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UNIVERSITY OF CALIFORNIA SAN DIEGO

Scaffolding Metacognitive Self-efficacy Models in Post-Secondary Music Andragogy: The Musicians Auditory Perspective Project

A dissertation submitted in partial satisfaction of the
requirements for the degree of Doctor of Musical Arts

in

Contemporary Music Performance

by

Berk Waldemar Schneider

Committee in charge:

Professor Stephanie F. Richards, Chair
Professor Diana Deutsch
Professor Steven Schick
Professor Wilfrido Damian Terrazas-Perez
Professor Shahrokh D. Yadegari

2024

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The dissertation of Berk Waldemar Schneider is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

University of California San Diego

2024

DEDICATION

To my close family, friends, and colleagues whose consistent support and willingness to listen and be heard contributed to many of the inquiries and discussions that have shaped my understanding of creative performance practice, allowing me to see the intellectual opportunity in life's contradictions.

EPIGRAPH

Reliquary

By Tiange Zhou

Home
A reliquary,
Me reflecting the bones' form
Of the overlapping infinity.
The best thing one can be
Is a broken mirror.
The person who sees me is me.
I am the call,
I am the echo,
Seeking with blind eyes
In an invisible dimension.
I imagine my wisdom,
Diving with the ears of the forest,
And the trees are secret arms,

Embracing the tears of time.

Me,

A riddle,

A sigh,

A fairy,

A reliquary.

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Chapter 2, is a collection of research inspired by wonderful pre-qualification conversations and interactions with Prof. Diana Deutshe, Prof. Stephanie Richards, Prof. Steven Schick, Prof. Wilfrido Terrazas, and Prof. Shahrokh Yadegari. Chapter 3, is a partial representation of the material as it appears in *Musicians auditory perception (map): Listening and empathizing in the creative process*. Schneider, B. W., Grond, F., Côté, J., Diba, P., Ko, M. S. P., Song, S., Zhou, T., & Yadegari, S., Zenodo, 2023. I was the co-first author of this interactive project report and spearheaded the project. The project would not have been possible without the dedication and trust of Prof. Yadegari and support of The Analysis, Creation, and Teaching of Orchestration Project (ACTOR). I would like to acknowledge Florian Grond for his constructive leadership and genuine interest in how musical minds work. For Sang Song and his impeccable attention to detail in preparation for the project's rigorous peer review, leading to its publication and presentation at conferences held in Montreal. These conferences were led by notable figures such as Stephen McAdams and were hosted in collaboration with ACTOR. I would also like to acknowledge Pedram Diba and Jeanne Côté for their incredible teamwork, investigative inquiry, and for presenting the project to The Institut de Recherche et Coordination Acoustique/Musique (IRCAM) in New York City. Finally, Peter Ko and Tiange Zhou for embodying the true nature of the project through your deep collaborative efforts.

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ABSTRACT OF DISSERTATION

Scaffolding Metacognitive Self-efficacy Models in Post-Secondary Music Andragogy: The Musicians Auditory Perspective Project

by

Berk Waldemar Schneider

Doctor of Musical Arts in Contemporary Music Performance

University of California San Diego, 2024

Professor Stephanie Richards, Chair

This dissertation investigates the role of modern music educators in cultivating positive self-efficacy beliefs among students and peers regarding their musical abilities. I will adapt four principal expectations of social learning developed by Albert Bandura: 1) *performance accomplishments*; 2) *vicarious experience*; 3) *verbal persuasion*, and; 4) *emotional arousal*, expanding his model to include research-creation praxis strategies that utilize specific metacognitive functions of self-efficacy during the act of musical creation: 1) *attentive memory*; 2) *adaptive and spontaneous aptitude*; 3) *empathetic engagement in the creative process*, and; 4) the *assetization of external and internal stimuli.* By connecting specific learning expectations with each mode of induction, I intend to illustrate how self-efficacious theories operated during

the Musicians Auditory Perspective (MAP) project, and how postsecondary mentors can encourage music experimentalism and hands-on mastery experience through participant modeling.

The MAP project provides evidence that through musical improvisation and use of binaural technology, we can empower peers by fostering positive responses to emotional arousal during collaborative musical performance. This achievement stems from acknowledging the creative significance of unconscious memory, emotional self-regulation, empathy, educational exposure tactics, timbral perception, and deep listening facilitated by binaural recording devices. By helping to scaffold self-efficacy beliefs via attentiveness towards learner interests and funds of knowledge, we not only enhance commitment and persistence in student and peer tasks, but we create opportunities for effective learning choices in the moment, ultimately contributing to an improved sense of well-being during the act of creation.

Introduction

Music scholars and educators have studied the concept of self-efficacy for well over two decades (McCormick & McPherson, 2003; McPherson & McCormick, 2006). Particularly noteworthy is its role as a crucial lens through which to comprehend students' self-beliefs regarding their capacity to establish personal objectives, cultivate resilience in the face of challenges, and self-regulate to facilitate the achievement of long-term tasks. The term self-efficacy was first published by Stanford University Professor Albert Bandura (Bandura, 1977) who believed that "personal agency operates within a broad network of social structural influences" and that "in these agentic transactions, people are producers as well as products of social systems" (Bandura, 2002). In other words, our own personal actions have as much influence on our lived experience as how we might react to actions we perceive are being prescribed upon us. Self-efficacy is, in essence, an individual's belief in their ability to achieve a goal through reflection on their own behavior and social environment.

Bandura outlined four expectations of self-efficacy that can be used for social learning: *performance accomplishments*, *vicarious experience*, *verbal persuasion*, and *emotional arousal*. Each expectation can be linked to a mode of induction specific to music education. For example, to boost self-efficacy in the performance domain, a music student might habitualized a successful behavior through consistent exposure during live performance, thus modeling the positive effect of self-efficacy. In this process, the student chooses goals they believe are achievable within the framework of their performance preparation. A teacher might assist this mode by prescribing repertoire that is appropriate for the student's skill level, by demonstrating the performance process themselves, or by providing positive feedback on aspects of the student performance that meet the self-regulated expectations defined in the student's preparation process. Of course,

emotional arousal is also at play. When combined with desensitization, students might receive graduated exposure to aversive events in tandem with anxiety reducing activities, such as cue-controlled relaxation, reciprocal inhibition, insight-relaxation methods (Galatus, 1989; Richard, 1992; Wardle, 1969), imagery therapy (Sweeney, 1981), muscular relaxation, or eye movement desensitization and reprocessing (Shapiro, 1997). Many modes of induction have been used to show the positive effects of self-efficacy in traditional music education settings. Numerous peer-reviewed publications, alongside plausible context specific pedagogical applications investigate self-efficacy tendencies, while taking into account gender and race across varying academic levels of instruction (Çiftçibaşı, 2021; Hendricks, 2016; Nielsen, 2004; Zelenak, 2020). Nevertheless, few of these studies on self-efficacy originate from an adragogic musical perspective, which I consequently build into Bandura's original model (see figure 1.1).[1]

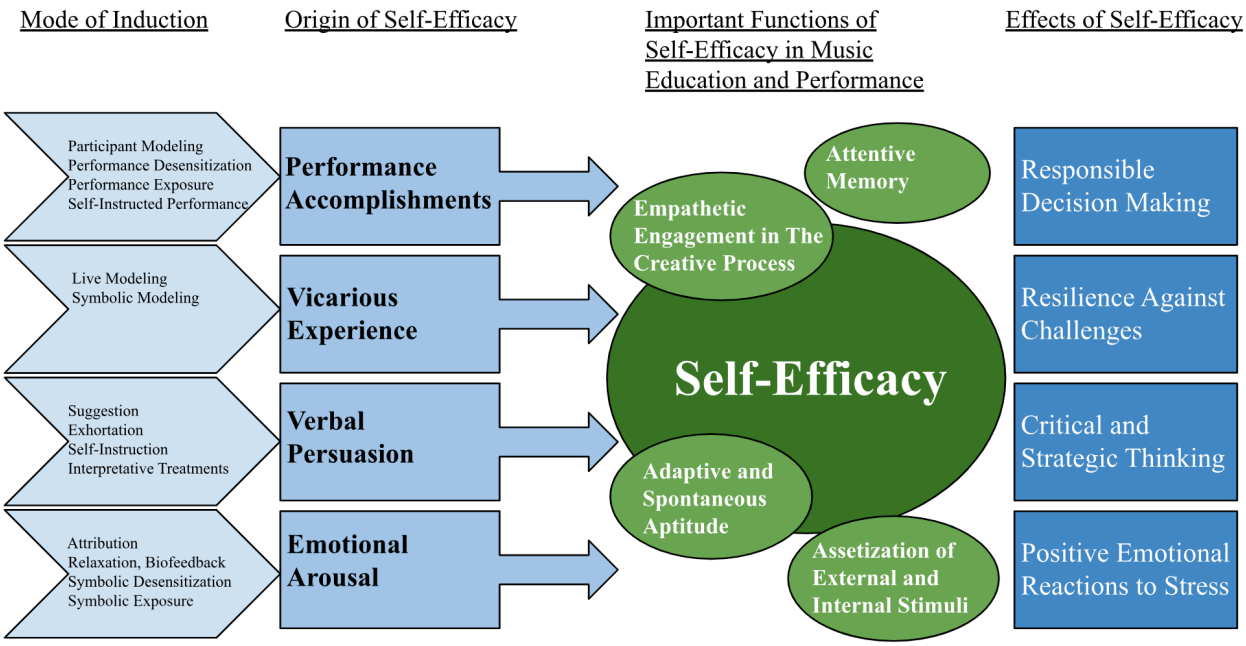


Figure 1.1: *Origins of Efficacy Information*

[1] *Note.* Origins of efficacy information and the principal sources through which different modes of treatment function as conceived by Bandura. The expected effects and important functions related to music andragogy are adapted by myself.

Chapter 1. Self-efficacy in Music Education

From a research-creation perspective, all musical engagements are acts of improvisation and mandate a high level of self-efficacy. Although improvisation is defined as the act of improvising, or performing without prior planning or expectations, this definition has of late failed to describe the variability that exists within the spectrum of improvised music. To illustrate this point one can consider, 1) a saxophonist delving into free-form jazz alongside a rhythm section; 2) a seasoned concert pianist, dedicating years to memorize and flawlessly execute a Rachmaninoff piano concerto; and 3) a composer meticulously crafting a woodwind chamber piece. These three scenarios exist on a continuum of improvisation, drawing upon distinct facets of self-efficacy to yield meaningful outcomes. We can organize these functions of self-efficacy into four basic categories: 1) *attentive memory*; 2) *adaptive and spontaneous aptitude*; 3) *empathetic engagement in the creative process*, and; 4) *the assetization of external and internal stimuli*. For instance, our concert pianist is not improvising the notes she plays, but she very well might be improvising the tempi, attack, or musical phrasing in the cadenza she memorized. Comparatively, the saxophone player may have greater liberty in selecting rhythms and notes, but will still need to respond to the pulse of the drummer he's playing with and make real-time decisions on whether to follow or lead. Meanwhile, our composer is planning a piece for a woodwind quintet, but through this process she is collaboratively improvising with the performers during its creation, drawing insight through inquiries to grasp each instrument's capabilities and the performers' nuances. These acts of spontaneity contribute to an enigmatic aesthetic that keeps music interesting and buoyant. An artist uses executive functions to target a memory (*attentive memory*), adapts an action to that memory in the moment (*spontaneous aptitude)*, engages with peers during the creative process (*empathetic engagement)*, and assesses

and develops habits when determining how to emotionally self-regulate during musical performance (*assetization of external and internal stimuli)*. An awareness of one's own cognitive processes can enhance the efficiency of each of these performance tasks while creating music. For example, our composer might *monitor* their own thought processes, understanding which compositional strategies are being used, and recognizing when comprehension or learning is occurring. They will likely *control* cognitive strategies based on feedback and self-assessment to improve learning or task performance, e.g. changing study techniques, seeking additional information, or modifying problem-solving approaches. And they will *evaluate* the effectiveness of cognitive strategies used, identifying strengths and weaknesses, while considering alternative approaches for future tasks or learning situations.

This metacognitive approach is crucial as it transforms interactions among the mind, body, and environment into deliberate action through enactive mastery experience. Consider an artist devoid of the need to respond to the acoustics of their performance space or to subtly react to the interplay among fellow musicians, whether human or artificial. It is precisely this enigmatic anticipation of the unexpected that makes art communicable, at least to some extent. Because expectations arise from accomplishments, experience, persuasion, and arousal, it becomes feasible to enhance our capacity to concentrate and recollect while remaining receptive to shifts in our surroundings and physical states through metacognitive functions of self-efficacy. By using Bandura's self-efficacy model alongside my adapted functions we can scaffold specific modes of induction that may positively impact all aspects of music performance and instruction, helping students build self-confidence while increasing personal and communal achievement, alongside overall well-being (see Table 1.1).

Table 1.1: *Functions and expectations of self-efficacy in andragogic music education*

Functions & Expectations	Attentive Memory	Adaptive and Spontaneous Aptitude	Empathetic Engagement in the Creative Process	Assetization of External and Internal Stimuli
Performance Accomplishments (Enactive Mastery Experience)	Habitualizing successful performance behaviors via targeted strategies of attentiveness	Providing real-time exposure to unexpected events in a variety of contexts during performance	Valuing active participation and peer-to-peer collaboration during the creation process, while attributing successes to specific strategies	Teaching self-directed performance desensitization that creates opportunities for positive student or peer performance experiences
Vicarious Experience	Attention given to live modeling of appropriate behavior by teachers and peers who share similar characteristics and/or interests	Witnessing and reflecting upon the improvisation of teachers and peers and acknowledging those who have achieved mastery	Supplying multimodal aids and technology that help students or peers understand music from multiple perspectives without directly comparing themselves with one another	Presenting proven tactics that address performance anxiety, while creating opportunities for student or peer understanding via interpretive therapies
Verbal Persuasion	Suggesting or empowering a student or peer to work towards achieving a long-term objective via self-instruction	Giving positive encouragement for students or peers who display appropriate risk management	Encouraging constructive and genuine peer-to-peer praise and critique	Using supportive therapies that address individual traumas or underlying conflicts
Emotional Arousal (Physiological and Affective States)	Applying qualitative data that makes physiological activity during arousal more visible and memorable	Advocating for self-direction in the moment while under emotional stress by focusing on musicality instead of perfection	Reflecting on writing and video responses that address active listening while creating a sense of community	Experimenting with symbolic exposure and desensitization via relaxation while helping students adjust negative internal attributions

Measuring Self-efficacy

Self-efficacy is dependent on individuals' funds of knowledge and thus is impossible to quantify. Nevertheless, It is possible to evaluate how a musician may be functioning in his or her environment with questionnaires.

There have been a number of methods used for gathering self-efficacy beliefs. The first study, by McPherson and McCormick, asked music students one simple question: “What result

do you think you will get for your exam today? Students used a 7 point scale to determine overall confidence before entering a performance situation (i.e., high distinction 91–100, low distinction 86–90, etc.). This limited approach has been expanded to broader surveys, including a number of questions that address specific performance concerns as well as the musical compositional process. This includes self-efficacy beliefs while generating compositional ideas and performing or recording sections of music (McCormick & McPherson, 2003; Ritchie & Williamon, 2010). Still others have combined pre existing surveys with more novel questions.

Michael S. Zelenak developed the Music Performance Self-Efficacy Scale as a component of his doctoral dissertation entitled "Self-Efficacy In Music Performance: Measuring the Sources among Secondary School Music Students" (Zelenak, 2014). This 24-item questionnaire takes into consideration the sources of efficacy information, allowing educators to monitor the development of self-efficacy in their students. From a teaching perspective, comprehending students' perception of each source of efficacy holds value because pedagogical techniques can be developed that address efficacy deficits.

However, a challenge arises once efficacy information is assimilated by students and expectations on performance are already established. Perhaps this is why few studies have addressed self-efficacy in post-secondary education and beyond. How do distorted memories, ingrained actions, and internal emotions alter one’s comprehension of self-efficacy? Especially when achievement is less well-defined, as within the separate accomplishments leading up to a musical performance. The aim is to exert greater influence over attention, encouraging students to heighten their awareness of habitual behaviors as well as the impact of others' conduct on self-perception via qualitative “thick” questionnaires alongside complex qualitative data.

A hybrid questionnaire that more thoroughly addresses the important origins alongside the functions of self-efficacy in music education asks students to reflect on individual experiences in more detail. The questionnaire below can serve as a guidepost, measuring a student's level of self-efficacy, allowing a teacher to begin scaffolding instruction so that it empowers students' strengths while reducing the negative effects of stress during musical creation and performance.

Attentive Memory

1. *I have mostly positive memories of previous musical endeavors ____*
    a. *Describe one positive experience in 2-3 sentences:*

2. *I have no problem self-directing my attention to specific tasks while performing or composing music ____*
    a. *What is your attention most drawn to during your creative process?*

3. *I have access to live or recorded musical performances by musicians that share similar characteristics and interests with me ____*
4. *I've had mentors that helped me organize my own musical goals ___*
5. *I receive constructive feedback from my teachers that helps me reflect positively on my musical learning progress ___*
    a. *What is some advice that profoundly changed your approach to the way you learn, why?*

6. *I'm aware of my body while performing or composing and remember feeling in control during various performance situations ___*

7. *I remember my successes more than my failures ___*
    a. *Describe a moment of success in 2-3 sentences:*

Adaptive and Spontaneous Aptitude

1. *I have a lot of experience creating music in a variety of environments ___*
    a. *Pick two different environments to examine further; how did your creative work change based on these spaces?*

2. *I have a lot of experience seeing and hearing my teachers and peers modify performance or composition plans in real-time ____*
    a. *List 2-3 examples:*

3. *I have a good idea of my limitations as a musician when it comes to executing a project with peers ___*
    a. *Describe 2 limitations that exist while working alongside peers:*

4. *I have a good idea of my limitations as a musician when it comes to executing a project alone ____*
    a. *Describe 2 limitations while working in solitude:*

5. *My emotional reactions don't change dramatically when my music isn't performed as expected ___*
6. *I find it easy to adjust my musical endeavors in the moment alongside peers ___*

Empathetic Engagement in the Creative Process

1. *I work well with others because I draw inspiration from my peers ___*
    a. *List 2-3 elements within your creative practice that you feel were heavily influenced by mentors or peers:*

2. *I often use technology (e.g., virtual reality, binaural recordings, videos) that allows me to experience what it's like to hear and understand music from someone else's perspective ___*
    a. *If applicable, what type of technology or multimodal devices are useful?*

3. *Peers and instructors give me positive feedback on my musical endeavors and provide me with reasons why specific events were successful from their perspective ___*
    a. *Which reasons are given and what inferences can you make from them?*

4. *I use journals or other methods to record my thoughts and actions on a regular basis, later reflecting on my interactions with peers ___*
    a. *List 2-3 thoughts or actions that helped you:*

5. *I feel inspired when peers are recognized by others for their successes ___*
6. *When working on a project with peers my input has a significant impact on our final product ___*

Assetization of External and Internal Stimuli

1. *I am able channel my emotional energy in positive ways while under pressure ___*
2. *I've witnessed teachers and peers succeed and fail when it comes to dealing with heated or stressful situations and have a list of techniques I can use to calm my nerves when necessary ___*
    a. *If yes, list 2 techniques you use:*

3. *I don't make judgments on the positive character of a person based on their daily behaviors ___*
4. *I like situations that may require me to deal with higher levels of stress ___*
5. *I don't often feel offended by people ___*
6. *I have no problem asking for help from peers and colleagues when I feel like I need it ___*

Chapter 2: An Overview of Self-efficacy Scaffolding Models

The instructional practice of scaffolding in education involves the chunking of complex individual or collaborative learning tasks into more accessible guided practices that support students' learning endeavors via inquiry, inference, modeling, feedback, and explanation. As students are able to accomplish more tasks independently, a teacher might remove an area of support or mode of induction. Metacognitive scaffolding refers to a pedagogical approach that supports students in cultivating self-directed learning skills and fostering reflection on areas requiring improvement. This method entails guiding students through the processes of planning, monitoring, and evaluating their cognitive strategies in the context of learning and problem-solving. For example, in the context of *assetization of external and internal stimuli*, a teacher's suggestions or strong advice for a student to actively listen to their own musical recordings while reflecting upon their emotions following exposure to a live performance situation can provide for valuable opportunities of self-instruction. Likewise, a teacher prescribing techniques for relaxing the body while addressing a student's misguided concepts of tension during performance via symbolic desensitization may help a student develop self-regulation strategies which can be applied before, during, and after musical performances.

These learning strategies can be differentiated with an aim to enable students with diverse learning needs to successfully grasp similar content, thereby creating opportunities for transformative learning. In music education, transformative learning holds particular significance for adult learners because it necessitates a deep understanding of existing beliefs or performance habits before incorporating new information rooted in life experiences. These experiences ultimately lead to a shift in one's previous perspective. The positive attributes of transformational learning theory are many. The theory fosters a sense of meaning behind creative endeavors by

connecting music to external social, cultural, and textual resources. Moreover, it provides a platform for the reevaluation of personal beliefs, values, and assumptions. Namely, transformational learning theory acknowledges that we are multimodal creative actors who balance levels of intuition and intellect to meet our learning goals. We (a) accumulate experiences, (b) make assumptions, (c) confront challenges to our perspectives, and (d) undergo life-changing learning experiences. Emphasizing the role of the learner in this constructivist approach provides a framework of responsibility that takes each function of my adapted self-efficacy model into account, i.e. *attentive memory*, *adaptive and spontaneous aptitude*, *empathetic engagement in the creative process, and assetization of external and internal stimuli*. Students and their teachers can utilize these functions of self-efficacy, scaffolding them to encourage responsible decision making, resilience against challenges, strategic thinking, and positive emotional reactions to stress during the creative process.

Attentive Memory: Evaluating Existing Understanding

If you were to inform a pedagogue about the significance of attentive memory, they would probably respond with a smile and a nonchalant shrug. A pedagogical teaching style is often associated with dull or pedantic teaching. But constructivist pedagogy rests in the guidance of learner interests and desires as opposed to mandatory curriculum. Considering this, what approaches can we take as teachers that fully engage our students' attention. Initially, developing a deeper understanding of what attentiveness means in the context of memory could assist us.

We derive our mental selectivity through attending to the world around us. The epistemology of the word *attentio(n-*) (from Latin) carries a variety of meanings. Attention can refer to the mental focus or concentration required for the "centration" of something being taken into "serious consideration". Attention can also imply an "interest" in processing the

environment via the senses. In addition, we can *tend* to "information received" or respond to information in an *affectionate* manner. Therefore, In some circumstances it is a *perceptual* phenomenon, rooted in our instinctual responses to the environment, e.g. a newborn's reflexivity to cry when exposed to loud sounds before developing the necessary cognitive mechanisms allowing them to "be afraid" (Thompson & Madigan, 2007, pp. 163-164). In other instances, it is a phenomenon related to *action*, structuring agency and willpower (e.g. an adult carrying out specific goals within a larger context).

The culmination of all of these forms of attention may result in a social *respect* for the accompanying cognitive processes and their many interpretations (Oliveros & Khaldi, 2005, p. 63). When addressing attention in music, one example of *respect* is the authoritative resonance of auditory *Aufmerksamkeit* (attentiveness) and Kantian transcendental aesthetics that inspired motionless music listening protocols during the German and French Enlightenment — expectations that are still very much a part of many modern music milieus today (Erlmann, 2010, p. 21).

Psychologists and philosophers alike have tried to make sense of attentive memory in order to better understand the mind's full potential. The *Ad Herennium*, dating from the *late 80's B.C.,* drew on Greek sources of memory instruction. Thought to have been compiled largely by Roman scholar Cicero, the book outlines advanced mnemonic devices in order to recall things (*res*) and words (*verba*), placing images on *loci* (easily remembered places or retrievable points). Whether attending to an abstract location to remind oneself of the general order of arguments within a speech (*memoria rerum*) or recording each individual word in the correct order (*memoria verborum*), the section (III, xvi-xxiv) on memory sought ways to organize mental images by pegging rhetorical structures into long-term memory banks, allowing them to be

retrieved through attentive behavior. Unfortunately, these were not simple tasks: ordering individual words was particularly challenging for the pupils of Cicero (Yates, 1966, p. 9). This demonstrates how we can view memories through lenses of attentiveness; some memories are actively attended to and may retain their accuracy when recalled over time. Nevertheless, one should not be too trusting of their stored memories. We can observe René Descartes (1596-1650) struggling with the fragility of human memory in his *Meditations on First Philosophy (1641)*:

> I suppose . . . that all things that I see are false; I persuade myself that nothing has ever existed of all that my fallacious memory represents to me. I consider that I possess no senses; I imagine that body, figure, extension, movement and place are the fictions of my mind. (Descartes et al., 1996, pp. 62-63)

He later attempts to utilize his attentive mind to sweep away doubts of 'truth' related to memory retrieval in his third *Meditation:*

> So long as we attend to a truth which we perceive very clearly, we cannot doubt it. But when, as often happens, we are not attending to any truth in this way, then even though we remember that we have previously perceived many things clearly, nevertheless there will be nothing which we may not justly doubt so long as we do not know that whatever we clearly perceive is true. (Descartes et al., 1988, p. 309)

This concept of "perceiving clearly" again exemplifies a conceptualization of imagery — a tool that helps prime the brain for memorization. In fact, parallel paradigms such as these have long provided crossmodal points of reference when examining more illusive auditory phenomena.

In 1871, an experiment conducted by Herman von Helmholtz and Nikolai Baxt, entitled "*Ueber die Zeit, welche nötig ist, damit ein Gesichtsausdruck zum Bewusstsein kommt*" (On the Time Necessary for a Visual Impression to Come into Consciousness) evaluated the time it took for stimuli to become conscious (attended to) on physiological grounds. The study led Helmholtz to conclude that "a voluntary direction of attention is a change in our nervous system that is independent of the motions of the external, movable parts of the body," in which "the excited

state of certain fibers reaches consciousness" (Erlmann 2010, p. 242). These results were later criticized in conjunction with Helmholz's many revisions of *Tonempfindungen* (Sensation of Tone), which drew fundamental connections between psychoacoustics and the practice of music. Among its skeptics, neo-Kantian scholars such as Hermann Ulrici (1806-1884) questioned its move away from the constructs of natural science, while still asserting that "attentive perception" was about something "higher" and beyond the attendees control or at least its "role as a mere stimulus shield" — making it clear that the cochlea's (inner ear) relative complexity, when compared to sight, served the brain's intellectual and ethical development beyond instinctual survival (Erlmann, 2010). Nevertheless, this critique indirectly provided an adaptation to Helmholtz's conclusions, complimenting his viewpoints which unraveled the impossibility of pure consciousness when it came to the continuous analysis of tonal partials in everyday life, thus contributing to an inevitable move towards a scientific culture that embraced experimental sonic psychology. Helmholtz held the notion that "the system of scales, modes, and their harmonic fabrics [did] not rest on unchanging natural laws but [was] rather the consequence of aesthetic principles that are, and will continue to be, subject to change with the progressive development of humanity" (Helmholtz, 1863, p. 358).

Therefore, we can infer that Descartes, Helmholz, and Ulrici viewed attentive behavior as a type of mediator between ambiguousness and clarity, albeit coming from different trajectories. In addition, we can begin to see that the perceived dichotomies between rationalist ideals and perception studies in actuality is more of an interdependent relationship when considering attention. For example, one can think about attention within the brain much like a theatrical spotlight: attention is malleable with many variations of radial focus, leaving parts of a stage (neural network) partially lit at times, while others are fully lit. This beam of light is our gateway

to perceiving the world and in many ways its field and our memories are codependent. However, in order to understand the complex dynamic qualities of attention and arousal in musical praxis, one must first grapple with the cognitive activity sparked by different types of attention within the brain.

The cerebral cortex is responsible for processing sensory and motor information, making us conscious of our surroundings. It is best described as a non-unitary system in which sets of "networks that are functionally and structurally independent" work together to achieve states of activation or semi-activation in different parts of the brain (Kenny, 2011, p. 143). However, attentiveness does not necessarily imply voluntary consciousness, which can be reduced to three categories of arousal: alerting, orienting, and executive control. *Alerting* is the bottom-up processing in which external stimuli are perceived. such as a startling sound may draw one's attention while performing on stage. *Orienting*, on the other hand, refers to the brain's ability to categorize brief moments associated with short term memory, saving fragments (3-5 seconds) of incoming stimuli to long-term memory (LMT) blocks such as one's explicit recall of a short musical phrase or an implicit reconstructed LTM of an acoustic space based on previous experience within that space. *Executive control* falls under the top-down processing of memories in which explicit memory models have been conceptualized and seek to actively resolve conflict or voluntarily control reactions to incoming stimuli. For example, the choices a musician may make while performing after restructuring episodic events from LTM banks, such as playing with more separation in a given acoustic space, would be an instance of executive control (Horvath, Herleman & McKie, 2006). It is important to realize that there is no specific order or hierarchy concerning these memory models since they activate one another — even though our sensory system may prioritize certain signals it deems more important over others (Pujal & Irving, 2020).

Therefore, from a cognitive bottom-up perspective, we can view attention as a reaction to bombarding stimuli which are coded within our working memory, while simultaneously being controlled and anticipated by top-down central executive processes — a mediation of working memory and LTM. For example, an individual that leans heavily toward bottom-up processing during performance may encounter issues when it comes to inhibiting disruptions to goal-oriented behavior and shifting attention for task-orientation processes such as reproduction of explicit musical gestures from memory (Kenny, 2011, p. 44). In contrast, a top-bottom emphasis may lead to performances that lack creative components which manifest themselves in emotional vallances drawn from one's environment — diminishing aesthetic appeal and connection with a listener or audience. A musician must negotiate these models of memory and retention — evaluating which best address their situation, experiences, skill set, interests, and goals and ultimately find a balance between the two.

How we scaffold education models for memory and attention depend not only on the student but the teacher's independent funds of knowledge and biases. The student's perceived accomplishments, teacher-student relationship, teacher's verbal support, and student's emotional awareness all contribute to andragogical successes (see Table 2.1).

Table 2.1: *Function of attention and memory within a self-efficacious andragogic music education framework*

Functions & Expectations	Attentive Memory
Performance Accomplishments (Enactive Mastery Experience)	Habitualizing successful performance behaviors via targeted strategies of attentiveness
Vicarious Experience	Attention given to live modeling of appropriate behavior by teachers/peers who share similar memories and/or interests
Verbal Persuasion	Suggesting or empowering a student/peer to work towards achieving a long-term objective via self-instruction
Emotional Arousal (Physiological and Affective States)	Applying qualitative audiovisual data that makes physiological activity during arousal more visible and memorable

Memory Models: Understanding Unconscious Memory Representations in Improvisation Praxis

One way to address attentive memory during musical learning is through unconscious memory models that utilize improvisation in order to construct adult learning schemas, thereby aiding in the development of new ways of understanding from established funds of knowledge. Conscious experience and its impact on memory has long been examined by philosophers and cognitive scientists. Fortunately, more recent technological advancements (e.g. MEG, fMRI, and skin conductance) provide opportunities to investigate the inner workings of more implicit memory systems, thus presenting new models which rethink the role of non-conscious processes and memory representations in music perception (e.g. neuroscience and computational modeling variations). This subchapter will cover some of these systems and provide possible applications for music improvisation praxis.

Perhaps the most convincing argument for subconscious attention within implicit memory systems is found within activation-based models (Anderson, 1983; Cowan, 1988;

Norman, 1968). In this kind of model, a temporary form of storage such as working memory is an activated event within a long-term memory system. These activation points are situated on a spectrum: the ambiguous representations which might inform memory and influence behavior unconsciously, as well as supraliminal representations, which attract full attention to a specific focus — usually a person's current goals or issues. The temporary-activated processes on this spectrum are attenuated to changes in the environment.

It was thought that unattended stimuli were completely filtered out before filling working memory (Broadbent, 1958), however, this was disproved by subsequent studies that determined unattended sounds could actually attract attention. This might mean hearing your name when your attention is voluntarily directed elsewhere (Moray, 1959). In 1964, it was proposed that our filters simply attenuated, instead of blocking all information that was unattended (Treisman 1964); but by the late 80's, Baars' global workspace theory as well as Cowan's long-term memory research seem to indicate that all sensory information was circulated through long-term memory banks in some form (e.g. semi-activating parts of the brain), even though certain overt actions (e.g. goal oriented activity) and abrupt environmental changes (e.g. fight or flight response) might spark more activation compared to stimuli which serve no immediate use. From this trajectory, it is not hard to imagine different levels of activation prompting equally different levels of consciousness analogous to the spot-light concept presented earlier. Nevertheless, it is important to note that the cyclical nature of these models appears to rule out an ability to voluntarily navigate memories beyond what working memory deems useful (Cowan, 2010).

One possible exception is *super-blindsight* theory (Block, 1995; Campbell, 2002, 2004). This theory posits that attention can enable both conscious and unconscious expository reference via intuitive thought. Similar to blindsight, in which persons that have damage to regions of the

parietal cortex — impacting attentive consciousness when it comes to visual motion or location of an object, but not object identification — a 'super-blindsighter' retains "total visual functionality despite lacking visual experience" (Jennings, 2015).

From a phenomenological perspective, we can use theories like *super-blindsight* as windows to the improvising mind. In Pressing's models, *tonal imagery* is used to determine object recognition within improvised music practice. But rather than thinking of these objects as conceptualized musical content, Pressing suggests using the terms *features* and *processes* to enable agency during improvisation. In this sense, *features* are the standard parameters of a grouping of objects while *processes* analyze changes in these features over time (Pressing, 1988). From this viewpoint, the human mind is heterarchical, reacting to a grouping of objects approximately two times per second by responding to bottom-up processing in *real-time*. During *real-time* analysis in improvisation practice, contingencies emerge that provide resistances to goal-oriented practice. One can view these as interruptions to conscious *flow* in which the human mind must recalibrate its varying levels of conscious awareness. Andrew Pickering describes this process as time fluctuation through resistance and constraint, stating that the two terms are "perpendicular to one another in time: constraint is synchronic (present time), antedating practice and enduring through it, while resistance is diachronic, constitutively indexed by time" (Pickering, 1993). This entire process compliments *real-time* events from day-to-day life, both "producing and being produced through praxis" in which improvisational models are drawn from *habitus*.

That is to say, the ingrained habits or dispositions that provide the constructs for individuals to perceive and react to the social world around them prevents "unpredictable novelty" while simultaneously providing a platform for "intentionless invention" through

varying forms of consciousness (Bourdieu, 1977). Dubbed as the interactive *object-feature-process* model (IOFP) by George Lewis and Benjamin Piekut, Pressing's research could help describe many of the cyclical creation processes that give rise to new kinds of analysis which engage *real-time* intention. Mainly, the act of implicit listening in which one's attention fluctuates rapidly during live improvisation (Sheehy, 2013). To put this in perspective, Paul Salmon suggests that one can imagine approaching a musical score in a similar manner, memorizing small fragments of material by slowly reviewing the visual material that once cued a performer's sonic memory. By "forming an internal representation" of the piece of music in this way, a musician can learn the capacity to "hear a piece of music that is not being played." That is to say, one develops a "global sense" of music in terms of forming the basis of a "cognitive map" that provides internal representations of how it "feels" to play a piece of music, such as motory elements that fall under the "tactile" and "kinesthetic" concepts which are normally part of our implicit awareness. Since our focus is usually on visual cues from the score and sonic information projected from ourselves or our instrument, this attention to "feeling" during play contributes to a bottom-up performance approach in which creative interests are mapped to different sensory sources (e.g., visual, auditory, and tactile) in addition to the traditional musical metaphors we use to conceptualize melody, harmony, and rhythmic structure (Salmon, 1992, pp. 94-96).

Furthermore, in relation to working memory, long-term memory, and attentional goals, Pressing outlines the importance of continuity in improvised music. He categorizes two primary models: *associative* and *interruptive* generation. In this context, associative generation refers to an improviser's choice to continue *features* which carry objects that are deemed important by the player whereas interruptive generation allows for disruption of the improviser's *processes* in

real-time. Together these generations form "dynamic patterns", which are "the core of improvisation cognition", giving the improviser perceived control (Bailes & Dean, 2014). Nevertheless, as stated before, an improviser must balance this control with a "sensory stance", meaning that they must also respond to external stimuli besides their own. For example, an improviser may develop an understanding of how a colleague's musical material reflects their own in terms of whether or not it should be associated with or interrupted. Furthermore, this improviser may explicitly or implicitly craft an exogenous or endogenous position towards a fellow improviser's material, contributing to ongoing streams of cognitive play or deciding to disrupt them (Pressing, 1988).

These theories are of particular interest for those fascinated by attention's role during improvised performance. But can they be empirically measured, and if so, what does this say about our unconscious cognitive facility while musicking? The interplay between associative and interruptive generation may indeed be mediated by top-down executive processes. In studies by Roger T. Dean and Freya Bailes, changes in skin conductance at pivotal points related to decision making during the improvisation process highlight physiological tendencies which reflect psychological arousal and attentive behavior (Bailes & Dean, 2014). These types of responses are unconscious and yet crucial to an improvising musician's sense of control. In one test, a piano performer's keyboard and pedal performance was recorded. Skin conductance was measured in conjunction with MIDI, acoustic, and video data. The performers were then asked to provide reflection via digital interface while listening to their recorded performance, identifying moments of musical change, including points at which their perceived arousal or emotional valence correlated with musical expression. By using an "autocorrelation" search algorithm, such as how successive events may form streams or, if the first note is loud, proximate notes are likely

to be loud, it was determined that skin conduction tests showed higher arousal during moments of interruption in these improvisatory streams.

These tests provide physiological support for a model in which Pressing's theory of associative and interruptive generation requires attentive behavior. But it is still unclear how much of this behavior is conscious during performance. By cross-referencing skin conductance arousal levels with data collected from neurophysiology and neuroimaging studies, attention's role in improvisation may become clearer. The challenge will be finding ways to study musicians in their natural habitat rather than in the abnormal acoustics of a magnetic resonance imaging chamber (fMRI). Given the complexity of improvised music, Berkowitz defines this conundrum as a balance between ecological validity and scientific interpretability, in which validity represents a real-world experience and interpretability reflects the reliability of scientific data collected from these experiences (Berkowitz, 2010, p. 131). Studies must take both principals into consideration to maximize productive results.

One such example can be found in the work of Siyuan Liu et al. in which the neural correlates of lyrical improvisation during freestyle rap were mapped using fMRI (Liu et al., 2012). The study found that improvised performance was characterized by dissociated activity within the brain, suggesting that stimulus-independent behaviors may develop in the absence of conscious control. In addition, an activity network linking motivation, language, affect and movement was discovered, suggesting that relationships between semi-activated regions of the brain were conjoined by intention and action. In this sense, they argued that conscious control during the improvisation process may be disengaged in favor of more automatic motor mechanisms. This idea of automatism is best represented by individuals who have experienced severe amnesia (Berkowitz, 2010, p. 129). These persons may be unable to recall past and future

events or even anticipate musical events, but their ability to improvise on the internally embedded knowledge they've collected over the years prior to the onset of disease remains intact. Pressing describes this as a "stage at which it has become possible to completely dispense with conscious monitoring of motor programmes, so that the hands appear to have a life of their own, driven by the musical constraints of the situation . . . In a sense, the performer is played by the music" (Pressing, 1988, pp. 129-178).

More recently, a study by Malinda J. McPherson et al. sought to uncover emotional motivations behind improvisatory behavior on the piano (McPherson, et al., 2016). During the study, each research participant was shown pictures of an individual representing positive, negative, and ambiguous emotions. Twelve professional jazz pianists were then tasked with improvising music they felt matched the emotion expressed in the photos. Malinda found that neural activity related to improvised activity may depend greatly on the emotional state of a player. From another trajectory, studies have found increased activity in the dorsolateral prefrontal cortex, aiding the brain's ability to quickly relate current perceptions to immediately preceding events (Bengtsson et al., 2007). A dissociated pattern of activity in the prefrontal cortex and activation of the medial prefrontal cortex reflect a combination of physiological processes necessary for spontaneous improvisation, where internal stimulus-independent behaviors take precedence over conscious control during an ongoing performance. This conscious self-regulation suggests "musical improvisation may be associated with behaviors that conform to rules implemented . . . outside of conscious awareness" (Braun Limb, 2008, p. 4).

Nevertheless, these studies still leave many unanswered questions regarding how habit and attention may impact improvisation. Mainly, *how* information that enters our working memory depends upon many different factors. Perhaps Cowan's embedded-process model can

offer some insight on how activated subsets of memory may allow for the focus of attention on an internal or external source since it depends largely on the relationship between familiarity and novelty within a stimulus — echoing Pressing's generation theory. For example, open-improvisation *features* that remain fixed over time may not capture attention, in which case top-down central executive functions are more likely to be implemented. On the other hand, contrasting and more dynamic *features* may increase the chances of reactionary events in which involuntary modes of focus direct attention (Cowan, 2010, p. 8).

It is generally assumed that conscious and unconscious stimuli have a place within working memory, usually becoming visible in cognitive behavior. However, when speaking of a musician's ability to prime musical events and also perceive simultaneously we hit an unfortunate roadblock. It has been discussed that subliminal stimuli have no direct correlation with primed behavior, suggesting that unconscious musical gestures may be admitted to our memory banks, but are not activated by attention (Balota, 1983; Cowan, 1999). Unconscious activation selective processes have been reported, albeit at very slow rates in which word pairs were given to participants (e.g. *taxi-fare*). Participants were later asked to choose two possible spellings (e.g. fare vs. fair) and would most often spell the word related to the previous pairing (Wood et al., 1997). However, as the speed of this exercise increased, the results became more problematic, as it became clear that participants may have involuntarily focused on certain words at the slower playback rate. Nevertheless, this example replicates the association methods used by many improvising musicians, specifically within different musical tempos. If one has ever improvised over a slow ballad as opposed to a bebop frenzy, it is incredibly noticeable how one has time to let their attention wander, thus giving themselves more cognitive facility to manage responses to internal stimuli. This thought connects us back to the concept of automation in

which certain motor functions can be habitualized so that processing space remains for endogenous interactions.

Cognitive scientists are divided on the premise that one can perceive localized events outside consciousness (Snodgrass & Shevrin, 2006; Marcel, 1983). It is more plausible that "the central executive's shifting of the focus of attention leaves in its wake an activation field" which semi-activates areas of the brain as it moves (Cowan, 2010, p. 23). Interestingly, it seems different individuals have varying ways of organizing this "activation field", an area of study that might be more accessible through qualitative research methods (Schneider, 2021). This notion of an "activation field" aligns well with the theater analogy introduced by Baar. In other words, it is more plausible our perceptual focus on certain (internal or external) stimuli may also semi-activate other information that is situated in close proximity, suggesting that even in the most aleatoric or complex improvisations musical patterns can be found via localized associations in different regions of the brain. Therefore, we can look at consciousness as something very continuous, a beam of light moving through our cognitive theater, exposing different color gradients in its path. These gradients may attract one's attention causing a change of course or focus.

Thus the dynamic goals of musical improvisation might sit on a continuum or spectrum in which some activity is conscious or unconscious while other activity may fall in between. In some instances, this may mean that focusing one's attention towards a particular gesture or "energy distribution curve" can indirectly amplify the desired subliminal processing of certain musical features (Terrazas, 2021). This is one method in which an improviser can maintain a level of control without interfering with the brain's implicit activity. Furthermore, by expanding upon preconscious processes of reference, it is possible to focus on semi-activated areas of

consciousness via top-down allocation of attention (Dehaene et al., 2006). This is a more direct approach in which a sound an improviser plays may correlate to another musical feature beyond the localized processing area. In this case, these stimuli are accessible to the musician as long as they provide adequate levels of attention on the preconscious items.

We can look at these two functions through the lenses of Pauline Oliveros' deep listening practices. Focal attention is "like a lens" with "clear detail limited to object of attention" whereas a concept such as *perceptual gist* lays on the fringe of consciousness, defined by a global attention that is "diffused and continually expanding" on a "whole space/time continuum of sound" (Oliveros, 2005). Gist extraction is a perceptual process that allows observers to quickly retrieve the global meaning, or gist, of sonic input. Cowan and Gilchrist state "that items that undergo this sort of processing [must] have sufficient neural activation to be present in consciousness, but are buffered into unconscious stores because of a lack [of] effortful directing of attention via the central executive" (Cowan, 2010, p. 28). Therefore, as sonic relationships are inferred by the improviser, otherwise conscious activity could quickly move outside the focus of attention, subsequently aiding the construction of a "global relationship between the full set of items" (Cowan, 2010, p. 27). These relationships are inferred and thus processed unconsciously within long-term memory, providing a possible explanation for improvisatory musician's ability to shift rapidly through internally driven musical feed-back loops which slowly evolve over time.

Although we may not be aware of it, It is clear that both unconscious and preconscious processing can influence an improvising musician's priming and perception during performance as well as the choices a musician might make to build upon or disrupt musical material. Furthermore, studies have shown that deactivation of the dorsolateral prefrontal cortex increases when less constraints are put on musical performance (McPherson et al., 2016; Pinho, 2014),

suggesting that attention is responsible for identifying so-called semi-activated memories of sonic devices on the peripheral of an improviser's knowledge schema, while habit involves the binding of current sonic experience and memory in which memory and perception become rather indistinguishable. Thus the relationship between attention and habit is interdependent in the sense that habituation is one of the primary ways a musical phrase is structured, but this structure is ultimately disassembled by the same executive function that sought stability in the first place. Therefore, as creators and learners, it is ultimately the improviser's choice to seek either stability or instability and negotiate the aesthetic and ethical repercussions of this choice within the context of their respective musical milieus. Next, we will explore how musical learners' reactions to performance stress during the process of habitualization through attention and memory may positively or negatively impact their musical performances.

Assetization of External and Internal Stimuli: Performance Stress and Anxiety

A major focus for adult music learners is performance related anxiety. This may be because of increased exposure to stressful events, perceived expectations associated with accumulated experience or societal norms, and cumulative stressors from life events increasing overall anxiety. When scaffolding self-efficacy models, an important facet of any successful music student's toolbox is the ability to leverage stress in opportunistic ways. If music undoubtedly carries attributes that support our emotional health and empower us in everyday situations (Asgaard 2002, 2004; Dempster, 2010; Rolvsjord 2006), how can it cause unwarranted reactions to stress and emotional arousal in performance settings? That is to say, what part of our consciousness is disengaged and in dire need to reconnect with the sonic qualia that inspired us to *play* in the first place? What has taken us away from a self-efficacious mindset? From this perspective, it becomes clear that conclusions made by functionalist psychology may indeed

provide productive cognitive sketches of how our minds respond under certain conditions, while omitting embodied and ecologically embedded resonances that could further aid us in understanding causal relationships between arousing stimuli and the mindset of an anxiety sufferer.

One way to compliment this doctrine of functionalism — outlined by the empirical and qualitative studies introduced previously — is to categorize the cognitive systems of perception and memory by relating their functional roles to reactions to external stimuli, creating a web of mental phenomena which can be cross-referenced with the following "'4E" principles of cognitive science (Schiavio & Schyff, 2018): *embodied*, *embedded*, *extended*, and *enactive*. This particular approach highlights four prominent principles which can be adopted by an adaptive anxiety andragogical model, giving an individual agency to respond to stress by altering themselves in accordance with their environment.

More specifically, embodied cognition can only be fully understood by involving the entire *body* of a performer in tandem with their mental processes. For example, this might entail using one's breath as a brass player or finger dexterity as a string player to mediate mind and physical space, *coupling* perception and action. Embedded cognition, on the other hand, is closely intertwined with each performer's co-determinant *ecological resonance*, whether it be spatial, social, or cultural. In other words, ecology matters. Here, we can consider the social environment in which music is negotiated and evaluated as a form of *ecological* or *external resonance* in which performers balance their needs with those of the environment. Third, aspects of extended cognition can be shared among many performers or non-biological devices in order to lighten an individual's mental burden and reduce anxiety, such as collaborative improvisation or audiovisual technologies that bridge perceptual differences and allow for *tacit* knowledge

exchange. Lastly, enactive cognition is born of meaningful relationships determined by adaptable exchanges between biological and phenomenological resonant *contingencies* that performer's actively configure and reconfigure in real-time, such as the ability for a performer to improvise and adapt in the moment.

We will take the 4E principles into account while addressing two forms of ecological resonance: *external resonance* and *internal resonance*. When addressing performance anxiety in the context of self-efficacy, I define *external resonance* as an individual's capacity to respond to environmental stimuli while under performance-related stress whereas *internal resonance* is an individual's capacity to respond to cognitive stimuli usually caused by an undesired expectation of performance related stress. An experience often dubbed a false-alarm or catastrophic thinking by psychologists.

First, it is important to clearly understand what *resonance* means in the context of music performance anxiety. The etymology of the word *resonance* is rather ambiguous and far reaching and thus incredibly effective when situated within the space of creative practice. The Latin counterpart of the word *resonance* is *resonantia* (an echo), whose root *resono* ("I resound") means the giving back or returning of sound. In French, on the other hand, the term *resonance* can relate to logic or the thinking behind an idea or concept. Modern English transformations of the word *resonance* have been used to describe natural phenomena in physics, chemistry, astronomy, and electronics, and have figurative associations with psychological affect.

The idea of acoustic resonance can be interpreted as the feedback a musician gains from a given performance space. But I propose the idea of *external resonance* that also encompasses the social dialogue accompanying the relationship between *fairness* and *spontaneous expression* within competitive music environments. This relationship has facilitated the negotiation of

aesthetic meaning-making in classical music practice since the late 19th century (McCormick, 2020). Thus, we can think of *fairness* as a representation of the socially-negotiated mechanisms we've assembled to judge musical performance (e.g. etiquette and consistency) whereas *spontaneous expression* represents the self-expressive output or creative 'essence' of the autonomous performer. Both aspects work interdependently to achieve convincing performances although performers who become overtly concerned with the former may be prone to anxiety disorders. It is for this reason that I will argue a balance between the two — or *external resonance* — is ideal in a performance context. Methods of obtaining this balance will be discussed further in Chapter 3: Empathetic Engagement and Spontaneous Aptitude In The Creative Process, The Musicians Auditory Perspective Project (MAP).

We can also identify non-representational or dynamic forms of *resonance*. Kevin Ryan and Shaun Gallagher cite Fuchs and Raja, stating that "according to proponents of neural reuse, different conjunctions of brain areas will be dynamically (re)configured as functional units depending on the task, setting up a specialized resonance in response to cognitive demands" (Ryan & Gallagher, 2020). In Fuchs' words, "the brain is not the conductor of the body; rather, it is like a musician in a group of jazz musicians jointly improvising on the basis of certain chords" (Fuchs, 2018, p. 134). Therefore, we can observe our performance models and their interplay, not only between organism and environment, but between inter-organism constructs (e.g. different brain regions and homeostatic resonances in the brain, heart, stomach etc.) which are situated outside of one's conscious control — thus external in a sense. Indeed, such shifts in thought are important for moving past the internalism/externalism dichotomy that torments more traditional viewpoints of cognition. These may include dynamic variables, such as cognitive, physiological, ecological, and neural couplings that can have an immense impact on music performance and our

understanding of the larger system of brain-body-environment. From this trajectory one can come to understand that a contradiction is built into our genome: we strive to stabilize aspects of our behavior (via physical and informational constraints) that implicitly remain flexible in order to engage with the external world. In the words of Gibson, "behavior is regular without being regulated" (Gibson, 1979 , p. 215). This contributes to my premise that the ecological stresses that may burden an anxious performer must be addressed in consideration with the interplay between the performer's entire body and their environment. We will connect these ideas to self-effical andragogical tools in the subchapter Enactive Mastery Experience: Targeting Successful Performance Behaviors Via Strategies of Attentiveness And The Case for Improvisational Performance In Music Education.

First, in order to better conceptualize my socially embedded meaning of *external resonance* during the musicking process, we can consider the visual arts. The visual arts have long been examined as a tool for aesthetic self-meaning-making through identification of symbiotic relations between perceptual and symbolic ambiguity. For example, it was important for De Jongh to understand "the hidden meaning" of a seventeenth-century Dutch painting and "know the private code or doctrine that furnished the interpretation." In his case, art that was perceptually unambiguous was only aesthetically appealing after it referenced something that was "conceptually hidden" (Turner & De Mey, 2006, pp. 278-279). By adapting his aesthetic response to obtain information from the painting's structure, De Jongh is not only acquiring a certain type of self-knowledge from the external world but also using the painting to propose new orders in which to perceive in the future (Turner & Steen, 2006, pp. 64-65). Although the painting's structure is initially objectified, through understanding its form, De Jongh's contemporaries can reflect upon his response via the lens of *external resonance*. This I would

characterize as an empathetic exchange between his perspective and those of his milieu. In contrast, we can view William Ely Hill's *My Wife and Mother In Law* as an optical illusion that exemplifies creative-ocular ambiguities from a purely perceptual perspective, in which the ambiguity expressed is more or less universally received by its viewers, resulting in a conflation of two perceptions seen in Figure 2.1 (Hill, 2020).

Figure 2.1: *American cartoonist William Ely Hill's "My Wife and My Mother-in-Law" from 1915*

From this standpoint, one can see *external resonance* as being a balancer of coalescing objects and subjects, not only between literal items such as vibrations and ear but also while tracing connections between observer's ecological perspectives and bridging the perceiver and perceived via sympathetic understanding and reason. Comparatively, as noted by Solomo, when addressing the characteristic of ambient sound, "synthetic" (from Greek *sunthetikos* or *suntithenai* which means 'place together') "is the primary characteristic of hearing, as opposed to sight, which is analytic'" (from *analuein* which means 'unloose' or 'separate') (Solomos, 2018,

p. 98). It is important to make this distinction while evaluating one's *resonance* in conjunction with their sonic environment or milieu because *external resonance* is synergistic with the natural tendency of musical sounds in that the musical sounds provide immersive events in which "inextricable links between the vibrating object, the milieu in which the vibration spreads and the subject who listens" inhabit the same meta-space (Solomos, 2018, p. 99). In a few words, these links are embedded in our co-determinant performance practices.

Suzzane Thorp's field research, *Resonance & Resemblance: Sound Perspectives of a Pluralistic World*, something she prescribes as "eco-logical musicking", takes this holistic performance model in a similar direction (Thorpe, 2020). Her approach to musicking connects participants with the phenomenon of the natural world, including the experience of acoustic resonance within diverse biological systems that depend on interconnectedness for survival. While *resounding,* she prepares participants for collaborative performance by orienting them within intersubjective nature walks, drawing their attention to environmental and sonic phenomena that might otherwise go unnoticed such as bird chirps, wind rustled trees, flowing water, and the commotion of other nearby hikers in addition to offering Schaeffer-esque soundscapes. By conducting spectral analysis of electronic pings sent reverberating through the rock-cut basin of Manitoga quarry, Thorpe *resembles* (matches) resonant pitches (or so-called "sonic seeds") that inform semi-composed performance. Participating musicians then respond and adapt to the sonic characteristics of the watery basin while floating on its surface, resulting in a true embodiment of physical and sonic space.

Fortunately, interactions such as these are not limited to the biological world. We can see clear extensions into the electronic realm, an observation that has been keenly noted by composers Kaija Saariaho and Jean-Baptiste Barrière. In an attempt to make the environment of

the digital medium a window to self-reflection, one can examine Barrière's music as an extended manifestation of the literal and metaphorical qualities of *external resonance* in electronic composition and performance practice. The following remark by Barrière's is particularly illuminating in this regard:

> Electronic devices for sound and video capture are not simply recorders; they modify reality. Not only do they send back images to us – literally and metaphorically – but they allow us, even force us, to get some distance from them, and therefore also allow us the possibility of taking up a new position in relation to them. At such a distance everything becomes possible: introspection or fear, auto satisfaction, amusement or painful questioning. An extreme case is the one in which we are confronted by our own image, our own voice. These devices then become objective and subjective analyzers at the same time (Barriere, 2001).

This insight harkens back to the exploratory and slightly masochistic perceptual research of Johan Wilhelm Ritter (1776-1810), who is known to have derived great jouissance from self-administering electric shocks up to 50 volts through his genitals, eyeballs, and ear canals (Erlmann, 2010, p. 191). A general obsession with his self-reflexive responses during the galvanization of his ears revealed a great variety of tonal sensations, which led to a reexamination of auditory perception, thought, and subjectivity. In other words, electronic currents sent through the body served as disruptors of a "physiological scheme" of force distributions, in which galvanic disturbances such as sound and light (i.e. vibrating air and photons) affected the ear and eye "as though the colors were mute tones, and tones in turn, speaking colors" (Erlmann, 2010, p. 196). This allowed Ritter to analyze the impact of external stimuli on embodied experience via qualitative means.

Thankfully, 21st century technology — as reflected upon by Barrière — has paved the way for more hospitable means of collecting similar data. Audiovisual media can be used as sonic boundary objects that enact inquiry into performance and health related stati. For instance,

Florian Grond's ethnographic study of binaural soundscapes from the perspective of his blind colleague, Piet Devos, provide not only documentation of lived experiences through the perspective of a blind individual but also allow for both participants to exchange tacit knowledge though re-immersion of experiences, bringing up many interesting questions when it comes to intersubjectivity, temporality, and civil ethics (Grond & Devos, 2016). In short, how we share perceptive knowledge often determines how we react to or resonate with it, which in turn carries many consequences within a performance context.

For Piet Devos, the human ear acts as the primary understanding of self and the external world. In fact, our cochlear (i.e. inner ear) resembles a conch shell, providing resonance between air (i.e. sound pressure) and liquid (i.e. the fluids perilymph and endolymph) and functions as a boundary object between our understanding of internal and external sonic stimuli, organizing frequency vibrations from 20,000 kHz, starting at the base of the cochlear, to 200 kHz, in the center (i.e. apex). The complex nature of cochlear tonotopy has been examined by philosophers, physicians, and psychologists for centuries. Marcus Hertz (1747-1803), for instance, inferred that the ability for the human soul to interpret external stimuli depended on a relationship between temporal processes and sensory impulses, stating that a discernible "perception depends as much on the nature of the stimuli received as it does on the perceiving sense organ" (Erlmann, 2010, p. 171). Johannes Müller's (1801-1858) theory, on the other hand, argued that external stimuli can be thought of as internal because the nervous system "illuminates itself, there sounds itself, here feels itself, and again smells and tastes itself." As Erlmann notes, this theory contributed to the understanding of the inner ear as a dynamic labyrinth of fluids, allowing for instantaneous sympathetic transference of wave pulses throughout the entire organ (Erlmann, 2010, pp. 204, 206). Last but not least, Hermann von Helmholtz (1821-1894) theorized in the mid-19th century

that “resonators tuned to different audible frequencies” were “spread along the basilar membrane . . . like piano strings.” Helmholtz’s idea was eventually superseded by Bekesy’s “traveling wave theory” in the 1950’s And, most recently, the contemporary study of living animals (Gleich & Johnstone, 1990) showed that active mechanics allowed for frequency selectivity, giving the inner ear the ability to differentiate between two similar vibrations. This discovery generated new inquiries into how the mind deciphers this dynamic resonance chamber (Rebillard & Pujol, 2021).

Nevertheless, the phenomenological premise of my concepts of *internal* and *external resonance* and the ambiguity between the two within musical performance is demonstrated by an earlier theory of self-generating *Naturphilosophie*. This precursor to natural science — an outgrowth of early German idealism — “posited that scientific comprehension of the natural environment and aesthetic judgments [were] compatible.” In other words, the natural world and art are kindred spirits since art is “the outgrowth of creative, vegetation-like forces, rather than the effect of mechanical process” (Erlmann, 2010, p. 159). While this theory offers an interesting system that reflects the contingencies behind musical performance, it also connects us to the perceptual issues of a more dynamic *inner resonance*: how our minds learn to interpret and react to stress differently during the creative performance process.

When addressing issues of musical performance anxiety, Dale Reubart notes two important psychological persuasions: a) those in “which anxiety and other emotional disturbances are seen as intrapsychic affairs requiring analysis of origins, nature and dynamics of the particular symptoms” and b) those “which are concerned solely with the observable, measurable symptoms of anxiety, irrespective of origins” (Reubart, 1985, p. 2). It is the tracing of these residual resonances of anxiety that illuminates a multifaceted approach to conscious

versus subconscious mentation. A realization of both encourages a "psychology of personal growth" through an "unquenchable curiosity about some persistent phenomenon of nature" while serving as a gateway into one's personal cognitive processing during a stressful event (Allport, 1955). In other words, through mapping the specific details of a performer's *inner resonance* and anxiety driven feedback loop, the cycle can be broken by refocusing attention on the phenomenalistic characteristics of sound production via task-orientation.

Connecting this point to emotional processing of music students, we can again address fear as a more rational approach to performance than anxiety since, in theory, fear "is experienced as a threat which can be located spatially and to which an adjustment can be made" (May, 1977, p. 180). Musician's personalities are often closely tied with their art making, increasing the odds that one finds it difficult to objectify a specific threat: instead of allowing it to remain. This creates an aura of uncertainty that chips away at confidence over time. Gabbard identifies the fear within narcissistic thought as a central cause of stage fright, in which a person's worth is connected to the success of the concert (Gabbard, 1981). These learned habits develop into trait anxiety, which means that, while an identifiable stimuli inciting fear may be completely absent, the subject still reacts as though it exists. An extreme example of this would be a musician entering an empty concert hall and becoming visibly noxious, even though the audience that originally triggered a false-alarm and impacted a previous performance detrimentally is now absent.

This is where biological anxiety necessary for self-preservation can mutate into the malady of neurotic anxiety, an apprehension that is disproportionate to the objective threat at hand and counterproductive when placed within performance praxis, disrupting a performer's *resonance*. At this stage, catastrophic thinking and an inability to focus on motor tasks become

so prevalent that the body is incapacitated. The situation snowballs especially when accompanied by such personality trait attributes that predispose an individual and worsen as anxiety grows as feelings of social inadequacy, alienation, and competitiveness. All of these mental insecurities act within a feedback loop triggering embedded primal autonomic responses, illustrating how the body and mind are intertwined. For instance, during an anxiety attack, peripheral vasoconstriction cools limbs and extremities while increased sweat gland activity lowers galvanic skin resistance. Dry mouth emerges as a "sympathetic response to the suspension of gastric flow" accompanied by increased adrenal activity. Finally, rapid breathing aids blood flow to large skeletal muscles which automatically contract, hypertension takes hold, rerouting energy that could be utilized to enhance performance instead of further facilitating a feedback loop between mind and body and increasing chances of physical injury (Reubart, 1985, pp. 8-9). As Galatas notes, "rigidity in the muscles is often accompanied by a psychological paralysis. Performers then have difficulty infusing life and color into performance" (Galatas, 1989, p. 9) — which ultimately makes their playing mechanical, emotionless, and uninspiring.

It can be argued that this state of necrosis may already pervade the life of a musical individual outside of performance. This is particularly true for musicians who use inhibition such as drug or alcohol use as a form of escape, actively avoiding the feelings associated with basic somatic responses to natural periods of stress. This can lead to, for example, the common embodiment of situational 'unluckiness' in which a performer interprets a lack of internal control, projecting it on the external world by voicing their general concerns. ("Life is all about luck and it's out of my control", for instance.) Therefore, performers must take a stance of self-control and redirect their attention to a personal sonic ideal rather than commit to the already

doomed task of taking control over a listener's interpretation or aspiring to objective technical perfection (Reubart, 1985, pp. 10-11).

As rationalized earlier, "the audience, milieu, and music are all challenges which could be variously interpreted depending upon the performer's attitudes — their self-regard" (Reubart, 1985, p. 12). From this standpoint, a performer's 'success' is largely based on their interpretation of a given event rather than the stressful stimulants associated with the event. Rollo May proposes that, in order to achieve a measure of self-realization and understanding, anxiety actually encourages creative thought and should be approached with open arms, moving "through it" (May, 1977). From this perspective, the ideas of imperfection and "dissonance" are "salutary components of living" and cannot be removed from the dynamic complexities of music performance. (Unless one desires a deadpan audience, that is.) Dale uses the word "vigilance" to describe the optimal amount of anxiety needed during performance. This concept, similar to the Yerkes-Dodson Law, encourages one to be in touch with the environment without incentivizing the neurotic symptoms that perpetuate "worry" during performance. Nevertheless, it is not enough to face extra-musical threats head-on as this can be considered "task-irrelevant ideation". It is the subject's willingness to enter the implicit nature of musical creativity and understand how to balance risks and rewards that will determine the outcome of a performance (Reubart, 1985, pp. 13, 15).

The key takeaway here is that automation of thoughts plays an enormous role in our cognitive processing and ability to balance *internal resonances* during musical performance. Psychologist Donald Meichenbaum aided the invention of a technique called "thought stopping" in which a performer verbalized the command "stop" when thoughts began to impact their performance in an unwarranted fashion (Salmon, 1992, p. 153). In one of the cases, a musician's

tendency to practice a musical instrument compulsively when anxious had to be inhibited by setting agendas such as timelines and schedules. Subjects connect mental and physical health via breathing exercises, balancing techniques, and "self-statements" that focus more on the response to an issue than labeling the issue as an object to be controlled. Through developing this regiment, fear was dissociated with the maladaptive impulse to practice without a task or goal in mind.

In addition, "Physiological arousal checks" have also been used to scan for careless or indifferent behavior such as profanity, openly demeaning remarks, rough informal dress, sloppy sitting, mumbling, playful aggressivity, manic movements, flatulence or other identifiable attributes of "regressive behavior" (Khan, 1959). Awareness of these behaviors facilitates implementation of therapies such as systematic desensitization, which can be used for cognitive training by musicians who are hyper-sensitive to stimulants. The procedure promotes relaxation between periods of progressively more provoking imagened inducers. For instance, when the patient feels anxious, the therapist returns to a state of relaxation until the patient gains control over overreactions to the most anxiety-provoking imagery (Galatas, 1998, p. 49). Automatic thoughts tend to awfulize situations as they are reflexive and impulsive. They "weave through the fabric of your internal dialogue" triggering chains of other thoughts — and, over time, one learns to think automatically. These learning systems usually stem from genes, childhood experiences, and conditioning from family and caretakers. "Instructional desensitization states that negative self-instructions, polarized thinking, and covert self-recriminatory instructions are among the main components of a complex array of events mediating performing anxiety" (Galatas, p. 58).

Other therapies that examine the epidemiology of music performance anxiety include rational emotive therapy based on self-intervention for symptomatic behaviors developed by Albert Eillis in the mid-1950's. Casey Mcgrath points out that practicing the embodiment of positive behaviors is just as important as diagnosing an individual with a behavioral issue. A connection between positive trait anxiety and habitual decision making must be reinforced by the enthusiasm of the participants who actively engage in rewriting detrimental internal self-talk (McGrath, 2017, p. 39). A final therapy which takes an entirely different approach is eye movement desensitization and reprocessing (EMDR). This therapy, first developed by Francine Shapiro to calm troublesome internal thoughts based on entrenched memories of emotional trauma, directs very anxious musician's through painful memories. The patient under this therapy, for instance, moves their eyes from side to side to increase activity to the frontal cortex, effectively "unblocking" congestion within the neural system responsible for healing the negative memory. According to one study, ninety percent of single-trauma victims no longer had post traumatic stress after three 90-minute sessions (EMDR, 2020). The goal in both of these studies is for inner-voice awareness: to move away from a self-conscious voice (i.e. negative inner dialogue) and toward a more non-judgmental voice by addressing all aspects of performance. By doing this exercise, an artist can eventually achieve a "creator voice" that supports a flow state or sonic-centric approach to performance, favoring a kind of attuned listening to one's psych (McGrath, 2017, pp. 110-111).

Performance Anxiety Disorders

So how can we codify or at least begin to prescribe a flexible praxis in which to use *external resonance* theory to address aspects of maladaptive performance anxiety? The answer to this question likely stems from each individual's lived experience and their means of

aesthetic-meaning making as artists, although, as you will see, it is only the first piece of a puzzle. First, in order to embody an awareness of *external resonance*, one must learn how to navigate their conscious reactions to the local milieu. That is, in terms of what environmental information to admit prior to and during a performance event and which to omit entirely. This is a point that has been previously evaluated through desensitization and cognitive restructuring therapy (see Galatas 1989; Richard 1992; Sweeney 1981).

Along this line, we can consider hypervigilance and its impact on performance, including how subjective perceptions of performance can be analyzed through understanding a musical event and its relationship with social constructs which may stress certain individuals. These high energy events may lead to heightened sensitivity and more pronounced sensations, ultimately distressing performers. The more we are aware of events going on around and inside of us the more highly aroused we are, the more keen our senses, often leading to phenomena such as dissociation. At this point, intense psychological pressures may trigger an "out-of-body" experience, observing the self from an external perspective. Furthermore, the performer may go black in a state of amnesia in which their perception of temporality can either slow down or accelerate. Many performers — especially those with greater experience — note that these events can be pleasant as much as they can be frightening depending on the circumstances (Salmon, 1992, pp. 58-61).

Nevertheless, there are methods to filter unnecessary environmental information through refocusing one's intentions. For example, if the purpose of a performance is purely for vocational reasons or unrelated to an aesthetic characteristic one wishes to embody, performance anxiety can likely take hold because the focus of one's desires is not in the creative production of a collaborative musical event but rather in the reproduction of what they feel an event is supposed

to ‘be’ (which is often based upon the imagined values of local peers and previous experience). This is not to necessarily advocate for the denunciation of socially negotiated competency parameters that advise ‘successful’ performances in different circumstances but rather to encourage one to pay careful attention to their own values when determining how a musical event holds meaning for them. In order to craft a genuine performance that projects authentic confidence, a musician must be in touch with how local collaborators (e.g. a composer, audition committee, or accompanist) negotiate subjective meaning-making in the milieu (Eyerman, 2006). In addition to social proclivities, a musician may also need to find a balance between the sonic resonance of a potentially unfamiliar acoustic space and their memory of previous space(s) (e.g. a rehearsal space), an ordeal that can likely take many different forms. Some find this balance based on the performer's past experience while others on the expectations held by each listener — which are factors a performer has limited control over at least outside of adjusting their present perceptions of space.

When discussing the socially-negotiated landscape of *resonance* and maladaptive anxiety, Gladys Sweeney aptly notes that the “existence of adaptive anxiety also complicates the task of conducting sound practice”, citing the 1908 Yerkes-Dodson law which evaluates the relationship between performance and anxiety as curvilinear. Certainly, the same anxiety that causes ‘failure’ may also propel performers to ‘success’ in many situations. In short, efforts to reduce anxiety via systematic desensitization and cue-controlled relaxation seem to be more effective when situated in environments where maladaptive anxiety begins to impair expected performance levels such as public performance spaces (Sweeney, 1981). A reduction of fear in relationship to one’s external environment through reciprocal inhibition, cue-conditioning, and habituation may also help alleviate performance-related anxieties that are considered maladaptive.

In general, a "treatment modality of choice is the one that works by diminishing the fearfulness of the external stimuli" (Sweeney, 1981, p. 7). Thereafter, patients can interpret their own feelings through self-reflection and decide which treatments address their needs in collaboration with a psychologist and therapist. This self-administered treatment option is supported by numerous other studies (see Appel, 1976; Kendrick et al., 1982; Craske et al., 1984). One of these studies is Joseph Richard's, whose focus is on the effects of ericksonian resource retrieval. The ericksonian method stands out in comparison to other studies since it is the only treatment to focus on the adaptation of positive memories by using them as starting points to restructure the perception of catastrophic thought processes. Restructuring these thoughts helps patients respond differently to external stimuli as opposed to learning new skills to cope with negative responses. The study supports ecological-self-renewal through restructuring one's thoughts, where patients recycle positive memories they already have at their disposal (Richard, 1992, p. 68) while disrupting the patient-provider power hierarchy that often fails to encourage natural and productive growth. It is worth noting that Richard's self-report measures were also useful in detecting effectiveness of treatment in musical performance via the irrational beliefs questionnaire and the personal threat index (Richard, 1992, p. 35).

Although empowering, these self-administered treatment studies bring up the inevitable thought that, in order to be frightened of a future experience, there must be something that this future-oriented fear is based upon. This is a stance that many psychoanalytic theorists argue manifests itself in emotions that become aroused or repressed by reactions to previous interpersonal experiences that have developed intrapsychically which emotions, in turn, 'internally' project themselves onto future external events (Kenny, 2011, p. 23). If so, then it follows that cognitive self-regulation gives us agency over our own thoughts and an ability to

avoid swaying to the stresses of the external world. On top of this, self-efficiency belief allows one to regulate goal-oriented efforts through examination and filtration of external stimuli that would otherwise be interpreted as negative, dangerous, damaging, or problematic (McGrath et al., 2017, p. 123). In other words, if *external resonance* is not achievable within the external world, one can mitigate this imbalance by turning inward, adjusting counterproductive cognitive and bodily reactions to stress with *internal resonance*.

It is important to note that one must avoid confusing self-regulated thought with automatic-emotional regulation, especially in relation to negative social evaluation. This is because automatic responses are detrimental if coupled with interpersonal perfectionism (a common attribute of neurosis) as it will trigger a positive feedback loop that values self-preservation alone. From this thought, we can return to the concepts of competitive music environments. Take the case of a musician who may complete many auditions in which there will be very little constructive feedback from the audition committee as an example. As is commonly known, during orchestral auditions, body language and facial expressions are usually veiled by a curtain to prevent bias in assessment — which means that the only concrete feedback is rejection or acceptance into the next round of playing. This aversive environment makes performers particularly susceptible to critical self-appraisal, which, after a certain number of unsuccessful auditions, may lead to a lack of self-efficacy and motivation for practice to prepare for the next audition. This specific example represents elements of the emotion-based theory of anxiety development, a development that starts very early in the life of a performing musician.

Environmental factors aside, a specific individual's personality or genes may predispose them to debilitating anxiety while on the audition circuit. This means a person with a certain fragility of self or lack of agency would benefit from avoiding a shift from an 'external' to

‘internal’ focus of attention during performance. In these situations, stress is essentially sounding a false alarm creating anxious apprehension as the performance was likely more subjectively interpreted by the committee than the auditionee perceived. This stress, if not responded to, can eventually impair ‘real’ performance quality in the perception of the committee. This impairment then sets off a second alarm that catalogs the anxious reaction as a learned cognitive response (Kenny, 2011, pp. 162-163). It is after these alarms are stressed and conditioned that music performance anxiety symptoms become debilitating.

To get to the root of the issue, we can view this example from the lens of the paradoxical function of stress. After all, what keeps you alive also kills you. Our biological response to stress is necessary for survival under extreme circumstances while completely capable of inducing chronic disease if allowed to run rampant in day-to-day life. These stresses can be further exacerbated by narcissistic and introverted personality traits fanned by early childhood attachment disorders via inadequate care for an infant’s needs in the first three years of life (Erikson, 1968). Described as “autonomy versus shame and doubt” by Erikson, this premise asserts that a child whose freedom was appropriately moderated by a primary caretaker in regards to exploring a local environment had increased chances of developing a healthy sense of autonomy and self-assertion. Too many restrictions would lead a child to shame, doubt, and excessive conformity while too much liberty, detachment, or carelessness on the part of the caretaker might result in mistrust and fearfulness during emotional development into adulthood. Understandably, this study is only part of the picture and must be cross-referenced with the genetics of anxiety (often mother to daughter), a child’s behavioral imitation of parental anxieties, and the suffer’s tendencies such as shyness, hypersensitivity, and avoidance (Schurman, 2000). Nevertheless, monitoring responses to stress is a key focus as it is not

surprising to see how such experiences can spawn self-conscious emotions, leading to social phobia and performance anxiety in different environments.

Although it is impossible (and arguably detrimental) to remove all stress from daily life, one can develop strategies that can help address how we react to performance related stress by evaluating how environmental factors impact a musician in rehearsal and performance. Cognitive learning methods during musical production (e.g. improvisation/creation) and/or reproduction (e.g. score realization/interpretation) utilize analytical skills to craft complex contingencies. For example, a performer may isolate technical passages, later piecing them together in order to unify an image or interpretation of a composer's vision for the work. This fractured relationship between 'feeling' and 'technical execution', however, is often the beginning of a failure to 'let go' or go with the 'flow' during performances in which technical perfectionism's sterileness is often as appealing as its counterpart's turbulence (Salmon, 1992, pp. 98-99). It then becomes a question of how to calibrate motor-automation in tandem with emotional-deautomation, allowing oneself to execute a technical passage during performance based on trust of prepared skills without existentially questioning self-capability. That is to say, a performer remains in an emotional zone of reception, flowing with the external excitement of the performance event as it unfolds, while avoiding internal judgment. Automatic-emotional thought must be cognitively rewired if deprecating emotions, attention-binding that focuses on the 'danger' at hand, or catastrophic thinking interfere with musical actions and decision making during skill retrieval via one's working memory. This is especially true in situations when music is memorized.

We can find that a balance of motor, emotional, technical, and interpretive skills are outlined by Stanislavski's "circle of attention" in which focus on specific tasks fosters control of 'external' and 'internal' stimuli during performance (Salmon, 1992, pp. 118-119). This approach

stresses the importance of interpretive activity in the form of a sonic-centric mentality, especially when addressing performances that appear to support an authoritarian premise. The ideal of a one-to-one semiotic reproduction of written score to imagined sonic space proliferates much of 20th century modernist thought (including some postmodern reactionary thought) and its residual debris can be found in our competitively-driven music institutions to present day. These thoughts are echoed by Ryan and Gallagher's (2020) concerns regarding isomorphic resonance as a way of explaining musical performance. Indeed, facing this utopian complex of artificial perfectionism or reproductionism within performance practice is the first step in dealing with what Freud characterized as a "free-floating anxiety" of general, pervasive apprehension which routinely erupts into "sudden cases of more conscious discomfort." This apprehension is usually characterized as trait anxiety in today's research community. Freud recognized this mindset as a "failure to drive or repress painful memories, impulses, and thoughts from conscious awareness" while characterized "signal theory" as an adaptive response to realistic threats as a primitive, yet effective warning system for potentially dangerous external events (Salmon, 1992, p. 125). There is great consensus on the distinction between the terms fear and anxiety in that fear (which is derived from *fǣran* 'frighten') "denotes immediate danger, in contrast with anxiety that denotes the feeling of being troubled in mind about some uncertain event" (Kenny, 2011, p. 27). The former is transparent, while the latter is hidden and subjective in nature — which means that fear can be attributed to explicit behavior while also being considered the most overt and physical representation of implicit anxiety in many performance situations.

Although behavior tendencies influence and can be impacted by physiological and cognitive components, it is important to note that behavioral anxiety manifests itself in a "tendency to avoid or escape from anything perceived as dangerous" sparking "somatic reactions

that accompany heightened arousal" (Salmon, pp. 127-128). This escape response can lead to a quasi-feedback loop triggering psychosis in which automatic responses to potentially stressful external stimuli are promoted even though these events present little to no objective threat. It is therefore important to regulate external feedback, be it through positive thoughts, cue-controlled relaxation, or other behavior patterns, as all of these elements can serve as external stimuli, activating one another and promoting unchecked cyclical patterns in which anxiety driven attacks thrive (Salmon, 1992, pp. 131-132). One method of such regulation is operant conditioning. This approach highlights the "relationship between behavior and environmental events, both antecedents and consequences that influence behavior" (Kenny, 2011, p. 119) and requires that a performance contingency consider the following three concepts:

(i) antecedents (external stimuli that precede or trigger a behavior);

(ii) behaviors (reactions, usually identified as maladaptive); and

(iii) consequences (outcomes of a behavior, i.e. events that occurred immediately after).

In order to address a performer's maladaptive behavior, this method identifies factors that influence a conditioned problem response, including all aspects of the subject's physical location and social environment. For example, a vocalist may tighten her throat muscles during a public performance while remaining relaxed in the practice room. Likewise, a trumpet player may play with very little tension while performing for colleagues in a studio class but feel more uncomfortable performing for a panel of judges in a more formal setting. Since not all performers will react the same way in a given set of circumstances, operant conditioning is

helpful in understanding why some behavioral responses are based on environment factors while falling short in identifying more tacit causes of performance anxiety. In other words, why different consequences may be considered positive or detrimental within personal performance praxis.

By observing behavior responses to stress, it becomes clear that a musician must filter a great deal of stimuli while preparing for a performance. But what if the negotiation of which external stimuli could be afforded by a musician's public performance preparation procedure ended long before the first practice note was played? It is here that the concept of inner monologue — or *inner resonance* — takes over. This concept requires a return to sound through self in which attuned skills emerge from autopoiesis, self-learning, and social interaction (e.g. musicking). As we shall see, these skills become malleable when situated in different environments and contexts.

Integrating Meditative Thought for Anxiety Relief

Each of the aforementioned therapies and approaches aimed at addressing maladaptive performance anxiety can be incorporated into a self-efficacious andragogic learning framework, emphasizing real time experience over mere execution, experimentation over replication, and a keen focus on honing attuned listening skills. For instance, as musical creators, we can begin a process of attuned listening with students and peers by being mentally and physically *balanced*. "Stand with feet about a shoulder width apart. Shoulders relaxed, soles of the feet connected to the earth, knees a little soft, palms at the sides. Eyes are in soft focus, seeing everything" (Oliveros, 2005, p. 5). Imagine your head as a "bobble-head" on your shoulders with the weight of your body falling evenly through your lumbar spine. Feel the weight fall down your entire skeletal system and into the ground. Now, breathe deeply through your nose and notice where the

air goes. If your body is properly balanced you should be able to feel the air entering your body, eventually residing between your clavicle and sternum. If you are balanced the spine should gently detract while breathing in and lengthen on exhale. If you are balanced your muscles will naturally relax and will work in cooperation with gravity (Vining, 2009). You can now begin to regulate your breathing through improvisation by "toning" — hold a vowel sound for the duration of a breath and "sounding" — begin to improvise with any kind of vocal sound (Oliveros, 2005, p. 11). Draw attention to how your body vibrates and the emotional state of your nervous system. One can then begin to visualize the shape and speed of airflow as an objective and controllable substance (e.g. spitting warm buttermilk) stemming from an *internal resonance* within the body as well as the *external resonance* or feedback one may receive from the surrounding environment.

Enhanced concentration via self-regulating the mind with meditations like these can help channel performance anxiety, filtering out negativity while harnessing positive awareness of 'internal' and 'external' experiences in the present moment (Lin, 2007). Tibetan buddhist nun Pema Chödrön explains that "what we are talking about is us getting to know fear, becoming familiar with fear, looking it right in the eye — not as a way to solve problems, but as a complete undoing of old ways of seeing, hearing, smelling, tasting, and thinking" (Chödrön, 2002, pp. 2-3). Thinking back, we can connect this thought to Freud's idea of fear and anxiety being different: fear is transparent while anxiety is the unknowing looming danger with no identity. McGrath states that meditation does not serve to reduce anxiety but to redirect it and utilize its energy for positive outcomes by changing one's disposition toward an experience. Meditation also allows for a reevaluation of the constructs we use to judge fairness in competitive classical music environments. Meaning that, we can begin to see spontaneous expression being fostered

via different performance styles, outside of the traditional western classical aesthetics. Introducing deep listening practices through the genre of improvised performance can provide self-therapeutic methods in which breath and bodily awareness allow a music student to trust themselves and their work leading up to particularly stressful events (McGrath, 2017, pp. 91, 106). The lessons learned from these experiences can then be transmitted to other genres of music. In order to start addressing some of these experiences, we must begin to examine anxiety through a subjective lens, understanding that no one will understand the sufferer's disposition better than themselves. A performer's learned stage presence can often mask the maladaptive behaviors associated with anxiety as they do not have the opportunity to evaluate 'objective progress' when focused on their musical efforts during performance.

Therefore, we can further define the boundary between *external* and *internal resonance* when it comes to refocusing one's thoughts on task-automation during musical performance. An awareness of *internal resonance* must harness the willful creative nature of the individual performer by rehabituating adaptive emotional responses to false-alarms, including responses to the external stresses responsible for triggering those alarms. In contrast, in order to achieve *external resonance*, one must place trust in practiced automated-motor skills, which have been pre-negotiated within a musical milieu. Both resonances focus on the tasks at hand, avoiding introspective thought or judgment prior to, during, or after the event, independent on whether the event is perceived 'successful' or 'unsuccessful' by the performer or creative milieu. A performer must learn to separate themselves from their artform during social critique, quickly redirecting attention to the musical task at hand if emotional responses distract from attention and working memory. Unfortunately, there is no periodic table for understanding the internal mind since interpretation on the part of any researcher skews the data collected. Nevertheless, we

can further investigate prescriptive forms of andragogy that may aid musicians in finding balance via *internal* and *external resonances* — recalibrating the mind for a healthier approach to music performance (see Table 2.2).

Table 2.2: *Function of external and internal stimuli within a self-efficacious andragogic music education framework*

Functions & Expectations	Assetization of External and Internal Stimuli
Performance Accomplishments (Enactive Mastery Experience)	Teaching self-directed performance desensitization that creates opportunities for positive student or peer performance experiences
Vicarious Experience	Presenting proven tactics that address performance anxiety, while creating opportunities for student or peer understanding via interpretive therapies
Verbal Persuasion	Using supportive therapies that address individual traumas or underlying conflicts
Emotional Arousal (Physiological and Affective States)	Experimenting with symbolic exposure and desensitization via relaxation while helping students adjust negative internal attributions

Enactive Mastery Experience and Spontaneous Aptitude: Enhancing Performance Behaviors Through Attentiveness Strategies and Improvisation

How do the learning advantages and disadvantages of delving into different states of consciousness and emotion, which may not require conventional forms of attention, relate to performance anxiety, behavior, and memory? Similar to attention, Jennings defines her theory of *conscious entrainment* as "the experience of being entrained to a task as though one has no other interests or tasks" (Jennings, 2015, p. 287). The difference between entrainment and traditional attention-based consciousness is that entrainment implies a sense of focus without the effort that is normally associated with top-down executive functions. Therefore, we can understand *entrainment* as an event that occurs through habituation to a task similar to learned implicit motor skills but one in which attention is largely absent in active performance. Entrainment

assumes that consciousness does not necessarily go hand in hand with attention or concentration. These notions are backed up by numerous studies on alternate forms of consciousness, including models mentioned in previous subchapters (e.g. *perceptual gist* and *super blindsight*) which imply the importance of referential, propositional, and nonconceptual modes of thought necessary for musicking. It is important to note that these observations offer only a partial understanding of how and why we utilize unconscious memory representations while performing and it still remains unclear if certain aspects of 'unfocused focus' can be practiced or called upon in a cue-based manner.

As mentioned previously, it's assumed from a cognitive and psychological perspective that as soon as attention is drawn to these models they are no longer unconscious. Nevertheless, it is possible that one can become more attuned to their presence through phenomenological reflection and by doing so can semi-activate regions within the brain via a three pronged approach. This self-reflective approach can be translated into action that is not unlike *flow state* but differentiates because of the absence of attention. This is to say, *conscious entrainment* derives from the automaticity of habituation which reaches a certain threshold, becoming the antithesis of controlled attention, instead informing a general awareness of global attention — "diffused and continually expanding" within the "whole space-time continuum of sound" (Oliveros, 2005).

First, consider *conscious entrainment* within improvisatory performance praxis. Awareness of its boundaries can be determined by a) undivided *attunement* to a single task or process while b) using metal resources efficiently, accessing a distinct feeling of effortlessness outside one's conscious control via c) the synthesis of *subject* and *object* while performing. It is important to understand that we are not necessarily seeking objective results of positivity (e.g. as

Csikszentmihalyi's *flow* consciousness does) in performance but rather an event in which a performer is no longer thinking about oneself, their surroundings or the temporal dimensions that may define their past or future — at least not with top-down concentration. Indeed, *conscious entrainment* can lead to what is often described as peak musical performance. A zone in which habituation of a skilled activity results in the peak production of a specific skill set. For instance, a pianist that has performed the same concerto so many times that implicit motor functions and stylistic characteristics have synergized into a single chunk of long-term memory, retrievable and malleable in its own right. At this point, these habitual actions are no longer triggered by attention, but simply *flow* through the concentration of resources during the process of performing. There is no need to attend to the sound, technique, acoustics, or the instrument because all of this has been so thoroughly habitualized it no longer beckons control.

Second, when these objects, activities, and processes no longer desire control our mental energy resources can be effectively repurposed. This is also called *letting go* — the ability to stop personal oversight over one's actions. This is obtainable by professional musicians with significant experience, since it is unlikely novice performers have moved on from a *flow* experience which stems from effortful attention to specific features of their instrument or the response of their sound within certain acoustic environments. This is not to say that an experienced musician does not consider these features, but their responses are not defined by what they may perceive in the live-performance-moment, but rather the accumulation of what had previously been perceived and what is now being transmitted unconsciously without willful intent. An unawareness of past, present and future, even though their skills exemplify countless hours of intense and detail oriented focus. This is also different from the perspective of

open-improvisers as the musician is not necessarily touching base with their environment, gathering feedback, and responding.

Third, we must learn to stop separating ourselves from the objects we attend to. Although it is often our innate understanding to exercise control over an object from a distance, entrainment bridges this schism. We can again attribute this to the learning curve during the development of a skill on a musical instrument. One might find playing a single note or scale requires a great deal of attentive consciousness in the early stages of learning an instrument, but as concepts become habitualized this need for attention fades until the player feels as if the instrument is essentially an extension of oneself.

A great example of this can be found acoustically. When professional musicians play for many years in the same performance space they grow accustomed to their surroundings. At some point their style, sounds, and techniques fuse with the feedback of the hall — a phenomena that is particularly noticeable when they go on tour and sound very different than you would expect! This is also the reason so-called 'bad' habits are so difficult to unravel. Once you learn a skill set, especially early in your development, it is extremely difficult to change. For these reasons, it is probably best to adapt, using the tools you have at your disposal — modifying them for new purposes. Even if you manage to forget a habit, in the sense that you no longer recognize it consciously, it will still manifest itself in some form or another — possibly entangled with other implicit skills that one might not wish to part ways with. This issue arises because of the dynamic nature of habitualization in music. It is not as simple as remembering to floss your teeth because there are so many activation triggers involved: the firmness of a musician's embouchure or bow hand may feed into specific goal-oriented sonic endeavors, some of which are necessary for your 'good' habits to function.

So the question remains whether these theoretical premises are useful or even possible in a 'real' performance setting. I would say *yes* and *no*. To obtain *conscious entrainment* at specific moments during a performance, before, or even after could be beneficial for a variety of reasons, e.g. reduce performance anxiety, increase audience engagement, and promote peak performance probability, to name a few. Nevertheless, there are moments when one wants or needs to respond to external stimuli (bottom-up) or take emergency action (top-down), adjusting to elements that seem to call for realignment. This might entail an open-improvisation in which a performer wants to respond to a collaborator's material or the tuning of an oboe that must be matched by an orchestral trombonist. These are common occurrences that have "real" aesthetic consequences during live performances. Therefore, they must be addressed via performer-based discretion while being negotiated within the local musical milieu. After all, contingency planning is a critical part of any musician's approach, so it is of utmost importance that one learns what needs to be attended to, habitualized, and eventually just felt heuristically. Performance is not a linear process and needs to be evaluated depending on the circumstances.

Taking all of this into consideration, it is important to understand that being too entrained within a specific musical ecosystem may be as detrimental as being too introspective. As covered in previous subchapters, our intention and reaction to musical events often go hand in hand. The separation of these characteristics may increase the likelihood of a mundane performance. It is the action and ability to choose that entices a genuine reaction, whether it be from an audience or fellow ensemble member. So obtaining holistic unawareness of one's surroundings might be advantageous in the short term, especially when relying on inner stimuli to drive a musical gesture home. Nevertheless, in order to couple inner and outer body spaces, musical

intentionality must emerge — a materialization of action via perception. According to Marc Leman:

> Action-intended ontology goes well beyond the statement that perception focuses on the action-relevant cues of physical energy. Instead, it states that perception induces the simulation of intentions that may be attributed to the environment. In fact, perception can be seen as the creation of a motor image of the world that is based on sensory information. (Leman, 2008, p. 87)

Similar propositions on the properties of causal relationships (e.g. work/event and music/material) that either enable or constrain action in musical space have long been addressed (Born & Barry, 2018; DeNora, 2011; Piekut, 2014; Small, 1998).

So where does this leave us? At first glance, it's probable that *conscious entrainment* might be more useful within the domain of competitive sports or the musical audition circuit for that matter. Because of the suggested lack of interdependency with features of the surrounding environment there is less need or expectation for a musician to respond to external stimuli and in some cases these responses could be attributed to negative aesthetics in performance (i.e. losing focus by becoming distracted by external events). However, in most music performance environments, and especially within improvisatory music — where more emphasis is put on the expressive freedom of each participant — an ability to sense one's environment and adapt in *real-time* appears to be the true allure of engaging performance practice. For example, Eisenberg and Thompson (2011) searched for links between improvisation and competition, discovering that improvisations were critiqued as more creative when they were told that musical experts would be evaluating the "best improvisers", suggesting that many contextual factors might shape creative flux in performance. This introduction of creativity connects us with an ontological hypothesis of its own, examining whether the Fluxus movement may have carried an accurate definition of experimental improvisation, defining it as a process rather than a product. In other

words, an improviser has been traditionally evaluated on their ability to foster an atmosphere of novelty (Lewis, 2013).

My hope is that, after reading the previous subchapters, one can begin to see how generalized novelty in music more often than not is actually a variation of what came before simply because it distinguishes itself from the objective unoriginal. This position is adequately illuminated by the ecology between top-down and bottom-up memory systems in which a continuous recycling of information (conscious and unconscious) produces concatenations of materials that have always existed, but may become subjectively perceived as 'new' by the performing subject. In this sense we can see perception as a tool that orientates us to an environment, rather than providing unique interpretations of that environment. More likely, it is simply a matter of which stimulant driven items (e.g. rhythm, pitch, timbral, etc.) the improviser voluntarily or involuntarily collects and acts upon, reconstructing devices into emerging musical *features* that can be deemed potentially novel in any sense of the word.

I believe it is here that *conscious entertainment* may offer some fruitful guidance as it is completely dissociated with attention driven memory systems. In other words, an accomplished improviser may find oneself in a situation in which there is no choice over whether they should contribute to an ongoing stream of consciousness or disrupt it, they simply focus on the task of being enveloped by the spatiality of a sonic environment — becoming one with it. While in this other conscious state, although theoretical, it might be possible to unlock arrangements of musical material that profoundly impact and potentially transcend certain ontological characteristics or performance customs — an open-improviser's dream world. Although it may be undesirable to perform in this zone of consciousness regularly, to tap into this mindset in particular situations might allow a musician to better express oneself while facilitating

self-actualization and deeper connections with peers. Thus, freeing oneself from events of miscommunication that might negatively impact performance endeavors.

This is also where Jenning's theory of *conscious entrainment* breaks with Baars' global workspace theory, suggesting that an artist could bypass top-down functions necessary for awareness outside of conscious perception (discussed earlier). She proposes a *performance hypothesis* to replace Baar's *theater hypothesis* stating that consciousness is "more like a performance art piece in which the artwork is created by both the performer and the audience, together" (Jennings, 2020, p. 122). Important to her argument is that the "form of consciousness that occurs without attention is sensory, but not perceptual. That is, it does not have the "structured meaning that allows an experience to provide us with information" (Jennings, 2020, p. 129). Indeed, more transient forms of consciousness associated with iconic memory have been noted by researchers (Crick & Koch, 2007). This brings up questions regarding the plausibility of having the experience of consciousness without actually attending to it, since *conscious entrainment* thrives within a more holistic realm. It is her suggestion to avoid highlighting the conceptual relationships between stimuli (e.g. object/subject divide). This might mean an improviser is no longer receiving information from their environment in a way we consider to be traditionally conscious, because an automation of the sensory system (stemming from implicit memory) and thorough habituation of attentional (executive function) mechanisms (cognitive and perceptual) have reached an apex in which attention is no longer needed for a musician to focus on a specific task.

To understand this perspective clearly it is necessary to see automation and habituation as two distinct layers within consciousness. Automation of certain musical features derives from bottom-up processing, whereas habituation forms over many years of attentive practice and

tuning of those features. At some point this causal structure introduces a form of phenomenal cognition that bridges the subject-object divide. Jennings cites that a subject's *interest* within the performance unifies this epistemological dualism (subject/object). For example, as habit becomes increasingly automatic, perpetuated by a solo improviser's enclosed feedback loop process, the attention once associated with habit slowly dissipates until an improviser no longer needs to re-attend to separate objects or focal points embedded within the task.

Mozart describes this experience as being "both a creator and a kind of witness" in which, in a letter to his sister, he notes that during improvisation he commits to the "first thing that comes to mind" while Robert Levin describes these moments as a coordinated dance between motor memory and the brain's ability to respond to these memories, defining a "highly explosive sort of internal-relationship" (Berkowitz, 2010, pp. 121-123). A more vivid representation could be pianist Ivo Pogorelich saying, "the notes have become you and you have become the notes" (Chaffin & Imreh, 2002). Indeed, when a subject enters *conscious entrainment* it is as if the object no longer exists, because the habitual behavior that once focused it as such has been replaced by automation — an unremembered distinction.

Jennings further defines this form of consciousness as an *interface* that mediates the constraints of the world directed upon the musician and the musician's own actions in response to these constraints. In contrast, a performer can interact internally with this form of consciousness in a sort of self-reflective echo chamber as mentioned previously. To better understand this, it is important to see the distinction between the focus an improviser puts on the task at hand, as opposed to the attention given to separate objects or elements that are embedded within this task. As previously stated, Jennings uses the idea of focus without attention. The problem with this viewpoint is that focus and attention have become so synonymous and

interchangeable that it can be difficult to observe them as separate entities. Perhaps for this reason the term *locus*, a place where this conscious *interface* is situated and receives all aforementioned musical materials (e.g. automated or created) is a better conceptualization of *conscious entrainment*. That is to say, an attuned musician no longer attends to fragments of a task through action because these have been automated through habitual action, which in turn have been recycled into the bottom-up sensory system, thus becoming a form of awareness disassociated with the constructs of goal-directed behavior.

Although there could be many plausible explanations for this, Jennings' connection with activation in different areas of the brain offer some evidence of this happening on a neurological level. For example, we can see a bridge between the lateral prefrontal areas of the "associative network" (attention driven) and the cortical elements of the "sensorimotor network" (Jennings, 2020, p. 147). She argues that heavily familiarized goal-oriented tasks (i.e., ones that require personal *interest*) eventually rewire the hierarchy in the brain. Thus, it is no longer the prefrontal area's primary responsibility to further control habitualized behavior, rather it prevents interruption of the task at hand.

Under more scrutiny, one could ask how *conscious entrainment* is any different from the conscious rehearsal or practice of objective tasks and performance of those tasks. However, entrainment is more than simply practicing and focusing habitualized behavior by going with the *flow*. It is the ability to do this and then forget why or how the behavior was habitualized in the first place. A kind of hypnotism in which one is zeroed in on a task without actually remembering how they got to that point. Therefore, after much experimentation, an improviser can leave the technical tools that helped them achieve goal-oriented results behind. Instead, looking with a wide lens through a conscious *interface* that unites them with the outside world.

So how does one prime this experience? As noted previously, the process is very different for every improviser, but I can speak about my process. For me, habitualized actions must be set within musical practice by 'triggers' (sensorial or attended functions) in order to become fully automated — moving away from the executive function's will to interfere. I would describe the experience of improvising as very kinesthetic. These could be learned motor gestalts and schemas which help me to craft particular improvisations. For example, I might prepare my sonic body with a certain physiological feeling, energy, balance, or shape with pure focus and attention in order to trigger an automatic response to this action. I then use this automatic response, e.g. the feedback of my vibrations, to trigger another response until the sound quality I desire no longer needs to be incentivised by attention, developing a life of its own.

The interesting thing is that by this final stage these sonic building blocks can be reassembled or deconstructed in ways that would otherwise be impossible, hence the dynamic nature of musical improvisation. Of course this approach takes time and dedication, emerging from one's *interest* in playing in the first place. For instance, If I lack a willingness to approach a musical gesture with my full attention during rehearsal, meaning derived from my *interest* in a musical *feature*, it is less likely that the sound produced will enter a zone of full automation in which it can be developed creatively on a separate plane of consciousness. If this were to occur, the event would fit within a multitasking territory in which attention is attempting the impossible — total focus on two tasks rather than grouping them together via automation. The end goal is to move attention away from the object by a) habitualizing layers of technique that eventually become b) automated via lack of oversight until c) fusing or resonating with the object that was originally being focused upon. I thought a reasonable sonic analogy would be sympathetic

resonance. If you've ever sung into an open piano you can feel and hear when your sound resonates with its strings, making you feel as though you're part of the instrument in some way.

Unfortunately, this analogy is too simplistic because organizing sympathetically excited tones and timbres hierarchically ignores the dynamic temporal processes our minds and bodies undergo to perceive this information, not to mention the influence of ecological variabilities. Perhaps then we can understand *conscious entrainment* not as an end goal, but a process in which our central nervous system continuously *self-tunes* with its environment. This process includes complex interactions between mind, body, and environment. A balancing of *internal* and *external resonances*.

Returning to the analogy of the reverberations of a performance space, in an interview, Stuart Dempster, a modern trombonist, mentions that he advises his students to play in different acoustic spaces as often as possible: from a very resonant stairwell that reverberates the sound of the trombone with ease to the muffling walls of a janitor's closet (Osborne, 2014). The key intention here was to find a balance between acoustic resonance that stroked one's ego and the lack of said feedback that might cause distress in less experienced musicians. It is known that professional performing musicians have found solace in acoustic spaces that they've grown in familiarity with. For example, a brass player who plays in the vibrancy of Severance Hall in Cleveland, Ohio for thirty years will have a completely different approach to playing than a musician who calls the dry shoebox-esque acoustics of Jones Hall in Houston, Texas home.

This stark contrast brings about questions of andragogical approach. If a musician becomes increasingly familiar with a space, will this impact their approach when teaching students or working alongside peers? If so, can an acoustic space be a natural extension of their instrument? I am certain there are generations of musicians who have been taught to perform in

spaces they might never set foot in, a dilemma that is so often heard when large orchestras go on tour and struggle to adjust to new spatial parameters. There is no doubt, however, that this can become a fundamental and systemic aspect of pedagogy as a sound which was fine tuned to the resonance of one space may fall flat in another or vice versa.

Therefore, it becomes crucial that musical performers learn to observe, moderate and change their performance practices as needed while actively collaborating with their sonic space as well as their social environment. In the words of Paul Salmon:

> [T]he successful performer is probably someone who has developed the capacity to effectively evaluate feedback from others, while at the same time retaining a perspective that facilitates informed judgements about one's own best interests . . . you are in the best position to assess how well your private thoughts and feelings correspond to the feedback you get from others. (Salmon, 1992, p. 138)

One might think of this as "self-centering" as opposed to being "self-centered" (Salmon, 1992, p. 139). This ability to intuitively adapt in realtime can be extremely advantageous to any inspiring musician. I prefer to call this function of self-efficacy one's *adaptive and spontaneous aptitude* (see Table 2.3).

Table 2.3: *Function of spontaneous aptitude within a self-efficacious andragogic music education framework*

Functions & Expectations	**Adaptive and Spontaneous Aptitude**
Performance Accomplishments (Enactive Mastery Experience)	**Providing real-time exposure to unexpected events in a variety of contexts during performance**
Vicarious Experience	**Witnessing and reflecting upon the improvisation of teachers and peers and acknowledging those who have achieved mastery**
Verbal Persuasion	**Giving positive encouragement for students or peers who display appropriate risk management**
Emotional Arousal (Physiological and Affective States)	**Advocating for self-direction in the moment while under emotional stress by focusing on musicality instead of perfection**

Connecting these thoughts to praxis once again, music improvisation is one tool that allows for spontaneous aptitude during musical performance through unconscious engagement with the self. Norman Bolter coordinates a meditative masterclass for adult musicians entitled *The Amazing Club* (TAC for short). The classes are based upon a fictional tale Bolter wrote about a futurist trombonist who must learn to balance the viewpoints of "narrow" objectivity (i.e. "things outside of ourselves") and "feeling" subjectivity through discovering "the marvelous original self, and its potential to guide and lead" by "tuning into" the interdependent relationship between the two during musical performance (Bolter, 2009). The project targets feelings of disconnection from the joy of music performance, which are ideas often associated with significant rejection on the audition circuit. The sessions start with participants identifying their internal tempo, frequency, and timbre which allows individuals to reclaim a sense of subjective ownership and embodiment of sonic characteristics that are often used for objective judgment of 'poor' or 'successful' performance in competitive contexts. Through establishing meditative processes on the instrument, Norman guides participants through a philosophical understanding of holism and reconnection with the natural world, often developing alterations of the TAC acronym *Tolerance Accountability Compassion*, *Thinking Anew Consciously*, to emphasize his points. The meditative exercises bring awareness to the body and mind through the act of playfulness, allowing each musician to find their own path while still being conscious of the relationships and "blend" they develop in collaborative performance settings.

Likewise, In an interview about collective improvisation, experimental musicians Jenn Baker and Kyoko Kitamura discuss how "structural improvisation" promotes the growth of a musical "vocabulary" or a lexicon that reveals opportunities for experimental music to flourish in different spaces (Crane, 2011). This intimate form of improvisation, using longtones and other

loosely dictated sonic elements to inform improvised choices, relies heavily on an openness to the external environment. Thus, 'Open improv' differs greatly from score interpretation since it relies more heavily on sound experimentation and exploration.

According to Baker, extended sonic textures and timbres such as multiphonics or air sounds were a big reason why she became interested in improvisation. While these elements would not necessarily be accepted within the creative milieu of classical music (which she had a history of playing), they gave her agency in the experimental music scene. Kitamura, on the other hand, had no formal training as a classical musician and had a completely different perspective as she did not "have expectations of what a voice would sound like" in a classical environment. Instead, Kitamura developed her voice by reciting newspaper clippings and freely associating zombi voices from the movies. At one point in a performance, the duo stops a unison melody abruptly, verbally arguing with each other about mistakes or imperfections that occurred. Eventually, this fictitious (or performative) argument falls back into a liberated rendition of the original melodic line.

This brief exchange speaks to the goals of the duo: they are seeking out original sounds by breaking away from the known to "find things" that they haven't heard before. A process that most certainly liberates their creative souls from parts of a musical ontology that might otherwise prevent an authentic musical performance in their eyes. The two, instead feed off each other, treat musical performance as a conversation through sound. Katamura determines the 'success' of her performances on the trust she develops with peers she performs with, implying a state of vulnerability required for improvised experimental performances as well as the potential therapeutic opportunities via social connectedness. In the rawest sense of the word, these musicians are *playing* with and for one another on their loosely negotiated terms, free from the

constraints of judgment by the listeners or themselves. Thus, there is a balance between the *external* and *internal resonances* which inform their sonic-centric methodology. Both musicians agree that improvisation for them is about finding moments that are unexpected and surprising. It is the process of searching that is the aesthetic event per se, not necessarily the product of that searching.

Thomas Turino defines improvisation in a similar light: for him, improvisation is "instances where I surprise myself with purposeful alteration, extensions, or flights away from the model and habitual formulas" (Solis, 2010, p. 105). In the case of habitual stock formulas that serve as fundamental structures of improvisation, it is often the 'happy accidents' or interpreted 'mistakes' that form the spontaneous nature of the piece which in turn get recycled as modular material later on. This thought process is useful since it can be conceived as the antithesis of more traditional approaches to classical music reproduction in which even the smallest alterations, seen through a hyper-traditional homogenous performance lens, can be considered 'true mistakes' and are to be avoided at all costs.

For many open improvisers, attuned listening and "participatory tradition" become the main determinants of 'successful' performances with fellow musicians, distinct from the perceived "impact on artistic forms" or different skill levels musicians bring to the table. Again, this notion supports a self-therapeutic approach to adult student performance issues during the improv process in which musicking becomes an 'internal' task completed by and for the participating musicians, rather than an adoring audience. Of course, this is not to say improvising musicians avoid developing and honing their techniques autonomously while also being keenly aware of the artist milieu they might represent. But their art straddles a line between more determinant formulaic repetitions which serve presentational music styles (e.g. 'expert' soloists

playing in obscured ABA form to receptive listeners) and more liberal sound collages (e.g. the conduction practices of Buch Morris). For instance, Buch's approach disrupts the traditional western hierarchy between conductors and ensemble by avoiding authoritarian structure and instead promotes sound making via bringing out individual participant's contributions. Thus, conduction organizes an intimate dialogue through a lexicon of embodied, embedded, and enacted gestures. Having said this, Buch's approach still derives from a personal vision of the sound world he wanted to create within a clear performance context, thus exemplifying a contradiction when considering his anti-authoritarian sentiments.

More evident examples of participatory style music that avoid performance entirely can be found in ritualistic, ceremonial, spiritual, and modern chamber music styles that engage the audience as participants rather than onlookers. Specific music may include gospel music, christian rock concerts, and Ensemble Modern CONNECT concerts (Venables & Bianchi, 2018). Participatory models offer conditions for *flow* (which often translates into enjoyment) for people at all skill levels. Nevertheless, to balance these conditions is challenging as it often depends on each artist's interests, personality, and background. A strength of the participatory model is that it strives for complete inclusion and for a diversity of artists and students. Participatory models, however, may also place limits on individual freedom, creativity, and skill development at the expense of more experienced performers. For example, more experienced performers may wish to engage in binary relationships with audiences and find their *flow* by technically challenging themselves (Solis, 2010, p. 111). The same can be said of traditional western classical music aesthetics, however, as improvisers can be found in all styles and genres of music. It is simply a question of how flexible the evaluation of aesthetics are in each musical milieu.

At any rate, it becomes clear that one's ability to improvise or spontaneously adapt is a critical tool helping to balance the functions of *attentive memory* alongside *assetization of external and internal stimuli* during the act of musical performance. This is because music improvisation is one tool that allows for "self-centering" during performance. Both participatory and performance improvisation models can be placed on a spectrum. Both models are highly dependent on the individual musician's definition of agency. They are not immune from traditional aesthetic archetypes such as repeatability, consistency, or authenticity that may constrain classical music practices. Nevertheless, the nature of improvisation mandates a return to participatory models which support the educational needs of an entire diverse artistic community, regardless of perceived skill level within these communities.

A post-secondary scaffolding process that takes improvisation into account includes targeted strategies that can help students develop implicit behaviors that are advantageous to their performance goals while rewiring habits that are less desirable. Performance tasks that rely heavily on working memory are more likely to impact performance pressure than those that are performed more intuitively or automatically (Maddox & Ashby, 2004). This brings up interesting questions regarding implicit and explicit memory models within musical performance and the implications for voluntary and involuntary action. For instance, how can implicit or subliminal memory help reduce stress on performance related processing by activating learned skills without necessarily drawing conscious attention to them? Furthermore, are there memory models that may assist understanding unconscious memory representations for task completion via attentive behavior that can be readily implemented by teachers?

To get to the heart of some of these questions, it is important to first take a look at how our mind processes information unconsciously. It is clear that musicians innately separate

implicit (automatic) and explicit (voluntary) memories, usually by developing muscular coordination. Implicit motor memory, for example, is the reason why we don't forget how to ride a bike or need to explicitly recall previously rehearsed fingerings for piano scales while sight reading a new piece — making space in working memory for us to interact more deeply with our environment. Nevertheless, there are aspects of musical performance that require regular rehearsal in order to develop and maintain alternating and divided attention schemes. This is where dual-task studies have demonstrated that habituation assists in decreasing dissonance between concurrent tasks, allowing amateur and professional musicians to react to internal and external stimuli simultaneously, e.g. alternate quickly between a conductor and a score (Hine 2010). To reiterate, controlled or goal-oriented performance seems to originate from the prefrontal cortex whereas involuntary or automatic responses activate a sensorimotor network that contributes to the activation of cortical and subcortical structures (Yin & Knowlton, 2006; Poldrack et al., 2005; Goldberg et al., 2006).

Again, between these two zones, we can further elaborate upon unconscious memory with a phenomena described as *perceptual gist*, a zone where one may "experience a partial or degraded scene in a short timescale with little or no attention" (Jennings, 2020, p. 134). This idea has also been viewed as an auditory gist in sonic studies (Harding et al., 2007). The premise here is that recurring conceptual representations (habit forming) of an original experience degrades awareness of the sensory stimuli that originally attracted attention in the first place (Jennings, 2020). This is why it is commonly believed that a second objective (non-primary task) is eventually habituated, performed with little to no attention so that more processing power can be retained for the primary focus of attention. This replacement of attentive behavior with habitual

behavior is also evident in day-to-day life. The experience is described beautifully by Lewis Hyde:

> Outside my study window stands an ugly nest of power lines, I see it all the time, so I hardly notice it. Nearby, the wild beauty of an ancient elm with its breakdance branche— that too can elude me. Were I traveling in a foreign country, however, little would have such invisibility. Strange lands leave the traveler by turns enlivened and anxious, alert and weary, every unknown thing demanding attention. (Hyde, 2019, p. 301)

Furthermore, Lewis discusses this disposition as a "tradeoff between the delight or anxiety of fresh perception and the comfort or dullness of the habitual" which "stands in the way of the very suffering our growth requires" (Hyde, 2019, p. 302). Indeed, as previously stated, habituation schemes such as operant conditioning are useful in certain situations but can also set the stage for rather lackluster musical performance if used excessively. However, is it necessary to help a student choose between attentive action and habitual action? Do we have a choice? Perhaps it is because of this supposed binary opposition (attention and lack thereof) that musicians and artists in general often seek out novelty through *expression*, holding a recurring infatuation with its tendency for rebirth or at the very least a *fresh* recycling of ideas. Studies have long shown that habit allows for dual-task processing between concurrent tasks, allowing a performer to execute separate tasks without any noticeable loss of performance (Hirst et al., 1980). Habits are different from other implicit reflexes in that they are sensitive to content and can be learned in a hierarchical manner in order to free up processing power for other musical endeavors. For example, Jazz improvisers and freestyle rappers have been found to utilize habit beneficially by operating without attention while engaged in multiple tasks (Limb & Braun, 2008; Liu et al., 2012).

Needless to say, habit-based performance models are not always ideal for music performance and education since the processing power allocated for each habitualized task can

often be taken for granted and is largely removed from the performance experience and therefore may become dissociated from the context or environment in which listeners are situated. For example, a brass player may approach a technical excerpt of a notated contemporary chamber work by developing and rehearsing (i.e. habitualizing) new embouchure skills so that it's easier to freely express the overarching musical structure during performance. However, at the same time the individual's habitualized actions may take more processing power as one must alternate between different zones of attentiveness (e.g. selective, divided, or sustained attentiveness) in order to restructure representations of the technical passage via executive top-down functions. The musician may generate a slurry of learned executions, but not necessarily the most dynamic musical gestures.

Interestingly, habitualization techniques resonate with many who argue that fully memorized music eliminates the real-time effort necessary to process the symbolism of a visual score. Habit thus facilitates the translation of immutable mobiles (i.e. scores) into the sonic realm — freeing up working memory to instead address aesthetic choices during performance (e.g. Reubart, 1985). This thought opens Pandora's box. Although cue-based symbols can be useful to remind one of the architecture of complex music and greatly reduce preparation time, does symbolism authentically represent what is to be heard? There are numerous avenues of research one can follow concerning semiotics within the creative arts (e.g. Turner, 2006) — they will not be addressed here as this topic is well outside the scope of our focus. Nevertheless, this phenomena is best summed up by observing musicians who perform unannotated music in exclusivity. So-called open-improvisers may evaluate the performative function of memory as a bottom-up feedback loop which informs practiced musical *models* during live performance, thus eliminating executive processing via live compositional techniques and encouraging creative

spontaneity instead (Pressing, 1988). These models are described by Baar as “any highly practiced and automatic skill [that] tends to become ‘module’ — unconscious, separate from other skills, and free from voluntary control” (Baars, 1988, p. 51).

This is not to say this type of music performance is void of compositional focus or clear thematic development and form, but it takes its lead from a *creative flow* and an intrinsic desire to develop strong interpersonal relationships with fellow ensemble members and listeners. This form of attention is also in alignment with holistic cognition as opposed to the analytical. Instead of an object-oriented focus on attention, often associated with Western cultures, improvised music may stress interdependent forms of context-oriented attention, more often practiced by Eastern cultures (Ketay et al., 2009; Masuda et al., 2019). Before getting ahead of ourselves, it is important to note that this schism between east and west has been overgeneralized as technologies further globalize populations and recent studies target specific demographics in more detail (Talhelm et al., 2014; San Martin et al., 2018). In short, it is particularly difficult to come to an ethnographic consensus model with such a dynamic practice as music.

Therefore, as mentioned in previously, it may be interesting to approach improvised musical experiences from the psychological studies of *flow* consciousness which serve as a jumping-off point into the performance attributes of the unconscious mind (Csikszentmihalyi, 1992) and a method for developing a self-efficacious attitude during musical performance. We can view the state of *flow* as a methodology that helps us conceptualize what it might be like to take habituation to the next level, meaning that even though a habituated or “module” task might be performed without attentive consciousness, it need not result in lack of other forms of consciousness. Musicians have labeled this mindset as an “ecstatic state”, requiring a development of ”modal ecstasy” or trancelike “amnesia” in which top-down interference during

performance is minimized (Berkowitz, 2010, p. 127). Again, Jenning describes this form of consciousness as "conscious entrainment" — a state of mind in which one focuses "on a task that no longer requires our attention" and thus enters a new realm of possibilities, i.e. *attunement* within a task rather than *attentiveness* towards a task (Jenning, 2015). The improvising musician can use this state of consciousness to build self-efficacious learning models.

Scaffolding Self-efficacious Learning Through Integration of Memory Models in Music Performance

When considering specific andragogic strategies that can assist in helping students achieve more enactive mastery experiences via attention, striking a balance between these implicit understandings of learning alongside more explicit learning outcomes during and before musical performance is important. Enactive mastery experiences help scaffold self-efficacious learning and can be organized into clearly defined learning tasks (Figure 2.2).

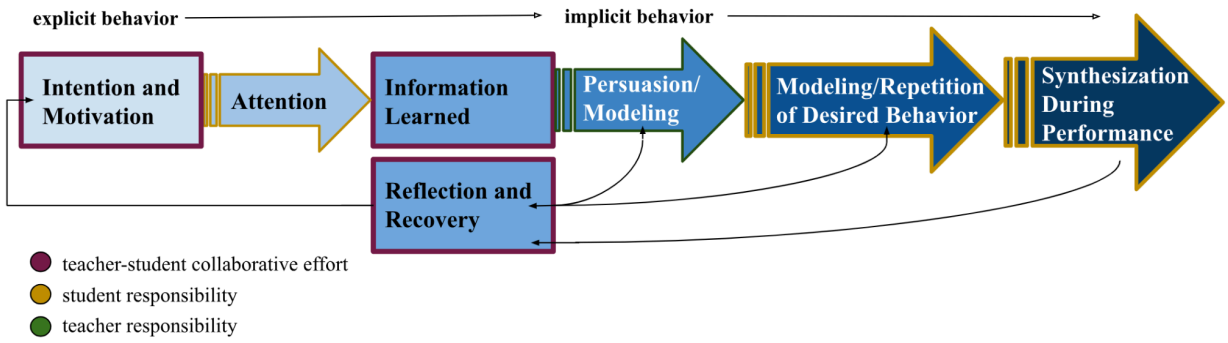


Figure 2.2: *Experimental design for an andragogical approach to attention and behavior in music performance*

While explicit and implicit behaviors consistently operate in conjunction, specific tasks within the musical preparation process may be perceived as employing one memory model more than the other. Why are these tasks of self-efficacy so important in the context of attentive memory and improvisation? Just as the human mind can find *attunement* with a task through attention and habituated behavior, we can build familiarity with what it is to become 'in tune'

with our confidence and ability as musicians. Like a digital tuner or metronome, developing a tool kit that helps orient ourselves within the guide posts of self-efficacy imparts purpose to our musical practice, making it more engaging, creative, equitable, and powerful. I posit that these tasks are not always intuitive in our musical practice and can be learned by drawing awareness to them during the act of creation.

During the first task we can observe the goal of targeting an explicit learning intention.[2] This intention must consider a pupils' funds of knowledge, including previous cultural, familial, educational, and performance experiences. A teacher must find aspects of their own expertise that resonate with those of their students. This is because constructivist learning requires the learner to develop their own knowledge schemas while adopting aspects of those presented by their teacher. Intention and motivation is thus the precursor to the attentive mind and this is a collaborative effort since the information deemed necessary to learn is determined within the student-teacher or peer-to-peer relationship.

This learning intention typically arises from intrinsic motivation, a concept widely regarded as fundamental to well-being and arguably the most valuable asset for any student. A teacher or peer's role is to guide this motivation, not craft it. During this stage, a student or peer's expectancy, their perceived success in a given attentive task, instrumentality, one's understanding of the present attentive task as it relates to a future goal, and valence, the positive or negative psychological value attributed to an attentive task, must be carefully negotiated. Students or peers must see that making an effort will lead to improved performance and that a high level performance will bring an outcome that is attractive. At the same time, an excess of expectations, as outlined in Bandura's self-efficacy model, can become the poison of any discipline and if met

[2] *Note.* It's crucial to recognize that the journey toward self-efficacy isn't a straight line; rather, it's a dynamic continuum. This implies that the steps involved can be taken in varying sequences or merged together.

should be used as informative guide posts rather than a determination of success. Success is finding pleasure in *attunement* with tasks that are self-mediated and improvised. Seeking recognition is a fallacy, finding it is not. Recognition, if received, is a positive byproduct of one's own craft and does not reflect the success of the student or teacher and can actually be detrimental to one's long term well-being if focused upon. Success, from a learner's perspective, is thus self-made and does not cater to any social hierarchy, rather working in conjunction with peer and mentor support. This is intrinsic motivation in a nutshell and is a critical step in developing self-efficacy within an educational environment.

After a point of motivation is determined a roadmap of intent can be structured towards specific learning objectives. This map can vary, depending on the student, but should include clear points of reflection where the student or peer can inquire, apply, and adapt information while developing ownership of knowledge. In a college environment, this might look like allowing students to draw on internal resources that inspired them to attend college in the first place, e.g. passion, career aspiration, cultural and historical interest, social impact, or creative challenge. In andragogy, the goal is to provide for growth of critical thinking in regards to content and apply these thoughts to real-life settings. Although developed with the intent of helping adults learn, the andragogical model can also assist adolescents who have sufficient background knowledge related to the subject being taught. The model has five main principles: 1) students or peers must know why something is important to learn; 2) students or peers are shown how to direct themselves via information; 3) topics are related to students' or peers' interests and prior experiences; 4) learners must be intrinsically motivated in order to be ready to learn. 5) Acquiring an understanding of these concepts requires assistance on the part of the

teacher in helping their students or peers overcome deeply rooted inhibitions, behaviors, and beliefs associated with learning (Reeve, Deci, & Ryan, 2004, pp. 31-60).

When all of these principles are met, students can begin the modeling process. Because adult student belief is so closely tied with their learning, teachers must persuade and model positive behavior through genuine engagement, elaboration, praise, performance demonstrations, and respectful treatment of peers and other students. The student then adapts this modeling for their own use, repeating desired behaviors that assist in the pursuit of personalized learning objectives. The evaluation of these results can be conducted through summative assessments, such as solo recitals, competitions, or finished compositions, as well as formative assessments, which encompass individual reflective journals, studio class presentations, group rehearsals and presentations, as well as structured Socratic seminars or meetings.

When the modeling process is complete a student has reached readiness to perform and integrate the knowledge they've acquired. Many of their conscious thought processes have evolved into refined, automatic behaviors that support self-directed goals. Following this phase, learners enter a reflective period during which they have many choices. A student and their mentor will reflect on each learning experience and identify transformational events which may have aided desired outcomes. A learner might then decide to review moments that were perceived successful or unsuccessful, such as performance recordings or previous social correspondences, assessing if goals are being met. If certain behaviors are determined to be productive they can be reinforced with more repetition before synthesizing learned information with live and participant modeling once again. Another route is to completely reconstruct the learning goals, starting with the personal intention and motivation phase again. The central prevailing inquiry for the student: what is the rationale behind acquiring particular skills and

knowledge, and what are my personal objectives as a learner? In the following chapter, we will explore possible answers to this question in the context of an international creative-research project I developed from September, 2020 until August, 2022.

Chapter 3. Empathetic Engagement in the Creative Process and the Musicians Auditory Perspective Project

"Tell me, and I will forget. Show me, and I will remember. Involve me, and I will understand."[3]

— Confucian aphorism (Xun Kuang)

To illustrate the metacognitive scaffolding process of adult learning in more detail I will explore The Musician's Auditory Perspective Project (MAP), a creative-research project I spearheaded while studying at the University of California San Diego. In the summer of 2020, during the peak of the Covid-19 pandemic, I conceived this research-creation project, which aimed to critically assess the creation of three solo pieces for cello, trombone, and violin. My intention was to investigate the timbral qualities of each instrument in a variety of spaces while analyzing the initial perceptions of each participating musician. However, due to campus closures, the nature of the project soon shifted to more self-referential endeavors addressing memory, improvisation, collaboration, and reflective thought.

In my mind, these domains acted as windows into the recent surge of creativity driving the metamodern University of California education system—a system that is still striving to deconstruct the narratives of the postmodern age by utilizing its digital and postindustrial assets to build social awareness via integrative pluralism; a concept that I will use to synthesize each aforementioned function of self-efficacy during the act of creating music alongside technology. This refers specifically to empirical modes of scientific collection and how we use knowledge to illuminate the imperfect relationship between truth and belief, especially when it comes to acknowledging the existence of multiple valid viewpoints and seeking to incorporate them into a

[3] Knoblock, J. (1988). *Xunzi: A translation and study of the complete works*. Stanford University Press & 1990 May 4, The Philadelphia Inquirer, Editorial: To the limit: The Franklin Institute's Futures Center is a burst of light in a dark hour, Quote Page 18A, Column 2, Philadelphia, Pennsylvania. (Newspapers.com)

comprehensive understanding of something as complex as musical creativity. The progressive complexification of dialectic thought through technology has brought us to a pivotal moment, disrupting structural thinking through a more perspectival postformal consciousness. Simply, one's ability to see the world from multiple perspectives outside one's own, albeit at the cost of potentially losing a sense of "being" or "living" in this process. Fortunately, MAP allows for dialogue around and the synthesization of musical circumstances never directly experienced while maintaining the dialectic origins of thought associated with each collaborative development through thick qualitative analysis and audiovisual recording. This facilitates opportunities for tacit understanding between participating artists, while maintaining artistic anonymity during the creation process, in turn, opening doors to new and exciting compositional challenges.

Furthermore, although the analysis of contemporary music often focuses on structural and cognitive aspects, the remarkable bonds and friendships that develop between individuals during the composition process became worth studying and understanding from an embodied and sensory perspective during the MAP project. The purpose of MAP was to collect qualitative data via sonic ethnography in order to promote and analyze: (a) auditory learning during sonic collaboration (i.e. an active musician's ability to learn through listening), (b) modes of sound information gathering (via binaural audio recordings), and (c) the innate creative expression of musicians, while disrupting common pedagogic misconceptions that reinforce hierarchical education and performance practices by taking a dynamic approach to learning. For example, a set of textual instrumental etude books might be replaced with experiential learning documentation, which includes illustrations, audio/visual materials, and recorded

correspondences related to a specific compositional or performance technique developed during the project.

From this perspective, auditory learning is not viewed as a linear process but a complex and dynamic one that implies a skill set that is synergistic and deeply connected with a creator's self-efficacious attitude. MAP enabled three student composer-performer duos from two Analysis, Creation, and Teaching of Orchestration (ACTOR) partner institutions, UC San Diego (UCSD) and McGill University (McGill), to document their collaborations while creating with binaural recording devices, adopting the concept of 'sonic boundary objects' — a concept first introduced in the context of blind ethnographies by Grond and Devos (2016). In our study, binaural recording devices served as 'boundary objects' that helped us negotiate between individual's differing perspectives. In this sense, we adapted 'sonic boundary objects' and their original use as a tool and practice that helps to understand and share the perspectives of individuals with different sensory skills and sensibilities. In the MAP project, 'boundary objects' are transferred to the field of music composition and performance and we apply them to nurture and understand the highly dynamic process between a performer and a composer during joint music-making. The overall outcome being that these 'sonic boundary objects' promoted skill-sharing among all participants by bridging differences in perception. Additionally, and specific to the situation of the COVID-19 pandemic, the application of binaural recordings allowed for a digital transfer of tacit knowledge by promoting an individual yet shared perspective during a challenging time to communicate for many artists. Throughout the project, each composer-performer duo produced a musical score and recording, while also documenting self-observations made during the creative process. In doing this, they provided a creative

framework that emphasized self-efficacy during the learning process through collaboration in the form of virtual meetings, creative output, and reflections.

Interestingly, albeit unintentionally, this lens into the diverse and dynamic nature of our creative consciousness was insightful in that aspects of musical creation that might have gone unnoticed in a traditional setting were increasingly cogitative in nature, largely due to MAP's remote format. Examples that follow include sounds recorded with binaural and ambisonic microphones, the digital exchange of textual and visual material, as well as live collaborative meetings and recorded correspondences between participants. Given the depth of inquiry and discussion that unfolded over the course of twelve months, I am eager to employ the MAP framework as an experimental design for scaffolding a self-efficacy model suitable for implementation by post-secondary level educators.

Motivation and Method

The Musician's Auditory Perception (MAP) Project arose from a curiosity in how contemporary musical performances are traditionally recorded by our technology as well as by our memories. An important inquiry was how these modes of understanding influence our sonic learning. While participating as students in the Composer-performer Research Ensembles (CORE) of the Analysis, Creation, and Teaching of Orchestration (ACTOR) Project, I soon realized that the complexity of the experimental music being composed and performed mandated qualitative approaches which emphasized first-person accounts during creative activities. What we found important was the potential ecological validity when it came to studying collaborative musical orchestration, in turn framing the internal validity of the ACTOR Project's many perceptual studies (e.g., Upham & McAdams, 2018).

Due to this qualitative approach, the musical participants in the project took center stage. In contemporary musical practices, the dichotomy between the composer and performer has undergone a shift. The intermediary-performer is not limited to being a mere interpreter, as seen in works by Cage or Feldman, and is sometimes entirely replaced by technology in the music of electronic pioneers such as Babbitt and Stockhausen. More recently, we find ourselves at a turning point in which both actors (performer and composer) engage as fellow creators. Much musical research in recent years has analyzed the relationships fostered among the improviser, performer, and composer (Denora, 2011; Foss, 1963; Lewis, 1996; Nooshin, 2003), and yet, it is still commonplace to think of Western music composition in a certain hierarchical light, seeing the composer as the creator and the performer as a player that plays out that creation. We see this issue problematized in spaces in which creative recognition is not negotiated, but rather given blindly to either actor and resolved in spaces in which creative practices are reflected upon and reevaluated accordingly, giving equitable air space to all creative participants.

In this light, we can understand musical improvisation as a way of knowing, in that improvisation puts less emphasis on the power dynamics between different actors, instead focusing on modes of shared experiences that fuel creative compositional practices. The MAP project documents these implicit or improvisatory behaviors via an online database of contextual interviews and surveys (Schneider et al., 2021), thus providing a framework for qualitative inference that can be used to understand complex relationships between its creative participants alongside each andragogical strategy influencing improvisation and adaptive behavior (see Table 3.1).

Table 3.1: *Function of adaptive and spontaneous aptitude within a self-efficacious andragogic music education framework*

Functions & Expectations	Adaptive and Spontaneous Aptitude
Performance Accomplishments (Enactive Mastery Experience)	• **Create opportunities to investigate timbral soundscapes via instrumental experimentation during performance.** • **Emphasize responses to unexpected salient sonic events in live project meetings.** • **Share a variety of musical performance concepts in different contexts, i.e. differing acoustic spaces, instrumental directionalities and extended techniques, audiovisual recording techniques and microphone placement, expanding upon the possibilities of contemporary musical performance and production in realtime.**
Vicarious Experience	• **Digitally cataloging improvisations as evidence for how to activate or supply musical background knowledge, highlight compositional patterns, elicit sonic relationships, and maximize comprehension transfer and generalization through multiple means of sonic representation so musicians can actively learn from one another.**
Verbal Persuasion	• **Utilize multiple media for sonic communication, i.e., text, imagery, oral meetings and seminars, graphic organizers, videos, the use of stereo, binaural, and ambisonic microphones, and miscellaneous media that resonates with participant needs and interests. This gives a voice to all participants.** • **Use multiple tools for construction and composition, i.e., digital audio workstations (DAW), annotated or electronic scores, and improvisatory graphic scores that enhance musical choice during the creation process.**
Emotional Arousal (Physiological and Affective States)	• **Guide information processing to facilitate proper management of information and resources during the act of improvisation.** • **Develop self-assessment and reflection skills by reviewing previous contributions to the project.** • **Reflecting on past performance experiences and asynchronous binaural recordings, allowing for time and space to guide appropriate asynchronous or synchronous responses to co-conceived musical material.**

The MAP project utilizes acts of improvisation as vehicles for empathetic engagement during the creative process, developing spaces in which collaborative learning and performance accomplishments benefit all participants by providing opportunities for representation, action, and expression (see Table 3.2).

Table 3.2: *Function of creative empathetic engagement within a self-efficacious andragogic music education framework*

Functions & Expectations	Empathetic Engagement in the Creative Process
Performance Accomplishments **(Enactive Mastery Experience)**	• **Value active participation throughout the musical composition and performance process.** • **Clarify musical notation, symbols, and syntax that promote a heightened salience of goals and objectives for all participants throughout the creative process.** • **Foster collaboration and community through increased mastery-oriented feedback from peers during performance.**
Vicarious Experience	• **Supplying multimodal aids and technology that help project participants understand and express music from multiple perspectives without directly comparing themselves with one another, i.e., shared understandings of academic texts, sonic spaces, and aesthetic influence.** • **Share experiences with project collaborators while acknowledging perceptual facets of investigative research that may resonate with all or some project participants.**
Verbal Persuasion	• **Encourage constructive and genuine peer-to-peer praise and critique.** • **Codify musical vocabulary and symbols that promote understanding and communication across different languages.** • **Demonstrate options for collaborative score construction and performance tactics through multiple media.**
Emotional Arousal **(Physiological and Affective States)**	• **Guide appropriate goal-setting when it comes to emotional engagement with peers, enhancing social emotional intelligence.** • **Provide access to perceptual lenses, offering ways of creating, sharing, and reflecting alongside peers through differentiated learning goals.** • **Consider the affect and representation of musical notation.**

The ability to empathize during the project increased dialectical thought, taking pressure and judgment off participants, instead helping to guide moments of intrinsic motivation that allowed participants to take steps towards balancing or reconciling contradictory perspectives while making music (see Table 3.3).

Table 3.3: *Functions of assetization of external and internal stimuli within a self-efficacious andragogic music education framework*

Functions & Expectations	Assetization of External and Internal Stimuli
Performance Accomplishments **(Enactive Mastery Experience)**	• **Promote self-regulation through internalized expectations and beliefs that optimize intrinsic motivation during and after performance accomplishments.** • **Facilitate personal coping skills and strategies that are purposeful during performance.** • **Develop self-assessment and reflection skills that help minimize distractions during performance.**
Vicarious Experience	• **Notice how peers vary demands and resources to optimize challenges over the course of the project.** • **Build opportunities for collaboration and communal engagement by developing tacit knowledge skills.**
Verbal Persuasion	• **Sustain effort by building a heightened salience of goals when it comes to understanding self-constructed objectives and evaluating them in conjunction with supportive peers.** • **Guide engagement by optimizing individual choice and autonomy.** • **Emphasize the musical strengths of each participant by recruiting interest in relevant, valuable, and authentic composition and performance goals.**
Emotional Arousal **(Physiological and Affective States)**	• **Reduce irrelevant stimuli and distractions.** • **Self-reflect on internal attributions or possible misconceptions through qualitative analysis.** • **Share understandings of intrinsic motivation through asynchronous video and audio exchanges, allowing time for social emotional learning and individual reflection by all participants.**

These opportunities for composer-performer pairs to express, communicate, and self-reflect during the creation process through experimentation with audio technology, video software, as well as experimental and extended instrumental techniques contributes to a perspectival education framework that takes thick qualitative evidence into account. This evidence, specifically the video recordings, can be used to heuristically evaluate the perception-action coupling that occurs when one is interacting with musical instruments or creating a score over time (Goldman, 2016). A simple example is the correlation between vision and movement while playing an instrument. For example, the extended techniques a violinist may share with her collaborator are based on her ability to understand her movement over time and how her gestures may impact the sounds of her instrument. Unsurprisingly, both performers

and composers have contrasting enactive perspectives (sensorimotor skills) that are required for their individual creation processes. In this situation, the performer has honed her skills through experience, offering tools with which to compose, while the composer may have a fresh stance and capability to hear things the performer has either forgotten or ignored due to her systematic habituation of skills over time.

In view of these complex interactions between the worlds of the composer and the performer, we developed our own roles, as musical collaborators, and tools, in the form of scores and taxonomies, adopting the concept of 'sonic boundary objects'. Introduced first as binaural recordings in the context of disability ethnographies (Grond, 2016), analyzing boundary objects became a way to express and illuminate the invisible exchanges between creative individuals. This sensory approach based on listening presented itself as a natural fit for our investigation into the role of recordings and memories during collaborative musical creation, including how we gather and translate information during score construction as well as how timbral identification is used while playing musical instruments.

Furthermore, given that all project participants were practicing musicians, we chose a research-creation approach that focused on binaural recordings of varying acoustic contexts, amongst them an anechoic chamber, supporting the artists in their quest to reflect on their practice while working on their intimate creations. The research-creation approach is a good fit because artists not only hold specific knowledge related to their practice, but they also generate knowledge as innovators and contribute to contemporary music through the development of novel forms of artistic expression in performance and notation. By creating an inference space to enquire about our sonic perceptions during different points of the creative process it becomes possible to investigate how singular moments may impact the learning process and final

compositions. Through the creation of three collaborative scores, informed by each participant's enactive experiences (such examples throughout this research paper are labeled Exp.) and correspondences (labeled Corr.), we can strive to enhance tacit knowledge structures that may assist experimentation within equitable artistic milieus while identifying specific expectations and functions of self-efficacy that make experiential learning possible. Towards the end of the project each participant was tasked with completing an exit interview and write-up that reflected on their collaboration. The following is a brief summary of each participant's contributions to the project.

Composer-performer Collaborative Summary

Jeanne Côté and Pedram Diba, Embodiment and Intimate Space

Jeanne Côté (violin) and Pedram Diba (composer) traded two very distinct sonic experiences during the first two weeks of the project. These initial exchanges helped them share experiences learned prior to beginning the project, while developing intent via improvisation before starting their collaborative composition process. Pedram recorded the sound of heavy rainfall (Exp. #1: Pedram). Pedram noted that this recording led him to experiment with the sound of a coin spinning on a tabletop, which he felt was much more satisfying (Exp. #2: Pedram). Jeanne was carrying out experiments of her own. She recorded the sound of hot air squeaking through the fissures of pancake batter (Exp. #1: Jeanne), later imitating the sounds on her violin (Exp. #2: Jeanne). Pedram then began to experiment with audio equalization (EQ) on both of his recordings in an attempt to "take out the background noise" (Corr. #1: Jeanne and Pedram). This experimentation aligned with the concept of space for Pedram. He was also interested in the perceived gestural quality of the coin. He used a digital audio workstation called Reaper to add a gestural trajectory to the rotative sound of the coin. Finding this very interesting,

he noted the listener can follow the discourse for two levels of rotation. According to him, all these experimentations aligned with the idea of *spectromorphology* — a term coined by Denis Smalley to describe how a perceived sonic footprint manifests itself in time, usually electroacoustic in nature (Smalley, 1986). Thus, Pedram's creative motivation became sonic space.

Influenced by *Antinoo* (1999) by Francesco Filidei (Magalhães, 1970) and binaural technology, the duo focused on the idea of perceiving sound from the point of view of the performer, and they started to think about ways personal, "human born" sounds could be transferred to a listener (Corr. #2: Jeanne and Pedram). Jeanne used the binaural microphones to record the movement of the violin (Exp. #3: Jeanne) and herself bowing her own hair (Exp. #4: Jeanne). The pair became focused on a theme of intimacy in enclosed spaces. They were interested in sounds that could be translated using binaural microphones—in other words, sounds that "put you in someone else's body." The duo combined the concepts of embodiment and intimate space into their collaborative composition *As Close as Breath.*

Berk Schneider and Sang Song, Sonic Memory in Spatial Environments

Sang Song (composer) and myself (trombone) decided to focus on the theoretical concept of autobiographical memory instead of working directly with the sounds we sampled (Corr. #1: Berk and Sang; Exp. #1: Berk). Sang shared his initial understanding of flashbulb memory, describing how active emotional valences associated with collective events, such as the 9/11 terrorist attack, allowed individuals to not only remember the main event, but the relatively insignificant 'side-events' which occurred synchronously. I took these concepts and decided to freely improvise using both ear-hook binaural and stereo microphones (Exp. #2: Berk — binaural; Exp. #2: Berk — stereo; Exp. #3: Berk — binaural**;** Exp. #3: Berk — stereo**)**. We

experimented with the binaural microphones in outdoor spaces. It was determined that my movements through space likely impacted Sang's representation or memory of the holistic features of the acoustic environment (Exp. #4: Berk; Exp. #4: Sang; Exp. #4: Video — stereo).

In post-reflection, Sang connects the seemingly implicit sounds augmented by the binaural samples to side-events. He describes these peripheral memories as "very mundane things that are not directly related to [an] event itself, and you retain [them]. . . what seems insignificant can be memorized as something very important. . . small things being elevated to a memorable thing" (Corr. #2: Berk and Sang). One particularly salient sonic memory in which Sang recalled falling acorns near his family's village was (Corr. #3: Berk and Sang) especially powerful when read aloud while listening to his percussive binaural improvisations (Exp. #1: Sang). It was interesting to note the funds of compositional knowledge that Sang was drawing from. Sang and I became interested in two different remembrances of a Grimm Brothers' fairy tale (Corr. #4: Berk and Sang). We continued our discussions of memory in text, sound, and space, composing a work entitled *Anura*.

Peter Ko and Tiange Zhou, Poetic Fragility and Private Experience

Peter Ko (cello) and Tiange Zhou (composer) took an experiential stance towards technology in their first two weeks of collaboration. Tiange sent a few audiovisual samples to Peter, highlighting her trip from the United States to Germany. One sample included the roaring sounds of a jet plane from inside the cabin (Exp. #1: Tiange) and another featured the pastoral sounds of urban Germany (Exp. #2: Tiange). In the midst of the COVID-19 epidemic, Tiange noted that these contrasting experiences held a certain holistic fragility in her mind. She notes that she "realized, you know, [this] sort of system is very fragile. . . how could things we suppose

are strong, also [be] fragile, so the [fragility] of the sound itself [is focused upon]" (Corr. #1: Peter and Tiange).

This conversation inspired Peter to demonstrate what he perceived to be "fragile-stasis" by recording three variations of ponticello (Exp. #1; #2; #3: Peter). After receiving Peter's *sul ponticello* samples, Tiange started "trying to translate" his "fragile sounds into notation" by filtering out what she perceived as the fundamentals, leaving only the skeletal overtones (Corr. #2: Peter and Tiange). For Peter, Tiange's "little filtering was actually quite interesting because it reflected a little closer to what I was hearing under my ear." Peter noted that perhaps his stereo recording device captured the fundamentals more strongly, as compared to what he was hearing from his vantage point with binaurals—closer to the cello (Exp. #4: Peter). The pair developed this concept of poetic fragility into an open score for solo cello entitled *To Become.*

Four Strategic Lenses

In MAP, binaural technology was used as a tool for meta-learning, scaffolded by four strategic lenses that amplified the functions of self-efficacy during musical creation: (1) a musician's individual relationship with musical instruments and enactive mastery experience; (2) a self-reflective binaural approach to the creative process alongside the assetization of external and internal stimuli; (3) technology as a device for tacit knowledge exchange, improvisation, and empathy; and (4) attentive memory and intention via notation. All four lenses helped refine each duo's collaborative motivation, goals, learning outcomes, modeling, and final performance. Furthermore, the musicians utilized all four functions of self-efficacy to accomplish varying tasks during the creative learning process.

I. A Musician's Individual Relationship with Musical Instruments and Enactive Mastery Experience

Ultimately, binaural technology changed the way each musician listened to their instruments, impacting performance. Over the course of the project, our experience together was an opportunity to investigate how we identify different ways of knowing within our musical practice. One of the project's goals was to discover how the development of particular performance experiences facilitates particular interactions with musical instruments via improvised perception-action coupling—that is, how one's behavior is regulated by one's perception and action within an environment. As mentioned previously, perception-action coupling is important for musical learning, since after long-term musical training, movements and intended sounds become strongly associated with each other.

To see how this action-relevant information is developed and used to regulate movement, we can examine Jeanne and Pedram's experiment with intimate gestures. Pedram's interest in "spectromorphology" was combined with Jeanne's interest in the musical mimicry of inanimate objects within her personal space. Both experiences derived from sensory experience in that the knowledge both musicians gained from interpreting how "certain movements affect certain perceptions, along with the knowledge of the environmental regularities that govern such a relationship" (Goldman, 2016, p. 11) (i.e., the structure of the instrument, inanimate object, and acoustics) allowed them to approach the production of spatialized timbre through fluid gestures, eventually adapting them for the violin. Interestingly, this movement-oriented approach provided more than a method for Jeanne and Pedram to interact with each other and their environment: it also changed the way they perceived their own actions and the instruments they used as interfaces to execute movements to produce sound during performance.

It was noted by Pedram and Jeanne, for example, that after reflecting on their binaural recordings, they could hear a clear timbral distinction between the sounds of Jeanne bowing her hair and rubbing her fingers on the frame and body of the violin (Exp. #3: Jeanne). These otherwise "white noises" would have been indistinguishable in most acoustic spaces with stereo microphones, but they retained their distinct timbres after closer inspection with binaural microphones. Furthermore, the timbral difference between tapping the strings with the wooden part of the bow (*col legno, battuto e tratto*, Italian for "with the wood [being hit]")—as opposed to different kinds of *pizzicato* (plucking the strings with the fingers)—could be heard clearly with the binaural microphones (Exp. #5: Jeanne). Breathing sounds and extended techniques behind the bridge also carried distinct timbral qualities (Exp. #6: Jeanne) when compared to traditional stereo recordings:

> Recording so close to the musician allowed us to capture very delicate and naturally quiet sounds. Besides exploring mechanical sounds, I investigated various techniques like rubbing the strings against my hair, sliding my hands over the violin and blowing into the f-holes (Write-up: Jeanne).

Because of Jeanne's newfound awareness of timbral space, the physicality and general compositional approach to violin changed for Pedram. This was precisely because of the subtle timbres, which had been made more audible by the binaural recordings (Interview: Pedram). Their decision to explore these sounds in an anechoic chamber furthered the violin's timbral potential within an intimate space:

> The first goal was to record various soft and delicate sounds on the violin that we had previously decided on. . . The space in the anechoic chamber allowed for these sounds to be captured without any sound coming from the outside of the performer's intimate space (Write-up: Pedram).

Jeanne confirms the impact of binaural listening within the anechoic chamber on her practice:

> This silent room allowed us to collect samples of 'pure' timbres without the interference of any other noises… This research project has led me to reflect more specifically on my own instrument's timbre, and its variants, pertaining to my own perception and spatial positioning (Write-up: Jeanne).

According to Jeanne, "three gestures produced results unique to the performer (hair, skin, breath), which is why my colleague and I called them "intimate sounds." This formulation of knowledge and the way it enabled the duo's behavior when it came to composing a spatialized work for violin is strongly intertwined with the concept of 'sonic boundary objects' they wished to make visible. It also changed the way they perceived success or failure of past experiences since more homogeneous understandings of how sounds produced by violin had to be reinterpreted in the context of an intimate space alongside intimate gestures driven by Jeanne's own perception and spatial positioning. This idea contributed to stronger efficacy expectations while giving her a greater sense of agency during the act of creation.

Similarly, the intimacy of the cello's timbre in space, specifically its overtones, were observed by Peter and Tiange with binaural technology. Something that surprised Peter was the perceptual qualities of *sul ponticello,* a technique in which the bow is kept near the bridge of the cello, thus "subverting the balance of overtones in the sound" by bringing out the "higher overtones of the fundamental'' pitch (Exp. #1; #2; #3: Peter). Peter found that the timbre of this extended technique would sound very different depending on the listener's distance from the cello. During these *sul ponticello* experiments, Peter used his head as an equalizer (EQ) in order to balance the sounds he heard around him. When turning to his right the lower frequency overtones were more audible and left the higher frequencies more abundant—C, G, D, and A open strings. He developed a hypothesis that there would be "some sort of progression in terms of the EQ of the binaurals" (e.g., a panning of sound from left for the C string to right for the A string), but this turned out not to be the case. He then recorded himself with the binaural

microphones and video at the same time (Exp. #4: Peter). To his surprise, Peter noticed that he had deeply ingrained habits in which he would slightly tilt his head in relation to the cello, ultimately changing the way in which he heard the overtones of each fundamental pitch. He confirmed this by listening to each binaural ear-hook microphone individually (i.e. left and right ears), noticing that small "transients, noises, chiffs" such as sudden, short-lived bursts of upper harmonics in each cello string were sounding slightly differently, not only based on his cello technique, but on the position of his head: "I want to be able to hear myself and I want to be able to hear myself clearly so I position myself so I can hear in a balanced, clear way" (Interview: Peter). The sounds resulting from Peter moving his head can be heard thirty seconds into his binaural recording of *To Become*. The realization of these subtle bodily movements reinforce cognitive principles that value full body engagement during the creative process. Because of this, Peter was able to balance his *internal resonance* (i.e. personal perception of body movement) in relation to his *external resonance* (acoustic environment). His relationship with the acoustic space and Tiange's differing auditory understanding of his higher overtones assisted in modifying his performance techniques, making them more nuanced and dynamic, ultimately elevating their music to new heights.

This intimate experimentation with timbre, that of Peter's *sul ponticello* and Jeanne's submission to the visceral noise pallet of the violin in the anechoic chamber, was complimented by my binaural observations related to sonic directionality on the trombone. For instance, Jeanne's statement that "playing for my own ears turned out to be quite a challenge. Among other things, I had to resist the impulse to project far into the hall, which is normally a concern of mine" was similar to my initial reaction after listening to my first-person binaural recordings of the trombone: "everything was muffled, I felt like I was under water when I was listening to

these binaural recordings. . . I wish I could extend my ears outside of my body. . . biologically adapt!" (Corr. #5: Berk and Sang). These sentiments, which were shared amongst all performance participants yet yielded different reactions, suggest ingrained performance habits that favor projecting sound outward to an audience. A critical understanding of what is seen as a "successful" or "unsuccessful" performance approach in the context of differing acoustic environments and a common measurement of musicality during performance.

For example, the awareness of sonic projection was complemented by involuntary or mechanical sounds made by each instrument. Some instrumental sounds were not 'projected' into a traditional stereo recording, but were otherwise audible with binaurality:

> Given the close placement of the mics, these sounds came through so clearly on the playback it made me want to refine my playing in order to eliminate them. . . In a creative-research context such as this, it seemed wiser to take the time to explore these mechanical sounds than to work on polishing my sound, as I would for a concert performance. Our interest in these kinds of sounds led us to seek out others that might be produced in the same space (Write-up: Jeanne).

Peter also became more aware of the smaller "fragile nuanced parts of the sounds" that he gravitated towards, very much like Jeanne; however, interestingly, the "daily sounds" or environmental noise in his recordings were perceived as interruptions to his musical "meditation" (Interview: Peter). Peter goes on to say that "listening to binaural recordings made me really understand the importance of spatialization in terms of how we perceive timbre, how distance can change the character of a sound as certain transients of the sounds disappear after a certain distance."

Similar observations were made by Sang and I; however, because of the trombone's innate sonic directionality, its reverberant quality in acoustic space, and lack thereof suitable recording spaces during the evolving Covid pandemic, we embraced environmental noise over

softer, “intimate” or “fragile” sounds, utilizing the binaural microphones in San Diego’s city parks. This initial experimentation in acoustic space soon took turns in unexpected directions. While reviewing the recordings, we began noticing how the sound of the trombone, once the primary sonic gesture of intrigue, was fading into the background (Exp. #4: Berk; Exp. #4: Sang; Exp. #4: Sang with video, stereo). This was striking for Sang because he realized he was not listening to his memories per se, but a representative smörgåsbord of external stimuli that had allowed him to craft his memories (Corr. #1: Group Meeting):

> Listening to the recordings made during that al fresco recording session afterwards. . . turned out to be revelatory: the binaural recordings so vividly captured everything that I either ignored or was simply unaware of during the recording session that it prompted me to question the role of memory in such a context (Write-up: Sang).

I also “found that the ear-hook binaural microphones were actually much more effective when used to record large soundscapes rather than the trombone sound alone,” revisiting memories in which “rainstorms and early morning strolls. . . [with] waking birds were captured beautifully.” To me, these sonic time capsules, as I might call them, were very special in that my movement through space became the focal point, rather than the sound objects moving around me.

Thus, how the trombone’s timbres could be perceived differently—e.g., a timbral “dullness” or “brightness” based on the acoustic space the trombone inhabited, its directionality/movement in that space, and how it was recorded via technology—became important aspects in our collaborative efforts. The effect of space on the trombone’s timbre can be heard clearly in my early indoor improvisations (Exp. #2: Berk — binaural; Exp. #2: Berk — stereo); Exp. #3: Berk — binaural**;** Exp. #3: Berk — stereo) and outdoor park recordings (Exp. #4: Berk; Exp. #4: Sang; Exp. #4 with Video — stereo). In both environments, sounds can be heard differently, independent of the microphones being used, suggesting that the environment a

performer inhabits has a deep impact on the timbral perception of their instruments and surroundings.

These interactions during the MAP project present situations in which improvisational music may stress interdependent forms of context-oriented attention during enactive mastery experience. They highlight that listening habits are not permanent, and that goal-direction can be restored by several environmental manipulations, including exposure to unexpected reinforcers or context change. Habits are more context-dependent than goal-directed actions and we can use binaural technology to prime parts of our unconscious mind to traverse portions of creative tasks, essentially switching on and off a state of *attunement* with specific learning tasks during musical performance. From a cognitive perspective, participants who were able to quickly adjust their intention or motivation via attention towards tasks within a specific sonic and social context developed a high sense of self-efficacy during the act of creation. The experiences show that a roadmap of intent can be discovered through the act of improvising with peers, musical instruments, and technology thus fulfilling the andragogical premise that musicians self-direct themselves based on prior interests so that they can become motivated to learn, while dismantling deeply rooted anxieties, behaviors, and beliefs associated with playing musical instruments that may otherwise inhibit transformational growth.

II. A Self-reflective Binaural Approach to the Creative Process: Assetization of External and Internal Stimuli

Binaural recording technology changed the way participants created music by giving them a chance to reflect on their individual and joint perceptions during collaboration. Two factors contributed to this outcome:

a) There was time/space to think and perceive before responding or reacting in real-time (we could call this an unavoidable deep listening exercise).

b) The collaborators had the opportunity to re-evaluate past interactions with other participants by sharing various documents on the Google Drive (Schneider et al., 2021), which enabled the participants to return to points where communication had been lost, if necessary.

During the course of the MAP Project, our focus on *processes* rather than *products* stimulated development of problem-solving and critical thinking skills that assist reflective practice during the creative process. The key mediator in each composer-performer pair appears to have been time and space: time and space (provided by the COVID-19 pandemic) allowed the participants to reflect on embodied sonic experiences on their own as well as with their collaborators. This process provided each participant not only an inner context of their creative process, style, and technique but also possibilities for further analysis of binaurally recorded dialogues. In cases where communication between participants needed to be reviewed, this possibility gave each participant the agency to re-experience and deduct meaning from their previous interactions. One example of this was Jeanne and Pedram's sonic gestures which would have been very difficult to reproduce and orchestrate without reviewing the binaural and video recordings. Importantly, these gestures derived from these recordings. Making an effort to understand what is sensible to peers and collaborators is particularly important in this context, since the methods in which qualitative research may inform how individuals make sense of knowledge exchanges can have an immense impact on their own approach to education and self-expression.

For example, revisiting immersive first-person recordings and interviewing the participants throughout the course of the project helped us to identify significant moments of interactions between the parties ex-post through self-report, which allows the validation of data gathered through complementary approaches. The study thus provides both first-person binaural perspective and third-person binaural perspective. This setup complements a classic stereo mix and the experience from the performer's perspective, providing insight into how both perspectives might inform the creative process. Florian's mix of *Anura* alternates between the first-person binaural perspective of the trombonist, and shifts to a third-person binaural perspective of a dummy head that was wearing binaural microphones. This allows the listener to experience two sonic perspectives within one recording. Each prospective alludes to either the locus of the personality of the prince or the frog. Another example is the sonic perspective of Peter's cello bow or Berk's trombone tuning slide, which the performers acquired by attaching binaural microphones to their instruments (see Exp. #5: Peter).

Reconstructed experiences aided the creative process; Jeanne notes that Pedram had sent her spatial sounds, e.g. a penny rolling: "I was paying a lot of attention [to] the movement". . . "dividing the sound, analyzing the sound," but, for the sound of rain, "I was experiencing the space, imagining I was there, the feeling of how it looked, sensed, and the temperature." She could sometimes hear the spectromorphology of a sound, as it evolved over time, a realization that compelled her to mimic the sounds using techniques she developed on the violin (Exp. #7: Jeanne; Exp. #8, Jeanne).

For Jeanne, it was important that "the process was very creative, open, fun and liberating," as the goal to compose a work through the investigation of the binaural microphones as well as the soundworld they revealed was enriching: "In the beginning it was strange to call it

research, because it seemed like there was something missing to call it research," but in the end, "I uncovered sonic elements that I wouldn't have otherwise" (Interview: Jeanne).

Furthermore, Jeanne said that the "use of binaural technology greatly contributed to the discovery of new timbres and to a new perspective on listening" (Write-up: Jeanne). She noted that:

> When the microphones were [on] my ears, I played the role of both musician and audience member. . . Having this dual role within my own space and without an audience to act as intermediary, it felt as if I [was] working with raw material. I was therefore able to quickly adjust my playing, including my timbre, by reacting directly to the sound as I heard it (Write-up: Jeanne).

Pedram and Jeanne experimented in an anechoic chamber, concluding that "the binaural recordings of both the violin sounds and the [other] sounds captured during 15 minutes of silence (breathing, digestive sounds, swallowing and so forth), helped to intensify the intimate aspect of these sounds as well as giving a clear idea of the timbral quality of each sound for a listener listening from outside of that space" (Write-up: Pedram) (Exp. #9: Jeanne).

This realization through self-reflection on binaural recordings helped the pair understand how differences in perception of timbres ultimately enriched their creative process:

> This outside perspective from my colleague, who was interested in things I had not considered, encouraged me to further explore certain sounds. Our numerous exchanges of audio or visual material as well as our work sessions also helped me to clarify my thoughts and redefine my ideas and objectives so as to better communicate them to my peers (Write-up: Jeanne).

Self observations and correspondences such as these enabled the duo to foster a creative process, helping to develop innovative music that can be heard in their composition, *As Close as Breath*.

In contrast, Sang and my binaural experimentation in more reverberant spaces helped develop our creative intent to comment musically on a morphology of autobiographical memory, rather than on sound itself. Our solo trombone work reflects on two very contrasting perspectives within the story of the Frog Prince (Corr. #4: Berk and Sang):

> Just as our literary mechanisms adapt and change over time in accordance with artistic milieus. . .our memories of sonic form and gestures shape-shift in an effort to remain relevant (Write-up: Berk).

These adaptations are communicated and preserved via my interpretation of *Anura*, which is subsequently augmented by Florian's mixing of the two audio perspectives of the prince and the frog. This mixing reflects on the interindividual perspectives of the internal or external listener, furthering the narrative transformation of the frog into a prince:

> In Brothers Grimm's version of the Frog Prince story (entitled *Frog King or Iron Henry*), what transforms the annoyingly tenacious frog into a "prince with beautiful kind eyes" is the princess throwing the frog against the wall in a rage, with an apparent intent to kill it. What, then, happened to the kiss—and what about the modern proverb "You've got to kiss a lot of frogs before you can find your prince"? In his study on the topic, the paroemiologist and professor of German folklore Wolfgang Mieder concludes that the proverb "is not so much a reduction of the fairy tale but rather an imprecise allusion to or reminiscence of it" (Mieder, 2014). In other words, this relatively simple story of transformation has somehow been transmogrified in our collective memory (Score: *Anura*).

Interindividual differences in perception were also a source of inspiration for Peter and Tiange. These differences added "a large degree of subjectivity to timbral perception, since Tiange seemed to perceive overtone structures differently than me" [Peter] (Schneider et al., 2023). Reviewing Tiange's binaural recordings helped Peter understand what "the realities of binaural recording were" and how the recordings captured sound differently from what he heard under his ears:

> I would sometimes need to modify slightly what I did in order for the effect to come across with the recording. At the same time, it also opened my ears to certain sounds and effects that I either took for granted or filtered out, which allowed me to notice and attune to them as I played in real life (Write-up: Peter).

For Peter, the research-creation design of MAP allowed for rigorous exploration of material to learn and understand conclusions that might support an initial hypothesis or intent via memory. He notes that he already does this in his daily preparation for performances, considering all possibilities and trying to view his own work somewhat objectively. For him, a certain level of scrutiny, involving binaural microphones or a particular objective that "explores a set of questions it might evoke" was important. Research, for Peter, thus gave Tiange's composition a purpose and rigor through ownership by the artist. "Playing" with binaural microphones was the research portion of the project. The creation part of the project was the "learning process" that occurred through the "provided background" of that research. Thus, according to Peter, "in some ways [binaural technology captured the] performer's intention in a much more subtle and different way" when compared to traditional modes of sound information gathering (Schneider et al., 2023).

During the course of the project, Tiange took Peter's lead, conducting experiments of her own that utilized Peter's fragile timbres. She stated that through this experimentation with sound, it was important to avoid using all the sonic variables on a specific instrument. Instead, she decided to focus on one pitch, evaluating how it changes from different perspectives. Her reflection on Peter's recordings greatly impacted her creative process. She noted that "sonic nuances" within a single sustained pitch produced with *sul ponticello* can be so "fragile" that it becomes less important to emphasize rhythm and more important to analyze the transformation of timbre and sound from one phrase to another. She stressed that Peter should not use a metronome in this context, instead reinforcing "a self-reliant time frame." This approach gave

Peter the ability to reflect on how he perceives time while a timbre is changing, providing many different trajectories: “I provide a playground for Peter, to try different timbres and then create a certain trajectory that he is going to pursue” (Interview: Tiange).

A common consensus thus became that binaural recording technology allowed participants to bridge the gap between internal and external sensibilities or *resonances* during the act of creation. Each musician began the collaborative process with internalized biases and funds of knowledge that influenced their decision-making. Binaural technology helped promote self-regulation by internalizing expectations and beliefs in a way that optimized intrinsic motivation during and after performance accomplishments. It provided opportunities for peers to notice how fellow collaborators approached challenges over the course of the project, fostering self-reflective skills that helped minimize distractions during performance or internal attributions that might fuel misconceptions during the qualitative analysis of perceptive data. This self-regulated approach to the creation process increased individual choice and autonomy while emphasizing the musical strengths of each participant via relevant, valuable, and authentic composition and performance goals. This, in turn, enhanced social-emotional learning and reduced reactions to stressors that might otherwise stifle productive musical collaboration, making it possible to develop equitable learning environments.

III. Technology as a Device for Tacit Knowledge Exchange, Improvisation, and Empathy

Binaural technology changed the way participants shared musical knowledge. Because the interpretation of the final compositions is embedded in the creative process, it was almost as if the perceptual boundary between composer and performer had been removed. The MAP Project’s learning model was based on internal elaboration, interaction, connectivity, and shared

knowledge building, and this provided its members with several methods and tools to analyze timbral composition and performance practice. To the participants of the MAP Project, tacit knowledge exchange was as much about the technological equipment changing the way one listens as it was about the acoustic space, particular instruments, and participating musicians.

Binaural technology helped the composer-performer pairs by encouraging positive personal auditory habits in which listening intentions transformed musical practice, making these practices quasi-prescriptive. For example, through learning how to hear key differences among individual sonic perspectives, shared soundscapes, acoustic-studio recordings, personal embodied experiences, and re-constructions of remembered experiences, each duo had the opportunity to analyze timbral characteristics from a variety of perspectives. They embraced the agency of the binaural perspective and what it brought to the process, not just as a mediator, but also as a tool for creation.

Because we viewed the use of binaural audio as a tool to break down the phenomenological barrier between musical *process* and *product*, including the commonly held belief in the binary opposition between compositional practices and improvisation, where improvisation processes are seen as incomplete compositional products, the MAP Project provides evidence that movement between acts of improvisation and composition are dynamic, rather than linear. During our collaborations, performers and composers alike improvised at different points in the creation process. It is not clear, however, where these points begin and end, corroborating the view that efforts to distinguish improvisation and composition is as much a political question as one of intention and action (Lewis, 1996; Nooshin, 2003). It is our hope that, by reinforcing collective forms of agency, it will become easier to break with hierarchical norms that exacerbate the separation of creational roles within different musical milieus. Having

said this, since the intimate exchanges of the MAP project provided for a safe place to exchange ideas our focus became one of intention and action in creation. The binaural medium of exchange influenced intention and action during the creation process in that it sought to do away with myths that sow perceptions of aloofness or lack of intention during the act of improvising, replacing these notions with clear evidence of intent and action. In this sense our organized improvisatory experimentation with binaural media was structured around an intent to better understand our own actions during the creative process. This intent changed the way we composed and performed music. This is evident in the fact that each final score illuminated the intimate exchanges between the composer/composer duos. Peter and Tiange's score was left completely open, Jeanne and Pedram's score bears traces of the performer in the musical clef, and Sang's score included a fixed media version that made the performer's perspective part of the artistic intent.

The trading of improvised iterations between composer and performer duos redefines our understanding of improvisation in the context of creation. Instead of examining structural novelty, freedom, and constraints (which are contextually driven), the MAP Project seeks methods to evaluate composition as a way of knowing via shared understanding (Goldman, 2016). In our case we are curious about how our individual experiences influence our work together. This curiosity connects with how musicians transmit knowledge sonically and via scores, written theory/texts on technique, including the *dispositif* that upholds this knowledge distribution. An instrumentalist, for instance, might describe how they create a sound very differently than how they perform it, highlighting the separation of the physical apparatus required for performance and the embedded knowledge of how to maintain it. Fortunately, our

use of binaural technology allowed each participant to grasp the unexplainable, if only momentarily, via enactive perception.

This shared understanding was reinforced by common perceptions between participants. For instance, the participants all agreed that loud musicking at a distance was the least desirable way to utilize the binaural mics and that intimate sounds and soft gestures enhanced a sense of embodiment. Thus, binaural technology allowed each participant to *experience* these shared understandings rather than to rely on the interpretation of less immersive or static media such as written scores or traditional stereo audio recordings alone:

> During our initial audio/video exchange, Jeanne and I both had a shared interest in the quality of space that was captured via the binaural recordings. Considering this shared interest and the important role of space in perception of timbre, we concentrated our focus on the concept of space, more specifically, space as perceived by binaural recordings [Pedram] (Schneider et al., 2023).

This observation of the intimacy of binaural listening is echoed by Jeanne:

> Binaural recording technology allowed me to more easily understand the ideas Pedram was trying to convey. It specified the position of the subject so precisely that I felt as if I were in Pedram's shoes. . .Listening to these intimate sounds created the feeling of not only possessing the musician's ears, but of being in their skin (Write-up: Jeanne).

Furthermore, for Jeanne, it was "fun to imagine [herself] as another person" and to be "open to other's ideas." The use of the binaural devices changed the way she communicated with Pedram and other musicians. Because there was time to digest and brew on ideas before responding directly to a collaborator, Jeanne felt more empathetic towards her collaborator's viewpoints (Interview: Jeanne).

This intersubjective experience was amplified in the anechoic chamber: "by turning the lights off, we hoped to make the listening even more sensitive to the human linked sounds that

were already perceptibly amplified by the space of the anechoic chamber" (Write-up: Pedram). Pedram wanted to know if it would "be possible to translate [Jeanne's] experience to the composition" (Interview: Pedram). It was here that Jeanne noticed a certain ambiguity between the feeling of her heart beating and the literal sound of it, and the two went about trying to turn this visceral experience into a notated score for violin and electronics.

Other participants shared similar observations. Peter noted that binaurality for him "is not as much about recreating the sensation. . . hearing a sound and looking to see it, rather what I find when I'm listening to binaural audio with headphones [is that] instead, I feel different regions of my body being activated in response to the binaurality. . . I feel a response physiologically at different points [around my head]" (Corr. #2: Group Meeting). These shared observations suggest a sense of embodiment rather than mere translation of sound via technology, which allows participants to communicate tacitly through 'sonic boundary objects' in ways that would not be possible verbally.

Furthermore, for Pedram, bodily sounds gave a certain intimacy to his collaboration with Jeanne. He felt very close to her, noting how the anechoic chamber helped make specific perceptual timbral similarities and differences between the two more evident: "we can have [two] open spaces with similar reverb, but we can still differentiate the different timbres between the two" (Interview: Pedram). In the anechoic chamber, however, the perceived timbre of the violin would be less dependent on its distance from its sonic source, meaning Pedram had a window into Jeanne's intimate space. "When something is closer to us we hear higher partials and further lower partials are present" (Interview: Pedram). Thus, different perceptions of acoustic space were more translatable while using the technology:

> After sharing ideas and discussing how we thought of space, we realized that we had some similarities as well as differences in regards to this concept. Some similarities were: space as a means to communicate timbres, distance of various sound sources, and size of the room the listener is put in (Write-up: Pedram).

The main differences between Pedram's and Jeanne's perspectives included the importance of movement and counterpoint of various sounds in space for Pedram and the personal space of the performer and the sounds that were perceived within this personal space for Jeanne. In order to make these perceptual differences audible in *As Close as Breath*, the duo went a step further:

> With the help of Florian, we recorded impulse responses (Exp. #10: Jeanne) in the anechoic chamber to be able to recreate the close and intimate space of the anechoic chamber on specific sounds in the composition of the electronics portion of the piece (Write-up: Pedram).

This concept of space being translated between participants was also noted by Sang:

> I would say one of the most salient features about binaural recordings is their vividness. . . While I remain a skeptic when it comes to the use of binaural technology in concert halls, there is no doubt that binaural technology has the potential to significantly enhance composer performer communications thanks to its ability to preserve a sonic event/environment in a vivid and palpable manner (Write-up: Sang).

Emphasizing his experience while listening to Berk's binaural recordings, Sang stresses that because of the COVID situation, "we ended up turning inward" because it was not possible to interact in person and within public spaces. Sang noted, "the only options that I had were recording the things around me." This was "something I didn't really expect" and it "added another dimension" to our friendship. The "vividness" of the binaural recordings "made me feel like I was being invited into his daily life" (Interview: Sang).

Berk shared similar sentiments:

> I felt through using the technology we both developed a deeper understanding of how we operate as musical beings. Binaural technology acted not only as a bridge between our perceptions of sound, but perhaps, more importantly, served as the catalyst that helped drive our interest in memory from a theoretical/intellectual viewpoint. This connection helps me convey more meaning through his musical form which in turn, I hope, engages the listener in a meaningful way (Write-up: Berk).

Regarding his collaborative relationship with Tiange, Peter said:

> Binaural listening framed the approach of how we decided to form the concept of the piece. We felt that it represented an opportunity to explore an unusual level of perspectival intimacy in regards to sound, which involved a lot of discussion in trying to understand how the other partner perceived sound from their own perspective, rather than the typical mode of listening that focused on how sound would be projected in a more standard, "objective" sense (Write-up, Peter).

These statements suggest that binaural technology increased a feeling of connection within composer-performer pairs while playing a critical role in the development of their scores. Peter describes these moments of shared tacit knowledge as "agreements on listening." For him, there was an objective mode of listening and a subjective (binaural) mode of listening when it came to timbre descriptors: "Tiange and I hear things a little differently; I get the impression that she hears overtone structures a little differently than I do." For this reason, their collaborative process was not a stereotypical composer-performer relationship in which a performer judiciously polishes the finished score and performs it. It was more of a hands-on approach, which Peter labeled "old fashioned" or "baroque style." Peter notes, the "composition would only dictate so much, and the rest was decided by the performer's intuition, improvisation, and ornamentation." He states, "we worked a lot collaboratively like that." The binaural technology thus assisted in their endeavor to develop a lexicon of timbral vocabulary pertaining to *sul pont*.

In addition, working closely with Peter also motivated Tiange to learn a musical instrument. Her work with *sul ponticello* had made her sensitive to the many intricate layers of a

cello's timbre and she began learning subtle finger movements on the djembe, stating excitedly: "I'm sitting too much in front of the desk. I need to be more on the stage!" (Interview: Tiange).

In this context, the MAP experiments continued to unravel nonsensical divisions between composers and performers, a perceived binary relationship that has long been discussed (e.g., Foss, 1963). Binaural technology did this by providing for an immersive sonic perspective: the binaural microphones allowed musicians to embody one another, creating an experience of oneness with the collaborator. In addition, the technology itself seemed to demystify each participant's approach to the act of performing and composing, making these acts intersubjective experiences.

It is clear that this integration of musical structures at varying levels of abstraction helps train our minds to be sensitive to differences in perceptual processes. And if perception of timbre irregularities is in fact trainable via improvisation (Vuust et al., 2012), we can hypothesize that differing perceptions can also be intersubjectively learned via immersive binaural audio. This shift in perception is visible while playing back a participant's process (whether it be performance-based or compositional), the binaural audio and video material, although not carbon copies of the original experience, eliminate certain barriers between participants. We can see this metaphorically and literally when analyzing timbres within space. Sounds resonate through time, and reverberate on, off, through, and across global ecologies, creating gateways for empathy and knowledge exchange.

IV. Intention via Notation

By giving a literal voice to each participant, the MAP Project breaks down two critical areas of interpretation—sound-to-text and the return from text-to-sound—thereby clearing many

assumptions or misconceptions regarding the affect of timbre by the observed and the projected affect made by the observer.

Through this intention to communicate via binaural technology, participating composers became comfortable sharing their compositional processes as well as their musical intentions through notation. The MAP project, accordingly, can be thought of as a meta-composition in its own right, in that it derives from self-reflection on the structures of each participant's individual creative processes. The documented communication between the members of each composer-performer pair as well as among the entire group represents collections of meaningful events that we can look back on and develop an aesthetic connection with (Schneider et al., 2021).

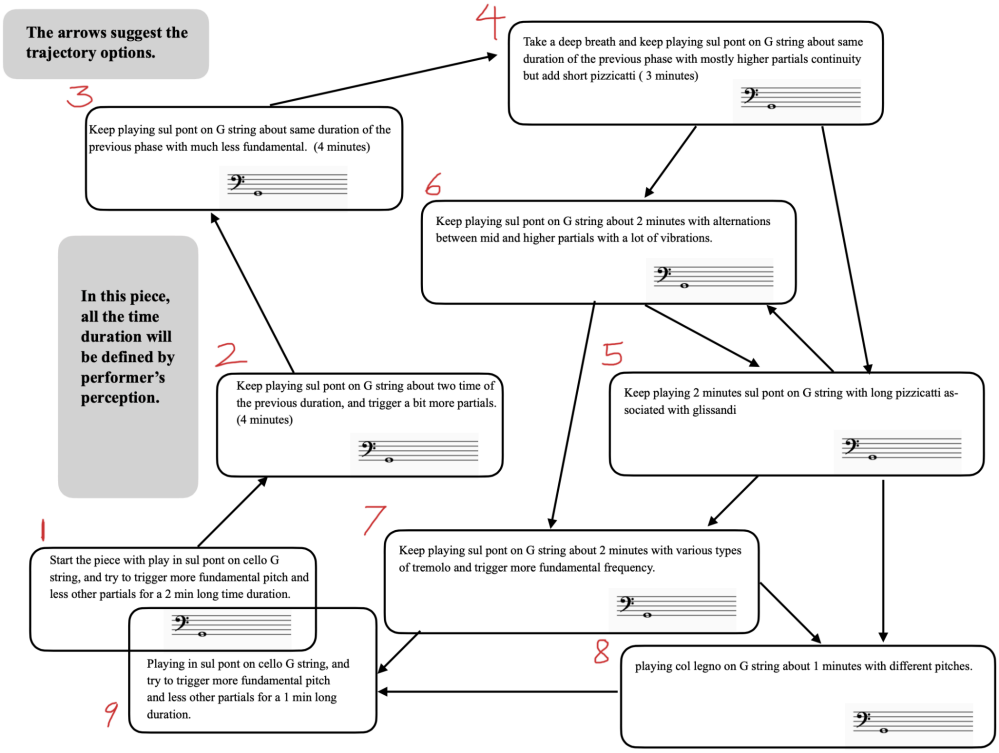
This approach changed the way participating composers addressed ownership of their final compositions. In Tiange's case, this meant listing Peter as a co-composer of their work for cello, *To Become*. For her, during their process of collaboration, Peter had contributed to core ideas of the composition, and she believed that they should share the copyright of the piece. This belief is reflected in her notation, an openly notated graphic score that puts importance on intersubjective relationships:

> Open as an adjective means allowing access, passage, or a view through space; not closed or blocked. If used as a verb, it means moving or adjusting to leaving a space allowing access and view. Therefore, it has to be comprehended into two different viewing angles. Beyond the specific composer-performer relationship in an "open" situation, an open score is an artistic format containing indeterminate aspects or dimensions, which provide opportunities to achieve the transformable morphologies of musical continuity (Write-up: Tiange).

For Tiange, this meant that Peter was a creative participant in score creation rather than merely a performer playing passively through the composer's will alone. Many aspects of Tiange's

musical experimentation are based on a flexible continuum or accumulation of music knowledge that was shared over the course of the project (Interview: Tiange). In this sense, the score of *To Become* carries a certain plasticity, adapting the traditional context of a musical score that carries its influence from a specific source (i.e., Peter's playing of a single tone) by returning to that source to be reinterpreted in an indeterminate way by the performer and their enactive perception:

> The open score composition based upon one fundamental pitch [diminishes] the parameter variables. For experimental purposes, this [approach] would help me quickly [review] the recordings from the workshopping sessions with the collaborating cello player Peter Ko to make reliable choices and organizations among all possible sonic phenomenons. . . Focusing on listening to small and fragile timbre transformations is the key to this experimental piece. Creating a time flexible zone is critical for performers to approach the sound one tends to achieve slowly. Therefore, in this piece, the duration markers depend on the performer's perception instead of the absolute time (Write-up: Tiange).



Example 3.1: *To Become by Peter Ko and Tiange Zhou*

To Become takes *sul pont*, on the open G string, to an extreme, displaying how the performer can to some extent influence which partials are brought out. The first three sections outline a progression that gradually works towards higher partials, sometimes at the complete suppression of the fundamental. Peter's ordering of the "trajectory options" are shown in red above (Ex. 3.1). The important thing to note here is that these variations in timbre are accomplished solely through the bow alone, with no influence from the left hand.

The following sections thereafter feature the left hand working in various ways to indirectly influence the *sul pont* tone, by plucking notes on other strings and influencing other points of sympathetic resonance. Furthermore, by weakening the fundamental and emphasizing higher partials with *sul pont* Peter primes the listener's ear so it can be more sensitive to the individual timbres that make up each distinct tone on the cello. We eventually return home, to a more conventional cello tone, but now with the knowledge and experience of having explored the different parts of the instrument's resonance. Much like how a chord in a string quartet is made up of many individual tones (played by four string instruments), Peter's single tones are composed of an overtone series that can be separated by a trained ear. These parts comprise its whole, thus the parts become the perceived whole.

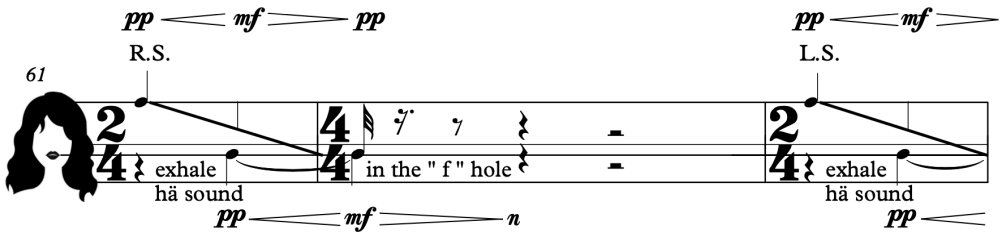
Likewise, Pedram and Jeanne felt that their collaboration during the course of the project had an immense effect on their composition, *As Close as Breath*. "To give material to a composer" they "developed a theme". "The ideas were so strong, that clearly there were things we exchanged before that were going to be there" (Interview: Jeanne). Jeanne notes that this preparation, leading into Pedram's experimental notation, made things much more accessible during performance. The collaboration process thus fed into a certain readability of the score.

Pedram's composition practices came from experimentation with electro-acoustic ideas of EQ:

> As a composer, I am always interested in [the] timbral qualities of sounds in my listening. These timbral qualities could be shaped from various parameters such as harmony, morphological shapes, energetic distribution between the components of a sound, orchestration, and so forth (Write-up: Pedram).

In an effort to explore the very subtle, soft, and delicate noises of Jeanne's violin, Pedram designed his electro-acoustic composition to reflect the intimate space of a performer:

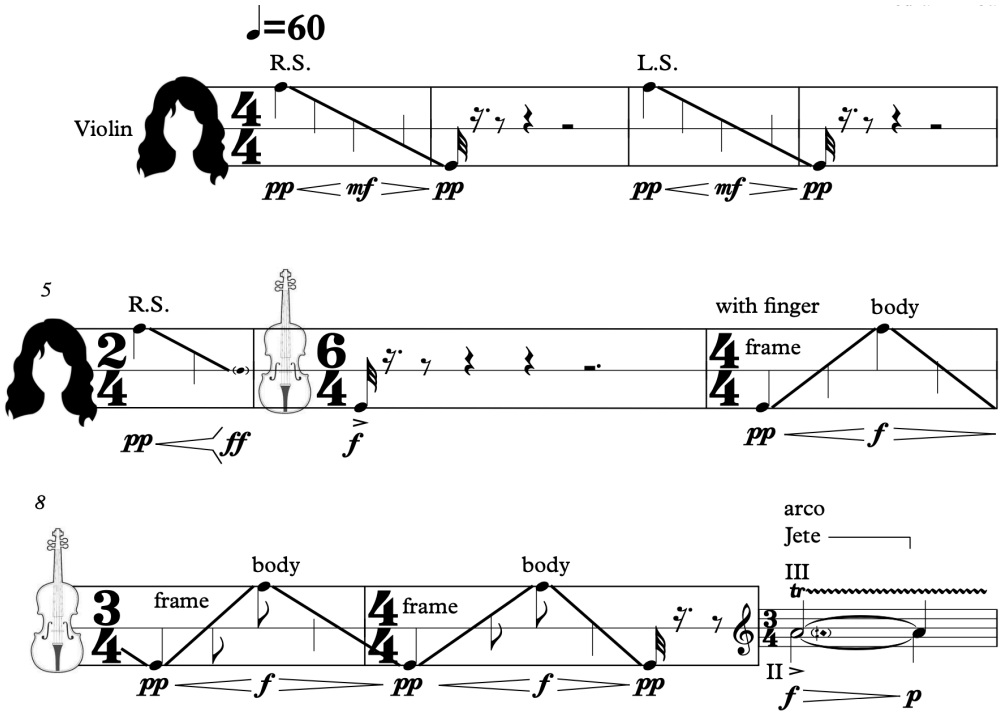
> *As Close as Breath, a piece* for amplified violin (with binaural microphones) and electronics written for this project, explores the ideas that Jeanne and I experimented with. The title of the piece refers to being so close to someone that you feel the blow of their breath. This touches on the closeness of the space as well as the intimate aspect of it. Additionally, the last thing the performer does is [breathe] into the f hole of the violin (Ex. 3.2).



Example 3.2: *As Close As Breath mm. 61-63,*

The score is for digital audio track and violin. Pedram notes that for the instrumental part, he used several sounds that the duo explored in the anechoic chamber:

> The use of binaural recordings helped me understand each sound's characters and timbral qualities. As a result, I was able to put these sounds into musical time and discourse to create a cohesive formal structure. A lot of these sounds redefine the performer's relationship with the instrument in the way that they are produced, therefore, an efficient system of notation is necessary to communicate these ideas. During one of our conversations, Jeanne explained to me that the hair has three main timbral regions (the top, the middle, and the bottom). This gave me the idea of creating a clef in the shape of a head and a 3 lined musical system where each line represents one of the timbral territories. For the other sounds explored on the body and fingerboard of the violin, I used a violin clef similar to the one Helmut Lachenmann uses in Pression (Write-up: Pedram) (Ex. 3.3).



Example 3.3: *As Close As Breath mm. 1-10*

Jeanne discusses the motivation and challenges of the notation:

> All of the conversations and ideas that emerged over the course of this research project resulted in a work that employs the musician's inhabited space, movements, and personal sounds. The piece is written for amplified violin with binaural microphones and is accompanied by a digital audio track. Some logistical adaptations had to be made; since it is impossible to wear both mics and headphones, I will have to play without hearing the track. A graphic score, a visual metronome, or both may solve this problem (Write-up: Jeanne).

The piece was later recorded using a Max patch that embedded a visual metronome into the score. Jeanne played along with this metronome, which was synchronized with the digital audio track (Figure. 3.1).

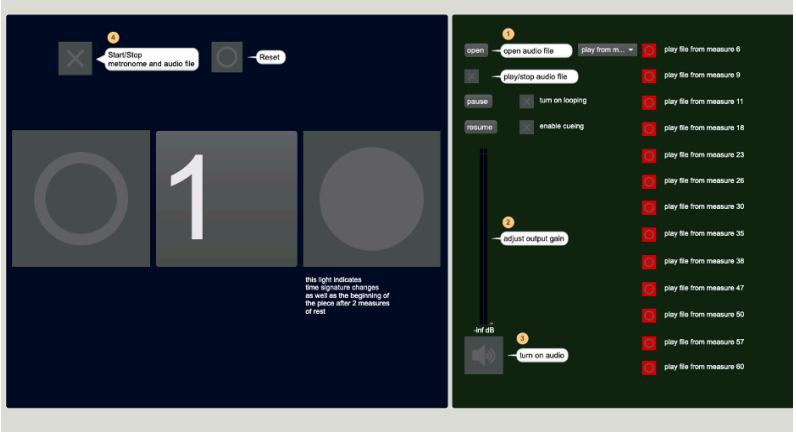


Figure 3.1: *As Close As Breath Max patch*

MAP also impacted the compositional intent of Sang's notation, but from a different trajectory. Berk reflects on how his experimentation with binaural listening may have influenced the scheme for *Anura*:

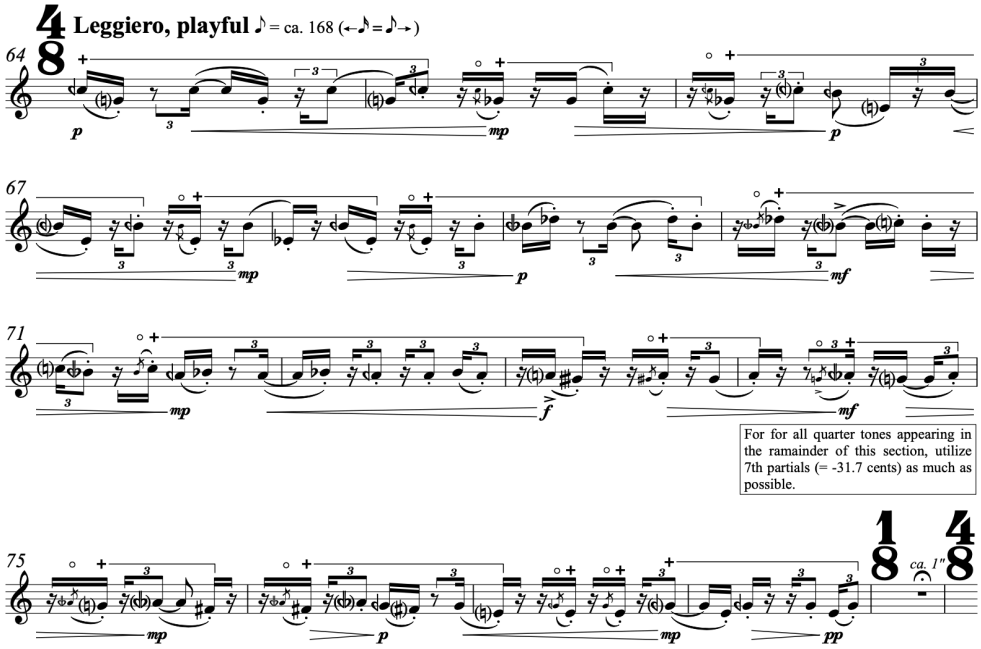
> Binaural listening made me aware of Sang's intent to communicate musical ideas about memory. . . These gestures are performed as isolated motifs in a quasi-tone painting style and thus provide for a programmatic compositional approach to the original Brothers Grimm's "The Frog King" and "Iron Heinrich" stories. . . It seems to me that Sang's compositional intent is less built from the technology itself, rather the binaural technology serves to support a premeditated-theoretical approach within his compositional practice. That is to say, we were curious about the way binaural technology [changes the way we remember]. . .Therefore, by performing the musical form as accurately as possible the concepts of memory adopted from our experiments with binaural technology take shape [within the score] (Write-up: Berk).

Describing his creative intent, Sang notes:

> In *Anura*, the frog's transformation into the prince takes the form of two musical threads that were originally fused to form the frog's annoying croaking gradually being separated as the music's transformational process unfolds. In reflection of the multiple stages of a frog's metamorphosis, this process takes place in discrete stages—and, in the end, the thread representing the frog vanishes and only the thread representing the prince is left behind (Write-up: Sang).

Sang states that within binaural recordings, you hear two "streams" or "rhythms" in either ear—our auditory cortex naturally processes a composite of both streams. However, while reflecting on binaural technology, these streams appear more separate. *Anura* is made of these two streams of sound, one stream representing the frog and the other the prince. By adopting concepts from experiments by McAdams (e.g., 1979) to bifurcate two streams of sound, Sang introduces an interesting parameter to his composition: "one potential way of realizing this piece is by assigning one stream to one ear and the other to the other ear," thus bringing out the bifurcation. This approach introduces a challenge that is difficult to realize in a concert hall setting. Sang mentions that a trombone player could play the "frog notes" in one microphone and

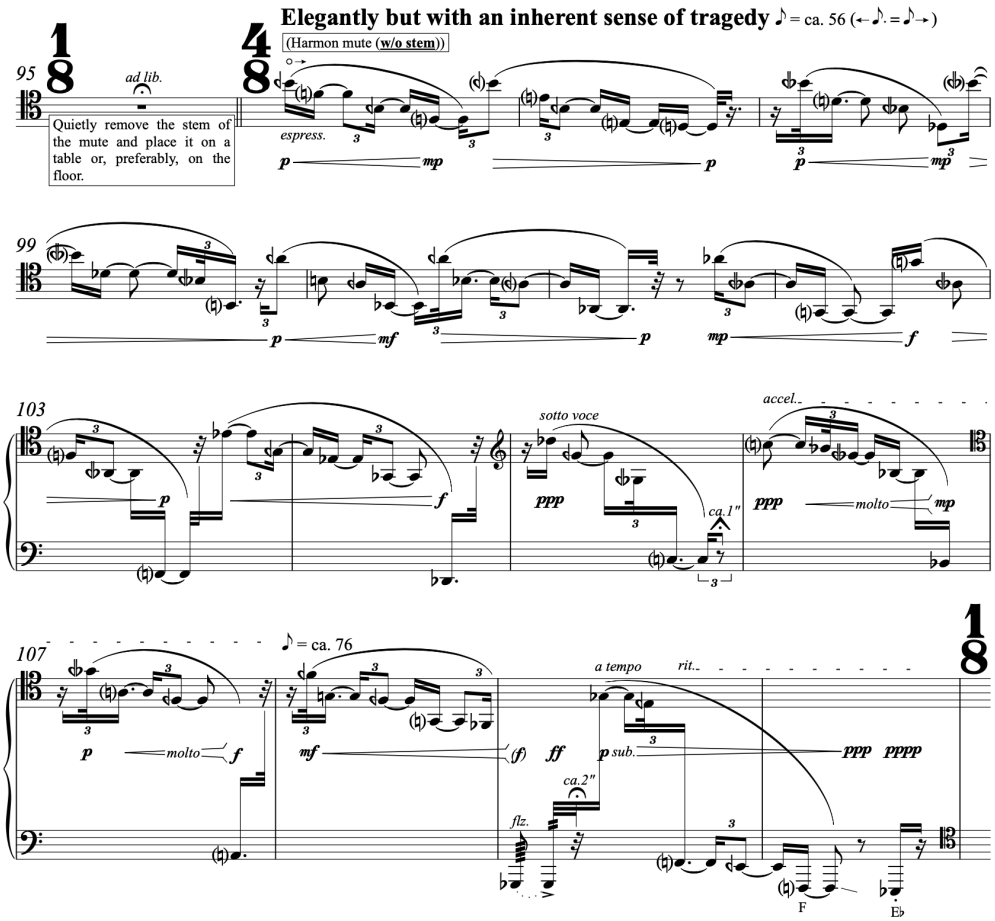
only the "prince notes" in another microphone, combining them later in a recording (Interview #2: Sang). Florian was able to artificially produce this effect within *Anura*. In the *Leggiero* section, Florian crossfades between the binaural microphones, starting from Berk's perspective, slowly shifting to an external third person perspective (Ex. 3.4).



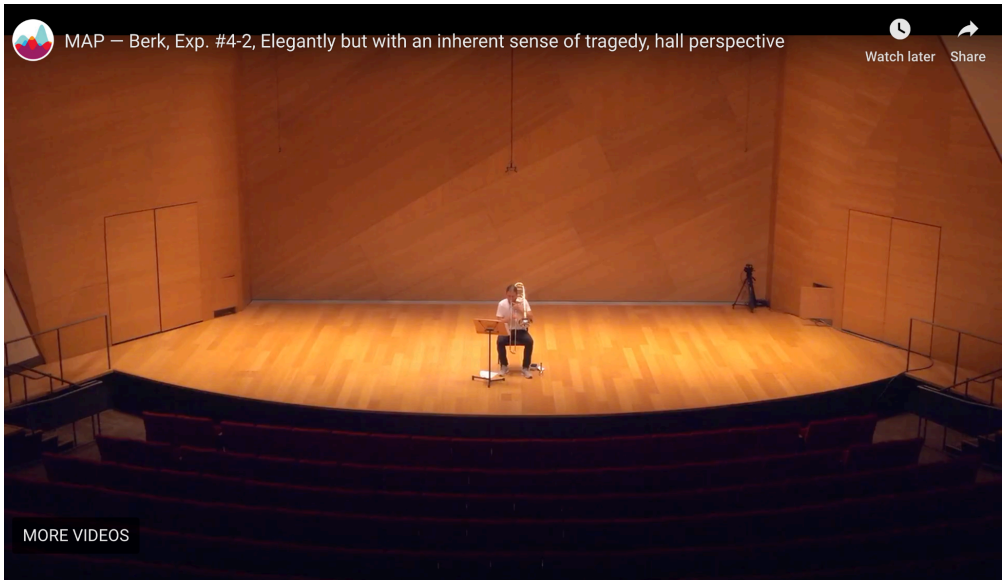
Example 3.4: *Anura mm. 64-79*

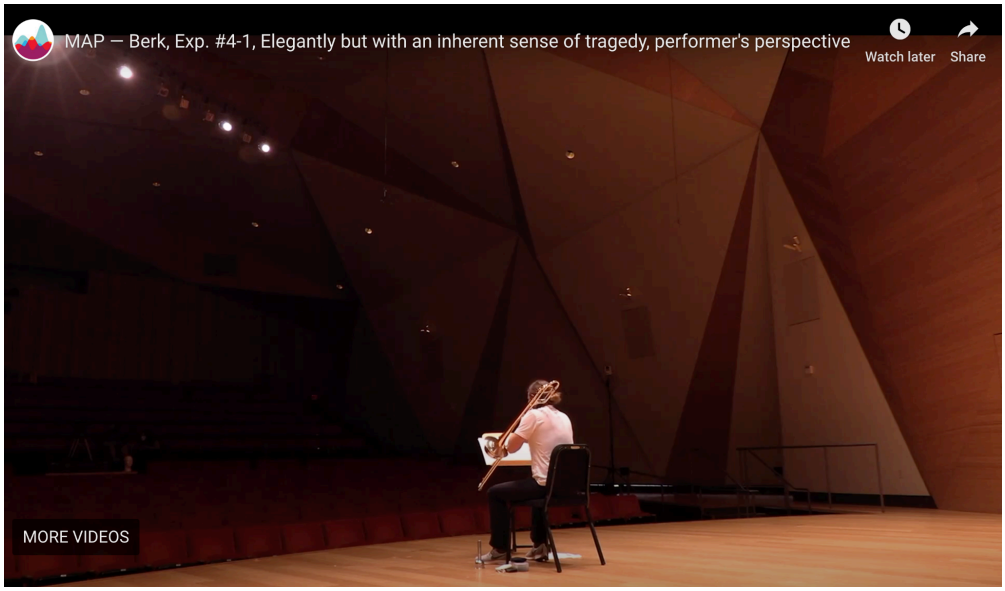
These streams gradually become more distinct throughout the composition as the frog stream disappears and the prince stream remains. The grotesque metamorphosis is represented by discrete motifs which are further illustrated by the annoying quarter-note E ♭ s (serving as the frog's initial croaking), falling microtonally, until completely pulling apart into larger, more ambiguous intervals. In the middle section of the work, however, lyrical phrases longingly pause to reflect on Meider's proverb (Meider, 204). Not only do spatial effects provide contrast between the muted microtonal upper register (frog) and more prominent diatonic low register (prince), but they also accentuate the distinct characteristics of each binaural ear-hook microphone, which capture the performer's perspective (Berk's) in addition to a listener's (third

person). Although these natural acoustical differences are apparent in Anura's *Elegantly* section, mm. 95-110 (Ex. 3.5; Exp. #5: Berk, performer perspective vs. hall perspective), this effect is even more prominent in the final *Steady* section in which the frog and prince "streams" become increasingly distinct. Florian's spatialization situates the lower stream of the prince in the forefront by the end of the piece, thus making the frog's transformation complete (Ex. 3.6).

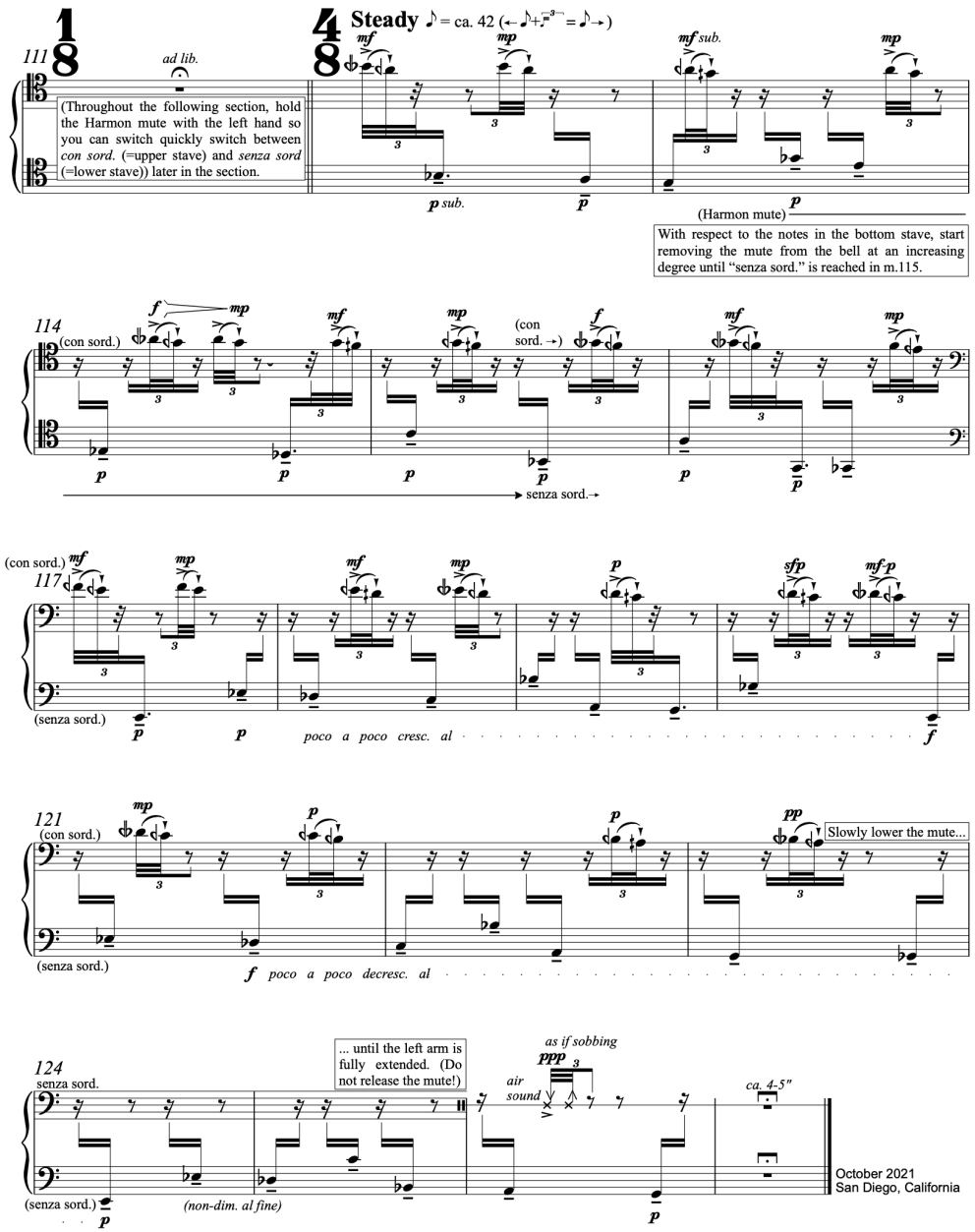


Example 3.5: *Anura mm. 95-110*





Example 3.5: *Anura mm. 95-110*



Example 3.6: *Anura mm. 112-127*

Discussion

The lens through which we perceive our listening experience profoundly molds our acquisition of knowledge. Binaural technology helped develop a self-efficacious approach to composition for each composer-performer pair by creating opportunities to investigate sounds via instrumental experimentation and sonic improvisation. The project emphasized unexpected responses to salient events, providing real-time exposure that allowed for each participant to witness and reflect upon the enactive mastery of peers while providing positive encouragement and methods for self-regulated compositional and performance practices via intent.

This phenomenon arose because the habituation of personalized auditory skills, wherein listening intentions transformed musical practice, rendered it quasi-prescriptive. The process was facilitated by quantitative audiovisual media, which aided physiological activity during arousal, making it more visible and memorable. By allowing composer-performer pairs to navigate targeted strategies of attentiveness via monitored task completion participants were able to build self-efficacious attitudes during the creation process. For example, through learning how to hear key differences between individual timbral perspectives, shared soundscapes, acoustic-studio recordings, personal embodied experiences and re-constructions of remembered experiences, each duo had the opportunity to analyze sonic characteristics from a variety of perspectives. Each participant embraced the agency of the binaural perspective and what it brought to the process, embracing it not just as a mediator but also as a tool for creation.

During the project, emphasis on collaboration and community through increased mastery-oriented feedback from peers, provided opportunities for clarification when it came to musical notation, symbols, and syntax in the context of musical creation, while refining personal coping strategies that created purpose during performance, boosting intrinsic motivation.

Drawing awareness to how peers varied demands and resources through attuned listening helped empower the participants to achieve long-term objectives via self-instruction. Furthermore, improvisatory approaches to sound creation helped facilitate engagement with and agreement on sonic information, allowing project collaborators to share experiences while acknowledging perceptual facets of the investigative research that may resonate with their peers.

This study is an effective pilot evaluation of the potentialities for ethnographic research related to music education and improvisation. Our focus on *process* rather than *products* stimulated development of problem-solving skills and critical thinking that assist reflection on past performance experiences via recordings, allowing for time and space to guide constructive asynchronous or synchronous responses to co-conceived musical material. To the participants of the MAP Project, it was as much about the technological equipment changing the way one listens as it was about *playing* with sonic space, texts, aesthetic influence, particular musical instruments, and their fellow musicians. Supplying multimodal aids and technology helped participants understand and express music from multiple perspectives without directly comparing themselves with one another, enhancing communal goal-setting, while building emotional intelligence and constructive peer-to-peer critique.

Furthermore, by demonstrating trajectories for collaborative score construction and performance strategies through a variety of media, we can use binaural audio as a tool to break down this phenomenological barrier between musical *process* and *product*, including the commonly-held belief in the binary opposition between compositional practices and improvisation where improvisation processes are seen as incomplete compositional products. This issue is made transparent by Pedram and Sang's preliminary statements in which they refer to "real" composition (see Schneider, 2021, p. 11). Ultimately, these perceptions manifest

themselves within Western values of institutionalized classical music, which can be unpacked by utilizing multiple media for sonic communication, including text, imagery, oral meetings, tables, and audiovisual material that resonate with each participant's needs and interests (Schneider et al., 2021).

This idea connects with how musicians transmit knowledge sonically and via immutable mobiles (e.g. written theory/texts on technique/musical scores), including the *dispositif* that upholds this knowledge distribution. It's likely that integration of these musical structures at varying levels of abstraction helps train our minds to be sensitive to differences in perceptual processes. We can enhance these approaches to music making by connecting our dynamic autonomous approach to music making with different tools for construction, i.e., digital audio workstations (DAW), annotated or electronic scores, and improvisatory graphic scores that enhance musical choice during the creation process. In fact, it has been shown that musicians with more improvisatory experience are more sensitive to changes in pitch, timbre, loudness, rhythm, and sound source location (Vuust et al., 2012), a conclusion we find encouraging. If perception of musical irregularities is in fact trainable via improvisation, even by exaptation, we can hypothesize that differing perceptions can also be intersubjectively learned via immersive binaural audio, increasing the autonomy of the creator's self-efficacious attitude.

MAP's foremost objective is to continue to provide ACTOR members with an outlet for creation. We believe that our metamodern era creates a moment for reflection on habits and practice amongst musicians which in turn is an opportunity for research and learning. It is our hope that as we continue to develop these tools that our binaural ethnographic work on the musician's position, her relation to the instrument and environmental acoustics and the resulting timbral relationships can be further evaluated.

Conclusion

The forms of attuned listening learned from MAP's experiments have assisted in uncovering the subtleties of creation, translation, and reproduction, while mapping them over plausible semiotic representations in composition. This has not only helped the participants to discover their own roles in musical creation, but also to sort out each musician's enigmatic courtship with the idiomatics of instrumental writing. Each participant moved fluidly between the role of composer and performer, helping to transform this traditionally dichotomous relationship into a dynamic spectrum-based model of creative exchange. In this non-hierarchical space, improvisatory methods for sound production helped foster collaborative auditory education and the training of inquisitive adult contemporary musicians. Based on the positive experiences we gathered, the study serves as an evaluation of the potentialities for binaural recordings in ethnographic research related to andrological music education and improvisation — a method to unlock the creative potential of all young adult performers and composers.

As addressed in Chapter 2, it is increasingly apparent that music improvisation holds a key to understanding dynamic interactions between performers and their environment. By sharing lived experiences via workshops (Bolter, 2020), meditations (Dempster, 2010), collaborative research (Grond & Devos, 2016; Schneider, 2021; Thorpe, 2020), and open improvisation performances (Crane, 2011), it is possible to circumvent worry while revisiting expressive sonic andragogy that engages how we feel at any given moment rather than how we assume we're *supposed* to feel. Because of this, it is more evident than ever that improvisation has an important role to play in educating adult performers (e.g. see Biasutti, 2015; Burrows, 2014). Moreover, It is entirely possible that active performers who seek knowledge outside of a unidirectional pedagogical lineage (e.g. teacher to student knowledge transmission and

reproduction) have a better chance of understanding heuristic approaches (e.g. self-investigative and relational understanding) to music learning. These approaches may help a musician become better acquainted with the recursivity of a self-efficacious driven health-status — a status that may be deemed 'positive' by the musician and the local milieu.

As a final thought, we can connect our analysis of *attention*, *habit*, and *consciousness* within the musical mind by returning to the concept of *perceptual gist*, as discussed in Chapter 2. We can think of the outskirts of our sonic perception similarly to peripheral vision, with one key distinction; music connects us more strongly with sensorial experience before being attended to conceptually. This is because the cochlear (or inner ear) is intimately situated in between neural pathways that control both sensation and perception. In order for conscious auditory perception to function our auditory system must decode information while simultaneously introducing sensory messages. Interestingly, the nonspecific neural pathways connect to the limbic cortex, impacting emotions, motivations, and vegetative functions, while the primary auditory pathway regulates alert reflexes and discrimination memory. This nonspecific order of creative thinking is what MAP makes viable.

Therefore, as noted earlier, if we consider the processing energy required for multi-tasking, it appears that *perceptual gist* offers a more diffused method for attending to the world around us. Much like a memory activation field, *perceptual gist* offers a way in which attention can travel, highlighting semi-active items in its peripheral. Dual-task studies have not yet proven that consciousness exists outside of this moving field. Therefore, it is possible that we sense something before we consciously perceive it, thus misconstruing this feeling via expectation of consciousness without attention. Nevertheless, this does not explain particularly salient events in which task orientated focus is present, but habit is not. Habitual behaviors

appear to be intentionally driven while automated behaviors are sensory driven, bridging the explicit and implicit. At some point these two memory facets may combine, creating a transcendental consciousness which is focused on a task, but no longer requires top-down executive control.

The MAP project allows for this transcendental consciousness since each participant is given adequate time to navigate a variety of musical tasks which are recorded for later review. Investing time into this schema requires a self-efficacious mindset that aids in building upon participants' funds of knowledge. This helped the participants develop autonomous motivation and intent, alongside open dialogue about modeling performance and composition tactics during the synthesizing of creative events. Perhaps most importantly, each artist was able to reflect on their own creative contributions while carrying out these processes, helping to develop autonomous confidence, but also a personal connection with their peers. Much research is still needed to support the existence of this form of consciousness and all current research is limited by our technologies. Nevertheless, observations here show that musical improvisers utilize a variety of memory models during performance which are *not* adequately explained by our present theories of consciousness. If we can understand how the brain learns to consciously attend we can better adapt within a changing world. This potential is reflected in musical improvisation which occurred during the MAP project.

Lastly, and perhaps most importantly, in regards to performance stressors and anxiety, through developing personal contingency plans and attuning oneself to *external* and *internal resonances*, each MAP musician had time to adjust their responses to environmental and cognitive stressors, reassuming a harmonious relationship with the act of performing. That is to say, a performer could anticipate what resources were needed within a specific performance

while addressing the needs of their peers. This thought can be extrapolated via DeNora's viewpoint on music therapy. She states that by ignoring alternative and "too-little theorized tacit bases of action and subjectivity — the aesthetic, expressive, and emotional dimensions" which represent a "matrix of more overtly conscious and deliberate" communication is undermined (DeNora, 2011, p. 152). These tacit "dimensions" are, by nature, the dynamic constructs that make music communicable and purposeful. Which means that, if they are eliminated, we miss out on the rich relational variables present within music performance that could aid our understanding of health and wellness outside of the medically prescribed "containers" that inform our public perception of maladaptive anxiety during the act of musical creation. Because ample opportunities existed for each participating musician to think before acting in the MAP project, the methodical recording of each compositional step served as a scaffolding technique, structuring the creation process in a way that values each participant's input, thus avoiding anxious apprehension in communication and musical performance.

Future Research

From a praxis perspective, it may even be possible to trace the qualitative connections between musician's creative behavior to developmental factors unrelated to their musical training. During the project participants met with Diana Deutsch to discuss her tritone paradox, which revealed many fascinating tendencies in how each participant heard pitch (Deutsch, 1986; Deutsch et al., 1987). We found correspondences between the pitch range of an individual's voice and their perceived peak pitch classes. In addition, connections were made to different languages and dialects in which speech patterns influence how we interpret higher or lower tones while listening to sets of tritones. These sets may outline a pitch class or 'chakra' that each participant gravitated towards based on geographical background and linguistic upbringing. Nevertheless, more investigation is needed to determine if this experiment and the data collected impacted the project.

The most interesting element, according to Diana Deutsch, was that the tendency to hear pitch class sets in different ways likely formed in early childhood and is closely tied to the speech patterns one grew up with, thus giving our collaboration a deeper socio-ontological resonance. For instance, just as our musical instruments can be tuned to resonate within an acoustic space, our neurons can be "tuned" over a lifetime of engagement with different environments. Importantly, It is not yet evident how structures such as these might connect to spatialized sound, but the tritone paradox outlines the possibilities of how quantitative perceptual data can be cross-examined with qualitative inference when it comes to experiential learning designs.

Future publications include "Timbrenauts: Creative Explorations in Timbre Space (2024)," co-authored with Yuval Adler (Adler & Schneider, Forthcoming). This project involves

the utilization of experimental designs derived from the MAP project to construct data models that guide the creation of innovative compositions for the unconventional instrumental pairing of cello and trombone. In the summer of 2023, we had the opportunity to present our preliminary data at the 6th CIRMMT-ACTOR Symposium on Orchestration Research in Strasbourg, France. In the experimental portion of this project, we ask participants to rate the similarity they perceive between samples chosen from the recorded sounds. Rather than focusing on the possibility of blends between the sounds, our approach was to choose sounds from each instrument that match 10 phenomenological categories of diverse sound production. For example, we could have chosen a sample from each instrument producing a sound which fits the category of "sustained pitch with heavy vibrato" and another pair of sounds fitting a wholly different category, such as "sustained noise with fluctuating brightness." The motivation behind this approach is twofold: 1) to map an expansive timbre space using a limited number of diverse samples; 2) to demonstrate the richness and variety inherent in these instruments' sound production potential. The former motivation is exploratory, motivated by the desire to give the composers in this project an overview map of the timbre space available to them. This data could then be used by the composers to validate their own models for the entire collection of recorded sounds. The latter motivation is connected to our hypothesis that extended instrumental techniques can cover a wide enough range of timbres that each instrument will be better visualized as overlapping regions like in a multidimensional Venn diagram, rather than single points in a timbre space. For instance, at what point does the instrumentation of a piece of music become less important than the phenomenological category of sound being performed by an artist.

Participants rated the sounds in an acoustically controlled environment at the Music Perception and Cognition Laboratory at McGill University. As they rated the 210 pairs of sounds, the participants interacted with an experimental interface (Figure 3.2).

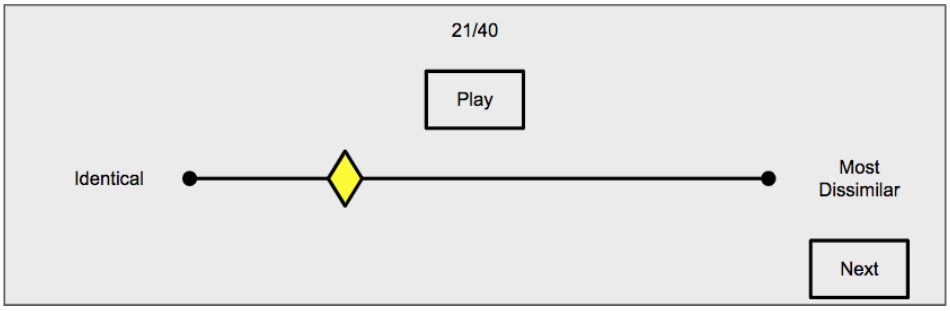


Figure 3.2: *Example interface for the similarity judgment trials*

The preliminary data is intriguing. It is clear individual perceptions of quantitative timbres can be measured while drawing the relevant connections between these perceptions and the creative work completed during MAP. Furthermore, through investigating how voluntary forms of attention on sonic events may be informed by implicit — or 'background' — semi-activation in the brain via bottom-up processing we can use binaural technology to test the processing time for the recognition of target timbres and see if these timbres can be readily ignored or attended to in the context of space using mismatch negativity (MMN). Visual and sonic paradigms already exist, but we are unaware of any study that focuses on sound and space in this way (see Czigler & Winkler, 2010; Siedenburg, 2019; Vuust et al., 2012). The goal would be to create a quasi-lexicon that organizes spatial timbre identifiers: e.g. closeness, surrounding, movement, density, depth, surface, giving composers more control over the creative parameters of spatial (dis)orientation while eliciting complex responses from the listener. At the same time, the binaural ear hook microphones would continue to help participants develop an understanding of how their perception of sound and space differs from the listener by allowing them to hear the

cello and trombone as resonating chambers (‘closeness’ to the ear of the performer) and projection devices (‘surrounding’ the listener). By cultivating the skill to anticipate perceptual sonic elements, musicians at any proficiency level can enhance their engagement with dynamic and immersive musical settings, thereby facilitating transformational learning through a self-efficacious mindset during the act of creation.

Chapter 3, is a partial representation of the material as it appears in *Musicians auditory perception (map): Listening and empathizing in the creative process*. Schneider, B. W., Grond, F., Côté, J., Diba, P., Ko, M. S. P., Song, S., Zhou, T., & Yadegari, S., Zenodo, 2023. I was the co-first author of this interactive project report and spearheaded the project.

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