PUSH AND PULL:

CREATIVE PRACTICE AND CREATING TECHNOLOGIES

Sophie Rose

The lures of technologically enhanced performance are numerous but present challenges. This paper discusses the interplay of creative practice and embodied technology design as I experienced it through the co-development and construction of a set of data-gloves for use in performance. The project grew from the desire to engage with technology in an intuitive and visually exciting way. Using an embodied technology to interact with the voice radically changed my experience when performing. It led to feeling immersed in the sound and performance in contrast to disconcerted (with sampling) or nonplussed (with effects pedals). The gloves encouraged specificity in performance techniques and the use of movement cues. Audio manipulation via embodied interactive technology was startlingly empowering. The gloves connected to Ableton via MAX/MSP. MAX/MSP monitored the movement of flex sensors and buttons and communicated this by Musical Interface Digital Instrument (MIDI) to Ableton. Data triggered samples and audio effects in Ableton that affected the audio output of two microphones. Making, evaluating, troubleshooting, and curating sonic effects led to the creation of the piece, *Tāwhirimātea* (Rose 2018a), the adaptation of *Te Karanga* (Rose 2018b), and use in *These Would Be Other* (Burke & Mann 2019). This is an ongoing project, which will build upon the initial iteration discussed in this paper, to explore using embodied interactive technology to manipulate, alter and spatialise sound in surround sound and Ambisonic environments. There is further work to be explored within the design and

technical capabilities of these gloves, including how it changes the user experience and what effects the types of interactions have on composition and performative outcomes.

Push and Pull

The lures of technologically enhanced performance are numerous but present challenges. This paper discusses the interplay of creative practice and embodied technology design. Technology has become far more accessible, easy to use, and relatively inexpensive for the practitioner and consumer alike. In early 2018, I began using MAX/MSP (Cycling '74 2018), and a world of possibilities for interactive audio manipulation unfurled. This led to co-developing a set of data-gloves for performance purposes. These gloves connected to Ableton via MAX/MSP using virtual serial ports and Bluetooth. MAX/MSP monitored the movement of flexible sensors and buttons that triggered samples and audio effects in Ableton via MIDI data affecting the audio output of two microphones. The project grew from the desire to engage with technology in an intuitive and visually meaningful way. The commonplace grids of knobs and buttons found on commercial MIDI controllers had always felt unintuitive. By making the controllers mobile, I hoped to escape the constraints of the singer-songwriter stuck behind an instrument. This investigation quickly became entwined with other aspects of my practice. Making, evaluating, troubleshooting, and curating sonic effects lead to the creation of the piece, *Tāwhirimātea* (Rose 2018a), the adaptation of *Te Karanga* (Rose 2018b), and use in other's pieces such as *These Would Be Other* (Burke & Mann 2019). This enterprise inspired an ongoing exploration of the use of effects on the voice through embodied interfaces.

This project explored technology development with composition, performance, and improvisation according to the practice-based methods outlined by Candy (2006) and Mäkelä (2007). Contemporary designs with similar technological outcomes include eMic (D. Hewitt 2011; D. Hewitt & Stevenson 2003; D. G. Hewitt 2006), VAMP (Jessop 2009, 2012, 2018), Alto.Glove (Thorn 2018); GloveSense (Wiegman, Wells, Hedlund, & Erad 2015); AirSticks (Ilsar 2012); and

Mi.Mu (Mi.Mu Gloves LTD 2016; Mitchell, Madgwick, & Heap 2012). The most influential project for our design was Mi.Mu. The Mi.Mu gloves have eight sensors per glove (two per finger, with no sensors on the pinky finger). They communicate via WIFI through software, Glover, to Ableton (or any other DAW). Glover is used to interpret gestures which can be mapped to sounds or effects. Jessop created the Virtual Augmentation and Manipulation Prosthesis (VAMP) as a super-human voice prosthesis for an opera character. VAMP enables the wearer to 'pinch-to-hold' notes while singing, allowing the performer to move off the note while 'holding' the previous pitch. The performer can thus sustain, pitch-shift, or otherwise affect their voice (for example, vibrato) to enhance performance. We did not examine non-glove based gestural music technologies for the implementation of this project, but we were interested in the gestures and philosophies underpinning the eMic and AirSticks. Hewitt and Stevenson (2003) used the eMic controller as a tool to explore the singer's use of gestures with a microphone stand. The gestures that they explore include the stroking, tilting, and rotating of the microphone stand which are sensed through tilt, ribbon, and pressure sensors, and mounted joysticks. Hewitt (2006) notes that audience-performer communication is harmed when the audio manipulation is conducted behind the barrier of a laptop. The eMic removes the barrier to the audience whilst allowing the performer to use the traditional codified language of the microphone stand for control and audio manipulation.

Our interactions with technology shape us in physical and psychological ways (Burt 1994; Erkut & Dahl 2019; Höök 2018; Weintraub 2015; Wilde, Schiphorst, & Klooster 2011). The implications of this are evolving interface designs that engage the performer in embodied interaction during performance. As a kinaesthetic learner (Gault 2016), I integrate new techniques into my practice to internalise information fully. This experience aligns with embodied cognition philosophies (Ádám 2013; Geeves & Sutton 2015; Leman & Leman 2008) and somaesthetic approaches to design for optimal use of objects. Embodied cognition is the theory that our understanding, knowledge acquisition, is shaped by the body and environment that we inhabit (Cowart 2019).

It has roots in Merleau-Ponty's phenomenology (1965), Dewey's pragmatism (1920), and is linked to modern somaesthetics (Höök 2018; Shusterman 1999). Somaesthetics and soma design dictate that objects should deepen the user's mindfulness and engagement with the item through use. Merleau-Ponty incorporates the mind-body connection in phenomenology, placing the body in the foreground of understanding perceptions. Shusterman argues that we must analyse the body's responses to understand our perceptions of reality entirely.

Or, How

Figure 1. Materials used to create DIY flexible sensors.

(We used practice-led research and research-led practice (Candy 2006; Smith & Dean 2009) as applicable to each design stage. Literature informed the programming aspects, and the electronic design and physical fabrication used our pre-existing knowledge and skills.

We used MAX/ MSP (Cycling ’74 2018), Arduino (arduino.cc 2019), and Ableton (Ableton 2018) to develop the technology and drew inspiration and ideas for problem-solving from Jessop (2009, 2012), Mi.Mu development blog (Mi.Mu Gloves LTD 2015), and GloveSense (Wiegman et al. 2015). This literature demonstrated a variety of approaches that other creators had used and provided a framework to formulate our process. To keep the construction achievable in the limited time frame of two months, we modified parts of default projects from Arduino and MAX/MSP, such as the Virtual Colour Mixer. We built bespoke, flexible sensors using jumper cables and static insulation bags (shown in Figure 1 and 2) to proof the concept and assess the ranges of data gathered before switching to more durable, commercial-grade flexible sensors. The wearable elements were constructed from swimming grade Lycra, lace, metal eyelets, polyurethane vinyl, plastic project boxes, and shoelaces. The circuit boards and housing for the electronics connected directly to the sensors, which were attached to the gloves. Each glove sent data to one virtual serial port channel into MAX/MSP. Small capacity power banks, hidden within the performer's clothing, powered the gloves. Cloud Unknowing, my collaborator, designed the circuit boards and electronic looms, and I constructed the gloves and tested physical materials and prototype sensor designs.

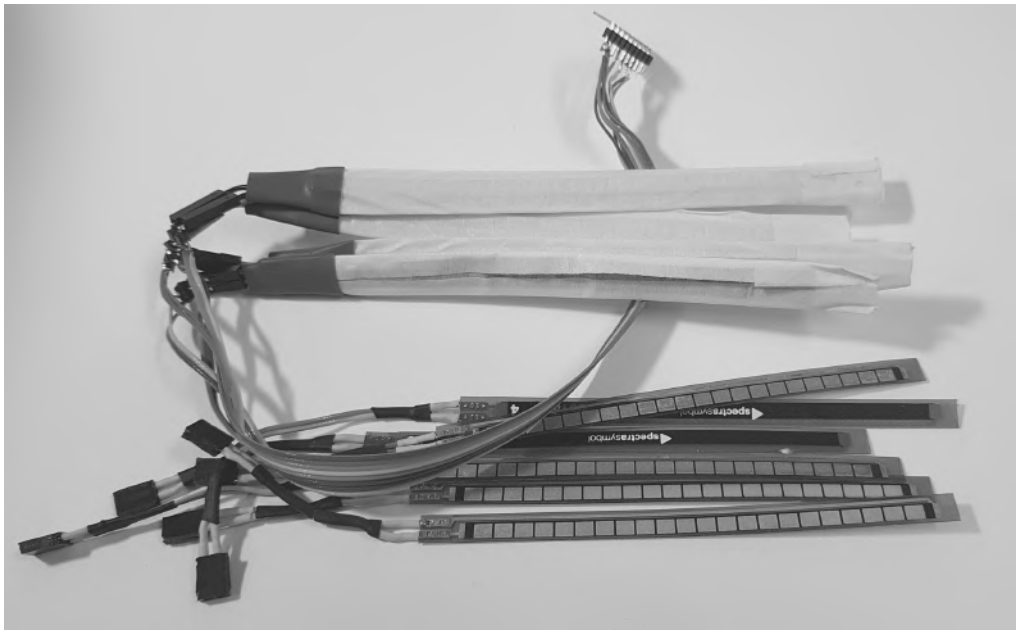

Figure 2. Commercial and DIY flexible sensors.

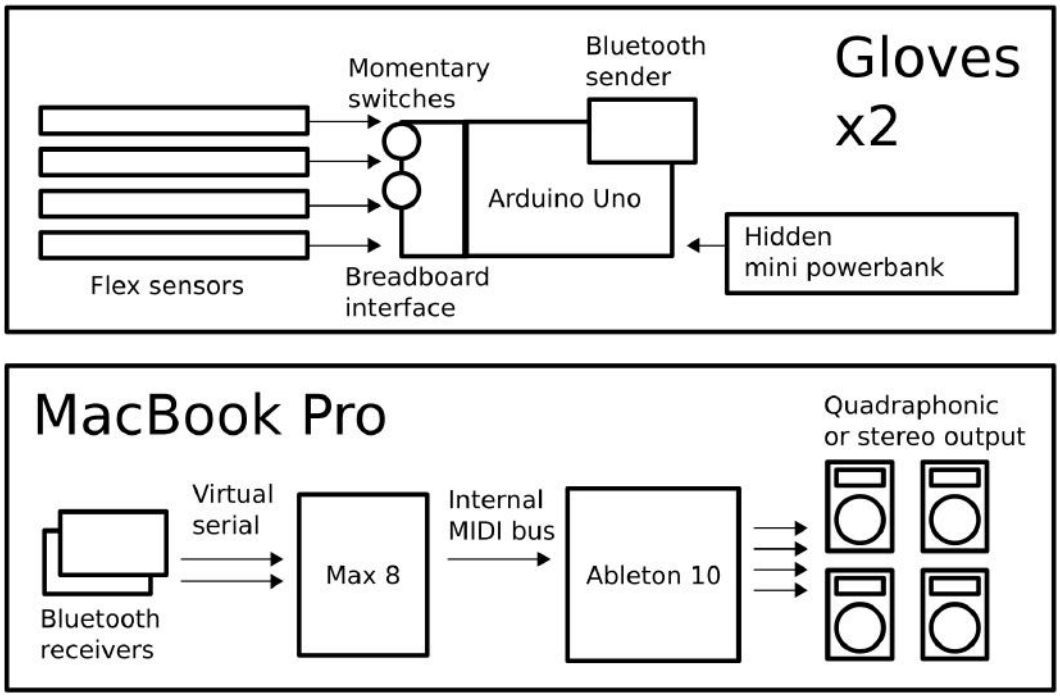

Figure 3. Functional diagram of performance set-up.

The primary research output of the original design, *Tāwhirimātea* (Rose 2018a), was composed through my exploration into the use of gesture on digitally mediated singing. The work is around 20 minutes long and is written for a singer and a percussionist, both using extended techniques. I used the legend of the separation of Ranginui (sky father) and Papatūānuku (earth mother) as inspiration for the sonic effects. Tāwhirimātea is the god of storms and thunder. He is furious when he learns that his brothers have torn Ranginui and Papatūānuku apart from their eternal embrace for what he perceives as selfish motivations. Tāwhirimātea calls up storms to attack his brothers Tūmatauenga, Tangaroa, Rongo, and Haumia-Tiketike, and he pursues them still. A graph score and conducting cues were developed with my collaborator-percussionist (Cloud Unknowing) allowing room for improvisation, a sense of movement, and storytelling. These gestures included: a violin bowing hand and arm movement which triggered substantial delay and reverb while limiting the audible frequencies according to the position of the ring finger; a fist striking downwards to cue mallets on cymbals which would produce a small amount of delay with the right hand or a massive amount of distortion with the left hand; a flat palm moving up or down parallel to the floor to indicate volume changes which produced a large feedback delay into substantial reverb effect of

Riffs

the Ethereal Canyon plugin in Ableton; and rubbing the index finger and thumb together to cue a drone which created small amounts of delay on the voice. There were four buttons on the black boxes, shown in Figure 4, one of these captured a new sample for use in a granular synthesiser, and the other three triggered thunder and bird call field recording samples. Effects were curated per hand so that if the battery on one glove failed, the effects used would be aesthetically consistent. Compositional and aesthetic inspirations were drawn from *Licht & Abyss* (Pouget 2012); *Idol* (D. Hewitt 2010); *The Litanies of Satan* (Galás 1986); *Bad Body Double* (Heap 2009); *Sappho* (ChagallMusicOfficial 2015); and *Moving Creates Vortices, Vortices Create Movement* (teamLab 2018). **Please see the QR code if you would like to experience this piece.**

Tāwhirimātea (Rose 2018a)

Figure 4. Initial glove design and fabrication.

MIDI Mappings

C..	Note/Control	Path	Name	Min	Max
1	CC 1	Live Mic | Ether...	Feedback	150 %	0.0 %
1	CC 2	Live Mic | Rubb...	Frequency	500 Hz	19.9 kHz
1	CC 3	Live Mic | Laundry	LFO Amount	6.50 ms	0.00 ms
1	CC 3	Live Mic | Laundry	LFO Rate	10.0 Hz	0.03 Hz
1	CC 4	Loop Pedal | La...	Dry/Wet	79 %	0.0 %
1	CC 5	Loop Pedal | Pit...	Fuzz Amount	74 %	11 %
1	CC 6	Loop Pedal | Ga...	Feedback	95 %	19 %
1	Note C3	Plain Audio	Slot 1		
1	Note C#3	Stored Loops 2	Slot 1		
1	Note D3	Stored Loops 3	Slot 1		
1	Note D#3	2-Granulator II ...	Grab		

Figure 5. Ableton MIDI routing.

Whereas *Tāwhirimātea* (Rose 2018a) was composed to demonstrate and chart the potential of the technology, *Te Karanga* (Rose 2018b) was arranged from a pre-existing gestural piece for the use of the gloves. *Te Karanga* was initially written for an ensemble of eight to twelve performers using Foley techniques and controlled by a conductor-narrator. The conductor-narrator told a story in Te Reo Māori while giving sound cues based on demonstrative gestures to the ensemble. For example, a two-fingered walking motion cued footstep sounds and speed, and a Māori dance move that flicks the fingers upwards and outwards cued water bubbling and percussion. These and similar sounds contextualised the story, which is the journey through the New Zealand bush to a marae (meeting house). When the main character of the text reaches the marae, a karanga (welcome call or song heard at the beginning of a pōwhiri – welcoming ceremony) begins. The demonstrative gestural cues were adapted to glove performance by retaining enough of the gesture to function as a cue whilst triggering the desired chain of effects. For example, I changed which hand performed certain gestures to avoid engaging the distortion at inappropriate moments. This piece was used to refine further the use of effects and experience embodied interaction with an interface.

I Learnt to Stop Worrying and Love the Technological Failures

The first iteration has proven successful as a performance tool, composition device, and provided a unique nexus between practice and interaction with technology. I will use our current version to look at design following embodied cognition, composition, and live performance in future iterations. The experience of developing this prosthesis unequivocally affected my creative practice, and forced a change in workflow by refocusing aesthetic choices on spatial audio and creating sound environments for an audience. Questions that my practice previously explored were, 'how does a melody flow and develop?' and 'how do I integrate this theory?' These concerns changed to, 'how far can I push this device?' and 'what are the limits of it and me?'

Design evaluations had a significant role in the incorporation of technology. Technical hiccoughs and troubleshooting imposed limitations on rehearsals and workshopping of Tāwhirimātea. This encouraged specificity in techniques to be performed and the use of movement cues instead of rigorous rehearsals and memorisation. During the first concert, a persistent bug in Ableton inserted audio glitches due to an incompatibility with my laptop's screen refresh rate. The problem stuttered playback whenever a sample looped. To combat this, I tried altering the sample audio, the loop duration, and removing, reformatting, and re-entering samples. These intractable digital glitches became a feature of the composition. Bluetooth did not endear itself for future projects. Bluetooth 4 was not compatible with my devices, and Bluetooth 2 had difficulty connecting and remaining connected to the computer. The introduction of audience members into this ecosystem added more competing local Bluetooth devices, further reducing Bluetooth's robustness. This unreliability made every outing an exercise in patience and persistence. The low current draw of the Arduino Uno was not sufficient to keep larger powerbanks running as the powerbanks could not detect the current draw and would turn off during performance. This complication necessitated having several small, pre-charged powerbanks on stage in case of battery failure. When batteries failed on stage, one would once again be faced with the Bluetooth debacle. Irritatingly, the time it connected without fuss was during a performance of John Zorn's *Cobra* (1984), when both the stage and venue were crammed full of performers and audience members, and I ran out of battery on one side. As we developed and altered the technology, the reliability of the machine changed my interactions with it. This relationship will be discussed in conjunction with music for surround sound, quadrophonic, and Ambisonic environments in future research.

Using the gloves necessitated incredibly deliberate movement to control the sound output. This control improved with continued exposure to the system and became more refined and malleable as the gloves were assimilated into practice. Although I was freer to move on stage than I had been with a guitar or piano, I remained tied to the microphone stand and computer for monitoring purposes and to stay close to the failsafe panic buttons. Through erroneously dissecting the technology, audience feedback provided valuable

insight into how we interpret gesture, technology, and sound connecting. For example, one thought that the percussive elements created by granular synthesis were linked to a pulse sensor. This idea is interesting, though it would be finicky to implement in performances. It could be useful in a meditative or therapeutic setting as demonstrated by the BrightHearts project (Burton, Morrow, Beswick, & Khut 2018; TEDx Talks 2013) which uses the individual's pulse to affect visual and musical stimuli to reduce anxiety in children awaiting surgery. The design seemed like witchcraft – which was surely supported by the costuming and staging. The costuming (black makeup, feather Māori style cloak (korowai), feather neck and chest covering, and exposed muscle patterned leggings, see Figures 6 and 7) alludes to shamanism and magic and was framed by blue-green lighting with a chrome drum kit which reflected the lighting towards the audience and around the room. The feathers gave the illusion of complete coverage to the waist and undressed past the skin below that.

Oh God, It's in My Body

The glove concept was seductive with its promises of freedom, movement, and the ability to manipulate sound in a visually exciting way. Inherent in this is the use of gestures – their meanings, emotional transference, preserving natural movements, and extending creative abilities. The voice and body are intimately connected; the embodied cognition approach seeks to include the mind, body, and location into phenomenology to ensure the capture of the full picture when gathering data. The practitioner may exploit or subvert common gesture usage. This technology returned the use of my arms in live performance in contrast to my regular self-accompanying performance experiences as experienced by Hewitt (2003) with the eMic controller. It also gave me back an enhanced potential for expressive gestures usually available to singers, but not to instrumentalist-singers who have their hands occupied. By being hands-free, I could conduct efficiently in *Tāwhirimātea* and *Te Karanga*. Gestural assignments were unsophisticated due to the relative simplicity of the first iteration of this project; for example, the 'all sound off' gesture was the 'Fuck You' double finger sign. This gesture was unintentional but was kept for my amusement. It was satisfying when it became a useful feature.

The gestures used in *Tāwhirimātea* were specific to instrumental percussion cues. In *Te Karanga*, I drew the gestures from a combination of Māori Kapa Haka dance representations of animal and elemental sounds. I used the gloves in an avant-garde improvisation of *These Would Be Other* (Burke & Mann 2019) at the Make It Up Club with Brigid Burke and Steve Falk. We began with a piece composed by Brigid Burke derived from an untitled spoken-word piece by the late Chris Mann.

Figure 6. Gloved performance of *Tāwhirimātea* and *Te Karanga*. Photo by Kylie Supski and ReVerse Butcher (2019).

In my interpretation, it made the spoken word sound more like the shouting-into-the-void sense that I get from much of Mann's recorded works. The piece was simultaneously internal self-talk and public rambling. Being able to convey these electronic enhancements through gesture added to this interpretation. The Ethereal Canyon delay supported the Chris Mann style of delivery, and the 'all off' gesture fit the text.

Make it Up Club Performance (audio only).

Unforeseen emotional consequences that I experienced while performing with the gloves were dramatic. I felt a sense of empowerment when using the technology which I have not felt in acoustic performance or when using effects on other instruments, such as distortion on the guitar. The embodied nature of the voice leads me to believe that this may be a shared experience by those whose first mode of expression is the voice, that is, singers, actors, poets, and laypeople that do not actively engage in visual or tactile art. It may even be a broadly common phenomenon across any demographic. This experience differs from sampling one's voice and gives an engagement with the voice which sampling cannot. It is instantly responsive and does not provide the same human recoiling or uncanny valley feeling as sampling. I think more about the physical and virtual space I occupy, which alters my artistic choices. When sampling my voice (for use as a synthesizer or as pre-recorded audio), I would feel disconnected from my voice. Often, I would not be able to recognise that voice as my own or I would experience an uncanny feeling when hearing it played back. For example, the third movement of *Life... Certainly is Very Interesting* (Rose, Rudegair & Wilson 2018) incorporated live voice and a synthesizer made from my voice. That fact had to be pointed out to me by my collaborators. When using effects pedals, as I experimented with in my master's thesis, I was engaged with the sound, but it did not feel like an extension of my being. When adding the effects via the gloves, I feel fully immersed in the sound and activity of creating. It gives an impression of haptic control over my voice.

The procedure for performing with the gloves has developed into a ritual, albeit not always a calming one. Step one: suit up and curse the bulkiness and inability to hide the technology; Step two: anxiety when waiting for Bluetooth to engage and connect; Step three: hope that the sound engineer is paying attention to the audio levels; Step four: pull the voice outside of my body to externalise and manipulate it as an instrumentalist might. This is an emotionally complex sequence, especially steps two and three. The development of this new performance ritual provides a unique sense of freedom in performance. For example, I know that if I use samples, there will be audio stutters as they loop. Therefore, these glitches may be exploited to focus in on the acoustic voice for a small moment before it is plunged back into the technologically mediated sound.

Using embodied technology in performances immerses the artist in the sound in a way that feels like a virtual haptic feedback. In this way, it has similarities to virtual reality technology, such as the Oculus Rift (Facebook Technologies, LLC. 2019), and may be used to immerse an audience in the sound-world that the performer engages in through spatial music and performative actions. The immersive environment and storytelling potentials speak to our human desires. The merging of two worlds and experiencing the physical sensations for information based in fiction is an exciting concept.

Conclusions and Future Work

Using an embodied technology to interact with the voice radically changed my experience when performing. It led to feeling completely immersed in the sound and performance in contrast to disconcerted (with sampling) or nonplussed (with effects pedals). Further exploration is needed in the design and technical capabilities of these gloves, including how it changes the user experience and what effects the types of interactions have on composition or performative outcomes.

Figure 7. The modified feather korowai cloak, necklace, and leggings.

Although the system is still rudimentary, it has been useful in different performance contexts. Use of the gloves created new performance rituals. The use of gesture, costuming, and sound cues may build a ritual or shamanic sound environment which can influence the audience experience to create immersive sound worlds and performance experiences. This work has been ongoing, and project development will continue at a doctoral level, investigating the incorporation of embodied technologies in practice and embodied cognitive perception. The second version of the gloves project began in February 2020, and an installation work using a tangible interface with photosensors to explore different technologies' impact on performance and composition has begun. The overall construction and programming will be altered to have custom software and improved versatility.

Sophie Rose is a Contemporary Vocals lecturer at Australian Institute of Music and a doctoral student at the University of Melbourne.. She is a singer, extended vocal technique enthusiast, composer, improviser, performer, and maker. Originally from New Zealand, Rose incorporates Māori mythology into many works and creates new technologies with collaborator, Cloud Unknowing. She performs and collaborates with Sophie Rose & the Manual Breathing and surrealist music collective Little Songs of the Mutilated. Her exploration of the relationship between creative practice and technology development is ongoing. This concern is reflected in her master's thesis, which explores the effects of physical and non-physical environments on extended vocal techniques and throat-singing as a creative practice.

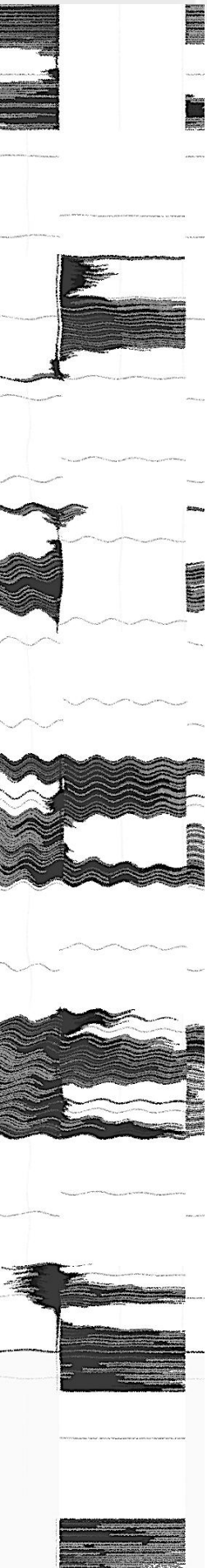

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Photo by Kylie Supski and ReVerse Butcher (2019).