



At the farewell family gathering

Music is a multi-dimensional experience informed by much more than hearing alone, and is thus accessible to people of all hearing abilities. An inter-disciplinary team of researchers at the National University of Singapore (NUS) are working on ways to help people with hearing difficulties gain a richer musical experience.

Dr Elizabeth Taylor, Head of the Marine Mammal Research Laboratory, Tropical Marine Science Institute at NUS has a long-standing interest in bioacoustics and multi-sensory perception and wanted to explore the idea of enhancing the musical experience of a deaf person using a vibrating 'Haptic Chair' and a computer display of informative visual effects that correspond in real-time to musical features. This idea became the doctoral research topic for NUS Research Scholar, Suranga Chandima Nanayakkara. Since this goal crosses conventional academic disciplines, Associate Professor Lonce Wyse (Director, Arts and Creativity Laboratory, Interactive and Digital Media Institute, NUS) and Associate Professor Ong Sim Heng (Head, Biomedical Engineering Group, Department of Electrical and Computer Engineering) are co-leading the project.

The research team developed

'Haptic Chair' hearing for the deaf

a prototype system which has two components: a 'Haptic Chair' that vibrates with the music; and a computer display that generates different visual effects based on musical features such as note onset, pitch, loudness, key changes and timbre. This system was developed based on information obtained from background surveys conducted with deaf people in the USA, Singapore and Sri Lanka, and from feedback received from two deaf musicians who first tested the 'Haptic Chair'.

During the first phase of the evaluation, a formal user study was conducted with 43 participants (aged 12 to 18 years) with differing degrees of deafness. In a result that surprised and delighted the research team



Formal User Study (clockwise, from left): Suranga Nanayakkara (Member of the research team from NUS), Ishan (One of the participants), Tineke De Silva (Principal of the School) and Buddhini Gunasighe (Sign Language Interpreter).

beyond their expectations, all participants reported that the 'Haptic Chair' was both very effective and enjoyable. A statistical analysis of the results suggested that the system is capable of substantially enhancing the musical experience of even a profoundly deaf person. Many of the subjects reported that the visual display alone was 'not very effective' but when presented together with the 'Haptic Chair' the visual effects conveyed additional musical meaning.

After the formal study was completed, there was an informal interaction session to assess how well this system would work in a less structured environment. Eleven particularly enthusiastic subjects were given the chance to

the most. She said, if she could read the lyrics of the songs karaoke-style and if she had the opportunity to change the properties of the visual display (colour, objects, how they move, etc.) whenever she feels, that would make the system even more effective.

Many of the participants reported that the 'Haptic Chair' enabled them to immediately identify the rhythm of a song or piece of music, and they could hear the song much more clearly than when they relied on their hearing aids. One subject mentioned that he wanted to use headphones together with the chair and display so that he could detect the sound through the headphones as well.

A few participants who were born with profound deafness said that this was the first time they actually 'heard' a song and they were extremely happy about it. They expressed a wish to buy a similar 'Haptic Chair' and connect it to the radio and television at home.



Enjoying a new musical experience

listen to songs of their choice. They were asked to imagine the 'Haptic Chair' was their own and to use it in whatever way they wanted – according to guidelines! They were given a demonstration of how to connect an audio device (mobile phone, CD-player, Apple iPod, or notebook computer) to the 'Haptic Chair', and they were free to choose whether or not to use their hearing aids. The behaviour of the participants was observed and, after the session, some informal questions were asked about their reactions to the experience.

One very excited participant said that it was an amazing experience unlike anything she had experienced before. She said now she feels like there is no difference between herself and a person with normal hearing. She preferred the combination of the 'Haptic Chair' and visual display

It was observed that many profoundly deaf participants were actually 'hearing' something when they were sitting on the chair. The following comments were encouraging:

"Yes, I can hear from my legs!"

"I will ask my father to buy me a similar chair."

"Now there is no difference between me and a normal hearing person. I feel proud."

The icing on the cake for the research team was a report by a speech therapist at the school who said that, after trying out the system, she believed it would be helpful in teaching the deaf to speak more clearly.

On the last day of the user study, the School organized a special 'farewell family gathering. It was held at the School Auditorium and most of the deaf students displayed their performance by dances and dramas.