can encourage eye contact and turn taking and read and respond to facial expressions, always concentrating on and attending to the participant. It is important to accept people as they are and not to try to change them in a way which might seem better or more appropriate to an external observer. The focus is on what people WANT to do which allows us to concentrate on abilities rather than on the compensation for disability.

One fundamental feature of the approach is the phenomenon of *aesthetic resonation* [13], a fleeting state of well-being in which a feeling of 'rightness' or 'wholeness' can be experienced. These are special 'inner moments'. A combination of delight, discovery, wonder, intrigue, success, joy. External signs include spontaneous smiles, physical movements of no use – a wriggle of the shoulders – moments of arrival, actions not seen before and behaviour sometimes deemed not possible in normal life.

5 Session Structure

There are typically three parts to a VAST session :

1. Active or interactive activity centred upon use of a microphone;
2. Active or interactive activity centred upon the Soundbeam;
3. A receptive end section where the participant can 'let go' of aches and pains, anxieties and worries, and become immersed in a warm and enveloping 'bath of sound' in the Soundchair, which can often induce feelings of happiness, of soothing and care, calmness and well-being.

1. Sound is captured by a microphone and enhanced in different ways by using a sound processor. Even the quietest of sounds can be captured and subsequently given additional effect through the application of reverberation, delay patterns, and changes in pitch (pitch-shifting). Adding reverberation to sound encourages vocalization. Without this effect the tendency is to feel exposed or isolated, but adding reverberation somehow makes the sound warm and induces confidence and pleasure. Different delay patterns (echo) can induce self-confidence and sense of fun, with anticipation and turn-taking being encouraged. A pitch shifter can turn one pitch into an expanding chord, which leads to exploration, intrigue and playfulness. All vocalized sounds are visualized with the G-Force software.
2. The second experience is of generating sound merely through physical gesture or movement, voluntary or involuntary, and with the elderly this is most usually hand and arm movements. The abstract coloured graphics generated from sound via G-Force is the initial activity with the Soundbeam. Subsequently, using Arkaos

software, control over picture sequences personalized for the user and/or the kaleidoscopic projection follows. Customised picture sequences can trigger reminiscence as well as intense interest.

This part of the session can become energetic, so that the final phase of a session is designed to be less physically demanding.

3. In the final part the participant can adopt a more receptive mode. During this section, carefully selected pieces of music are played. These have been combined with a low frequency sine tone, typically between 30 – 80Hz. Skille [14], Wigram and Dileo [15] have extensively researched this aspect of using low frequency sound for therapeutic purposes, including many clinical trials. In this work a focus on the pitch has been associated with particular organs of the body which can alleviate numerous complaints, being independent of the music which may here be used as a 'cover'. In VAST however the exact pitch of the low frequency tone is determined by the music, its tonic key providing the pitch of the sine tone, and these tones regularly pulse for somewhere between 4 – 8 seconds in time with the music itself. The *aesthetic* of the music is thus the determining factor with regard to the pitch, speed and regularity of the pulsing. The choice of music is important and McClellan [16] and Williams [17] recommend music devoid of over-intellectualization, being calm and non-polemical, related to meditative states, possibly with a drone-like element and ostinato figures. Music without sudden changes of tempo, timbre or volume seems most effective and I have prepared music from a wide range of classical composers as well as 'music for relaxation' CDs.

Participants who experience this regularly report feeling happier, less stressful, more relaxed - generally an improved state of well-being.

Fig. 5. A resident 'playing' a picture sequence

6 Evaluation

All VAST sessions are recorded on video for analysis and archiving. Over a period of weeks and months, sometimes years, it is thus possible to chart the effects and responses from individuals and customise future sessions to target particular conditions or expressed wishes. From longitudinal observation of video recordings [13] it is possible to identify indicators of change and well-being. The chart below shows how it is possible to identify such changes. At the beginning of a sequence of therapy sessions the resident might well exhibit characteristics in the first column – 'Dependent'. Over

time these can often change to those of the 'Responsive' column, and finally become those of the 'Independent' list. This is not a definitive or exhaustive catalogue of development, and it is of course qualitative rather than quantitative in nature, but in terms of aesthetic resonance and human happiness has its importance for well-being for this time of life.

Isaac Asimov [18] remarked that 'life is pleasant, death is peaceful. It's the transition that is troublesome'. It is this 'troublesome' phase which becomes more apparent in homes for the long-term care of the elderly, and the immediate feeling of well-being made possible is one focus of VAST sessions. In addition to this longer term benefits which might accrue from the activities can include anticipation together with residual feelings of well-being and the relief of aches, pains, stress, anxiety and depression.

Table 1. Markers for indicating progression

Dependent	Responsive	Independent
isolated	aware	contributing
indifferent	reactive	expressive
frowning	smiling	laughing
crying	laughing	expressing
silent	content	receptive
withdrawn	thoughtful	communicative
inward	poised	interactive

7 Case Study

During the past decade VAST has been experienced by more than 40 elderly people living in long-term care homes and also in sheltered accommodation. This case study illustrates the effectiveness of VAST with one man. The description of his responses is by no means atypical.

Robert was born in 1915, left school at 14 and had a long working life. He was married for more than 60 years and was devoted to his wife. I first met Robert in May 2006 when he was resident in a home for the long-term care of the elderly with dementia. He and his wife had moved into the home the previous year and their sitting room had been replicated for them in the home. Shortly before I met him his wife had died and he was devastated by this and was consequently very upset and low, in addition to being physically very frail.

Overall, Robert had 17 VAST sessions spread over 7 months with a six week break in the middle due to summer vacation. The study falls into three phases:

1. Accepting – Robert was understandably sad and generally lacked physical and mental energy or vitality. Walking to the session he needed two sticks and the assistance of a carer. At first there was little response to the microphone. He sat very still and appeared uninterested. With the Soundbeam at first he did not appear to like generating sound from his movements and was seemingly confused. However, he relaxed more when listening to the music and described this as 'restful and

soothing'. Gradually he became more vocal and began to smile and use more energy in vocalising, listening and responding to the sounds produced. Similarly with the Soundbeam his movements became more energetic and varied, with some focus being given to the visual projection, both of graphics and of picture sequences. The vibration became a significant feature for him, and after a few sessions he commented that

'I can feel the vibrations through my whole body – its soothing and relaxing'. Having finished a session listening to the music he commented that 'the vibrations were doing something – now sometimes I feel like going to sleep. I enjoy it'.

A few weeks later, at the end of his seventh session before we stopped for summer vacation he took a breath and said:

'I get something out of it
I don't know what it is, but there's something I'm getting out of it
Because I'm quieter now, and I'm taking things as they are – now – and –
I don't know what it is
I'm just carrying on
Taking things as they come and I'm not worrying about – I do worry –
But I'm not worrying so badly like it was before when it first happened (the death of his wife)
But now I can look on it and face the wall and I can say
I'll be away soon'.

2. Becoming

I did not see Robert during the six week break over the summer vacation. During this time he apparently went into something of a decline, beginning to seriously worry again, although when we next met he seemed outward looking and quite bright, saying during the session 'that's very good – when I feel the vibrations'. However in another session he said:

'Feels good – feel the vibrations
When it stopped I had to go to the doctors – worse with worry
I've had depression – the doctor says badly
I'm going to give the doctor up
Today or tomorrow going for the last time
It is easing up
I think 1 or 2 doses of this and I'll be OK'.

In the sessions which followed he developed more energy and after two more sessions was walking to the Therapy room unaided and using just one stick.

3. Being expressive

No longer on medication, Robert was comparatively more active and energetic – his vocalisations could be heard for some distance from the therapy room, and he often smiled broadly showing real enjoyment. His physical gestures and control of sound were at times energetic and always purposeful. The enjoyment of listening to the music was self evident, and he focused on the benefit he felt he received from the vibrations. He commented 'very good, getting the vibrations going down my body'.

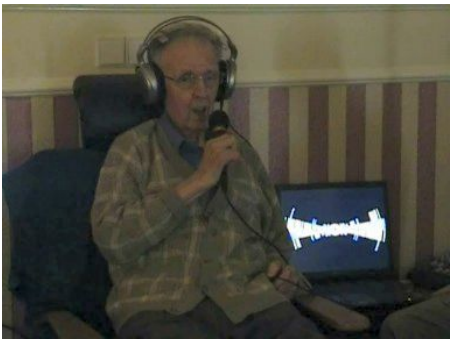

Fig. 6. Robert generating graphic displays from vocal activity

On his final session I asked him how he has found it, and he said;

'I enjoy the vibrations -
If it wasn't doing me good I wouldn't be having it'!

He then got an infection and was admitted to hospital.

In the final months of his life VAST gave him motivation, enjoyment, comfort and an improvement in physical and psychological well-being. Relating his time in VAST to the markers for progression table above in virtually every category we see a change from the first to the third column. From being sad, frail somewhat uninvolved and uncommunicative he had come to an acceptance of his situation, could look forward to the future without worry or fear. He gained pleasure from being expressive with sound both vocally and through movement, and experienced being moved aesthetically whilst feeling soothed and relaxed by the music with low frequency tones. These sessions provided for a stimulating, expressive, gentle and soothing transition.

8 Conclusion

Observed benefits from VAST can be short, medium and long term, and improvements in mood, perceived aches and pains, and communication often result from therapy sessions. Additionally, some residents talk about their sessions during the week, and actively look forward to the next visit. Many participants have shown that the vibrations received through the chair 'eases the pain' in joints, particularly the legs, hips and back regions.

Currently, two ladies in their 80s have been having regular weekly VAST sessions within *i*MUSE for more than three years. Both have various aches and pains from arthritis and other conditions, and both are adamant that the sessions improve their physical condition as well as contributing to an improvement in general psychological well-being. It is interesting to note periods of behaviour emanating from *aesthetic resonance* in these sessions; people with arthritis apparently forgetting how stiff or painful their hand or arm movements usually are, and 'playing' with sound for extended periods in the Soundbeam.

One lady who had a mild stroke and did not use her left arm spontaneously started to use this with the Soundbeam during one session, and continued to do so thereafter. The microphone seems to serve two purposes. It can help regenerate communication skills in a non-verbal way with people who have lost speech due to stroke; it can re-energise and motivate action and a sense of fun, and it can serve as a powerful way of generating the physical vibration which so many of the elderly in this project seem to value.

The elderly and the older old may not remember as younger people do, nor be as physically active. We allow and encourage the young to develop and enjoy life to the full. Asimov's 'troublesome transition' is an inescapable phenomenon. As increased ageing in society continues, so this awareness will generate more opportunities for giving positive support and emotional, expressive meaning through aesthetic engagement, with *i*MUSE perhaps being one way to enrich this time for some people during this stage of life.

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