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Mia Shocket April 3, 2024

Unconscious Entrainment: Investigating the relationship between movement, music, and the brain

by

Mia Shocket

Julio Medina

Adviser

Dance and Movement Studies Program

Julio Medina

Adviser

George Staib

Committee Member

Hillary Rodman, PhD

Committee Member

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Abstract

Unconscious Entrainment: Investigating the relationship between movement, music, and the brain

By Mia Shocket

Inspired by the intersection of dance and neuroscience, I researched the neurological processes behind the phenomenon of when certain music makes humans want to move. This instinct to dance can be found in universal head bopping, foot tapping, hand clapping, or body swaying. Entrainment occurs naturally and unconsciously as our bodies synchronize with biological and external rhythms. The phenomenon of coordinating physical movements to sounds has remained one of the strongest behaviors uniting humans through natural selection. In collaboration with my dancers, I created a movement work exploring entrainment. Through academic, choreographic, and performance research, this project investigates the relationships between movement, music, and the brain.

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I. INTRODUCTION

Inspiration

Even among a crowd of hundreds, my mother stands out unmistakably amidst any dance performance audience based on her body language. Her head nods and torso rocks with more enthusiasm, vigor, and energy than anyone around her; these dramatic movements help me identify her every time. I have always wondered what caused her embodied response to sounds. Turns out, my mom's innate ability to express music in her body is not uncommon. An evolutionary novelty among humans is the unconscious entrainment that occurs when music fills the air. This instinct to dance can be found in universal head bopping, foot tapping, hand clapping, or body swaying. The idea of unconscious entrainment inspired the title for my choreographic work and precisely captures what humans experience daily. Entrainment occurs naturally and unconsciously as our bodies synchronize with biological and external rhythms.[1] The phenomenon of coordinating physical movements to sounds has remained one of the strongest behaviors uniting humans through natural selection.[2]

Entrainment within dance, synchronizing movement with music and potentially other surrounding individuals, exists solely within the human species.[3] Humans are born to dance to music, regardless of culture, making it fundamental to human nature.[4] In certain languages, such as some African dialects, the same word is used to refer simultaneously to both music and dance.[5] Musicality is a superpower among humans, considering that our closest primate relatives do not share this ability. There are very limited species that can link auditory and motor rhythms. To sense a beat or rhythm, many strong connections within the brain are required.[6] The desire to dance to music may be rooted in our brains. Sound begins as air vibrations. With repetition,

sounds become pitch or rhythm. Eventually, what was originally perceived as sound has transformed to music.[7]

Inspired by the ways in which the brain reacts to various sensory stimuli, I started an exploration of how certain beats drive my movement vocabulary and patterns. My inquiry led me to discover that some genres of music made me want to dance more than others. I became influenced by the vibrant soundscapes of house, techno, disco, and funk music genres. Through the knowledge I gained in my neuroscience courses along with personal anecdotes, I refined my primary research focus and question: What happens at the neural level when certain music makes humans want to move? Despite the associations of movement, music, and brain activity in my own life, I discovered that these topics seldom intersected in broader discourse. My thesis aims to unravel the connections between movement, music, and the brain through the research of neurological processes and embodied choreographic and performance research.

Neuroscience and Dance

While exploring this topic, I found that scholars like Neuroscientist Daniel Wolpert claim that the brain's role is to control the body.[8] Rather than thinking or feeling, Dr. Wolpert believes brains solely exist for movement. He points out that all organisms that voluntarily move must contain a brain.[9] Without a brain, there is no movement. Additionally, there is no one region within the brain that is responsible for movement, but instead it is the sum of multiple brain systems working together. The primary motor cortex, premotor cortex, supplementary motor area, primary somatosensory cortex, and posterior parietal cortex all play a role in conducting movement.[10] These areas of the brain, along with the spinal cord and a network of nerves, make up the nervous system that is critical for moving.

Without the nervous system, dancing would be impossible. Studying the neuroscience of dance is crucial for a sufficient understanding of the art and sport. Dance, the brain, and music are intimately connected. Dance provides an important model to explore how the brain integrates sound and movement.[11] Preceding any initiation of movement, the nervous system processes auditory and other stimuli and initiates preparatory processes.[12] While continuing to process relevant external stimuli, dancers skillfully integrate these with their internal representations, expectations, and predictions.

Prediction is as necessary in dance as it is in music. The predictive coding (PC) theoretical framework is a tool used to study the neuroscience of dance.[13] In dance, predictions are made from auditory, visual, and haptic stimuli. The brain is also constantly generating predictions while listening to music, engaging many overlapping brain networks with dance, including guiding perception and action. To accomplish this, the brain uses Bayesian theory to make inferences and act accordingly based on sensory data and prior knowledge.[14] When beats are isochronous and grouped together, that is rhythm.[15] Rhythmic regularity, composed of a meter's temporal framework and opposition between strong and weak beats, activates the expectations of the auditory system. When certain beats or accents are displaced, the listener's expectations are violated, and this is known as syncopation.[16]

Listening to music is an auditory and motor experience. It can often induce a pleasurable desire to move, also known as groove.[17] This sensation of groove depends on an interaction between predictability and surprise, encompassing repetitive rhythms and rhythmic deviations. A sweet spot exists between predictability and surprise where the patterns maintain a moderate level of rhythmic complexity and an intermediate amount of syncopation.[18] This sweet spot or middle ground is the most desirable for groove as it is simple enough for humans to interpret but

complex enough to keep them engaged. These medium-complexity rhythms are known to elicit the highest ratings of pleasure and desire to move. Recent studies have produced novel evidence that groove is the intersection of motor timing and reward processes, engaging motor and reward neural networks.[19] The basal ganglia, a group of subcortical nuclei responsible for both motor and reward functions, play an essential role in sensing groove.[20] Moving rhythmically requires well-tuned sensory systems to acquire input and the capacity to produce rhythmic output.

The neuroscience of groove and auditory processing is a relatively new field.[21] Compared to the observation and training aspects of dance, the neuroscience of movement has received limited attention. Whether this lack of focus is due to technical difficulties, sampling challenges, or other factors, the neural connections between music and dance have barely been researched. Therefore, the neural mechanisms controlling when music makes humans move are complex and not yet fully understood. Considering groove is a key link between dance and music, there is a need for further research on the neuroscience of groove.

Methodology

To learn about the neuroscience of groove, I initially pursued an exploration of published work in the field to further understand the links between auditory processing music and music-induced movement. I began by analyzing secondary research and composing a literature review to summarize the current findings. I read novel primary research conducted by leading neuroscientists and books written by them. My choreographic process was informed by this literature along with my experiences with music and those of my cast. Through the movement of our bodies, I continued learning about and exploring a dancer's relationships to music.

Improvisation sessions, set to music with varying levels of rhythmic complexities, served as a laboratory for investigating these dynamics. Additionally, my cast made a playlist wherein

each member contributed music that made them want to move. They then choreographed individual phrases to their respective song choice. I, too, shared music that prompted my own movements, and the cast wrote down word associations to these songs. They later translated their word lists into movement phrases, matching the nouns, verbs, and adjectives with gestures. To showcase each of our unique relationships to music and movement, it was important that the cast had input in the choreographic process.

I used this embodied research to question what constitutes music and the definition of groove. I witnessed how moving to music can differ between solo, small group, and large group work; I observed dancers moving to music and compared their actions to what I had read about non-dancers. Within these disparities, I looked for commonalities and overlap. I viewed brain scans and brain waves from various intersections of neuroscience and dance or music as sources of imagery. This imagery later inspired certain shapes, rhythmical patterns, and spatial compositions within the work. As I began choreographing and setting the piece, my aesthetic choices continued to be based on the conceptual framework I previously laid out.

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II. MOVEMENT GENERATION

Cast

When selecting this cast, I chose dancers who had previously worked on my first choreographed piece entitled *Sondage* where I began to explore music, movement, and the brain. These dancers were established as being technically proficient to perform my work. Through their involvement and commitment to this piece, we developed mutual trust, respect, and bonds as a group. Although different from their own styles, the dancers already experienced my movement and choreographic styles during this process. Further, I was committed to having a large cast to explore the differences in solo, small group, and large group dynamics in relation to my research. Out of the twelve dancers that were in my original piece, one had graduated, one was studying abroad, and the other ten accepted a role in my thesis. Including myself, the thesis cast evolved into eleven undergraduate dancers:

1. Gab Crum
2. Ilo Elder
3. Gracie Evans
4. Deena Goodgold
5. Lydia Hamby
6. Dominique Jones
7. Caroline Kim
8. Madison Lee
9. Kalya Lim
10. Sophia Shahin
11. Mia Shocket

To navigate being both a dancer and a choreographer within the piece, it was necessary that I took extra steps to maintain strategic planning and organization. Throughout the process, I consistently updated a Google Drive folder of rehearsal footage shared with my cast. This collaborative platform allowed the dancers to absorb the material, immerse themselves in the piece, review at their convenience, and witness the evolution of their own movement. Additionally, the dancers could observe everyone else in the cast and see the project from an audience's perspective. The videos also helped me watch portions of the piece that I was dancing in and otherwise could not watch. When moving alongside other bodies in space, I was able to receive energetic feedback that informed my process. I could feel when the surrounding dancers were supporting my energy versus when they were pulling away. I could hear them breathing which would establish when they were fully immersing themselves in the piece as opposed to when they were losing steam.

Finally, I showed the work at multiple stages throughout the spring semester. Outside of my committee members, I received external feedback at various points in the process from arts fellow Annalee Traylor, dance major Chi Rung Chan, neuroscience major Lyndsey Lipson, and dancer and neuroscience major Arielle Segal. I chose individuals who would challenge my perspective in diverse ways. The process of receiving feedback before the performances allowed me to push myself deeper as an artist and question the intention behind my choices. For example, some inquired about the locomotion between sections, causing me to include running on and off the dance floor. Others provided performance notes, allowing me to let genuine smiles occur on the stage.

Sequences of Movement

Overall, I relied on four different approaches to generate the movement for this work:

1. Material generated from music
2. Material generated from scientific claims
3. Material generated from word prompts
4. Material generated from imagery

The work was split into sections determined by the songs. The opening section is called "One, Two, Three." The movements in this section were generated from the phenomenon of "entrainment", referring to humans synchronizing to music. Human instincts are to breathe, head bop, foot tap, hand clap, body sway, or jump to music. These familiar actions became the inspiration behind the "One, Two, Three" choreography. Most of the phrase work consists of smaller, subtler gestures that symbolize these quotidian ideas. The piece starts by re-creating elements from daily life before moving into abstract shapes and patterns. The movements and music remain magnetized, blurring the lines between the two. I performed the introductory phrase alone followed by everyone repeating the same introductory phrase with me. First, my movement had to synchronize to music, and then that movement became synchronized to other people. Another reason for this choice relies on my portrayal of the auditory cortex processing stimuli first before the motor areas subsequently get involved.

I deliberately placed all cast members onstage for the opening section to depict this universal human experience. Additionally, the eleven bodies working together represent the diverse regions of the brain responsible for orchestrating these rhythmic processes. Often, everyone was performing the same movements to symbolize the synchronization component of "entrainment." On a few occasions, the cast separates into individual roles to embody the multiple jobs required to perform these processes. This individuality was showcased once the cast shifted from being spread across the stage into a tight clump, illustrating the strong

connections that are required in the brain. The final element of this section is the breathwork, bringing the research back to the most primal and vital human function.

The second section entitled “Ready, Set, Go” transitions directly from the first song. Although these are similar soundscapes, the original breath rhythms slowly develop into a hunger to move to new rhythms. This section begins with a duet between Ilo and Madison. To start building their phrase, the dancers instinctively wrote a list of words in response to music selected by me. They then collaborated and used their combined word lists to generate the movement material. Their duet was placed in this section to expose the intricacy of their gestures when aligned with distinct sounds. The second half of this section contains solo material from Madison and Dominique. Their solos were originally crafted to different songs that “made them want to move”, and then we reset their same movements to the “Ready, Set, Go” music. This approach allowed the dancers to follow their individual inclinations when moving to music. The placement of two contrasting solos back-to-back forced the audience to witness and reflect on the variation in movement, choreographic, and entrainment styles of my cast. While they are both equally compelling and fierce, Madison’s solo is thrilling and grounded while Dominique’s solo is focused and graceful.

Following this solo material, the whole group returns for the third section entitled “Skarabush.” This sequence was choreographed by me while listening to the “Skarabush” music with the intention of being performed by many bodies. The section depicts the communal aspects of moving to music. Dance can be used to feel a sense of community, strengthening social bonds between individuals. As community is rooted in the evolutionary pasts of humans, we naturally long to feel a sense of belonging to a group.[1] Dance can create bonds between people, bringing them closer together in a way that other activities cannot. Not only does moving alongside others

build community but moving synchronously blurs the lines between individual and group. Both the awareness of oneself and the awareness of others are coactivated, becoming one entity.[2] Along with a heightened sense of connection, the energy has increased by this point in the piece. The dancers begin to loosen up, letting the music take control of their bodies. This section concludes with a solo performed by Sophia. Like the other solos, she generated her material to a different song that motivated her movement, and then we reset those movements to the "Skarabush" music. Coming back to this approach allowed Sophia to follow her individual inclinations when moving to music along with simultaneously experimenting with the element of timing. I was curious about the speed she would naturally choose to dance and whether she would groove along with the music or against it. Unsurprisingly, she was moved to match her phrase work to the sounds.

The fourth section, entitled "Cadence," contains three small group parts. These phrases were originally strung together based on a list of words they wrote while listening to provided music as seen in Appendix B. One meaning of cadence is to rhythmically articulate sounds. It can also mean the end of a phrase, symbolizing the first half of the piece coming to a close. The intention behind this section developed into imitating different aspects within a music concert setting. Concerts came up in my research as a tangible and prominent example of when many people move together to music.[3] The first trio, Dominique, Kayla, and Sophia, portray instruments that an artist could play at a concert. Each of them tapped into past experiences playing instruments to inform their choices. For example, Dominique played the saxophone, Kayla the guitar, and Sophia the violin. This brought up questions like, how would a chordophone instrument move compared to a woodwind instrument? Would their sounds make humans want to move in different ways? Their musical investment resulted in a textured and

dynamic phrase. Second, Deena and Gracie explored being a part of the crowd in their duo. At a concert, the audience members share the same physical space while connecting to each other and the performers. They witness a performance unfold unpredictably over time. The music induces synchronous movements and physiology experiences among the crowd. To reference this, over the course of their duet, Deena and Gracie entered in and out of synchrony. They investigate the view from seated positions, standing positions, and various placements in space. The third group, Gab, Caroline, and Lydia, played around with becoming disc jockey sound equipment and systems. The imagery of these structures inspired the movement vocabulary of this trio, allowing them to achieve both linear and circular forms in succession. Using collective movement at concerts as inspiration, this section investigated the vast range of possibilities that this form of musical engagement could include.

The piece's fifth section is "One Minute Man" with a subset of the dancers. The movement language pulls from a hip-hop style, incorporating hard-hitting elements between floorwork and modern flow. When originally creating this sequence, I was envisioning breakdancing, the street dance that originated in the Bronx during the 1970s by Black and Hispanic youth.[4] The placement of this section within the framework of the piece along with the instrumental track both match how breakdancing typically occurs during the "break" of a song. The "break" of the song is when the vocals drop out and the percussion plays unaccompanied. Breakdancing started as an outlet to move to music within certain communities, so the style remains relevant to my research. The music called for an introduction to groove, switching off between repetitive rhythms with predictability and rhythmic deviations with surprise.

Within the "One Minute Man" section, the song unexpectedly and dramatically cuts out, leaving the stage filled with silence and stillness. The dancers are forced to hold their position for

a full minute, representing that when no music is present, no movement would be present either. I chose a one-minute timeline as a play on the title of Missy Elliott's song. The moment starkly contradicts all the unison phrase work that preceded it. The heavy breathing of the dancers is what lingers onstage. After hearing the recorded breath rhythms at the beginning of the work, the audience gets to re-experience breathwork, but this time caused by overexertion of the dancers' bodies.

The sixth sequence entitled "Mad" is my self-choreographed solo. I deliberately chose that this solo would emerge out of the prolonged period of silence. This part of the work explores the relationships between my brain, my body, and music. One of the concepts I investigated was repetition. Since music is created through the repetition of individual sounds, I played around with repeating the same movements until they transformed into new ones. Additionally, I attempted to physically express the chosen auditory stimulus. This included embodying more complex sounds and theatrics in relation to the music. For example, the inclusion of laughing is a call back to my first choreographic piece, *Sondage*, where I originally explored the relationship between music and the brain. In that work, I introduced an exploration of laugh rhythms. Further, in my solo I experimented with groove movement in untraditional ways through less obvious positions and body parts. Overall, I was fighting an uncontrollable desire to move to music. Even if I wanted to stop moving, my body kept going as the soundscape took over. Lastly, the progressive shaking motif that landed in my solo felt specifically unique to me.

"All Night" is the seventh and final section of the piece. Contrasting my solo, all the dancers returned to the stage. This time, though, not everyone was called to move at the same time or perform the same movements. The section starts with randomized chaos, showcasing each of them being called to move at different times. The locomotion that occurs between the

phrase work depicts the idea of running to and from the dance floor. While on the dance floor, the section illustrates the brain at the club, grooving in multiple ways at once. Eventually, everyone drops to the floor to watch Ilo's solo, exposing the possibility of an individual's desire to move without the rest of the group. His solo was originally crafted to a different song that motivated him to move to generate physically satisfying and emotionally joyous movements. We reset that choreography to the "All Night" music, creating a textured and elevated solo. The opportunity presents itself for the other dancers to watch and react. There is one last unison phrase that returns to movements that were introduced earlier in the work along with the introduction to high energy grooves inspired by house dance. House is a freestyle and social dance form that originated in the 1970s in the underground clubs of Chicago and New York.[5] The house style contains some of the most popular groove movements, maintaining importance to my research. The piece is finally at its energetic peak. The dancers acknowledge this escalation through their emotional expression of enjoyment. The piece concludes with isolated breathwork, bringing the work full circle to the beginning.

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III. PRODUCTION ELEMENTS

The music, costumes, and lighting were the elements of this work that provided an opportunity to highlight my research outside of movement.

Music

During the process, I asked myself and my cast, "What constitutes music?". We discussed the nuances of what distinguishes musical compositions from other forms of sound. We articulated that music is often composed of organized sound elements, including melody, harmony, pitch, timbre, rhythm, beat, and tempo. They brought up the importance of repeating sounds and developing rhythmic patterns and cadence. Additionally, we talked about how music engages the senses, communicates expressive content, and elicits emotional reactions from listeners. Lastly, we acknowledged the importance of the artist's intent when making musical compositions.

My goal for the soundscape of the work was to choose music with varying rhythmic complexities. At a low level of rhythmic complexity, there is less syncopation, more predication, and expectations are typically met. At a high level of rhythmic complexity, there is more syncopation, less prediction, and expectations are typically deceived.[1] The lowest and highest degrees of rhythmic complexity often elicit the least desire to move as they are either too simple or complex. The songs with a medium amount of syncopation elicit the pleasurable desire to dance.[2] I was able to choose songs with less and more challenging rhythmic patterns. Lyrics were not important to me in this research.

The first two songs in the piece are "One, Two, Three." and "Ready, Set, Go." by Kenichi Kasamatsu. Kasamatsu is a working artist who was raised in Thailand and is now based in New York City. I had the privilege of training with him occasionally growing up and I have

long admired his work as a dancer and choreographer. In addition to dancing, choreographing, and teaching, he began to make his own music for an additional outlet of creativity. When he transitioned to music, I immediately knew I wanted to pursue his soundscapes for my own artistic work. He aimed to diversify the rhythms that the human body can move to. In conversation with Kasamatsu, he exclaimed that he often questions how his body would sound while it is moving.[3] He constructed two acapella songs by vocalizing noises on top of his rehearsal footage. Using breath, claps, snaps, and other self-generated noises, this music takes the dance back to a humanistic level, relating to those who may not be dancers themselves. Energetically, I wanted the piece to linearly progress. Therefore, it was important to open with these two pieces of untraditional music because they challenge what could be considered a groove rhythm.

The third song is called “Skarabush”. This was created by a group of body percussionists from Brazil known as Barbatuques. Their work is fully produced by sounds from the human body which provides a powerful experience for those listening. Their music is similar to Kasamatsu’s music but with greater intensity. They include vocals, breathwork, claps, snaps, beating of the chest, tap dancing, and other noises. “Skarabush” is immediately attention grabbing with layered and intertwined elements that gradually advance as the song progresses. The fourth song is by Travis Lake and is called “Cadence”. Travis is an interdisciplinary artist focusing on music composition, digital production, and dance choreography. This song has a strong driving force, building momentum throughout by using an array of instrumental sounds.

Since I asked my cast to dance to songs that made them want to move, I wanted to include a song that has always made me want to move. I chose the instrumental version of “One Minute Man” by Missy Elliot. Although her lyrics are playful and avant-garde, the instrumental

version still highlights her distinct and unique genius. Missy Elliott's music impressively mixes retro hip-hop with a futuristic flare. Through her blend of hip-hop with R&B and electronic sounds, her music has always stood out to me as invoking the desire to move in my body.

The sixth song is called "Mad" by CoH. I did not choose this song to showcase groove rhythms. Instead, I picked a song with a bubbling pulse to match my overwhelming desire to move. The song boils like water as the different sounds rise to the surface in various sizes and frequencies. The seventh and final song is called "All Night" by Soundstream. I chose to end with a song that included the original genres of music that inspired me, featuring a fun and upbeat mix of disco, funk, and techno.

Costumes

From the beginning of my choreographic process, I was committed to the color red for costuming. According to my research, red is the most highly effective but emotionally ambiguous color.[4] Holding both positive and negative connotations, red signals a diverse range of associations.[5] According to my cast, they associate red with love, heart, anger, fire, stopping, threat, warning, emergency, opportunity, intensity, energy, passion, blood, and flags. Studies have shown that exposure to red can evoke physiological responses such as increased heart rate and blood pressure.[6] Red can capture and maintain attention more than other colors. Among the spectrum of visible light, red has the longest wavelength.[7] In addition, red is commonly used in brain scans to visualize areas of activity and activation.

Without a budget, I decided to utilize the same costumes from *Sondage*, my previous choreographic work. The costumes were a red two-piece set composed of flowy pants with a loose collared button down top. The red is unapologetic, making the dancers unable to hide from the audience's view. I wanted my entire cast to be dressed in the same costume. This united the dancers in the same world. This made them all equals in one community. Aesthetically, the same

costumes also added precision and specificity to the unison phrase work sections. I decided to modify the costumes by cutting off the sleeves to expose their arms. I discovered that seeing the dancer's arms onstage allowed for some of my choreographic and movement choices to be more successfully perceived by the audience.

Lighting

Across the back of the stage, the black traveler was closed. On the sides of the stage, the black wings were left down. The space was left as a dark, black box, relying on the lighting to illuminate what I wanted to be seen. Primarily, the lighting accentuated the bold red costumes. There was not a lot of excess color used in the lights, and instead they reflected the cleanliness that was present in the movement and other aesthetic choices. At times, the lighting was used to highlight individual dancers in their solo moments through a spotlight. Alternatively, Sophia's solo included nine spotlights which made her look less alone on the stage. During the sections with more isolated movements, geometric lighting designs were lit across the ground to match the precision. Additionally, playful lighting designs were lit across the ground to reflect the lighthearted nature of the work. Lighting designer Gregory Catellier and I had built trust through his lighting of my previous work, so he understood my intentions during this collaboration.

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[1] Vuust and Witek, "Rhythmic Complexity," https://www.frontiersin.org/articles/10.3389/fpsyg.2014.01111.
[2] Matthews et al., "The sensation of groove," https://doi.org/10.1016/j.neuroimage.2020.116768.
[3] Personal communication (Kenichi Kasmatsu, phone call to artist, August 14, 2023).
[4] Claudia Kawai et al, "The good, the bad, and the red: implicit color-valence associations across cultures," *Psychological Research* 87 (2023): https://doi.org/10.1007/s00426-022-01697-5.
[5] Michał Kuniecki et al, "The color red attracts attention in an emotional context. An ERP study," *Frontiers in human neuroscience* 9, 212 (2015): https://doi.org/10.3389/fnhum.2015.00212.
[6] Kendra Cherry, "Red Color Psychology: The Color Red Is Associated With Both Positive and Negative Emotions," *Verywellmind* (June 2023) https://www.verywellmind.com/the-color-psychology-of-red-2795821.
[7] Kendra Cherry, "Red Color Psychology," https://www.verywellmind.com/the-color-psychology-of-red-2795821.

IV. CONCLUSION

Audience Feedback

Audience feedback was collected through in-person conversation with viewers along with a Google Form. A QR code linking to the form was included in the program. I received 19 responses to my work. The form consisted of two questions:

1. *What moments stood out to you in the work? What did you find memorable?*
2. *What meaning, themes, or intentions did you find in the work?*

One piece of feedback I received often was that the audience could tell how much work went into the dance. Many viewers noted that this stemmed from the large group's ability to move with such harmony and purpose. I think this contributed to making the first section as memorable as it was for the audience. Many viewers also noticed my choice to repeat motifs and slice and reinsert certain pieces of the choreography throughout the work. Others commented on the separate sections being thought out meticulously and flowing smoothly.

One viewer said that the work, "so beautifully captures what it is to hear a rhythmic sound and almost involuntarily move your body to it."[1] Another viewer said that the work, "emphasized how cognition affects our movements in some scenarios versus how involuntary connections are modulated by specific brain networks and innate reflexes in others."[2] I think these two comments reveal that the title of the work, *Unconscious Entrainment*, was successfully reflected in the dance.

Multiple form responses mentioned that the unified costumes allowed the audience to primarily focus on the movement. Also, almost all the form responses mentioned my solo. A viewer responded that my, "remarkable control and seemingly paradoxical loss of it - especially

within the electrifying shaking - visually manifested how music can command the body to move in both voluntary and involuntary ways through neurological pathways."[3]

Many viewers commented on the choreography feeling like an extension of the music. One audience member said the work scratched an itch in their brain that they did not know they even needed scratching. A couple audience members said that the varied movement styles and speeds throughout emulated the diverse processes in the brains. They said that it was satisfying to watch the dancers synchronize together and then divert to perform individual moments. Breath seemed to be used effectively in the piece. Overall, I think everyone agreed that they discovered themselves making small movements in the audience along to the music as they were watching the dance.

Dancer Feedback

The day following the performances, we met as a cast to discuss the process and outcome of the work. I offered these guiding questions:

1. *What did you value in this process? What was memorable, informative, or enjoyable?*
2. *What would you change about this process?*
3. *What changed for you (physically or emotionally or mentally) between the different sections of the dance? Was there a section that made you feel something particularly different from the rest?*
4. *What was the experience of performing this piece like? How did having an audience, costumes, and lighting impact your experience?*

The cast agreed that the year-long process helped my choreography sink and resonate in their bodies. Not only were they learning material, but they felt like they could deepen, texturize, and perform the material by the time of the shows. They noted that my choreography was

"innovative." The movements that felt unfamiliar at the beginning eventually got more familiar. Notably, Dominique stated that her movement style and vocabulary was diversified through this work. Additionally, others said that the movement was similar to how they danced in their head but had never been able to achieve in their body. This was the first time they had ever been able to replicate this vision of dancing. The cast commented on being challenged by the attention to detail, specificity, and precision that I was asking for. Gracie commented that during the moments that were not set, she let the music move her in a way that differed from my choreography. After she had a chance to improvise on stage, she found deeper connections to the music during the set material.

In response to changing the process, many of the cast members commented on various aspects of time. The dancers wished that we would have had enough time to spend more rehearsals not dancing, learning less phrase work, and instead discussing more of the research or improvising. As we only met once a month during the fall semester, I believe that meeting weekly instead would have added enough time to do this.

Deena stated that my choreography opened new layers to the music she would have otherwise never noticed. During the One Minute Man section, those in this part discussed feeling powerful and confident as they were locking eyes with the audience and dancing. During the minute of silence, Gab noted that although she could not see the others, she could identify them by the sound of their breath. Lydia referred to the lighting change during this moment as the reset of the piece.

Caroline and Sophia bounced off one another when discussing how much fun they had during the process. Working with the same group for almost a year made their comfort and collaboration reach new levels. The experience of dancing on and offstage with their best friends

brought a level of joy to performing that they had not yet experienced. They said the energetic progression of the piece allowed this to feel natural and not forced. By the end of the work, Ilo commented that there was a whole row of people bobbing their heads in the audience. He said that it was an informative experience to break the fourth wall and let it sink in that everyone wanted to move.

Since not every dancer was in every section, all the cast members resonated with the experience of dancing while they were in the wings. They liked observing each other's interpretation of the music. They watched other cast members do parts of the dance they were not even in while standing in the wings. They talked about how moving on the sides helped keep their energy up for the whole twenty minutes. Dominique stated that she got winded and tired throughout, but she never wanted to stop moving.

Process and Outcome

My thesis aimed to represent a neurological process through a choreographed dance work based on academic research. From a dance perspective, I created a piece that embodied the phenomenon of entrainment, synchronizing movements to rhythms. At both performances, the audience demonstrated that music does make humans want to move their bodies. Using my large cast, I showcased the variation between individual movers within this concept along with the differences between solo and group work. I explored synchronicity, instinctual response, repetition, groove, and a range of movement styles. From a neuroscientific standpoint, I identified opportunities for further investigation where brain activity could be observed and recorded while moving to music. Emory is uniquely positioned with strong programs in neuroscience and dance where interdisciplinary research could be conducted in this area.

[1] Audience member, Google Form survey, "Honors Thesis Feedback", March 24, 2024. https://forms.gle/xUZBAJ7PUYhK46hp7.

[2] Audience member, Google Form survey.
[3] Audience member, Google Form survey.

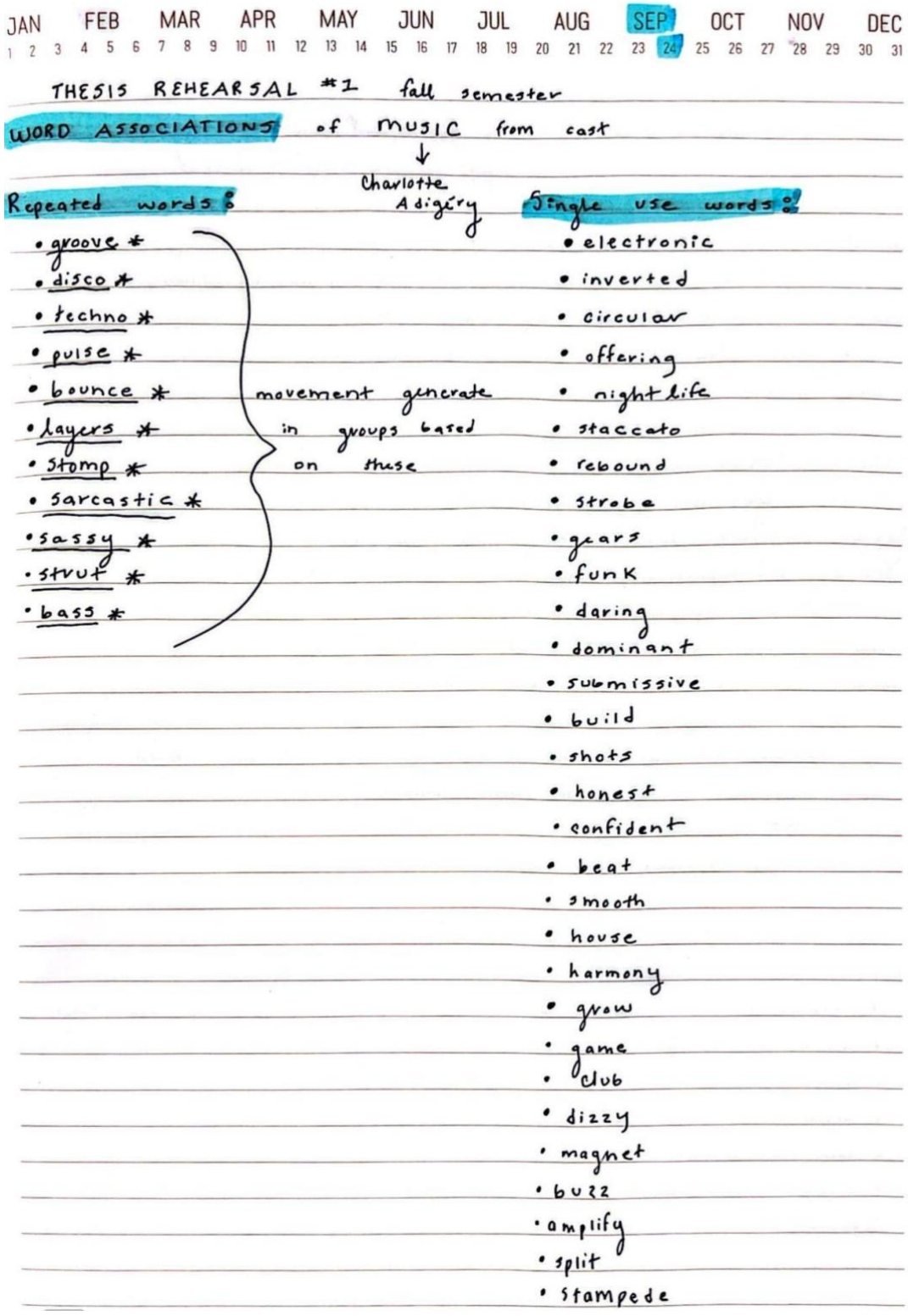
V. APPENDICES

Appendix A: Group Rehearsal Schedule

Fall Semester:
Sunday, 9/24, 2:30 - 4 PM
Sunday 10/22, 2:30 - 4 PM
Sunday 11/5, 2:30 - 4 PM
Sunday 12/3, 2:30 - 4 PM

Spring Semester:
Sunday, 1/21, 2 - 3:30 PM
Thursday 1/25, 5:45 - 7:15 PM
Sunday 1/28, 2 - 3:30 PM
Thursday 2/1, 5:45 - 7:15 PM
Sunday 2/4, 2 - 3:30 PM
Thursday 2/8, 5:45 - 7:15 PM
Sunday 2/1, 2 - 3:30 PM
Thursday 2/15, 5:45 - 7:15 PM
Sunday 2/18, 2 - 3:30 PM
Thursday 2/22, 5:45 - 7:15 PM
Sunday 2/25, 2 - 3:30 PM
Thursday 2/29, 5:45 - 7:15 PM
Sunday 3/3, 2 - 3:30 PM
Thursday 3/7, 5:45 - 7:15 PM
Sunday 3/17, 5 - 6 PM

Appendix B: Select Rehearsal Notes



JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

THESIS REHEARSAL #1 fall semester

WORD ASSOCIATIONS of MUSIC from cast

↓

Charlotte Adigéry

Repeated words:

- groove *
- disco *
- techno *
- pulse *
- bounce *
- layers *
- stomp *
- sarcastic *
- sassy *
- strut *
- bass *

movement generate in groups based on these

Single use words:

- electronic
- inverted
- circular
- offering
- night life
- staccato
- rebound
- strobe
- gears
- funk
- daring
- dominant
- submissive
- build
- shots
- honest
- confident
- beat
- smooth
- house
- harmony
- grow
- game
- club
- dizzy
- magnet
- buzz
- amplify
- split
- stampede

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

THESIS REHEARSAL #3 fall semester

Question to the cast: What music makes you want to move?

- Gracie = In This World by Moby
  Beam Me Up (Jacques Renault Remix) by Midnight Magic
- Gabe = Red Wine Supernova by Chappell Roan
  Oom Sha La La by Haley HendrickX
- Deena = Goodie Bag by Still Woozy
- Ilo = Balaye by A-STAR
- Madison = YEA by Aminé
  New Guru by Vulpeck + Vulf
- Kayla = Is There Someone Else? by The Weeknd
- Dom = Virgo's Groove by Beyonce
  Alright by Victoria Monet
- Lydia = Work by Charlotte Day Wilson
- Sophia = Doin' it Right by Daft Punk

~Task for cast: movement generate 30 sec solos to your chosen song

~Using Ilo, madison, Dom, Sophia, Kayla

☆What constitutes music?

- organized sound elements: melody, harmony, pitch, timbre, rhythm, beat, tempo
- rhythmic patterns } cadence
- repeated sounds
- emotional responses
- expressive content
- engage listener's senses
- artistic intent

SPRING SEMESTER THESIS REHEARSAL:

☐ Listen to "All Night" for repeating 2 versus 5 sounds

- I think Lydia has to move in 1st formation
- Dom missing 1st head left down after fist bumps
- Gracie come closer to clapping before coughs — Gracie airan up / sharpen beginning (avoid swinging arms)
- Where is our gaze after we inhale and lunge forward onto our left leg?
- Let's make T shape – lower legs above 90°
- Deena come up a little higher for slump
- Gab can go lower on clap hands up down down up
- Low release reach looking SU BETTER keep finding length → how open is shoulder?
- I need to move in during tight slump
- Lydia late on 1 2 3 ear part
- How apart are feet as we hold transition?
- Can Madison turn body during leg breathing part? (rotate on hand)
- shoulder roll in tight slump
- 5 ppl part, pushing chin out w/ higher energy + force
- Ilo & Madison duo cleaning – Madison not as sharp as Ilo – level on backing up hip
- feet width in tight slump breathing
- Dom push your "ha ha ha" as you get more comfy
- try to finish teasing ASAP for Skarabush music start — 1st position hold could be cleaned
- Skarabush Madison weight shift shoulder into two hits
- Deena looks different on the runs charging diagonal
- Skarabush teasing – if doing same as person in front of you, switch gears
- Dom's head on crazy part that we want over
- Skarabush counts getting to floor
- Each group should complete 4 clear movements
- Madison head release on shoulder transition
- Sophia can you be flat side to start shaking solo
- 1st trio clean over the toes knees on floor part
- Kayla looking front on back attitude after floor part
- Deena's leg, change the lean
- Gab's sit back timing
- 2nd trio clean lean back arms up + timing
- Kayla don't look front on crawls (no one)
- Clean Gracie arms during one minute man
- Kayla's roll up can be even slower
- Dom can lower pelvis during crab hold
- one minute man switches w/ hands on hips BIGGER
- Deena last section facing back arch contract
- Madison last section head on fist bumps

★ CLEAN GROOVES – Gracie arms don't mat – Paymer spring break hw

- Last exhale does not have to be angry, shift to and on a positive note
- Try to clean up falling to floor for Ilo timing

★ Remind cast you can see them in wings

Running:
- locomotive as pedestrians
- run to the dance floor

First song:
find balance of being sharper hitting harder while still being specific

overall, less freedom during unison work

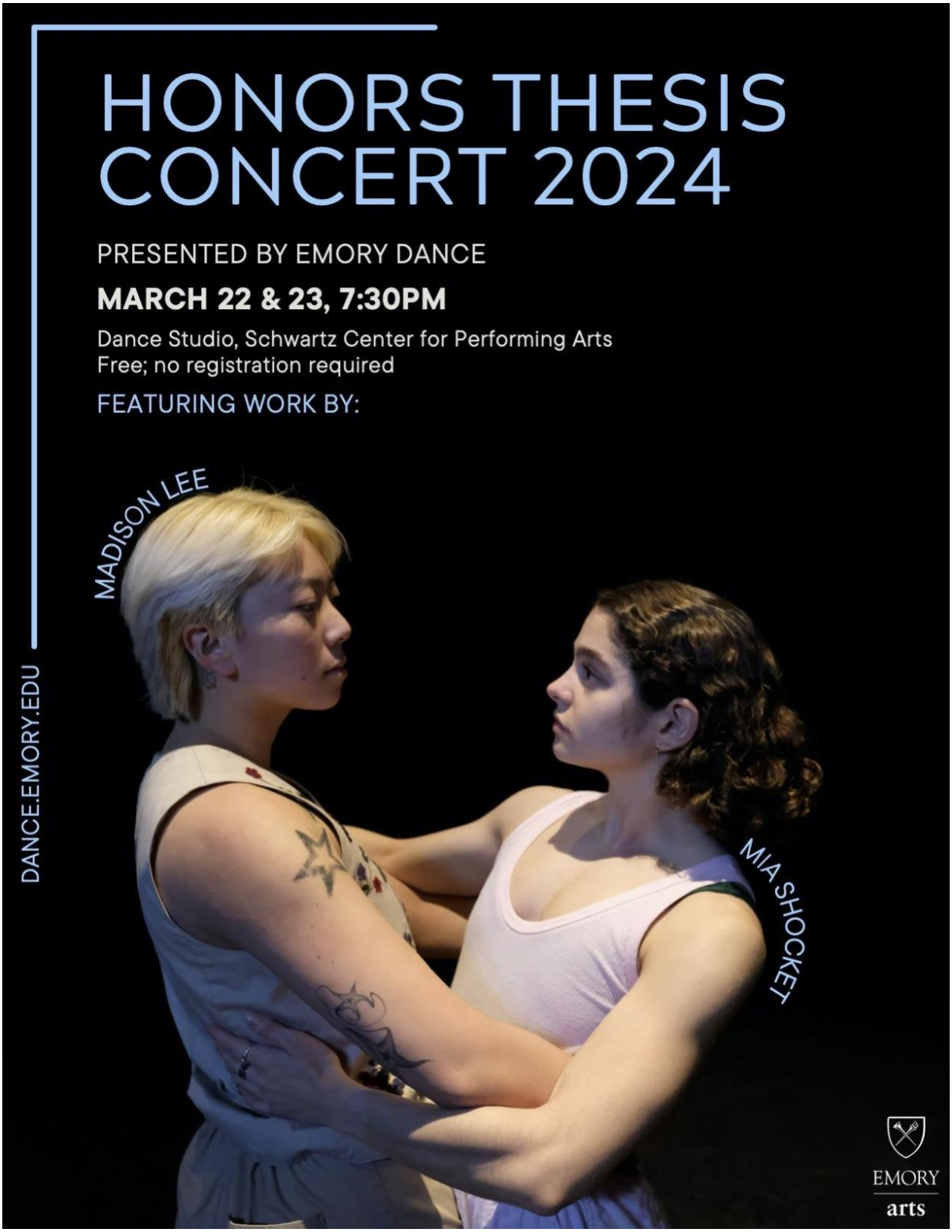
the time to take liberty is stage dive section

The whole thing really lacks performance in the way of how are you not enjoying this – what do you want the audience to feel

Remember use of full stage space during stage dive

Appendix C: Rehearsal and Concert Photos

Appendix D: Promotional Materials



Appendix E: Concert Program

Unconscious Entrainment

Choreographer: Mia Shocket
Dancers: Gab Crum, Ilo Elder, Gracie Evans, Deena Goodgold, Lydia Hamby, Dominique Jones, Caroline Kim, Madison Lee, Kayla Lim, Sophia Shahin, Mia Shocket
Music: Kenichi Kasamatsu, Barbatuques, Travis Lake, Missy Elliot, CoH, Soundstream
Costumes: Cynthia Church

Mia Shocket is a senior, double majoring in neuroscience and behavioral biology and dance and movement studies. She is from Washington, DC. Before college, she was in a dance company for fifteen years that participated in regional and national competitions and focused on artistry and versatility across many styles of dance and performance. She has consistently been involved in Emory Dance Company and Emory Dance Network. She is the co-president of Persuasion Hip-Hop Crew on campus. Outside of dance, she teaches yoga sculpt classes at Corepower Yoga. This is Mia's second choreographic work. Her first piece, *Sondage*, premiered in the Spring 2023 EDC show.

Unconscious Entrainment intersects dance and neuroscience, researching the neurological processes behind the phenomenon of when certain music makes humans want to move. This instinct to dance can be found in universal head bopping, foot tapping, hand clapping, or body swaying. Entrainment occurs naturally and unconsciously as our bodies synchronize with biological and external rhythms. The phenomenon of coordinating physical movements to sounds has remained one of the strongest behaviors uniting humans through natural selection. Through academic, choreographic, and performance research, she investigates the relationships between movement, music, and the brain.

Lighting Design: Gregory Catellier

Emory Production Staff
Technical Director: Gregory Catellier
Stage Manager: Thales Lathrop
Stage Crew: Carly Wynans
Electricians: Emory Dance Students
House Management: Brenda Porter
Sound Editor: Kendall Simpson
Dance Program Director: Sally Radell
Dance Program Coordinator: Anne Walker
Program Design: Patsy Collins

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