

AURALROOTS: Cross-modal Interaction and Learning

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Abstract

AURALROOTS is a media sculpture that combines viewer interaction with inspirations from tactile and aural sensory perception. The sculptural form is based on the functions and forms of the stereocilia, tiny hair cells on our auditory nerves of the inner ear in the cochlea. The content of AURALROOTS is about how we learn through sounds from being embodied in different environments: a) as a growing embryo in the womb, b) as a daughter listening to her mother and finally c) as a female artist communicating with auditory scientists.



Fig 1. *AURALROOTS*, 2015, Jill Scott, tactile media sculpture, ZEMAK, Poznan, Poland Copyright Scott.

Cross-modal Interaction and Learning

AURALROOTS offers a metaphorical learning experience that scales down the viewers into miniature characters and places them inside the inner ear where they can trigger acoustic reactions. By touching or moving two sets of these sculptural models, based on

volume and harmonics, the viewers can mix and manipulate up to 54 sound tracks to be heard on wireless headphones. A viewer/listener can choose different pitches that relate to these learning experiences, by touching an animated visualisation of the cochlea on a screen. This action triggers three sound compositions. A) Low pitch compositions 1: in the womb, (B) medium pitch compositions 2: in the environment and (C) high pitch compositions in the science lab. (1-technique) All three sound compositions in AURALROOTS encourage the viewer to learn through a combination of touch, sound and the embodied experience.

Sound Composition A: Hearing as an Embryo in the Womb

The viewer can hear as a foetus might hear: mostly in the low pitch range. She hears her mother's digestion but also traffic noise outside, the blood cells rushing through the mother's veins, but also a refrigerator motor. Do the lungs breathe, steadily or is that the sound of a river rushing along on the outside of her mother's body? She differentiates between a heart pumping and the beating of a base drum. She can hear her mother swallow, or the low pitch syllables from her singing voice while she is playing the piano.

Sound Compositions B: Daughters listening to their Mothers

Speech occurs mostly in the mid-range of our frequency response. Many communities practice oral storytelling: the passing of knowledge from one generation to the next. In this composition, oral "herstories" are told by Australian indigenous women to their daughters about how to gather plants and roots for survival and for medical conditions. Due to colonialism this knowledge is slowly disappearing. When we talked with our indigenous advisors at the Koori Radio Station in Sydney about this form of knowledge transfer, they said that it requires extensive personal contact, regular interaction and trust: "At this stage if another person we trust wants to tell it let them tell it". To construct eight accurate scripts for the actors to re-tell; we sourced talks, interviews and written information by community elders and indigenous researchers. [1] The characters are not based on actual people, however, the names of plants; how they were collected and used plus the environmental

sounds in which they are located are directly source able. [2]

Sound Composition C: A female artist listing to scientists

This composition is based on high pitch frequencies and sound recordings based on my own subjective experience when I worked as an artist-in-residence inside two audiology labs in order to learn about hearing. High pitch frequency response is the first part of our hearing capabilities that decrease with age. I shadowed the experiments of researcher Helmy Mulders and her team, where knowhow transfer is based on a horizontal level of communication. Here the pathways from the ears to the brain are audified by a method called “Electro-physiology”, which measures the midbrain’s response milliseconds after tones are fed to the ears of anesthetised Guinea pigs. I recorded the firing sounds of single neurons in the mid brain and learn that the stereocilia are one of the few human cells that do not regenerate. I record their tests with researchers on the hearing impaired and witness a surgical operation of a cochlea implant. In audiology, there are more female than male scientists, but more men suffer from hearing problems at an older age than women. Statistics show that among women, teachers in day-care institutions suffer the highest incidences of Tinnitus [3]. It seems that the stereocilia is not only damaged by acoustic trauma but also by the filtering of constant noise.



Fig 2. *AURALROOTS*, 2015, Jill Scott, interactive screen composition A: Hearing as an embryo in the womb, Copyright Scott.



Fig 3. *AURALROOTS*, 2015, Jill Scott, interactive screen Composition B: Daughters listening to their mothers, Copyright Scott.

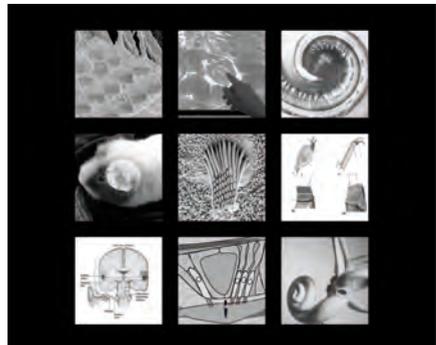


Fig 4. *AURALROOTS*, 2015, Jill Scott, interactive screen composition C: A female artist listening to scientists, Copyright Scott.

Examples of the Learning Experience

Here I give two more concrete examples of the learning experience based on what the viewers actually hear in composition 2 and 3.

Composition B: Daughters listening to their Mothers. The viewers can listen to these stories re-told by actors and match them with sound from the according landscapes where the plants come from. Some of this knowledge is lost – some is retold here! JACK tries hard to remember about how SILKY HEADS (*cymbopogon-obtectus*) was used for ear infections. He explains how this knowledge was only passed on from mother to daughter. DARRA talks about BRACKEN FERN (*pteridium esculentum*) and BUNGWALL FERN (*blechnum indicum*). The roots and leaves of both plants can be used against stings and tics or prepared for eating.

APANI, a young girl, describes the myth of the relationship between the GYMEA LILY (doryanthes excels), a source of minerals, and THE BULRUSH (typha orientalis, typha dominicensis) used by hunters for bodily stamina and to keep leeches away. KALINDA describes to young women, how to locate and gather LONG YAM (dioscorea transversa) and PENCIL YAM (vigna lanceolata), main sources of minerals and starch. CORREEN tells a story about how many women often come together to collectively hunt for BUSH ONIONS (cyperus bulbosus) - a good source of minerals. TATYA explains how to wash, cook and make a cast for a broken leg or arm or out of the roots of DEAD FINISH BUSH (acacia tetragonophylla). LYN tells us how to prepare and harvest the roots of the CUNJEVOI (alocasia brisbanensis) and use it for stings, burns, and to take the poison out of it for eating. MARGARET talks about the WILD BUSH ORCHID (cymbidium canaliculatum), a great preparation for dysentery and bowl problems.

By comparison Composition C is based mostly on what I learnt from listening to auditory scientists. An auditory lab is always full of tests and sounds particularly in the high pitch range. The viewers of AURALROOTS can hear and mix simulations of the behaviour of inner ear stereocilia compared to the outer stereocilia, as well as sounds from the lab and test tones to identify Tinnitus. They can test themselves by listening to the sounds from the actual hearing tests on people who have a wide range of hearing problems. These tracks are tainted with my own subjective experience of learning about the audified firing of the stereocilia from Electrophysiology³, and other sound waves extracted from music and tunings in the same environment.



Fig. 5. *AURALROOTS*, 2015, Jill Scott, touchscreen animation used by the viewer to travel through the cochlea and trigger the pitch based compositions, Copyright Scott.



Fig. 6. *AURALROOTS*, 2015, Jill Scott, sculpture: touching and moving the tactile stereocilia, Copyright Scott.



Fig. 7. *AURALROOTS*, 2015, Jill Scott, sculpture: viewers play with the relation between harmonics and volume, Copyright Scott.

Conclusion

All of these modes require the accumulation of tactile and sound knowledge from the purest forms of embodiment - either from inside the body, from being in the environment or from learning in the laboratory. By presenting this content, *AURALROOTS* encourages less formal, codified or explicit forms of knowledge. Composition A is a combination of sound, tactile and tacit information: this kind of knowledge is difficult to transfer to another person by means of writing it down or verbalizing it. In Composition B, the holder of information must be integrated into a network or a community of practice for survival. Here tactile and sound transfer is related to beliefs, ideals, values,

schemata and mental models -a more cognitive dimension of information that shapes the way we perceive the world. Finally, Composition C explores how different forms of information always exist in dialogue with other forms of knowledge and are transferred in a horizontal way: one that is dependant on co-productive participation.



Fig. 8. *AURALROOTS*, 2015, Jill Scott, sculpture examples of viewer interaction. left: ZEMAK, Poznan, Poland, right: Anatomic Museum Basel, Switzerland, Copyright Scott.

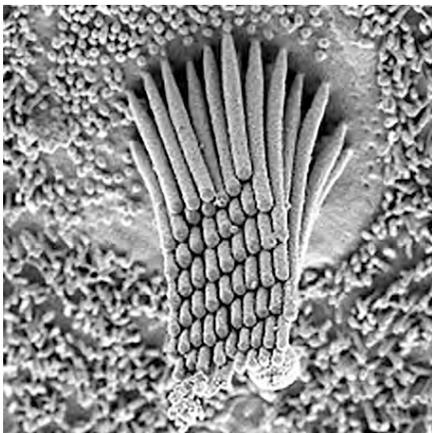


Fig. 9. Scanning Electron Microscope image of our stereo cilia in the inner ear of the cochlea, 2010, University of Basel, Copyright public domain.

Therefore, *AURALROOTS* presents the viewer with three levels of knowledge and illustrates that the transfer of knowledge is aided immersing the learner in each particular environment. The content of the soundtracks also encourages them to learn more about sound history

from a feminist perspective. The viewer becomes an active participant by “placing” him or herself inside the cochlea to explore the acoustic qualities of harmonics and amplitude. As far as I know, this is the first time that a media sculpture has been built that uses the scale and behavior of the stereocilia as a metaphor for an auditory sensual experience, inviting the viewer to work selectively, deeply listen and be contemplative, exploring and learning in ones’ own space and time.

Acknowledgements

AURALROOTS was generously supported by Pro Helvetia, The Swiss Arts Council.

AURALROOTS is programmed with Max MSP with C++. The stereocilia swing on balls that are connected to Joysticks and from there to a Minimac computer where 54 sound tracks are stored.

Programming: Nikolaus Völzow,
Sound: Jill Scott and Olav Lervik.

The sounds from the womb are based on recordings with contact mics places in the uterus at by Les Gilbert:

<http://www.magian.com/projects/>

Also from neuroscience research:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4256984/>

Actors and researchers’ credits: Koori Radio / Gadigal Information Service, Sydney, Australia, produced by King Street Studio with indigenous actors: Fred Copperwaite, Khi-Lee Thorpe, Wandjina Smith, Lillian Crombie, Elaine Crombie, Jinny Smith, Lyn- Paulette Whitton, Lily Shearer. The researches were Jill Scott, Tess Corino and Marille Hahne.

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