Part II
Case Study

The Project

We can interpret the design and development of the final project of on-body haptic devices through Chapman and Sawchuck's "Research-for-Creation" label. In all stages of the project, many 'new directions' were pursued. Largely due to necessary and specific research that took place such that any one of the technical components may be developed, designed or effectively interacted with, used or accessed. Although prior experience and knowledge provided guiding intuition and the assertive confidence to pursue complex technological options, a vast majority of the final on-body haptic system was the result of acquiring, synthesizing and analyzing a significant amount of previously unknown material. Similarly, research into a possible direction of collaboration between different technical components so as to inform the group as to what may be possible before a creative use becomes apparent was necessary. As such a cyclical information exchange of research informing creative use which then informs additional research etc. emerged during my individual exploration in the on-body haptic device design and build process as well as the cyclical interactions with other group members for feedback and interpretation of their subjective and objective comments and suggestions during all phases of the creative technological development.

Technical Design: On Concept and Implementation

If we accept Dufrenne's concept of the technical object in *The Aesthetic Object and The Technical Object* (1964) then what we have with the on-body haptic belts is of certain technical. It is not, as Dufrenne indicates, an "aesthetic object, i.e., ...an object intended solely for contemplation". Rather, what is accomplished through the use of this technical object is an interpreter of sensory mediums. An object that facilitates an emotional discussion within a user when actively engaged in improvisational play and deep listening. The on-body haptic belts transmit a sensorial experience that is stimulated by ones' aesthetic desires to connect with or against alien others and through an individual's personal interpretations of the environment. Thus inducing a direct causal relationship between the haptic feedback and a user's actions- actions that are continuously interpreted on a sliding 'similar-dissimilar' scale to the actions of others engaged with their own technical (haptic) objects and aesthetic (gestural) interpretations.

The general flow of the on-body haptic system includes a centralized Nodejs server running on a RasperberryPi Zero which receives OSC commands over Wi-Fi and transmits an interpreted set of command instruction over Bluetooth to the individual on-body haptic Arduino Lilypad motor drivers. I decided to build five devices that act like vibro-tactile belts, fit snug around the torso as many prior haptic tests, such as those highlighted in Giordano and Wanderly (2013), indicated that "better results were achieved on the waist and torso than on the forearm". Thus for my purpose, this would be the most responsive and accessible on-body position for the inclusion of a vibro-tactile response system for our collective performance. By creating five individual belts, for the purpose of the final showcase, there would be multiple interaction systems possible and that their use in an ongoing performative improvisational process could also constitute a test and source of research collection for the development of future on-body haptics that would encompass the four limbs and torso of any one individual. In this way the expectation of a full-body haptic suit, conceptually similar in purpose and design to the Ilinx garment found in Giordano et al. (2015) and Lamontagne et al. (2015) may be realized. As with Ilinx, the on-body haptic system here reacts in real-time to the OSC media input through a variety of patterns and intensities. In addition, I also decided to use a velcro wrap which snugs the motors in easily and both their placement as well as the belt size can be adjusted with ease and quickly taken on and off. This would therefore satisfy the requirement of multiple users removing and passing the belts to others during the final showcase.

A point of contention in my design process was evaluating the capacity of an Arduino to handle OSC messages entirely onboard with the possibility of eliminating the centralized Nodejs server on the Raspberry Pi. This was not included in the final design and is still open ended with respect to its performance capabilities. I also depart from the implementation described in Giordano et al. (2015) and Lamontagne et al. (2015) with the consideration that full system Arduinos and Micro-computers (BeagleBone, Raspberry Pi etc.) may not in fact be necessary to drive the haptic sensations. As such, I opted to test the capacity of lighter and smaller electronic devices such as the RaspberryPi Zero and the Arduino LilyPad. The reasoning here is to eventually fabricate custom designed printed circuitboards that utilize only the bare minimum in micro-electronic components. In fact, after a later evaluation of current literature post-fabrication of my on-body haptic devices, it was found that Hattwick, Franco and Wanderly (2017) describe their 'Vibropixels' as following this same design principle. The LilyPad Arduino is nothing more than a stripped

down Arduino highlighting the ATMega328 microcontroller with little else on board. By striping away the system power of a micro-computer I have separated the handling of incoming and continuous OSC media content and messages through the Raspberry Pi and delegated only the motor activation through the Arduino.

Pulling from Giordano and Wanderly (2013), I have considered that the placement of each haptic motor and its spacing relative to a body circumference was an important factor in generating the perceivable and distinguishable haptic sensations along the torso. I therefore decided to map out and create three 'main' sizes of the on-body haptic belts which were then augmented by elastic band front snaps to tighten or enlarge the sizing as desired by an individual for a snug haptic fit. Also synthesizing from the Ilinx design and Giordano and Wanderly (2013) I considered the integration of "conveying information through the sense of touch" where I focused more heavily on their concepts of "rhythm... pattern[s]... and attract[ing] attention to a specific part of the body" in the implementation of frequency and intensity code that drives the individual motors and is accessed by other media focused projects through the OSC commands. Specifically, the Nodejs server accepts OSC commands and then parses them as JSON-like objects of content from the media outputs. The information is then extracted via Regular Expression analysis and a serial string of interpreted instructions are then relayed to the motorcontrollers. Thus, those wishing to interact with the on-body haptics have control over the following parameters: individual buzzer control or pattern deployment; specific belt selection; number of repetitions; intensity and frequency of the vibrations.

Aesthetic Design: On Connection and Influence

Again drawing from Dufrenne (1964) I am choosing to interpret the collective intersubjective and improvised gestural dance that emerged between two and three interactants during the final performance as an *aesthetic object*- a creative piece of art that is to be contemplated. Here I highlight how this aesthetic dance emerged through the mediating effects of the on-body haptic technology.

Connecting the on-body haptics to the greater group dynamics centered around the vibro-tactile response acting as a mediating technogly that transmits the output from other, more media focused projects. Specifically, for the showcase presentation, particular association with a correlated gesture analysis using arm-tracking and sensing devices

was mapped directly to the haptic belts. In terms of an aesthetically connected perspective I consider Shusterman (2006) on somaesthetics to highlight the combative nature present between intrapersonal choice and the intersubjective rammifications this has on the collectively driven yet simultaneously independently felt tactile response: "the body may even be the prime source of our very ideas of agency and freedom. What could be a better, more fundamental paradigm of voluntary or willed action than the way we move our bodies to do what we will- raise a hand, turn the head?" In this way, the on-body haptic devices were constructed to both enhance, augment and alert interactants of their consistent decisions to either act and gesture collectively in harmony, to toy with complete abandon and gestures uncorrelated with others, or to provoke (conceptually and literally) the feedback system itself into vibrating in a subjectively pleasant haptic experience through some combination of the above.

The on-body haptic system that was created is both individualistic but symbiotic, both objective and subjective, and drives personal choice in movement decisions as improvised play takes place. We can feel each others' shared experience reflected in the vibro-tactile responses and we can watch in real-time how our minds, and in turn our experience of each other and the interaction, are affected by the presence of others. Here we relate to the interpretation given by Rudrauf et al. (2003) on Varela and his concept of mind in that the mind 'has to do with mentality, [with] cognition and ultimately with experience' and it 'cannot be seen to be independent from [the] self'. An uncorrelated and frenetic display of gestures from one user dominates the vibro-tactile response of all participants as much as a more controlled and calm embodied gestural reaction to the same environment. Both create a similar state of haptic feedback that alerts the interactants that they are choosing to interpret their spaces individually rather than collectively, but causality is from two different perspectives. This objectivity of spatial-temporal interactions between spatial-temporal elements creates an interesting dynamic for each persons subjective experience. Similarly, the pressing temporality of the relative 'speed' of ones gestures is emphasized in the rate at which the individual on-body haptic segments vibrate with changing 'frequency' and 'intensity', and is a reflection of Varela's wholeness- a co-dependency of parts in an ongoing process. There is a sort of biophysical circular-feedback that is apparent when one sees the relative differences in their gestures as being part of a system that is haptically tied to another individual's existence and experience, and the relative autonomous nature of losing oneself in the sensational experience be-

comes blurred into a tangible process that curiously begs to be consciously controlled. Thus, as with Varela, we see a non-linear system that 'depends on the dynamics of its mutually embedded systems' and one that is 'perpetually at risk of breakdown, of divergence, [and] operating at the edge of chaos'- both in every participating individual, and in the combined system they create. Yet, regardless of 'how much' one tries, the content of the mental act is still separate and distinct from the process through which the content appears (here we are drawing from Husserl- Costello (2000) and Varela- Rudrauf et al. (2003)). The emergence of consciousness, and by extension creativity, is reflected in both gesture and mind, emotion and reason, intangible and tangible- the 'selfless self' of self-inflicted, self-perturbing systems of subjectivity-making and objective experiences, and thus on the influence we exert by extension on others through the connected vibro-tactile responses to these reactions of 'self'.

The Critique

To further discover emergent patterns and trends that articulate distributed creativity in improvised performative contexts, a continuation in the critique of the project is extended into technologically grounding and agent amplified perspectives.

On Technology and Grounding Oneself

The use of technology that is intentionally designed to pervasively inflict interconnected somatic experiences allows one to exist along, and within, an 'action-response' continuum where one is encouraged to gain, and reinforced to retain, a complex awareness of self, others and environment. It is conceivable that the relationships developed between individuals and a particular mediating technology, here the on-body haptics, may intentionally create a space where pre-existing assumptions are challenged through sensory fusions. The direct translation of haptically 'feeling your willingness' to visually correlate your gestures to another interactant's provides an actualized example of bio-optical sensing and vibro-tactile transmission.

More complex relationships were expected to reflect the collaborative co-construction of meaning that arises from individual gestures, technology mediated relationships, and the artifacts of group awareness during performance. As such, the desired movement away from structured composition is a natural extension of these technological connections as no individual has both control of what they transmit and what they receive. Thus creativity is distributed on both an intimate scale- where one individual's gestures are collected and transmitted via a mediating technology to another for interpretation, and on a collective scale- where layers of continuous reflection and intention aggregate into a shared performative entity. Ever ubiquitous, however, is the question, "what does that mean?". Implementations of collectively decided, but previously defined, context-dependent gestures (such as those presented through Van Nort's soundpainting- 'who', 'what', 'how' and 'when') can provide live-action syntax for an inspired conscious collaboration of momentarily intentional creativity. Similarly, correlated gesture analysis that drives the vibro-tactile feedback was constructed from anticipatory 'standard' gestures that one may be expected to move through (such as arm resting at side) when articulating their subjective expression within the performative experience. The instantaneous emergence of a shared awareness from two or more members to move towards a desired

destination could be facilitated in this way and considered just one of many possible manifestations of distributed creativity and collective agency.

The emphasized role of bodies-in-space and touch through the vibro-tactile nature of the on-body haptics is significant when considered from the perspective of a mediating technology- one that is used in grounding oneself in both a place and among the collective group. Echoing Varela's concept of wholeness, I find this grounding haptic feedback symbolizes a sort of transition of individuality captured by the whole- many parts make up the whole and the whole is made of many parts, but neither does the whole exist without its parts nor does any part not join into a whole. Merleau-Ponty asserts in *Phenomenology of Perception* that the "experience of space [itself constitutes] a basis for unity", if not a grounding, in its own right. Consider also this question posed by Merleau-Ponty (trans. Smith 2002) "Is it true that we are faced with the alternative either of perceiving things in space, or (if we reflect and try to discover the significance of our own experiences) of conceiving space as the indivisible system governing the acts of unification performed by a constituting mind?".

Drawing from *Phenomenology of Perception* I relate the subjective perception of an interactant's understanding and interpretation of visual cues of the gestural expressions of other participants as well as the subjective experience of the vibro-tactile feedback positioned in physical space around the torso while wearing the on-body haptic belt as 'anchoring-points' in connecting 'spatial levels' of perception that entice a relative grounding, literally, through the perceived reconnected awareness of one's physical body in space. Morris, in *Touching Intelligence* also "turn[s] from the already constituted standards of the scientist to a conception of the object of perception as constituted *within* the interrelation of body and world" and ultimately reveals that "the experienced distinction between toucher and touched emerges in the melodic contour and modality of our dynamic coupling with things". When considered from the perspective of the on-body haptics resonating and vibrating as a result of a correlation analysis of individual gestural expressions it is not difficult to interpret this through Morris' *toucher and touched* dynamic. It is, however, interesting to question *who* (or what) is the 'toucher' and *when* are they touching as opposed to being touched? Are we touched by the tactile vibrations or are we touched by the relative changes in the correlated gestures of another? Are these distinctions irrelevant in a system where one interchangeably becomes both toucher and touched by the

very nature of a correlated gesture requiring two, or more, independent parts to describe their whole?

On Agents and Improvised Performance

During the final showcase a number of different experiences were observed as various individuals opted to try the on-body haptics. One memorable experience beautifully synthesized from a spectrum of the collective aspects of the available individual final projects present in the showcase. Two interactants, each wearing the on-body haptics, fell into a silent space where they moved with one another, symbiotically passing fluidic gestures back and forth as they danced across the stage through the dotted visualizations projected onto the floor. The on-body haptics felt as if they were responding to the correlated gestures- the vibro-tactile feedback was more constant, focused and stable. As soon as one interactant created more frenetic gestures while the other stayed grounded in the original embodied gestural space, alternative patterns in the vibro-tactile feedback responded by sending increasing ripples and more intense vibrations, successfully incorporating the gestural correlation analysis and reflecting, as a collective, human-machine agents as conditions to complexify and challenge our relationships to environment, self, and others.

Improvisational actions, whether conscious or not, provide a framework for exploration into the creative space. By forcing a directed and consistent exposure to others via the linked on-body haptic technology and content exchange through correlated gesture analysis, one is lifted from the confines of their internalized perceptive ideations (Husserl's eidetic intuition) and instead asked to engage in a participatory exchange of a collective presence. Grounded in this contemporary temporal experience, individual creative actions are distributed among the collective through the mediating technology thus connecting each individual into an intersubjective state of agency. The nature of consciously releasing oneself to the experience of the group opens a creative dialogue where inwardly focused intentions may instead be aimed at, and made about, what is sensorially experienced through the collective performance. Therefore, by deeply engaging with, and listening to, the collective 'voice', unpredictable relationships emerge as intuitive, individual and improvised alien responses. These relationships are encoded in the vibro-tactile responses resonating in the worn haptic belts. The cyclical exchange between collective and alien agency amplifies and persists in the present local time and space, and is, in fact, entirely

dependent on the interplay between the spatial and temporal interdependence of the interactants' embodied gestural interpretations in the moment. In the spirit of Husserl- through creation some *thing* was created- with the hope that complex and interesting patterns of creative expression were mediated by the on-body haptics and emerged within the spaces that must be (literally and figuratively) traversed as one transcends, awakened, towards another and they in turn, reach out to us in an embodied gestural response.