Extending/Appending The Perceptual Apparatus:
A History of Wearable Technology in Art
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Abstract

Our understanding of how we perceive the world, and our ability to manipulate it, has become increasingly mediated by technology. As this technology progresses, the possibilities for a closer coupling between technology and our sensing faculties is possible, blurring the line between body and technology. This paper explores the history of the relationship between wearable technology and our perceptual apparatus. It spans from the invention of the lens through to the current exploration of embedded technology, which allows for the manipulation of the perceptual apparatus itself. This paper discusses the various ways in which the relationship between our perceptual apparatus and forms of wearable technology has been developed and explored in the arts. It then uses this framework to speculate on new works, and describes two new works by the author: *Your Hearing Them,* and *Your Localisation Exposed.*

Keywords

Wearable Technology Artworks, Perception, History of Art, Bio-hacking, Sense Substitution, Artistic Framework.

Introduction

The intersection of art, body, and technology has produced a range of mind-bending, perception- altering experiential art works. The history of this coupling between technology and body has two simultaneous streams: innovations driven by medical needs, and technology explored through art. Through this coupling, sight can be fixed, hearing restored, and now with more active and advanced technologies, senses can be crossed. This can allow for a blind person to hear what others see. The other stream has been driven by a range of forces. Explorations of the ontology of this coupling between body and technology, the repercussions of how we think about our body, and how our perception filters our experience of the world. This stream is the domain of art, in which artists have created new forms of technology to create experiences that speculate and examine the ways in which we perceive the world. They

append and extend our perceptual apparatus, mediating our experience of the world.

This paper will focus on the intersection of art, perception, and technology. Specifically, the paper will focus on those wearable artworks, which explore couplings in which technology mediates our experience of the world by being a medium positioned between ourselves and the world. This is derived from Don Ihde's conception of embodiment relations between the body and technology (Ihde, 1990). The intent is twofold. Firstly, through ordering and explicating a history of the exploration of this coupling, this paper seeks to provide an overview of the different forms that have been manifested through this intersection. This is intended to both connect implicit themes in previous art-works, as well as provide a framework for new works. To this intent, the paper will then move to discuss two new works by the author that have been strongly informed by this framework: *Your Hearing Them* and *Your Localisation Exposed.*

The paper is divided into categories, which are all continuums. These distinctions have been made to group works and ideas together; however, they aren't intended to be exhaustive of all possible manifestations of this coupling. We start with the first examples of perception altering technology, showing how these innovations were developed as perceptual correctors. This will lead into those technologies that seek to amplify our current perceptual abilities through allowing us to experience things beyond the limitations of our perceptual horizon. Following this, those artworks that provide a translation of experience through altering and augmenting the organization of our perceptual apparatus are investigated. This rearrangement is then pushed further in the Cross -Sense and Biohacking category. These couplings start to blur the line between body and technology, and start to question what the repercussions are when this relationship becomes increasingly close. Some examples will be given of each of these cate-

gories, with most attention given to those works, which were directly influential to the author's two new works, *Your Hearing Them*, and *Your Localisation Exposed*, which will finally be discussed. This paper, then, explores a number of categories through which the intersection of art, technology, and our perception has been explored, and presents two new artworks which have been informed by them.

Perceptual Correctors

The following section will outline the development of wearable technology created for the correction of deficiencies in our perception. Although these lie outside of the field of art, they are heavily influential to the development of the field of wearable technology in art. Not only did they create new forms of technology that would later be used in artworks, they also formulated the idea of perceptual alterers through coupling our senses with technology.

The starting point for these wearable technologies can be traced back to the invention of the lens. Anthropologists George Sines and Yannis A. Sakellarakis's research indicates that the use of lenses was widespread throughout the Middle East and the Mediterranean basin over several millennia (Sines & Sakellarakis, 1987). With a very pragmatic perceptual purpose, these lenses were sometimes used as magnifying glasses to authenticate seal impressions. However, the lens wasn't incorporated into a wearable design until the invention of the eyeglasses, which required a semi-permanent coupling of the technology and eye. The eyeglasses were invented as a corrective tool, allowing for a malfunctioning visual sense to be repaired. As the technology for corrective lenses developed, a closer and more embedded coupling was invented in contact lenses. This progression of the relationship between technology and the body becoming increasingly embedded is at the heart of the transhumanism movement, provoking a range of artworks in the Bio-hacking and Cross-Sense category presented below.

This use of technology as a corrector is not limited to our visual sense, with deafness also being aided by technology. Early hearing aids were ear trumpets, hearing fans, and conversation tubes, developed in 1800 (Mills, 2011). In a similar design to the magnifying lens, ear trumpets were first used as passive amplifiers of the stimulus to help people who were hard of hearing. Their tubular shape funnels and amplifies sound waves. The end of the tube is pushed up against the ear, which, allows for better transmission of sound energy to the eardrum.

The history of the development of hearing aids is similar to the evolution of vision aids, as the coupling between perceptual apparatus and technology has become more embedded. However, one large difference is the adoption of digital electronics in modern hearing aids. The current technology transforms the hearing aid from a simple amplifier to a device that is capable of signal processing for speech enhancement, noise-reduction, and feedback cancellation (Levitt, 2007) . This allows for a dynamic relationship between signal and stimulus, automatically adjusting its filtration and amplification of sound depending on the environment.

Although these technologies were developed for medical, non-artistic purposes, these innovations and affordances have subsequently been utilised for many artworks, discussed below.

Sense Amplifiers and Extenders

Figure 1. PHOX Ears - Rebecca Kleinberger

There are a range of wearable artworks that seek to provide a heightened experience of our everyday environment through amplifying and filtering our perception. These works are related to other technological perceptual enhancers including magnifiers, microscopes, telescopes, and microphones. Their main departure is in their wearable nature, which allows them to be a tool or filter to explore the world through.

PHOX Ears (2015), by Rebecca Kleinberger, changes the way we interact with our sonic environment. The wearable technology consists of a pair of head-mounted, independently articulated parabolic microphones that allow the wearer to sharply direct their aural attention to far away sound sources. This wearable technology

mediates our experience of the world through changing the shape of the wearer's auditory field. Usually, we hear sound from all directions, creating an auditory field that is shaped as an omnidirectional sphere. What *PHOX Ears* allows for is an interactive negotiation of this auditory field, allowing the wearer to actively filter out areas, and amplify points at will.

This filteration of our auditory field is also present in *Eidos* (2012), a sensory augmentation technology artwork that offers the wearer the ability to enhance and control their senses in real time. Where *PHOX Ears* is intended to be an open interactive tool for negotiating the auditory field, *Eidos* has a more specific enhancement in mind. The auditory enhancement is a technological amplified version of the cocktail effect (Cherry, 1953). Through auditory attention alone, we are able to filter out parts of the auditory field to focus in, and make sense of, one particular element. This happens in busy social settings like cocktail parties to follow one person's voice against background chatter, however, in more dense settings this can be impossible. *Eidos Audio* extends this effect by using a directional microphone that allows the user to isolate a person's voice, and then amplifies this sound to a bone transducer and headphone set.

Figure 2. *Eidos Audio* - Tim Bouckley et al.

Eidos Vision takes on a different element of our experience, by compositing our temporal experience of motion. Similar to the effect that long exposure photography creates, the headset can detect motion and track the subject, showing how it moves over time. This is an example of an augmented reality technology that is heavily informed by attempting to enhance how we perceive the world.

These works afford the wearer a finer degree of autonomy over their senses through allowing them to intentionally amply and focus on an area of their world.

This coupling has the potential to not only allow the wearer to have more control over what parts of their environment they experience, but to also experience things outside of their limited perceptual horizons.

Perspective Changers

The following artworks are wearable technologies that allow for an interface between our perceptual apparatus and another form. They all share similarities through offering the wearer a change of perspective. In the case of James Auger and Jimmy Loizeau's *Social Tele-presence* (2001), and Takehito Etani's *Third Eye Project* (2002), this change is a translation in space of the wearer's point of perspective. Other works seek to offer the wearers another person's, or in some cases, another animal's, experience. Lastly, a range of works that rearrange the organisation of the wearer's senses are described. These works offer the wearer a new medium to experience the world through.

Perspective Movers

Telepresence is the use of virtual reality technology to al-low someone to transport their senses to another location. This translation of origin effectively removes the perceptual apparatus from the body's location, and translates another environment to it. While this technology is heavily used now in commercial applications like telepresence videoconferencing, early explorations of the idea can be found in the arts, with James Auger and Jimmy Loizeau's *Social Tele-presence*.

Figure 3. *Social Tele-presence* - James Auger and Jimmy Loizeau's

The work consists of two parts. A camera and binaural microphone is mounted on a controllable platform that canrotate through three dimensions. This is connected to a headset that has a pair of TV glasses, speakers, and a gyroscope to track the wearer's head movement. The

head movements of the user are monitored and translated directly to the remote camera in real time so that they can control the directionality of their transported perceptual field, while the camera and microphone stream the audio and visual perspective from the surrogate body. The authors speculated on different uses for this technology, including a rent-a-body service, where the wearer could rent the physical body of another person, and direct them around so they see and hear a place without having to physically be there.

Where *Social Tele-presence* transports the wearer's point of perspective to a new remote location, Takehito Etani has developed a work, which gives a new perspective of the self, through *The Third Eye Project*. It questions conceptions of objective and subjective perspectives of body through moving the wearer's visual point of perspective to a third-person view. This allows for a re-contextualisation of the wearers relationship of themselves to their environment, blurring the distinction of the self and the outer world.

Figure 4. *The Third Eye Project* - Takehito Etani

Translators of Experience

Works that seek to translate experience aren't limited to other people's perspectives, with many being influenced by the physiology and experience of other animals. Haus-Rucker-Co's were influential pioneers of creating a range of perception-altering architectural pods and headgears, as part of their 'Mind Altering Program'. *Flyhead* (1968) is a transparent bulbous green helmet that filters the aural and visual senses of the wearer. It fractures the visual stimulus into a multi-image vista, by using a split prism in front of the eyes. The differences between our perception of another animal's perceptual

faculties is used as a metaphor for creating an experience for the wearer, seeking an evocation rather than an direct duplication.

A series of works by artists Chris Woebken and Kenichi Okada's entitled *Animal Superpowers* (2008) explores similar themes through a range of methods. The *Ant Apparatus* seeks to offer the perspective of being a minute bug, exploring the relatively large blades of grass in a field. The technology consists of a headset with virtual reality goggles, and gloves that have embedded microscopes. The apparatus allows the wearer to see the world at the scale that an ant does, magnifying their vision to 50 times its original size, and translating their point of view down to a low level.

The *Bird Device* focuses on the perceptual abilities that other animals have that surpass the limits of our own senses. This is related to the 'Sense Amplifier and Extender' category, as it presents the wearer with an experience that lies outside the normal limitations of our perception. Inspired by the ability of birds to detect the orientation of geomagnetic fields for navigation, the wearable headband can detect direction through GPS, the wearer is led in a path by vibration feedback when they're on the right track. In this case, the experience of the bird is used as a metaphor for designing the experience of the wearers, as it is heavily limited to an approximation of the bird's experience.

Figure 5. *Ant Apparatus* - Chris Woebken and Kenichi Okada

Lastly, *Giraffe Device* focuses more on the wearer's perception of themselves, through the physiology and metaphor of a giraffe. The artists describe it as a child-to-adult converter, raising the height of perception through a periscope extension, and lowering the voice of the wearer to make them feel like they're older. This idea

of offering the wearer the experience that others have of themselves is shared with the author's work, *Your Hearing Them*, presented at the end of this paper.

Animal Superpowers is one of many works that are informed by the perceptual apparatus of various animals. Heavily influenced by Michael Land's comprehensive account of all known types of animal eyes, (Land, 2002) Clearly Connolly and Neil McKenzie's developed a range of *Metaperceptual Helmets* (2014). These works include *Hammerhead*, *Chameleon*, *Horsehead*, *and Giraffe*, and aim to translate the optical mechanism of these animals onto the wearer's visual sense. Each helmet changes the perception of the wearer in a different way. *Hammerhead* changes depth perception by widening the interpupillary distance. *Chameleon* allows for one eye to face forward, while the other faces behind. *Horsehead* widens the wearer's peripheral vision to 350°. Lastly, *Giraffe* elevates the height of the viewer's perspective. Through modeling these passive perceptual filters on other animals' physiology, the wearer becomes aware of the differences between how we see the world, and how other animals do, allowing for a meditation on how this colours our experience of seeing the world. These works are exemplars of Don Idhe's concept of embodiment relations, as they are clear mediums to experience the world through.

The authors have speculated on future helmets, which they have described as Para-perceptual (2015), and Exo-perceptual (2015). Through moving away from the zoological topologies that informed the metaperceptual helmets, these new works explore new forms of optical constructions, which are not based on natural arrangements. *Cross-Eyed* skews the direction of each eye outwards, and *Cyclops* explores binocular rivalry, with a large central eye in front, and a smaller eye focused downwards.

Figure 6. *Chameleon* - Clearly Connolly and Neil McKenzie

Perceptual Re-arrangers

Figure 7. *Upside Down Glasses* - Carten Höller

The move away from zoological organisation of the senses opens up new mediums for experiencing the world through. These perceptual rearranges may not have a functional intent, however, by confronting the wearer with new structures of experience, elements of their normal modes of experiencing are revealed. Carsten Höller explores non-natural arrangements of our visual perception, through his *Upside Down Glasses* (2001). This is an extension of the neural adaptation experiments of George M. Stratton, who devised a set of glasses that could invert both vertical and horizontal visual field of the wearer. *Upside Down Glasses* horizontally inverts the visual field of the wearer, and allows the wearer to explore the rest of his exhibition through this new arrangement.

In a similar vein, Alfons Schilling *Vision Machines (Sehmaschinen)* confront the wearer with completely

new organisational structures of their visual perceptions. This range of wearable visual alterers were influenced by Schilling's war against the 'tyranny of Cyclopic sight', with these works attempting to break out of our normal modes of seeing the world. The most emblematic of his antithetical intent are his works *Kleines Rad* (1978) and *Antelope* (1984). *Kleines Rad* inverts left and right, and front and back, creating a disorienting experience where the wearer can move through the world only through seeing what they've left behind. *Antelope* intensifies this idea by making far things now near on top of the previous inversions. Similar to the *Meteperceptual Helmets*, these works are informed by the optical physiology of other animals, however, it's intent is more grounded on a meditation of the limitations of our own visual senses.

This idea of inverting the perceptual field of the wearer is explored in a different modality in the author's work *Your Localisation Exposed*. The auditory field is inverted through effectively swapping the ears: making left and right reverse.

This category of works all explore how we experience the world through changing our point of perspective or modifying the organisation of our perceptual faculties. With the use of technology, it's now also possible to change the modalities of our senses, transferring one stimulus into another mode of sensing.

Cross-Sense and Biohacking

The 'Cross-Sense and Biohacking' category feature couplings between the body and technology that become increasingly embedded. The line between body and technology becomes blurred, and questions of identity are provoked. The category is heavily related to the transhumanist movement, which studies the potential of emerging technologies that could be used to overcome fundamental human limitations.

This category is divided into two sections: Sensory Substitution, and Biohacking. The two sub-categories are not mutually exclusive, as it is possible for some technology to be both. Sensory Substitution focuses on technology that facilitates a modality change of our sensory experience. One sense can be converted into a stimulus that another sense can interpret. Biohacking is an emerging transhumanist movement, which includes modifying the body with technology. This can include using technology to modify how we experience the world.

Sensory Substitution

Sensory substitution has become an emerging field in neuroscience since initial experiments by Paul Bach-y-Rita in the 1960's. Driven by research into the plasticity of the brain, Paul Bach-y-Rita's research investigated the possibility of the brain being sufficiently plastic to develop an entirely new sensory system. Through this research, the first sensory substitution system was developed as a practical aid for the blind, which substituted visual stimulus for tactile stimulus. The user sits in a chair, which has a camera in front of it. The visual feed from the camera is translated to a bank of 400 small vibrators that are connected to the back of the user. The pattern of vibration from this modality translation device allowed the person to detect faces and objects successfully (Bach-y-Rita, 1969, 2004).

Since Bach-y-Rita's initial research into sensory substitution techniques, a whole research field has emerged which has systematically approached this crossing of modality. A full overview is outside the scope of this paper, (for a detailed discussion see Hatwell, 2013) however, some recent developments include Bach-y-Rita's *Brain-port* (Bach-y-Rita, 2005), which gives vision through the tongue. Using glasses with an embedded video camera and a small tongue pad that hosts an array of 400 microelectrodes, *Brainport* can encode visual stimuli into electric current that can be interpreted as visual information by the brain. Users report the sensation as pictures being painted on the tongue with tiny bubbles. In another function, it can also aid the vestibular system. By using accelerometer data from the glasses, the wearable technology measures the tilt of the head, and stimulates the tongue to help the wearer re-balance themselves (Danilov, 2005).

Concurrent to the innovations of Bach-y-Rita, Dutch physicist Peter Meijer was also developing sensory substitution devices with the *vOICe* vision technology (Meijer, 1992). Designed for people who are totally blind, the *vOICe* converts a live camera feed into sound. Images are converted into sound by scanning them from left to right while associating elevation with pitch and brightness with loudness. This is an exemplar of how our senses can be translated to a new modality, with vision being traded for hearing

The exploration of sensory substitution in art is still in its infancy. There may be multiple reasons for this. The technology itself is still developing, however, it is becoming increasingly accessible for artists who

lack in-depth technical training. The coupling between the body and technology is often quite invasive, with many examples including a large array of electrodes coming into contact with the body's nervous system. The invasiveness may be a deterrent for a wearable technology artwork, which is intended to be used by a range of people. However, there are some examples in which less invasive technological couplings have been explored.

XSense (2005), created by Adam Danielsson, is an interactive helmet that crosses sight and hearing. Sounds are translated into colour through an array of 64 LED's. The visual stimulus is turned into distance information, which is then translated into stereo sound within the helmet. The helmet is much less invasive than many other sensory substitution methods, however, it is not intended to be a permanent aid. Instead, the helmet can be worn for a short period of time, asking the wearer to re-negotiate their navigation of their environment.

Biohacking

Other artists have embraced the invasiveness of some sensory substitution methods, and have questioned the repercussions for the identity of the self when this coupling between technology and body becomes so intimate. Neil Harbisson is a recognized avant-garde artist and cyborg. He was born with achromatopsia - an extreme form of colour-blindness that means that he only sees in greyscale. This inability to see colour was a part of his desire to augment his visual experience of the world, and, in 2004, he implanted an antenna in his skull. Originally, Harbisson collaborated with Adam Montandon to create, *Eyeborg,* a wearable technology, which consisted of headphones, a laptop and a camera (Jeffries, 2014). Eventually, this coupling became much more embedded by implanting the speaker itself in his skull, and by having the camera attached to be a permanent appendage. *Eyeborg* allows for Harbisson to hear colour, translating the colour data from the camera to a sound transducer that vibrates his skull, allowing him to hear via bone conduction. Harbisson uses this technological mediation of the world as the basis of many other art works in a range of media. Colour concerts, sound portraits, colour scores, city colours: all these projects are informed and mediated through the *Eyeborg*.

Harbison's adoption of this embedded technology, and his identification as a cyborg, is closely related to the ethos of the biohacking field. Whether these couplings still belong to Don Ihde's conception of embodiment relations is somewhat ambiguous, as biohacking has the ability to not just be a medium to experience through, but to approach the ability of modifying the perceptual apparatus itself. The field itself ranges further than just altering perception, with many couplings providing biometric data of the body, or augmenting their experience with informatics.

Tim Cannon was one of the first to implant an electronic sensing system that can provide biometric data of his body. The system wirelessly sends his body temperature and blood pressure to a computer, giving him real-time updates about the status of his body dynamics (Wainwright, 2015). Although this can be done through much less invasive means, part of the impetus for this project is start a dialogue of what could be possible through biohacking.

The Cross-Sense and Biohacking ethos provokes many questions about the relationship between the body and technology, what can be possible with this coupling, and what repercussions these relationships have for defining the self. The possibilities for new artworks, which use these embedded technologies to alter the perceptual apparatus, have yet to be thoroughly explored. With the technology becoming more accessible to artists, and smaller and safer to integrate with the body, this could a fruitful field.

New Works

This history of wearable technologies that mediate our experience of the world can be used as a framework for new works. As with most studies that focus on perception, the field is dominated by works that explore the visual sense. Some works included in this history focus on our experience of sound including *Phox Ears*, and *Eidos Audio*, however this is a largely under-explored field that has the potential for interesting new works.

This has informed the creation of two new sound-art works that use technology to append and extend the perceptual apparatus of the wearer. Both works fit in the 'Perspective Changers' category. *Your Hearing Them* is informed by both the 'Translators of Experience' works that seek to offer the wearer someone else's perspective of themselves, as well as, the 'Perspective Movers', which translates the wearer's point of perspective to a new location in space. Alternatively, *Your Localisation Exposed* explores the rearrangement of the perceptual

apparatus, forcing the user to renegotiate their aural awareness, and revealing their normal modes of localising sound.

Your Hearing Them

Figure 8. *Your Hearing Them*

Your Hearing Them explores the deeply personal experience of one's own voice, through allowing others to experience it as you do. When someone speaks, they hear the sound of their voice as it reflects off the surfaces of the room and then returns to their ears. Additionally, the skull of the speaker is resonated by the vibration of the vocal folds, creating a full-bodied sound with much low frequency content, as well as the embodied experience of the skull vibrating. This additional element causes the speaker to hear their voice differently than how others do, and is the cause of the 'foreign' sound of our recorded and played back voice when heard by the speaker.

A duplicate pair of wearable technology headsets enable two people to have an augmented conversation. Through appending the perceptual apparatus with the wearable technology, the bone transducers are able to reintroduce the speaker's extra layer of experience. This allows for a conversation to be had where two participants experience each other's voice the way the speaker hears themself - creating a powerful transportation of subjectivity and experience.

Your Hearing Them shares themes with the 'Perspective Movers' sub-category, as it translates the wearer's point of perspective. The work has a very specific perspective that it translates, and similar to Takehito Etani's *The Third Eye Project,* offers a new perspective of the self. The 'Translators of Experience' themes are also explored, as the work seeks to give the wearer the experience of their conversation partner.

Your Localisation Exposed

Your Localisation Exposed is a perceptual rearranger. The work is informed by the inversion of perception that Carsten Höller's *Upside Down Glasses* and Alfons Shilling's *Kleines Rad* both explore, with *Your Localisation Exposed* producing this inversion of perception in the aural domain.

Through a wearable headset that hosts binaural microphones and speakers, *Your Localisation Exposed* inverts left and right in the wearer's auditory field. This effectively rearranges the ears of the wearer, swapping the spatial location of their left and right ears. The user is invited to then go on a soundwalk, and to explore their surrounding with this new re-arrangement of their senses.

Through depriving the wearer of their normal mode of perception, the work re-contextualises our normal mode of hearing, and exposes an element of our hearing that is often sub-conscious. Our evolutionary history has shaped the use of our hearing as a survival mechanism, allowing us to determine the location of other animals and threats by sound. (Heffner and Heffner, 1992) This process is usually subconscious, yet constantly active. Through laterally inverting the auditory field, this localisation process becomes conscious, as the wearer is confronting with a paradoxical sensual world. The visual and aural worlds are in conflict, intensifying the experience of inversion.

Conclusions

The intersection between art, technology, and body is a fertile site for art across different mediums. The power of these works lies in the engagement and interaction with the audience. Their own perception is at the heart of the work, with many new couplings offering the allure of a new experience, or a new perspective on their everyday experience. Through the identification of these categories of works, it's hoped that this framework can connect previous works with shared implicit themes. This shows the ways that different facets of our perceptual apparatus have been explored, and reveals those that haven't. Although this history is not exhaustive, it is representative of the shape of the field. The visual sense is most heavily explored, with sound and touch being secondary. This is an element of

motivation for the new works *Your Hearing Them*, and *Your Localisation Exposed*, as often the nuances of our personal listening experience go unexamined.

This history has been used as the basis for the creation of two new works presented in this paper. It is the hope of the author that this history can be used as a basis for speculations of new works from other artists, and in a range of fields. The ways that biohacking, and the close integration of technology, can alter our perception are starting to be explored. There are still many facets of perception that haven't been explored yet through this framework. Visual works dominate the history, with some sound works included as well. Our other senses could prove to be fertile sites for exploring how technology can augment and extend our experience.

The themes explored in this history could have resonance in other fields as well. The emergence of Virtual Reality (VR) has created a proliferation of innovation in wearable technology. The history presented above has focused on works that use technology to mediate their experience of the physical world. However, as the VR technology develops, it may be possible to virtually create physical environments accurately enough that it becomes convincing to the wearer. The distinction between real and virtual may soften, and the same themes that have been explored in the perceptual alterers discussed above, may provoke interesting new experiences in the virtual realm.

Acknowledgements

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Authors Biographies

Blake Johnston is a New Zealand based sound artist, currently undertaking his PhD at Victoria University of Wellington Te Kōkī. His works explore his idea of the metaperceptual: the approach of using the perceptual apparatus of the audience as the base materials for his works.

Michael Norris is a Wellington-based composer, software programmer and music theorist. He holds composition degrees from Victoria University of Wellington and City University, London, and is currently Programme Leader, Composition at Te Kōkī New Zealand School of Music, Victoria University of Wellington.

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Jim Murphy is an artist and researcher working at the boundary between mechatronics, luthiery, and installation-oriented sculpture. His recent works focus on the act of obtaining unexpected sounds from objects through the use of mechatronic actuation and excitation. In 2015, Jim founded new media project Technical Earth with artist Mo H. Zareei.