

Embodied Flow in Experiential Media Systems
A Study of the Dancer's Lived Experience in a Responsive Audio System

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ABSTRACT

During the design of interactive dance performances, dancers generate a strong relationship to the responsive media after they are given information about how to use the system. This case study observes a dancer's experience of improvising in a responsive audio system (RAS). A triangulated analysis and conclusion is formed from Laban Movement Analysis in conjunction with post-experience discussions relating to Optimal Flow. This study examines whether or not providing information about how an audio system responds to movement affects a dancer's ability to achieve a heightened state of Embodied Flow while improvising in a RAS.

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CHAPTER 1

INTRODUCTION

Responsive audio systems (RAS) have changed the relationship between dancers and sound by allowing dancers to generate sound with their bodies' movement. Designing audio systems that respond to movement through computer technology is an area growing within performance, art installation, science, and healthcare. In most interactive performance research, the emphasis is not on the performers' experience of using the system, but instead emphasizes the system's ability to serve the work (Coniglio 2006, 78) or serve the audience (Broadhurst 2006, 141). This study assesses a RAS's ability to heighten a dancers experience by engaging them in Embodied Flow.

My theory of Embodied Flow merges somatics, an approach that emphasizes the wholeness of the body-mind, and Mihaly Csikszentmihalyi's principles of optimal flow¹ (1990). In his book, *Flow: The Psychology of Optimal Experience*, Csikszentmihalyi asserts flow activities "provide a sense of discovery," and push an individual to "higher levels of performance" (74). Embodied Flow generates growth and presence by constantly fluctuating between anxiety and boredom, internal and external awareness, and past and present experiences (Csikszentmihalyi 1990; Romero and Calvillo-Gamez 2011, 102; Lobel and Brodie 2006).

Embodiment expresses the complete integration of mind-body as a way to make meaning of human experience (Romero and Calvillo-Gamez 2011, 102). However, in studies of experiential system design, embodiment is task-oriented, with an emphasis on

¹ Optimal flow occurs when an individual fluctuates between anxiety and boredom, and achieves happiness through the acquisition of knowledge that leads to growth (Csikszentmihalyi 1990, 74; Polaine 2005, 151).

the system's ability to affect a user's experience (Levisohn 2007, 98). Instead, embodiment should be observed as an experience that involves continuous exchange between a system and a user. Not only does embodiment describe the human ability to perceive the world, but it also enables hyper-reflection, an awareness of how present experiences affect the future (Loke & Robertson 2013 and Kozel 2007, 22). Most literature describes embodiment as an if-then statement (Dourish 2001, 99), where the body is a tool the mind uses to perceive the world. However, in this study, embodiment functions as a loop, continuously routing information between the mind, body, and world.

This study observes the interaction between a dancer and a RAS. It is difficult to remain embodied while moving in a technical system, but the theory of Embodied Flow emphasizes that if an individual can maintain optimal flow, they will be consciously aware of their lived experience. This study examined whether or not understanding the relationship between a RAS and movement helped dancers experience enhanced states of Embodied Flow while improvising in the system.

CHAPTER 2

VERTIGO: DEVELOPING AN IMPROVISATIONAL INTERACTIVE DANCE

In 2013, I designed *Vertigo*, an improvisational, interactive, and audio-visual dance performance. The work was developed using Csikszentmihalyi's tools for achieving optimal flow. *Vertigo* is a type of play that increases flow by transforming the way we perceive reality (Csikszentmihalyi, 1990, 72). The composer of *Vertigo*, Michael Krzyzaniak designed a section called *Eleanor Combusts* (figure 1) using a RAS. The audio in this section was designed to increase vertigo play.

The dancers sometimes used the audio as a tool to inform them of their body's location in relationship to itself and to the world. During inversions, a movement that flips the body upside down, one of the dancers would use the sound to inform her of when her head was close to the floor. She stated, "It didn't matter what my eyes saw because my body would respond to what I was hearing instead of what I was seeing." (Group Discussion, Emma, December 17, 2013) In this case, the dancer had enough trust in the RAS that she was able to make choices that challenged her while improvising.

The rehearsals for *Vertigo* were centered around providing the dancers with opportunities for individual choice making, a sense of reliability, achievable challenges, and clear expectations. Csikszentmihalyi outlines these four provisions as interactions



Figure 1: *Vertigo* - Performance of *Eleanor Combusts* in Digital Culture Gallery, Arizona

that produce optimal flow (1990, 89). As I observed the dancers using the RAS, I began to wonder if the RAS also enhanced optimal flow.

After developing *Vertigo* I wanted to know if the RAS generated or increased the experience of optimal flow by providing the clarity, reliability, adaptability, and responsiveness that provided continuous opportunities for movement investigation. From this inquiry, I generated a case study that uses the RAS of *Eleanor Combusts*. Unlike *Vertigo*, the case study was not about achieving personal aesthetic goals. The study investigated elements of focus², full-bodied movement³, optimal flow, and the development of an interaction between the RAS and the dancer. These elements were analyzed to indicate whether or not a dancer experienced a state of heightened Embodied Flow.

² Focus is used in dance to describe where a dancer is looking, and whether they are externally engaging with the world or internally observing themselves.

³ Full-bodied movement refers to the development of connections that integrate the entire body such as a sense of the spine that connects the head and the tailbone.

CHAPTER 3

SYSTEM COMPONENTS AND METHODS

Analyzing Embodied Flow

This study analyzed elements of Embodied Flow in order to understand dancers' ability to heighten their embodied experience while improvising in the RAS. In technology research, quantitative data is valued over qualitative assessments of the lived experience (Davis 2007: 45). Post-experience observations from the user are categorized as internal mental events that contain too many variables (Kozel 2007, 9). However, in this study, the phenomenological⁴ aspects of experience are equally important in an assessment of Embodied Flow. As Marc Davis (2007) points out in his article *Theoretical Foundations for the Experiential Systems Design*, the “experience is not a collection of objects, but a process” (pg. 46).

Embodied Flow was studied through a triangulated research method that checked results by comparing Laban Movement Analysis⁵ observations and post-experience discussions that focused on optimal flow. The study decreased internal variables by comparing the researchers external observations with the dancer's post-experience discussions.

⁴ Phenomenology is an embodied first-person methodology that aims to understand, express, and extend lived experiences (Kozel 2007, 16).

⁵ Laban Movement Analysis is a codified movement analysis and exploration system used to observe physical movement patterns and qualitative aspects of movement (Kail 2007, 44).

Motion Sensing and Sound

Motion was detected by an accelerometer attached to a limb on the dancer's body. An accelerometer is a device that uses acceleration to determine its relationship to gravity. Accelerometers work well with dance movement because dancing accesses a consistent acceptance and rejection of gravitational pull. In this study, the information gathered from the accelerometer was sent to a computer in real-time with Open Sound Control (OSC), a protocol used for communication between computers and sensors. The audio composition in this study used the accelerometer to measure tilt and acceleration, two frequently used attributes of a dancer moving through space.

The numerical data from the accelerometer was sent to a computer that used the constant stream of data to generate sound. Michael Krzyzaniak programmed the audio in a language called C. Krzyzaniak's composition was designed to encourage the dancer to generate highly erratic movement choices (Krzyzaniak 2013, 3). These movements involved falling off their center of gravity⁶, inverting⁷ their bodies, and losing their sense of vertical through inverted spirals⁸.

The audio system was designed to encourage users to challenge their physical capacities and generate creative responses from the system. If the user did not experiment with their relationship to verticality or changes in momentum, the system would not provide variations in sound. When the audio did not change, the user would

⁶ Falling off their center means moving the body lateral of the vertical plane, or out of an upright standing position.

⁷ Inverting of the body occurs when the upper body is upside down (i.e. a handstand).

⁸ This movement invokes a vertigo state by spinning while inverting the upper body.

either experience boredom, or become frustrated by their inability to generate new qualities in the sound. When the users of the audio system were hyper-reflective of the relationship between change in movement patterns and change in audio, they experienced Embodied Flow.

Movement Analysis

A primary goal of the study was to observe Embodied Flow and recognize its occurrence through the framework of Laban Movement Analysis (LMA), a codified movement analysis and exploration system used to observe physical movement patterns and qualitative aspects of movement (Kail 2007, 44). LMA was used in this study to observe change in dancers' movements.

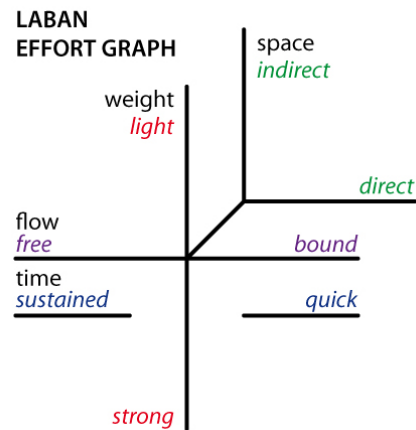


Figure 2: Laban Movement Efforts Chart

Developers of somatic methodologies such as Rudolf Von Laban (Laban Movement Analysis) and Irmgard Bartenieff (Bartenieff Fundamentals) have developed techniques to maximize our movement potential and identify ones movement pattern tendencies (Brodand and Lobel 2006, 69). Laban Movement Analysis is a codified description of movement patterns based on Effort, Space, Body, and Shape (Hackney 1998: 248). LMA terminology was used to describe

Laban's Efforts in relationship to Space, Weight, Time, and Flow⁹ (figure 2). The dancers' movements were also analyzed through Bartenieff Fundamentals, a system of movement pattern recognition based on psychophysical human development.

Bartenieff's Patterns of Total Body Connectivity, which include bodily relationships and support of breath, core/distal, head/tail, upper/lower, body halves and cross-lateral movement patterns (Hackney 1998), were observed and analyzed in relationship to primary research questions. Data suggests that when the dancers in the study began to understand their relationship with the RAS, their movement patterns became more dynamic, and Bartenieff Patterns of Total Body Connectivity became more clear and developed.

⁹ Flow in this instance does not refer to states of psychological flow, but instead describes movement actions that appear either free or bound in nature.

CHAPTER 4

METHODOLOGY: MAPPING THE MOVEMENT TO THE SOUND

The case study tested whether or not improvisational dancers experienced a greater sense of Embodied Flow in the RAS once they were aware of how their movement was mapped to the sound. The case study was developed to answer the following questions:

- Did the RAS inherently provoke the dancers to embody their experience, or did it encourage a separation between the external and the internal?
- Did the dancers become frustrated by a lack of knowledge about how to use the system, or did they enjoy investigating their movement in the system?

Four participants were selected for the study that had no prior experience with the RAS designed for *Eleanor Combusts*. The participants were recruited through an e-mail sent to Arizona State University undergraduate and graduate dance majors who participate in improvisation and somatic practices. The participants qualified for the study because they utilize hyper-reflection, view challenge as an opportunity for investigation, and have had exposure to the necessary language and movement concepts required to discuss embodied experiences.

For the purpose of this document, the dancers names are Olivia, Tania, Thea, and Felicity, and I will be referring to myself as the researcher. Each dancer participated in an individual hour-long session that consisted of a pre-study questionnaire, two 15-minute movement explorations observed by the researcher through movement analysis,

and two 15-20 minute discussions with the researcher following each movement exploration.

Pre-Study Questionnaire

The pre-study questionnaire and post-experience discussions focused on the interactions that produce optimal flow according to Csikszentmihalyi's (1990, 89). The questions and topics discussed related to choice making, reliability, challenge, and clarity of expectations. The pre-study questionnaire provided the researcher information about how the participant responded to situations where they experienced boredom, challenge, and choice making. The most important questions from the questionnaire were:

- How do you react to situations that are challenging?
- When you are unclear of how to execute a task, how do you respond?
- How do you feel when you need to make choices?

The pre-study questionnaire served as a foundation for each participant. Change in the participant's experience during movement analysis and post-experience discussion was detected when the researcher observed variation from a participant's foundation.

Part One: Before Movement and Sound Mapping

The first movement exploration served as a constant. The dancers had no prior knowledge of what the system was or how it worked. They were told that there were no

expectations, to tie the accelerometer to their body, and to improvise in the system for fifteen minutes. They were not told what type of sensor it was, anything about how the sensor operates or relates to the sound, nor were they told how to move. The researcher conducted a movement analysis during the improvisation. After the first movement exploration, the researcher and participant had a post-experience discussion. The post-experience discussion answered the following questions specific examples provided by the dancers:

- Did you feel a desire to control the system or did you allow the system to influence your movement choices?
- Did you feel challenged or underwhelmed by yourself, the researcher, or the system?
- Was the system reliable or unreliable?
- Did the system provide you with options or were you stifled by the technologies limitations?
- What knowledge did you acquire during your experience, and where would you like more clarity or feedback about how to use the system?

Part Two: After Movement and Sound Mapping

During the second movement exploration, the dancers were informed of the relationship between their movements, the information gathered by the accelerometer,

and the auditory response. After they were given this information, the dancers improvisationally explored the system for fifteen minutes while the researcher conducted a movement analysis. Through out the fifteen minutes they were given four separate movement tasks. After the exploration, the researcher and dancer had another fifteen to twenty-minute discussion about the dancers experience based on the same questions as the first discussion.

Sound	Sensor	Movement
Repeat Prior Sound	Relationship to Previous Location	Repetition of Movement Must Relate to an Entire Phrase of Previous Movement
Generate Wiggle or Swoop	Relationship to Axis of Sensor	Rotate Area With the Sensor/Size of Limb Movements
Tonality	Relationship to Gravity	Change Position of Sensor in the Vertical Axis

Figure 3: Part 2 – Information given to the dancers regarding the systems relationship between sound, sensor, and movement.

Before beginning part two, the dancers were provided information that would help them to understand their movement’s relationship to the system (figure 3). To ensure that the information presented did not disengage their sense of embodiment, the dancers were not over stimulated with technical details of the system. The information given included:

- **The sensor had a relationship to its past.** This meant that in order to repeat a sound, the mover must return the sensor to its location prior to making the sound the first time. This also meant that the sensor caused a change in the audio as it rotated in relationship to itself and its current axis, not the overall location in world space.

- **Verticality played a role in the sound.** As the sensor resisted the force gravity, the sounds would become more tonal in the A major chord, but as the sensor inverted, the sound would become atonal.
- **The amount of space the sensor moved through would qualitatively reflect in the sound.** For example, a large movement would generate a “swooping” sound, and a small movement would create a “wiggling” sound.

Part two tested the ability to maintain Embodied Flow by giving the dancers additional movement tasks while they were improvising in the RAS. These tasks included:

- Roll down from the top of the spine into a forward fold and slowly roll up, paying attention to the tonal shifts in the sound as you move from an inverted position to a vertical position.
- Initiate all movement from the top of the head.
- Use the head to propel through space.
- Spiral on a diagonal vertical plane.

The initial two tasks provided a clear framework to investigate the new information about the system. When the last two directives were given, the dancers began to generate more swooping and indirect movements¹⁰ that qualitatively matched the sound. However, all of the dancers reported in the post-experience discussion that it

¹⁰ Indirect movements are not directing towards an end point.

was not as enjoyable as the initial tasks because they could not maintain a sense of hyper-reflection. Their focus was directed on the challenging movement score, and they were unable to focus on the relationship between movement and auditory composition. In chapter five, part one and part two have been compared by observing the differences in movement qualities; exploring repetition and verticality; and discussing and observing the dancers' relationship between the movement, sensor, and sound.

CHAPTER 5

RESULTS

Movement Observations

There were changes in the movement for every participant between part one and part two. These changes are represented in the chart below (figure 4). For example, in part one, Olivia frequently moved from the distal¹¹ edges of her body, and in part two she moved with spirals that accessed a coiling in her core¹².

However, there were some changes in focus, effort qualities, and movement patterns that occurred consistently among participants. During part one, all of the participants focused on the body part with the sensor attached. They directed their vision to the location of the sensor. The movement that derived from this type of investigation separated the body into four quadrants: upper, lower, right side, and left side. Body halves occurred when the side with the sensor moved as a whole unit while the other side remained stationary (Hackney 1998, 181). Similarly, the separation of upper and lower halves mobilized only the upper body while the lower body remained stationary, and vis-a-versa. Continuous separation of the quadrants represented a dancer's inability to integrate the whole body.

In part two, the dancers reported feeling more familiar with the system, and the movement analysis observed more integration of the sensed limb into full-bodied

¹¹ Distal is away from the center of the body.

¹² Core is towards the center of the body.

Dancer	Part 1	Part 2
Olivia	Distal, Body Halves ¹³ Dabbing ¹⁴ , Shaking Visual Focus on Sensor	Spirals, Cross Lateral ¹⁵ Swooping, Circular Sustained ¹⁶
Tania	Off-Vertical Suspensions Shaking, Wobbling, Sliding, Snaking Circular, Release of Weight Fast and Syncopated Focus on Initiation of Sensor	Off-Vertical Suspensions Cross Lateral Tossing, Spiraling Large, Full-Bodied Small and Isolated Sensor as Initiator
Thea	Sustained and Expanding Quick Spokes ¹⁷ Syncopated Phrasing Off Vertical Initiate Movement from Sensor	Sustained Arcing ¹⁸ and Carving ¹⁹ Slower Transitions Use of back Space Initiate Movement from Sensor
Felicity	Distal, Separation of Upper & Lower Indirect, Sustained Wiggling, Loose, Swinging Lateral Plane Vertical Head Positions	Spirals, Head to Core, Full-Body Release of Upper Body Direct, Quick 3-Dimensionality in Planes Outward Focus

Figure 4 – Movement Observations from part one and part two

¹³ Body halves are a pattern that moves one side of the body and stabilizes the other.

¹⁴ Dabbing is a quick, direct, and light movement.

¹⁵ Cross lateral patterning utilizes the connection between diagonals in the body.

¹⁶ Sustained refers to a lingering, stretched out moment in time.

¹⁷ Spoking moves a limb or a joint in space on a direct line.

¹⁸ Arcing a movement of a joint or limb that creates a bridge shape.

¹⁹ Carving molds the body and the environment in a 3-dimensional rotation.

movements. The dancers utilized successive²⁰ movements, where they followed the initiation of body parts by rippling movement through their body until it reached the location of the sensor. Integrating the sensor into the overall activity in the body created cross-lateral movement patterns, an increase in head-tail connections, and movements that spiraled around the spine.

Data collected through discussing the lived experience in conjunction with movement analysis found similarities between all participants in the desire to control, investigate repetition and verticality, and the development of a relationship between sound and movement.

Controlling the System

According to Csikszentmihalyi's theory of optimal flow, responsive systems must contain enough challenge to encourage the user to discover new elements of the system, but must also ensure that the user does not become frustrated because the challenge is too difficult (Csikszentmihalyi 1990, 74). In both scenarios, the user quits. This study assessed what factors need to be in place for the dancer to have enough understanding and control to continue wanting to use the system, while also supplying a continued route for growth and discovery. The route of growth and discovery represents a constant challenge that once met leads to continuing growth if it remains within the path of flow (75). In part one, the dancers consistently tried to control the sound through repetition

²⁰ Successive movement occurs when adjacent body parts move one after the other.

and level changes, but rarely succeeded. Instead of becoming frustrated by the challenge, the dancers continued to explore and try to understand how the system worked.

I appreciate the opportunity to explore. I didn't reach boredom or frustration because I had to keep learning and pushing myself instead of someone telling me what to do and giving me a preconceived notion of what I should look like.

(Thea, Discussion, December 11, 2013)

The dancers welcomed challenge as a place for exploration. Enhanced Embodied Flow occurred when the dancers were challenged by the system but were able to fluxuate between the audio and their movements. Improvisational dancers welcome challenge as a source for growth, and do not frequently invoke negative feelings towards challenge.

I felt like I wasn't creating any new sound or any sounds that I liked, and I didn't know how to get the sounds that I liked. It was more of a disappointment followed by questioning, 'How did I make this the first time, I thought this was what I did?'

(Felicity, Discussion, December 11, 2013)

Felicity's comment could be read as an overwhelming experience, but instead the event resulted in questions that lead her to inquire about her experience, and ultimately lead to a deeper understanding of her body's influence on the system.

For dancers who consistently experienced optimal flow while improvising, it seemed that the lack of information they had about how the system worked created too broad of a spectrum for them to explore, resulting in an inability to figure out how to control the system. Since repetition and level changes affected all of the dancers' ability to embody a connection between sound and movement during part one, the information given to them about the system before entering part two directly informed these areas.

Repetition, Repetition, Repetition

Repetition was an activity that all four participants continued to be challenged by during part one. As a result, movement in part one included a lot of quick, direct, and strong jabbing actions that attempted to recreate sounds through short repetitive movements. Minimal decisions were made involving the Effort qualities of movements and the transitions in and out of movements. Sometimes if they did the same movement several times in a row they were able to recreate the sound and find a sense of control over the system, but if they would later return to the same movement it would not make the same sound. The dancers did not know that in order to generate a repeated sound, they not only needed to replicate the movement, they needed to complete the entire sequence of entering, executing, and exiting. For example, if they wanted to recreate a sound that occurred when they moved their head from an inverted position into backspace, the same sound would not be recreated if they began with their head completely vertical and moved it into backspace. They would need to begin with their head entirely inverted again, and then move it into backspace.

Once the dancers were aware of how to recreate events and sounds, they no longer needed to spend time investigating it. As a result, during part two, the dancers spent more time experimenting with changing qualities of movement during repetition, and studying the small shifts in the sound as their movement developed. Through their movement choices, the dancers began composing sound that was appealing to their own acoustic aesthetics. Understanding integration between the movement and the sound is an advanced level of exploration. Felicity describes her ability to use the relationship of the sensor to the sound as a toolkit for increasing her body awareness during repetition.

*Thinking of the sensor in relationship to itself was important.
Swooping at a different angle or speed would change and this
made me aware of why some of my attempts for repetition
would fail. I would try and repeat something and realize that
my body is actually not doing the same action as I thought it
had done in the prior repetition of it. (Felicity, Discussion,
December 11, 2013)*

Felicity was able to begin to have a greater understanding of her movements when she was able to experience her actions through sound. If the sound did not repeat itself, but she thought she was repeating an action, it meant that she was not executing an exact repetition of the movement. She was then able to use the sound as a guide to recreate her movement. In this way, the system relayed information to the dancer about their

movement in the x, y, and z-axis that was used to inform the dancer of their movement technique.

Verticality

Another area of investigation the dancers originally attempted to explore without success was level changes. They were able to sense an audible change in part one when they would move from high to low levels, but did not always receive the results they were expecting from the sound. During part two, they were aware of the changes in tonality as the position of the sensor changes its relationship to gravity. With this information during part two, the dancers realized if they went upside down, there would be a change in the accelerometers relationship to gravity as it rotated on the horizontal axis, thus generating an inverted quality of the sound.

In part one, several dancers thought their movement was being tracked through space the way camera motion tracking systems would track the movement of a blob in space. As responsive system designers, it can be taken for granted that not everyone is aware of the affordances of a sensor. Thinking that the sensor was tracking them in world space as opposed to the devices relationship to itself contributed to a disconnection between the amount of physical effort and auditory response. For example, if the sensor was on the back of their neck and they leapt through space, but did not change the vertical position or rotation of the sensor, the intended loud or expressive sound would not occur. Another action that provided a disconnection between physical effort and audible response from the system was if they had the sensor on the left arm that remained

stable in space while the right arm forcefully swung in a circle. In this situation, even as they put large amounts of effort into swinging their right arm, the sensor did not move so the sound would not change.

In part two, participants would repeat the actions that did not generate an effect in part one, but they would incorporate the movement of the limb with the sensor. The result was an overall full-bodied integration in their movement sequencing that increased both the dynamic changes in the movement and in the sound. Generating a matched response to physical action and auditory response pushed the dancers to try new movement patterns that were outside of their regular movement vocabulary. For example, in part two, if the dancer wanted to have a shift in the sound while running backwards quickly they would tilt their head into back space and run backwards, eventually moving into an off-vertical position of the upper body.

By understanding how to use the sensor to generate the responses the dancers desired, specifically in relationship to repetition and verticality, they were able to release the need to figure out how the system worked, and were able to gain control of the system. The ability to control the system could result in a failure of interactive system design because as discussed before, once the system becomes predictable the participant becomes bored. However, for improvisational dancers, there is still another level of investigation, the embodied experience. Through gaining control of the systems, the dancers gained the ability to spend more time embodying their relationship to the sound. As a result, the dancers moved into a deeper level of Embodied Flow.

Composing the Loop: Body-Sensor-Sound-Body

According to the pre-study questionnaire, during dance improvisation tasks, some participants become unaware of their surroundings, and/or feel self-conscious of their choice making. During part one, the dancers generated improvisational tasks and challenges that focused on trying to make the sound do something, figure out how the system worked, or tricked the system. The system influenced the dancers and provided them confidence in their improvisation skills.

Usually with improvising I do get frustrated because I get stuck, but because I had the sound, it helped me move because it was continuous and I could control it. It gave me a more open box and was not limiting me, verses with music that I am not in control of that creates a barrier for me that I can't break out of. I like using the analogy of a conversation because I have to respond to it. (Thea, Discussion, December 11, 2013)

In part two, the dancers knew some basic information about how the system worked, and were then able to spend more time existing in a dialogue with the system to compositionally generate an improvisational score. They began to equate monotone sound with a quality of monotone movement, and swooping sounds with circular movements that involved a release into gravity. For dancers working in improvisational

performance this is extremely helpful because there is a tendency to have a distorted sense of time, where things seem to last longer than they do or vis-a-versa. If they heard a similar sound consistently reoccurring they were able to assess the type of movement they were doing when that sound occurred, and would make an effort to either change the transitions in and out of that movement in the future, or to stop doing that movement. They could also tell through the sound how long they had been in stillness or in a repetitive cycle of a movement and make compositional choices about whether to maintain, evolve, or dissolve an idea. The dancers expressed a sensation of empowerment in their ability to make choices and directly live in the results of their choices, and would spend more time exploring stillness and variations of speed than in part one.

The silence was not boring, it was empowering that I was the only thing that could make it make more sound, there was no auditory stimulus, or a cue that I was waiting for to start going. I generated the sound and movement. It was a dual composition. (Tania, Discussion, December 4, 2013)

The dancers became more familiar with the relationship of their movement and the sound. They began to exist in a cycle of generating, listening, and responding (figure 5). The dancers were experiencing Embodied Flow by making a conscious effort to generate sound with their movements while also responding to the sounds they were creating. Eventually, they could understand the sound so well that they knew where the

sound would go after a movement. The dancers could then predict the ending of a sound and could select a movement that would transition the sound into a new phrase. An example of this would be if they circled their head laterally to the right in a downward arc, and quickly returned to an upright position. In this case, there would be a dramatic shift in the sound. They would prepare for this shift by bending into a plié preparing to jump as their head moved into vertical, amplifying the qualitative connection between the change in sound and the change movement.

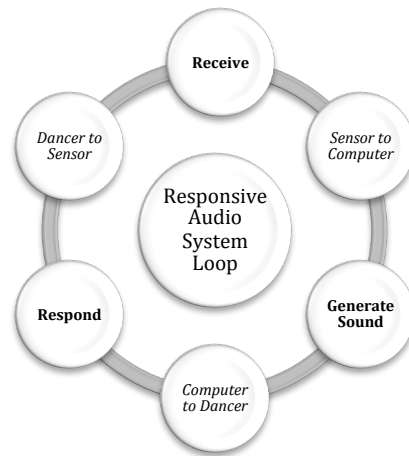


Figure 5: Responsive Audio System Loop

CHAPTER 6

CONCLUSION

This study assessed dancer's experiences in a RAS through movement analysis and post-experience discussions in order to assess whether the mapping of movement to sound brought dancers into an enhanced state of Embodied Flow. The research indicated that dancers experienced enhanced Embodied Flow when they understood the relationship between their movements and the audio, and were not overwhelmed with too much information.

When the dancers were given too many tasks, they were only able to focus on either their bodies or the sound, and were less able to use the RAS to deepen their experience of Embodied Flow. During part one, they were not given any information about the system or how to engage with it. As a result, over-exploration of the sound yielded a disembodied state where they were less aware of their movement choices. There was a lack of full-body awareness, and the body movements were focused on the quadrant of the body with the sensor. A lack of full-body awareness indicated that the dancer was not experiencing complete Embodied Flow.

The data suggests that when the dancers in the study began to understand their relationship with the RAS, their movement patterns became more dynamic, and Bartenieff Patterns of Total Body Connectivity became more clear and developed. Also, when the dancers were informed of the system's relationship to repetition, axis, and verticality, they existed in a cycle of generating, listening and responding. The dancers experienced Embodied Flow by making a conscious effort to generate sound with their movements, while also responding to the sounds they were creating.

The dancers were able to match qualitative aspects of movement and sound. For example, monotone sounds were a result of movement that lacked dynamic changes, and swooping sounds were a result of circular movements that released into gravity. The state of an embodied connection with the auditory environment provided a new way for improvisational dancers to perceive their movement qualities and time. They could tell through the sound how long they had been in stillness or in a repetitive cycle, and made compositional choices to maintain, evolve, or dissolve an idea.

This study demonstrates how responsive audio systems might effectively be used as an improvisational or somatic training tool for dancers. The audio aspect of the design made a type of feedback that cannot be received in a somatics training program. Unlike somatic training where an outside facilitator guides the body by providing tactile feedback, and verbal cues and instructions, the user of this RAS could self-facilitate, and guide their body with the auditory feedback they generated. The sensor itself also brought a heightened awareness to the area of the body where it was located, and inspired the dancer to generate new ways of integrating that body part into the rest of their movements. This is a tool that could be used to help dancers access movement patterns that are challenging for them.

The RAS, *Eleanor Combusts*, was designed for dancers to fall off vertical, utilize weight and momentum, move their head into backspace, and develop connections between the four quadrants of their body. Further research must be conducted to know whether or not these movement patterns would bring a dancer into a state of Embodied Flow in a RAS other than *Eleanor Combusts*.

As dancers and programmers continue to work together on projects, it is crucial that researchers begin to explore the types of information and the language that can be used to communicate pattern and effort-based relationships between responsive media design and movement. It is also important to create responsive systems that provide opportunities for flow so that users can continue to engage in growth and discovery. This study proves that it is beneficial to educate dancers on how to use the system to a certain degree, especially mapping movement and sound qualities. A knowledge of how the system works provides the dancer with confidence in choice making and also narrows the spectrum of investigation and discovery, allowing the dancer to embody the relationship between the system and their movements, and exist in a state of Embodied Flow where they can experience continuous growth and discovery.

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