UNIVERSITY OF CALIFORNIA,
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Duet for Flute and Video Game

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Integrated Composition, Improvisation, and Technology

by

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Professor Kojiro Umezaki, Chair
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DEDICATION

To

my parents, Anne and Edward Larkin

for perpetually affirming that I can be whatever I want to be when I grow up.

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FIELDS OF STUDY

Game Audio

Game Design

Human-Computer Interaction

Ludomusicology

Music Composition

Music Improvisation

Music Performance

Music Technology

ABSTRACT OF THE DISSERTATION

Duet for Flute and Video Game

by

Rebecca Larkin

Doctor of Philosophy in Integrated Composition, Improvisation, and Technology

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Professor Kojiro Umezaki, Chair

Musical improvisation and video game play are often treated as distinct practices, yet both invite participants to explore possibilities within structured environments through voluntary participation, real-time decision making, feedback, iteration, and agency. This dissertation investigates how the exploratory nature of video game play can serve as a framework for the composition and performance of improvised music through the creation and analysis of *Duet for Flute and Video Game*. In *Duet*, a live instrumentalist and an audience volunteer encounter and transform musical materials together in real time. The game player requires no prior musical training, and the instrumentalist requires no gaming experience; both learn to engage with the work through acting, listening, observing, and responding.

The dissertation argues that gameplay and improvisation do not merely exhibit parallel qualities within *Duet*, but transform one another. Gameplay foregrounds improvisation as interaction within a structured, rule-based environment, while improvisation reframes gameplay as an open-ended, expressive, and collaborative act. Game mechanics function as compositional materials that shape attention, timing, movement, coordination, and musical exchange. Together, these mechanics, affordances, and audio-visual materials form a “possibility landscape”: both the

virtual terrain through which the player moves and a conceptual field of discoverable musical actions.

This inquiry employs practice-based research and iterative design. *Duet* developed through cycles of designing, testing, performing, observing, reflecting, and revising across conferences, classrooms, demonstrations, and concert settings. The analysis draws upon creative and technical documentation, musical materials, recordings, firsthand reflection, and informal observations of participants and audiences. It informs the study of what continues to be an evolving artistic system.

INTRODUCTION

Musical improvisation and video game play are often treated as belonging to different disciplines, cultures, and performance practices. Yet both can be understood as forms of play that invite participants to explore possibilities within structured environments. Each involves rules, voluntary participation, real-time decision making, agency, and the emergence of outcomes that cannot be fully predetermined. Both also encourage iteration: participants learn through action, adapt their behavior in response to feedback, and discover new possibilities through repeated engagement. This dissertation begins from the premise that these shared qualities provide more than a useful analogy. The exploratory nature of gameplay can itself serve as a framework for the composition and performance of improvised music.

This inquiry also emerges from my own longstanding relationship with music and video games. I have participated in both since early childhood, and video game music is what first inspired me to study music composition. *Duet for Flute and Video Game* developed from my curiosity about how video games and live musical performance might be brought together as mutually shaping practices. Rather than using a game merely to accompany, illustrate, or visualize a musical performance, I sought to create a system in which gameplay could facilitate musical interaction. Within *Duet*, a live flutist and an audience volunteer encounter and transform musical material together in real time. The player does not need prior musical training, and the flutist does not need gaming experience. Both participants learn how to engage with the work by acting, listening, observing, and responding.

The central design challenge was to create a compelling music-making environment that could accommodate participants with different kinds and levels of experience. This required composing not only musical notes and prerecorded materials, but also the conditions through

which participants encounter, discover, activate, and transform those materials through play. Within what I describe as a "possibility landscape," the rules of interaction are not communicated exclusively through verbal or written explanation. Instead, players discover how to interface with the system and the performance through trial, error, feedback, and continued exploration. The system must remain approachable enough for newcomers while offering sufficient depth for participants with greater musical or gaming experience. Ideally, it meets each participant where they are and reveals further possibilities as their familiarity grows.

Underlying this work is an investment in presence and connection. I create interactive systems to invite people to make something together, and *Duet* examines how such systems can support shared attention and co-creative experience. By bringing musical improvisation and video game play into direct interaction, the project considers how the act of playing a game and the act of playing an instrument can become complementary forms of creative participation. In recognizing their common foundation in play, this dissertation proposes new possibilities for interactive performance and for the design of systems that facilitate collaborative creation.

At the center of this dissertation is the challenge of facilitating meaningful musical dialogue between two participants who enter the performance with different forms of experience. The live acoustic musician is already familiar with the techniques and expressive possibilities of their instrument. The volunteer game player, by contrast, encounters the interactive system as a new instrument—one that they may approach with extensive gaming or musical experience, or with little experience in either area. Regardless of their background, they must learn how to participate in the work while the performance is already underway.

Meaningful participation requires more than giving the player the ability to trigger a sound. The opportunities and methods for engagement must be perceptible enough for the player

to discover, and their actions must produce consequences that they can recognize as musically significant. Within *Duet*, agency arises when participants' decisions matter: when they can influence the system, its audio-visual environment, and one another in real time. The system must therefore support expression at multiple levels of familiarity and skill, allowing a newcomer to contribute immediately while revealing further possibilities through continued experimentation.

This creates a productive tension between immediate engagement and complete ambiguity. The system must communicate enough for participants to begin acting without relying entirely on prior training, extensive explanation, or rehearsal. At the same time, it must resist reducing the experience to a set of obvious instructions or predetermined outcomes. As the composer and designer, I guide and structure the circumstances of interaction, but the participants must retain the freedom to interpret those conditions, pursue their curiosity, explore the environment, and discover the opportunities they find most engaging. The resulting performance emerges from the relationship among designed constraints, individual decisions, and the participants' responsiveness to one another.

The central question guiding this inquiry is how the exploratory nature of video game play can serve as a framework for the composition and performance of improvised music. More specifically, the project considers how game mechanics can facilitate meaningful musical dialogue between participants with different forms of experience; how a game player can discover the system's rules and musical possibilities through experimentation and audio-visual feedback; how the environment can support immediate participation while revealing greater expressive depth; and how gameplay can facilitate shared attention, reciprocal influence, and co-creative experience.

In response to these questions, this dissertation argues that *Duet* does not merely illustrate preexisting similarities between improvised musical performance and video game play. Instead, it creates a performance space in which each practice transforms the other. Gameplay reframes musical improvisation by foregrounding its interaction with a structured, rule-based environment, while improvisation reframes gameplay as an open-ended, expressive, and collaborative act. The project does not equate these practices or erase the differences between them. Rather, it brings them into a reciprocal relationship through which the identities and actions of musician and game player are repositioned within a shared improvisational space.

Within this space, game mechanics function as compositional materials that shape experience, direct attention, and encourage listening. The performers respond not only to one another and to predetermined musical materials, but also to the mechanics and affordances of the interactive environment. These affordances operate as invitations rather than instructions, offering possibilities for rhythm, timing, movement, coordination, and call-and-response exchange without prescribing exactly how those possibilities must be used. Together, they form a possibility landscape: both the literal terrain through which the game player moves and a conceptual field of musical actions distributed throughout the environment. Composing *Duet* therefore involves designing not only sounds, notes, and musical structures, but also the circumstances through which performers discover when, where, and how musical actions become available.

The design of this landscape allows participants to engage expressively at different levels of familiarity and skill. Traversing the environment is sufficient to establish a basic musical interaction, while additional mechanics offer greater expressive depth to players who discover and develop fluency with them. Clear feedback makes the consequences of participants' actions

perceptible, but the system retains enough ambiguity for them to interpret its invitations, develop their own strategies, and pursue their curiosity. The interactive system does not independently create the resulting performance. It facilitates a real-time dialogue in which the flutist and game player listen, play, and connect through a shared environment. When both participants accept the work's affordances and constraints and become curious within them, their decisions can produce shared attention, reciprocal influence, and a co-creative musical experience that cannot be fully predetermined or repeated.

To examine this reciprocal transformation of improvisation and gameplay, this dissertation brings improvisation studies into dialogue with game studies, game design, game audio scholarship, and human-computer interaction. No single one of these fields fully accounts for *Duet*, which operates simultaneously as a musical composition, a game system, a performance environment, and a site of human interaction. Music scholarship provides frameworks for understanding performance, improvisation, interpersonal relation, composition, and the evolution of creative practice. Scholarship on games and interactive systems provides complementary perspectives on rules, mechanics, design, agency, affordances, and the ways users learn through interaction. Bringing these areas together makes it possible not only to apply concepts from game design to improvised musical performance, but also to consider how scholarship on improvisation can reshape understandings of gameplay.

Play, as explored in Johan Huizinga's *Homo Ludens*, provides the broad conceptual foundation for this interdisciplinary exchange.[1] Both musical improvisation and gameplay are voluntary practices in which participants accept particular conditions, encounter constraints and possibilities, and create meaning through their actions. The *magic circle*, the framework as

[1] Johan Huizinga, *Homo Ludens: A Study of the Play-Element in Culture* (Boston: Beacon Press, 1955).

codified in game studies by Katie Salen and Eric Zimmerman, helps explain how participants enter into, accept, and organize themselves within these temporary frames of play.[2] Once inside that frame, affordances describe the possibilities for action that participants perceive and discover, while agency concerns whether the decisions they make become meaningful and consequential. Improvisation accounts for the real-time composition, interpersonal negotiation, emergence, and continual evolution of the resulting performance. Mihaly Csikszentmihalyi's notion of *flow* further illuminates the relationship between challenge and ability as participants become increasingly absorbed in the work.[3] Together, these concepts describe a progression through which participants voluntarily enter the performance frame, perceive opportunities for action, make consequential decisions, and respond to feedback from the system and from one another. As their understanding and involvement deepen, these interactions may support flow, shared attention, and co-creative experience.

These theoretical concepts are examined through practice-based research and iterative design. The creation of *Duet* functions as research because questions of real-time interaction can only be fully investigated once the work enters public performance and demonstration across a variety of contexts. Within this process, I occupy overlapping roles as composer, designer, developer, flutist, performer, researcher, and observer. My analysis consequently draws upon firsthand creative knowledge, technical documentation, design documents, musical materials, reflective writing, observations from playtests and performances, audio-visual recordings, and informal comments from volunteers and audience members.

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[2] Katie Salen and Eric Zimmerman, *Rules of Play: Game Design Fundamentals* (Cambridge, MA: MIT Press, 2004).

[3] Mihaly Csikszentmihalyi, *Beyond Boredom and Anxiety: Experiencing Flow in Work and Play* (San Francisco: Jossey-Bass, 1975).

Duet developed through recurring cycles of designing, testing, performing, observing, reflecting, and revising. Each iteration responded to playtesting and performance experiences, artistic questions, technical challenges, and design goals, as well as questions and perspectives raised by audiences. Some design concerns became apparent only after the work entered performance: when a volunteer encountered the system for the first time, when the project appeared in a different setting, or when participants interacted with its possibilities in unexpected ways. These observations do not constitute formal user research, establish universal patterns of player behavior, or represent the experience of every participant. Rather, they help identify recurring patterns, unexpected interactions, design problems, and questions for further study.

Across these cycles, audio-visual clarity emerged as a central design requirement. The system's affordances and musical possibilities must be perceptible and discoverable if participants are to act upon them meaningfully. At the same time, clarity must remain balanced with exploration, freedom with constraint, and explanation with discovery. This balance enables newcomers to establish an immediate musical connection while preserving opportunities for curiosity, interpretation, creative development, and increasingly evolving engagement.

Accordingly, this dissertation is best understood as an argument developed through the creation and analysis of *Duet* as one evolving artistic project. It does not attempt to provide a comprehensive history of musical games, a complete survey of interactive music, or a universal theory of improvisation. Instead, it examines the designed system, its development, its performances, and the interactions it facilitates, with particular attention to mechanics, affordances, musical dialogue, player learning, and audio-visual feedback. The project's successive versions are treated as stages of development and as evidence of an iterative process through which its artistic and design priorities became increasingly clear.

The performances and demonstrations considered here took place across game audio conferences, expo floors, academic colloquia, music conferences, ludomusicology spaces, classrooms, and informal game-development contexts. The reception and unfolding of *Duet* were strongly shaped by the degree of alignment between the project's values and the culture of each presentation setting. Contexts closely aligned with the project often supported immediate engagement, while less familiar settings generated different questions, expectations, and perspectives. The backgrounds of individual participants likewise influenced how they approached the work and how each performance developed. Because these reflections draw upon informal observation, a limited number of participants, and substantially different presentation contexts rather than a formal user study, they are not offered as universal accounts of player or performer behavior.

The project also remains shaped by its particular software environment and by my role as its originating and most frequent instrumental performer. Although *Duet* was developed principally through my work as a flutist, other musicians have performed within the system; the capstone concert included trombone, violin, vibraphone, and saxophone in addition to my flute and piccolo. Its broader principles may therefore extend to other interactive works and to creative disciplines beyond music and gaming, but formal usability testing, accessibility research, and the study of long-term player learning remain outside the scope of this dissertation.

The dissertation moves from theoretical inquiry into the design, artistic construction, and practical realization of *Duet*. Chapter 1, "The Research," establishes the theoretical foundation for the project by examining play, the *magic circle*, *flow*, virtuality, actuality, creative risk, improvisation, and game design. By placing these concepts into dialogue, the chapter explains

why gameplay and improvised musical performance can productively inform and transform one another.

Chapter 2, “The Design and Technology,” describes the Game Design Document and the original technologies developed for *Duet*. It identifies the values that guided the project’s development and explains the role of each major technical component within the interactive system. In doing so, the chapter demonstrates how the project’s design and technology support its broader aim of using a video game as a framework for improvised music composition.

Chapter 3, “The Art,” addresses the project’s creative and compositional dimensions. It begins with a description of the musical assets composed for the game and their importance to the system’s design. It also develops the concept of the “possibility landscape,” explaining how mechanics, affordances, audio-visual materials, and conditions for interaction were composed within the human-computer interactive space.

Chapter 4, “Duet in Practice,” reflects upon the project’s public performances and demonstrations, including the capstone concert. Drawing upon practice-based observations, the chapter considers how different volunteers, audiences, and presentation settings shaped the work’s unfolding and reception. These experiences reveal where the system’s design successfully facilitated improvised musical interaction, where its possibilities were misunderstood or overlooked, and how future iterations might further refine the conditions composed among performer, player, and game system. Together, these chapters present *Duet* not as a fixed artistic object, but as an evolving interactive practice through which theory, design, composition, performance, and reflection continually inform one another.

CHAPTER 1: The Research

Duet for Flute and Video Game is grounded in the thesis that the exploratory nature of gameplay can be seen as a framework for improvisation-based musical composition. This highlights how both disciplines—game design/play and musical structure/performance—serve as mutually informative partners in creating structured yet flexible spaces for creative expression. Through the lenses of theoretical concepts such as *magic circles*, *flow*, and *play*, this chapter explores parallels between gameplay and music improvisation. Scholarship on these theoretic concepts provides a framework to reveal these intersections and to explore how gameplay's interactive, exploratory qualities and music improvisation's fluid, responsive nature can enrich one another—providing new insights to the design of games and the practice of improvisational composition alike. While an exhaustive survey and analysis of the literature from gameplay and music improvisation that would constitute the full nexus of the two subjects is out of the scope of this dissertation project, I nevertheless present in the following sections of this chapter some key ideas that serve as a starting point for such a survey and analysis.

Magic Circles and Play

In "An Exploratory Model of Play" (1971), Mihaly Csikszentmihalyi and Stith Bennet determine that play states are experienced when one's ability to act matches the requirements for action in their given environment, existing in the liminal space between anxiety, where those requirements are too high for the person's ability, and boredom, where those requirements are too few. They assert, "Play is going. It is what happens after all the decisions are made-when 'let's go' is the last thing one remembers. Play is action generating action: a unified experience flowing from

one moment to the next in contradistinction to our otherwise disjoint 'everyday' experiences."[4] Put another way, "The game simply begins when one or more players decide to play."[5] Katie Salen and Eric Zimmerman elaborate upon this phenomenon, formalizing it into a frame in their *Rules of Play* (2004). They call this frame the *magic circle*, inspired by Johan Huizinga's foundational work, *Homo Ludens* (1955).[6]

For Huizinga, play is not confined to games in the narrow sense; it also describes a broader category of voluntary, rule-bound, and set-apart activity within culture:

> All play moves and has its being within a play-ground marked off beforehand either materially or ideally, deliberately or as a matter of course. Just as there is no formal difference between play and ritual, so the "consecrated spot" cannot be formally distinguished from the play-ground. The arena, the card-table, the magic circle, the temple, the stage, the screen, the tennis court, the court of justice, etc., are all in form and function play-grounds, i.e. forbidden spots, isolated, hedged round, hallowed, within which special rules obtain. All are temporary worlds within the ordinary world, dedicated to the performance of an act apart.[7]

When people gather to take part in shared activities, they willingly enter a temporary frame of participation. Within that frame, rules and constraints that might seem arbitrary in ordinary life become meaningful because the participants agree to treat them as binding. While the term *magic circle* is often attributed to Huizinga from this context, its use in contemporary game studies is better understood as a later development of Huizinga's broader claim that play creates temporary, rule-bound worlds within ordinary life. When Salen and Zimmerman codify their frame, they describe the *magic circle* as the space in which a game takes place and within which objects and actions acquire special meanings.[8] Yet if the magic circle helps explain how a shared

[4] Mihaly Csikszentmihalyi and Stith Bennett, "An Exploratory Model of Play," *American Anthropologist* 73, no. 1 (1971): 45.
[5] Katie Salen and Eric Zimmerman, *Rules of Play: Game Design Fundamentals* (Cambridge, MA: MIT Press, 2004), 96.
[6] Ibid, 94.
[7] Johan Huizinga, *Homo Ludens: A Study of the Play-Element in Culture* (Boston: Beacon Press, 1955), 10.
[8] Salen and Zimmerman, *Rules of Play*, 95–96.

activity becomes temporarily set apart, Victor Turner helps describe what can happen between participants once they are inside such a frame. In these moments of shared participation, people may enter a social and affective formation that exceeds their ordinary sense of themselves as separate individuals. Turner describes this kind of experience as *communitas*: a mode of human interrelatedness in which participants can feel themselves part of an "essentially us" or become "totally absorbed into a single synchronized, fluid event."[9] This often comes with structure and rules that they would not otherwise adhere to in daily life, but that they agree to for the sake and pursuit of fulfillment, duty, or fun.[10]

Games, like musical improvisations, establish conditions for action. In both cases, participants operate within a shared framework: rules and procedures shape the game space, while musical conventions, idiomatic materials, and responsive interaction shape the improvisatory event. A.J. Racy's account of Arab *tarab* performance is useful here because he describes modal improvisation as shaped by "binding, often non-articulated, modal rules and structures," even as it allows a "wide latitude of flexibility."[11] Within such frameworks, constraint does not foreclose agency; rather, it creates the conditions through which creative expression can unfold. Musicians and players alike are empowered to make choices that meaningfully shape the unfolding experience. Because of this agency, each session can be iterative and unrepeatable, inviting a sense of play and discovery.[12]

Jesper Juul affirms the concept of the *magic circle* by affirming the psychological shift that occurs when one enters a play space. Boundaries between the everyday world and the *magic*

[9] Victor Turner, *From Ritual to Theater: The Human Seriousness of Play* (New York: PAJ Publications, 1982), 48.
[10] Huizinga, *Homo Ludens*, 10.
[11] A.J. Racy, "Creativity and Ambience: An Ecstatic Feedback Model from Arab Music." *The World of Music*, vol. 33, no. 3 (1991): 18.
[12] Mary Flanagan, Critical Play: *Radical Game Design* (Cambridge, MA: MIT Press, 2009), 35.

circle are blurred because "it is clearly not a perfect separation of a game from the rest of the world, but an imperfect separation that players negotiate and uphold."[13] Consent and buy-in are important preconditions for the kind of play that enables the *magic circle*, enabling new relational dynamics between player and game object.[14] This can mirror the experience of musicians who enter into an improvisational mindset, apprehending the context and material within which they make music shift and evolve over the course of a performance.

While there may not be a clear equivalent to an "everyday world" that complements the world of musical performance, musicians do marshal the totality of their musical training and lived experience into improvisatory situations, calibrating how that totality fits within the framework as communicated by the creator(s) of the work, and shapes and is shaped by the evolving musical context and material. This dynamic musical shaping allows for the altering of perspectives and behaviors, much like how improvising musicians navigate rules and boundaries to explore musical expression.[15] And, borrowing again from Huizinga, play—as one of many phenomena that create such temporary spaces—emphasizes that people bring these dynamic spaces to fruition in response to their personal needs and cultural backgrounds, which is also fundamental to improvisatory musical expression.[16]

To conclude this section, in my research, the concept of the *magic circle* elucidates the cultural and inner workings of *play*. Three elements in particular stand out to me. Play is 1) born out of the moment, 2) voluntarily entered, and 3) separated from daily life. In both musical

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[13] Jesper Juul, "The Magic Circle and the Puzzle Piece," in *DIGAREC Series 01: Conference Proceedings of The Philosophy of Computer Games 2008*, ed. Stephan Günzel et al. (Potsdam: Potsdam University Publishing, 2009), publishup.uni-potsdam.de/opus4-ubp/frontdoor/deliver/index/docId/2550/file/digarec01.pdf, 61-62.
[14] Salen and Zimmerman, *Rules of Play,* 95–96.
[15] A.J. Racy, "Musical Improvisation: Play, Efficacy, and Significance," in *The Oxford Handbook of Critical Improvisation Studies*, vol. 2, ed. George E. Lewis and Benjamin Piekut (New York: Oxford University Press, 2016), 232.
[16] Ibid, 244.

improvisation and gameplay, there exists a framework for enabling and activating these elements. The framework is communicated to everyone involved by the designer(s) and creator(s) of the game or so-called "musical work." The communication of the framework can be done verbally, graphically, visually, by text, or perhaps even by demonstration. Meanwhile, all participants enact these rules to various degrees, internalize their own relationships to them, and realize them in time, yielding a result that is born out of each moment. All participants are voluntarily present and actively in play. They are focused, observant, listening, and calculating, making choices informed by the emerging circumstances as they arise. In the process, this is an opportunity for people to reexamine themselves in a new light, question what they believe about themselves intrinsically, and make discoveries about themselves and the choices they make while playing.

Flow and Immersion

Proposed here as important to this dissertation project is Csikszentmihalyi's concept of *flow*, introduced in his 1975 publication, *Beyond Boredom and Anxiety: Experiencing Flow in Work and Play*. Flow provides a critical framework for understanding the nexus of gameplay and musical improvisation. Csikszentmihalyi argues that people experience enjoyment of an activity when the opportunities for action present themselves at an approximately equal level to that of their capabilities, which leads to an immersive, self-rewarding experience called *flow*.[17]

The concept of *flow* and its application to play studies was already anticipated in an earlier publication that has been mentioned previously in this chapter, Csikszentmihalyi and Bennett's "An Exploratory Model of Play," where the authors describe the conditions required

[17] Mihaly Csikszentmihalyi, *Beyond Boredom and Anxiety: Experiencing Flow in Work and Play* (San Francisco: Jossey-Bass, 1975).

for successful play.[18] Flow is not, however, exclusive to play. Csikszentmihalyi later describes it as a mode of optimal experience that can arise in creative and professional activities as well as in games.[19] The concentrated state entered while writing, solving a complex problem, or becoming absorbed in a demanding creative task may therefore be understood as the same phenomenon, provided that the activity establishes a productive relationship among challenge, skill, attention, goals, and feedback. In creative practice, these goals need not specify an outcome for the completed work in advance. They may instead operate as provisional or local aims, while feedback emerges through repeated acts of making, listening, evaluating, and revising.[20]

Play remains especially pertinent because games formalize many of the conditions conducive to flow.[21] Their rules and boundaries limit the field of relevant stimuli and possible actions, organize challenges, clarify consequences, and support sustained attention. *Flow* can lend "magic" to the *magic circle* by intensifying the participant's experience of inhabiting its bounded field of meaningful action. When flow is achieved, attention becomes concentrated upon the activity at hand, action and awareness merge, and concerns external to the temporary world of play recede from consciousness.[22] This does not mean that flow creates the magic circle or that entry into the magic circle guarantees a flow state. Rather, the circle's rules and boundaries establish a structured context that can make flow more attainable, while flow helps account for the heightened absorption through which that context may be experienced.[23] [24] Understood in this broader sense, flow connects the absorption of gameplay with that of

[18] Mihaly Csikszentmihalyi and Stith Bennett, "An Exploratory Model of Play," 45.
[19] Mihaly Csikszentmihalyi, *Creativity: Flow and the Psychology of Discovery and Invention* (New York: HarperCollins, 1996), 110–13.
[20] Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience* (New York: Harper & Row, 1990), 54–56.
[21] Ibid, 72.
[22] Ibid, 53, 58.
[23] Ibid, 72.
[24] Salen and Zimmerman, *Rules of Play, 95–96.*

composing a score, designing sound, performing music, and constructing the interactive systems that inform *Duet*.

In both games and musical improvisation, participants lose themselves in the act of creation or play, becoming fully absorbed in the present moment. Floris Schuiling describes *flow* in his musical field work as "a fluid sense of interaction with sounds, instruments, and fellow musicians."[25] From Csikszentmihalyi's perspective, this fluidity is attained when 1) goals are clear, 2) skills meet challenges, and 3) feedback is immediate, especially when one allows for a state of deep concentration. These are some of the conditions or preconditions, Csikszentmihalyi explains, that lead to flow.[26]

Since Csikszentmihalyi's influential work stated above, scholarship specifically comparing music and game play has emerged. While an exhaustive list of such publications is not the focus here, notable is William Cheng's *Sound Play: Video Games and the Musical Imagination*, a 2014 monograph on the examination of music and games, where Cheng notes that music and games, "both have potential to facilitate trance, flow, and immersion; and both possess transportative powers, ushering us into otherworldly spaces and alternative states of mind."[27] Cheng does not address improvisation specifically, but the notion that musicians and game players alike balance and negotiate technical proficiency with spontaneous creativity leads one to consider that parallels can be drawn between the trance-like states some forms of musical improvisation engender—David Borgo's essay on "Between Worlds: The Embodied and Ecstatic Sounds of Jazz" being one of many writings that discuss trance and musical improvisation—and

[25] Floris Schuiling, "'Making, Not Filling Time': Time and Notation in Improvised Musical Performance," in *The Oxford Handbook of Time in Music*, vol. 1, ed. Mark Doffman, Emily Payne, and Toby Young, (New York: Oxford University Press, 2021), 534.
[26] Csikszentmihalyi, *Flow*, chap. 4.
[27] William Cheng, *Sound Play: Video Games and the Musical Imagination* (New York: Oxford University Press, 2014), 4.

the flow a game player experiences while fully immersed in a game's mechanics.[28]

Virtuality, Actuality, and Creative Risk

As presented prior, the *magic circle* explains the state of players who allow themselves to imaginatively explore their surroundings due to adjacency from the daily, normative sense of reality. These surroundings can be simulated, virtual spaces (*virtuality*) in addition to the commonplace, sensory world (*actuality*). Virtual spaces may afford players greater security in taking certain risks because the physical consequences represented by many in-game actions do not ordinarily befall the player, although it is worth noting that this separation is not absolute. Virtual activity may still produce physical injury (e.g., player collisions in actuality while immersed in virtuality during headset-based VR gameplay; players accidentally striking objects and/or other people while engrossed in kinetic gameplay controls), psychological stress (e.g., a virtual experience that raises blood pressure), or social consequences that extend beyond the game space (e.g., online competitors or spectators swatting and/or doxxing the player). Even with these qualifications, the distinction between actions represented within a game's fictional world and the material operations through which players perform them can meaningfully influence behavior. Jesper Juul's description of video games as "half-real" clarifies this relationship:

> Video games are two rather different things at the same time: video games are *real* in that they are made of real rules that players actually interact with; that winning or losing a game is a real event. However, when winning a game by slaying a dragon, the dragon is not a real dragon, but a fictional one. To play a video game is therefore to interact with real rules *while* imagining a fictional world and a video game *is* a fictional world.[29]

[28] David Borgo, "Between worlds: The embodied and ecstatic sounds of jazz." *The Open Space* 5 (2003): 152-158.
[29] Jesper Juul, *Half-Real: Video Games between Real Rules and Fictional Worlds*, (Cambridge, MA: The MIT Press, 2005), 1.

Players interact with real rules while imagining a fictional world, and the consequences of the activity are generally negotiable because the operations required to play are predominantly harmless.[30] While children can face physical harm during game play in actuality (e.g. a game of tag, where someone falls and scrapes their knee), video game players may leap from tall buildings while risking a "Game Over" screen rather than the fatal physical consequences that such an action would carry in actuality. In this way, players are freer to risk behaviors that might seem inappropriate outside the circle, even though the magic circle cannot entirely insulate them from consequences in actuality.

For instance, imagine browsing a shopping center, and once you round the corner, you see fruit in midair, being sliced by someone with a katana. It would be bizarre, to say the least. Perhaps an odd street performance? If the person wielding the blade were a child, it would be horrifying! However, this is the objective of the popular mobile game, *Fruit Ninja*.[31] Responsible parents would never let their children engage with actuality in this manner, but the game allows them to imagine the experience without reproducing the same immediate physical danger. This distinction depends upon the player's recognition of what Gregory Bateson describes as the metacommunicative frame "this is play": wielding a physical blade carries consequences that the analogous touchscreen action does not.[32] While reckless to perform in actuality, the activity can be explored more safely when its consequences are largely limited to virtuality.

As an act, musical improvisation—while admittedly often having social, economic, and/or political implications, especially if done in the context of a so-called professional setting

[30] Juul, *Half-Real*, 1, 41-42.
[31] Halfbrick Studios, *Fruit Ninja*, (2010), iOS.
[32] Gregory Bateson, "A Theory of Play and Fantasy," in *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (San Francisco: Chandler Publishing Company, 1972), 180.

where there are meaningful stakes at play in actuality—also takes place within a context of relative safety. Simon Penny states:

> Infinite improvisation looks like chaos, or the world. One may play strange notes, but it is inadmissible to pour glacial nitric acid into the horn of your partner's saxophone. You may play soccer but it is unacceptable to shoot the ball with a bullet from a gun. I may improvise with the materials from which I build my house, but only from within the frame of viable materials—soap bubbles and birthday cake are out.[33]

In other words, even in improvisation tied to contexts of actuality, the rules and norms provide a safe space for exploration and risk-taking. These rules and norms help players understand how to operate within a space where permissible actions are otherwise blurred or illegible.

Jesper Juul's examination of the dual realities of games—where fictional elements interact with real rules and consequences—parallels the risks and rewards of musical improvisation.[34] Just as a player risks failure in a game by making incorrect decisions, a musician risks making the "wrong" choices in an improvised performance. However, in both cases, these risks are mitigated by the virtual or performative nature of the environment. Juul in a later publication states, "Failure forces us to reconsider what we are doing, to learn. Failure connects us personally to the events in the game; it proves that we matter, that the world does not simply continue regardless of our actions."[35] The ability to take creative risks within the safety of the game or improvisation is crucial, if not essential, for exploring and adjusting, and setting up the potential for innovative outcomes.

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[33] Simon Penny, "Improvisation and Interaction, Canons and Rules, Emergence and Play," in *The Oxford Handbook of Critical Improvisation Studies, Volume 2*, ed. Benjamin Piekut and George E. Lewis, (New York: Oxford University Press, 2016). 410.
[34] Juul, *Half-Real*, 1.
[35] Jesper Juul, *The Art of Failure: An Essay on the Pain of Playing Video Games* (Cambridge, MA: MIT Press, 2013), 122.

Commonalities Between Game Design and Composing Works for Improvisers…

It is "structured freedom" that both gameplay and musical improvisation share in common as a core characteristic. Central to both are *systems*. These systems govern interaction over time, with a framework built with elements of structured freedom. The rules of a game guide players in how they interact with the game environment, objects, and other players, just as a score or system for improvising musically guides performers in how they perform the work, the material, and, through sound, with others. Rather than strict prescriptions, these structures serve as prompts that invite creative responses. They lead to real time decision-making, where—borrowing from Juul in the context of gameplay—outcomes are shaped as much by emergent choice as by predefined systems.[36] In the context of music improvisation, the composer-performer-researcher, Jeff Pressing, who was an early pioneer in applying computational cognition to the study of music improvisation, postulates, "Rule models describe the common features shared by a set of rules which form the basis for a 'production system'. If the improvising musician is the production system, the important rules will be largely heuristic…"[37] In this way, both games and improvised performances are heuristic in process and outcomes unforeseen in result. Each iteration differentiates from the last, with participants making unique contributions based on context, skill, and intuition.

These systems also make shared demands on the participants. Oftentimes the degree of clarity by which these system-framework-structures are communicated to and understood by its players/participants lends more specificity to the identity of the musical work or performance. Furthermore, if one accepts Huizinga's notions of play, the players' voluntary choice to engage

[36] Juul, *Half-Real*, 73–76, 78–82.
[37] Jeff Pressing, "Improvisation: Methods and Models," in *Generative Processes in Music: The Psychology of Performance, Improvisation, and Composition*, ed. John A. Sloboda (Oxford: Clarendon Press, 1988), 152.

and to operate within and beyond the bounds of these systems—but always in reference to them—allows each system to become meaningful through enactment. And, in service of maximizing play, there is an inherent demand for presence: participants must be alert, responsive, and attuned to themselves and their collaborators.[38] This is critical, whether one is navigating a moment in a game world or a musical performance.

…and the Divergences Between the Two

Yet, while these parallels are illuminating, the analogy has its limits. Many games include win/loss conditions or other differential outcomes by which player success is measured, though sandbox and exploratory games complicate this model.[39] Improvised music resists such binary outcomes by being evaluated aesthetically rather than through fixed criteria.[40] Furthermore, while game rules tend to be rigid and enforced by the system itself, musical constraints are often more fluid, arising from performer consensus and social agreement rather than codified law.[41] This flexibility allows for greater nuance in interpretation, but also makes the "rules" of improvised music less universally understood.[42]

There are also distinctions in how participants and observers are positioned within each system, though these distinctions are not always clean. In many games, the player is both participant and audience, and their engagement is structurally necessary for the system to progress. Musical performance, by contrast, may involve performers listening to themselves and one another, external audiences who observe without directly shaping the system, or listeners

[38] Hans Weisethaunet, "Critical Remarks on the Nature of Improvisation," *Contemporary Music Review* 23, no. 3/4 (2004): 146.
[39] Juul, *Half-Real*, 36.
[40] Racy, "Musical Improvisation: Play, Efficacy, and Significance," 232.
[41] Weisethaunet, “Critical Remarks on the Nature of Improvisation,” 147.
[42] Penny, “Improvisation and Interaction, Canons and Rules, Emergence and Play,” 411.

whose attention fluctuates throughout the event. Likewise, games may be played privately, collaboratively, or for external audiences in domestic, streaming, or competitive settings. These relations shift according to each person's role, the venue employed, and the context of the moment.[43] And finally, while both systems contain internal logic, their expressive aims differ. Gameplay tends to prioritize consistent interaction mechanics, whereas improvised music—to borrow from Racy—often has the added layer of seeking to evoke emotion and meaning through sound.[44]

By exploring these intersections and divergences, *Duet for Flute and Video Game*—the creative work central to this dissertation—aims to create a space where the logic of gameplay and the expressivity of musical improvisation inform and transform one another. In *Duet*, gameplay is reframed as a live performance, and improvisation is treated as an engagement with a designed system. The work also complicates conventional distinctions among players, performers, and audiences by making one audience member's gameplay operationally necessary to the performance while the remaining audience observes the resulting exchange. This dual reframing opens up new possibilities for collaboration, responsiveness, and surprise. It invites performers and players alike to inhabit a space of creative risk and shared authorship. It is an expressive playground where play becomes performance, and performance becomes play.

The Relation of Game Logic to Music Improvisation

Conventional music improvisation often unfolds within known musical elements: stylistic conventions, harmonic structures, interaction with fellow performers, etc. However, performing with a system like *Duet* shifts improvisation into a negotiation with programmed mechanics that

[43] Philip Auslander, "Musical Personae," *TDR/The Drama Review* 50, no. 1 (2006): 107–109.
[44] Racy, "Musical Improvisation: Play, Efficacy, and Significance," 230.

may or may not be fully understood in the moment. In this setting, all participants discover possibilities afforded by the logic of the system through trial and error informed by any previous experience with gameplay, making the performance's objectives emergent rather than predetermined.[45] The game itself acts as an improvisational partner, not just an environment for performance.[46]

By merging musical improvisation with game mechanics, improvisatory exploration extends beyond sonic expression into spatial navigation, interaction, and discovery within the game world. In *Duet*, the two performers—game player and musical instrumentalist—are not only responding to one another but engaging with the game's mechanics and affordances. The system that enacts the game essentially takes on the role of a dynamic score, and its mechanics and affordances shape the players' choices in ways that are not always conventionally musical.

In *Duet*, the game player is placed in the role of a musical co-improviser from the moment they interact with the system. When presenting *Duet* publicly at conferences or concerts (as discussed in more detail after this chapter), invited players often have no warm-up, rehearsal, or prior knowledge of what will unfold. The moment of first engagement is the performance itself. If the game's mechanics shape the improvisation, then the game player is not simply performing music within the game; they are also performing their role as a game player. This blurs the boundary between "gamer" and "musician," repositioning both identities within a shared improvisational space.

[45] Salen and Zimmerman, *Rules of Play*, 170–171.
[46] Penny, "Improvisation and Interaction, Canons and Rules, Emergence and Play," 405.

The Influence of Music Improvisation over Gameplay

While gameplay highly influences the performance of *Duet*, the influence of improvised performance is equally impactful. When reframing a game as an improvisation, the experience becomes more about expressive interaction than mastery and optimization. It is common to find games designed with the objective of winning, solving puzzles, or progressing through a narrative, but musical improvisation is not about winning or achieving a predefined goal. It is about exploration, responsiveness, and co-creation.[47] In *Duet*, "playing the game" is as much about artistic decision-making as it is about navigating mechanics.

Improvised music demands real-time composition from the performer, requiring them to adjust phrasing, dynamics, and tone in response to the moment.[48] Likewise, when gameplay is approached through an improvisational lens, the game is no longer just a system to be played, but an instrument to be performed. Players are not merely engaging with mechanics. They are shaping the game experience with nuance and personal expression, just as a musician does with their instrument.

Music performance thrives on interaction—interaction between musicians, between musician and audience, between sound and space.[49] In *Duet*, this principle extends to the dynamic relationships between the flutist and the game environment, between the game player and the game environment, and between the flutist and the game player. These relationships are constantly evolving, generating a performance space that is not fixed or repeatable.

Just as a jazz musician's improvisation is influenced by the rhythm section, the players' choices in *Duet* are shaped by the emergent dynamics of the performance. This feedback loop

[47] Racy, "Musical Improvisation: Play, Efficacy, and Significance," 232.
[48] Weisethaunet, "Critical Remarks on the Nature of Improvisation," 147–148.
[49] Philip Auslander, "Musical Personae," 107–109.

between musical improvisation and gameplay challenges conventional ideas about both art forms. It transforms gameplay into a collaborative act and expands improvisation beyond the domain of music, opening new possibilities for interactive performance.

Why This Music-Making Space is Important

When I present *Duet* at conferences, I often conclude with a simple but essential idea:

> *Ultimately, playing a game and playing an instrument are both simply play, and in recognizing that, we can create new interactive art.*

Throughout my lecture-recital, I illustrate how players, both musicians and gamers, accept comparable constraints as conditions of play. Whether following musical structures, responding to game mechanics, or engaging in improvisation, both experiences involve negotiation within a system, adaptation to emergent challenges, and the pursuit of fluency within a given set of rules.

By acknowledging this shared foundation, my work invites a broader reconsideration of how we define interactivity and performance. It challenges traditional distinctions between structured gameplay and open-ended artistic improvisation, suggesting that gameplay itself can be an expressive act and that musical improvisation can function as a game-like system of exploration and response.

On a larger scale, this research opens new possibilities for interactive art and performance design. It encourages artists, game designers, and musicians to think beyond discipline-specific methodologies and consider how principles from one domain might transform another. If both games and music can be seen as structured play, then interactive art can become a bridge, fostering new ways of engaging with sound, space, and audience participation.

Conclusion

The exploratory nature of gameplay, defined by the balance between structure and freedom, offers a compelling framework for understanding musical improvisation. Both disciplines require participants to navigate predefined rules while engaging in spontaneous, creative exploration. The *magic circle* of gameplay, the immersive flow state, and the risks and rewards inherent in both games and improvisation, all underscore the deeply connected nature of these two practices. By examining the shared principles of play and improvisation, we gain a deeper understanding of how structured environments can foster creative expression in the domains of gameplay and music. The following chapters will turn toward more specifics on *Duet for Flute and Video Game* informed by the material covered in this chapter.

CHAPTER 2: The Design and Technology

The development of a video game may begin through a range of ideation practices, including conceptual discussion, written proposals, design pillars, visual references, technical experiments, and playable prototypes. The form and sequence of these practices vary according to the scale, goals, and uncertainties of the project. Game development does not always begin with a comprehensive game design document. Particularly in experimental projects, design knowledge may emerge through prototyping, implementation, and repeated testing rather than preceding those activities in a fully articulated form.

Such was the case with *Duet*. The project developed iteratively, with many of its defining features discovered through the practical work of constructing, performing, and revising the system. As development progressed, however, it became useful to create a Game Design Document that could define the game's fundamental elements and clarify how its mechanics, technical systems, and creative priorities interacted as a whole. The document therefore did not serve as the project's original blueprint. Instead, it functioned both as a means of consolidating the design and as a record of knowledge generated through the development process itself.

This iterative process produced two major versions of *Duet's* technical platform. Version 1 (hereafter referred to as *v1*) established the project's initial set of features, while Version 2 (hereafter referred to as *v2*) introduced an expanded and revised feature set. References to *v1* and *v2* appear throughout this chapter where distinguishing between the two stages of development is necessary.

A classic example of a game design document that is used in game design programs is the original design document for what became one of the most popular games, *Grand Theft Auto*.[50] The Grand Theft Auto design document, although much different from the one created for *Duet*, did serve as a model and starting point. The design document for *Duet* ended up including a Values Statement, Asset List, and Mechanics List. This chapter goes through each of those elements of the design document in detail to further explicate the design decisions that now underlie the *Duet* project. A brief description of elements of the technology implementing the design is also provided at the end of this chapter.

The Values Statement

The Values Statement section of the design document for *Duet* focuses on three key parts: 1) Collaborative Exploration, 2) Low Barrier to Entry, and 3) Performance as Play. They are outlined in Figure 1. Each of the three sections will be explained further below.

[50] Keith R. Hamilton, "Race'n'Chase Game Design Document" (provisional title for *Grand Theft Auto*), version 1.05, March 22, 1995, DMA Design Ltd., 2, archived by GameDevs.org, https://www.gamedevs.org/uploads/grand-theft-auto.pdf.

1. Collaborative Exploration (Co-op)
1.1. ***Duet*** *for Flute and Video Game*, at its core, is a **duo**. There are two players involved and they are a team.
1.2. The game and its player are not a backdrop for the flute performance; they are active participants.
1.3. The game as a system is what facilitates bidirectional communication between the players as musical performers.
1.4. This is a dynamic player-driven experience that seeks to transcend traditional gameplay.
2. Low Barrier to Entry (Approachability)
2.1. The video game element is designed with the goal of being accessible and approachable to anyone who finds the project of interest.
2.2. It is not “for gamers” or “for musicians” only. One could be both. One could be neither.
2.3. Of priority is a clear and intuitive feedback system that allows performers to quickly understand how their actions affect the game.
2.4. One can play with or without a priori skills in music or game playing and get something out of the experience.
3. Performance as Play
3.1. By blending live performance with a video game, of emphasis is the liveness of both mediums.
3.2. Structural and experiential parallels are drawn between music improvisation and gameplay.
3.3. Game mechanics and real-time manipulation of audio and visual components are valued as forms of musical expression.

Figure 1 "Duet" Game Design Document: Values Statement

Collaborative Exploration (Co-op)

There are four values stated under the Collaborative Exploration section. The first—*Duet for Flute and Video Game, at its core, is a duo*—is fundamental to this project because of its emphasis on team play. It gives recognition to play, not as a solitary act, but one that engages human interaction in a relationship between human and human, where the machine acts as a

facilitator. The second—*The game and its player are not a backdrop for the flute performance; they are active participants*—is fundamental to this project because the research goal of this work is to explore how gameplay can open new possibilities for musical improvisation and vice versa. It is not to showcase the instrumentalist, e.g., flute player. The third— *The game as a system is what facilitates bidirectional communication between the players as musical performers*—is fundamental to this project because it places importance on the players, as opposed to the game becoming a third, independent participant. The fourth—*This is a dynamic player-driven experience that seeks to transcend traditional gameplay*—is fundamental to this project because *Duet* is not to be traditionally goal-oriented like many games are. For example, referring to the design document for what became *Grand Theft Auto*, we see the following under the Objectives section:

> …the winner is the first player to drive from 'A" [sic] to 'B'...The winner is the driver who survives the longest…The robber's game is up when he gets killed or is captured by the police…The player controls a police car and must stop a getaway car from escaping.[51]

The finality of such objectives, commonplace in the design of games, in general, is precisely what *Duet* is trying to deliberately avoid in its design.

Low Barrier to Entry (Approachability)

In this section as well, there are four stated values. The first—*The video game element is designed with the goal of being accessible and approachable to anyone who finds the project of interest*—steers the game design towards ensuring the control interface (keyboard and mouse events) is easy to execute with its results easy to understand. It also guides the visual design as being broadly acceptable—in this case a forest scene—with enough distance from realism to

[51] Hamilton, "Race'n'Chase Game Design Document" (provisional title for *Grand Theft Auto*), 6-7.

reduce the possibility of invoking associations to specific locations in actuality that a player might have. The second simply extends the first with specifics: *it is not "for gamers" or "for musicians" only. One could be both. One could be neither*. The third—*Of priority is a clear and intuitive feedback system that allows performers to quickly understand how their actions affect the game*—serves as a guiding mechanism, particularly when deciding on the complexity of a musical result triggered by a player action or a musical pattern that triggers a change in the game state. The fourth—*One can play with or without a priori skills in music or game playing and get something out of the experience*—reiterates the previous values stated in this section, but adds the reminder that *Duet*'s aspirations include fostering a meaningful experience beyond the sense of accomplishment through meeting the objectives of a game.

Performance as Play

The earlier chapter on the research related is in dialog with the values in this section. The first—*By blending live performance with a video game, of emphasis is the* liveness *of both mediums*—emphasizes the moment-to-moment nature of the optimal state of *play* and the emergent *magic circle* resulting from both gameplay and live performance. The second—*Structural and experiential parallels are drawn between music improvisation and gameplay*—refers to the system-framework-structures and rules which enable states of *play* and *flow* to emerge. And, the third—*Game mechanics and real-time manipulation of audio and visual components are valued as forms of musical expression*—proposes that opportunities for a more explicit sense of creative expression in gameplay can be had by incorporating techniques more commonly found in the domain of contemporary music-technology, such as real-time dynamic processing of audio.

The Asset List and Game Mechanics

The original design document does not cleanly distinguish between the assets and mechanics. Nevertheless, Figure 2 is presented as the section of the design document that best identifies the assets. References to some of the mechanics associated with the assets are in Figure 3.

Setting
Forest
Map is split into two halves, divided by a barrier that is traversable.
Map features a time-of-day system, primarily used for communicating a shared sense of time passing by the two players.
Game Objects
Trees
There are five interactable trees (two on one half, three on the other) that are each capable of glowing and have their own audio layer attached (diegetic).
Game player proximity to trees determines audio layer volume.
Tethers
Player instantiates these by colliding with interactable trees.
Player removes these with a keyboard command.
Impacts the audio mix.
Huts
There are two huts total, one on either side of the map.
Player entry/exit impact the audio.
Triggers reverb live processing on the instrumentalist while within the hut.
Spheres
Player instantiates these by throwing them.
The throwing of these objects and their collision with interactable trees afford the player melodic and rhythmic performance ability.

Game Player
1st person perspective.
Can freely navigate within map boundaries. Two movement speeds: walk & run.
Can jump.
Can throw spheres.
Instrumentalist
An acoustic instrument like the flute, for example.
Imparts change upon the forest by performing a recognized pitch motif, resulting in glowing trees and tree audio layers. Each of the five trees is associated with a pitch motif that activates them.

Figure 2 "Duet" Game Design Document: Asset List

Cause	**Effect**
Key • (G) Game Player • (I) Instrumentalist, e.g., flute	
(I) Pitch motif match	matching tree glows; attached music layer sounds
(G) Cross map barrier/threshold	change base audio
(G) Attach tether	change tree audio layers; requires (I) Pitch motif match as a precedent
(G) Detach tether	change tree audio layers (attached layer is removed from mix); requires (G) Attach tether as a precedent.
(G) Hut entry	change audio mix (all layers removed temporarily; exception: tethered trees continue sounding); reverb live-processing impacts (I) until (G) exits
(G) Throw spheres	one percussive note of static pitch sounds on (G)'s cue; affords rhythmic performance
(G) Sphere collides w/tree	one percussive note of varied pitch sounds, resulting from (G)'s throw; y-axis collision point determines pitch; affords melodic and rhythmic performance in combination w/ (G) throw spheres
(G) Proximity to glowing tree	change tree audio layers; music layer volume in mix correlates to player position; requires (I) pitch motif match as a precedent

(G) Proximity to glowable tree	distance between (G) throw sphere and (G) sphere collides is expanded or condensed; affords rhythmic performance variation
(G) Walk/Run speeds	change tree audio layers; adjusts the rate of change in all audio elements that respond to player proximity

Figure 3 "Duet" Game Design Document: Mechanics List

Forest

The open-ended sandbox environment of *Duet* takes the form of a forest. The map of the forest (see Figure 4) is intentionally modest in scale, using a compact, bounded 3D environment rather than an expansive open-world map. This scale was chosen to support live performance conditions: the player must navigate, search, and respond, but the environment remains small enough for an inexperienced player to understand the task quickly and participate meaningfully.

Figure 4 Top-Down View of Forest Map in "Duet"

This environment is divided loosely in half by a threshold. This threshold is depicted as a translucent barrier that divides the map (see Figure 5), and there is a clear sonic signature that identifies either side: one in elastic time and another in pulsed time. There is also a third space, called a hut. Depicted as blue domes (see Figure 6), these huts are found on either end of the threshold (on the far left and right edges of the map) and entering them removes game audio altogether, with some exceptions to be described later in this chapter. Lastly, there are five special, activatable trees in this forest that can glow bright blue and emit musical sound (see Figure 7). Three of them are on the elastic side of the map and two of them are on the pulsed side.

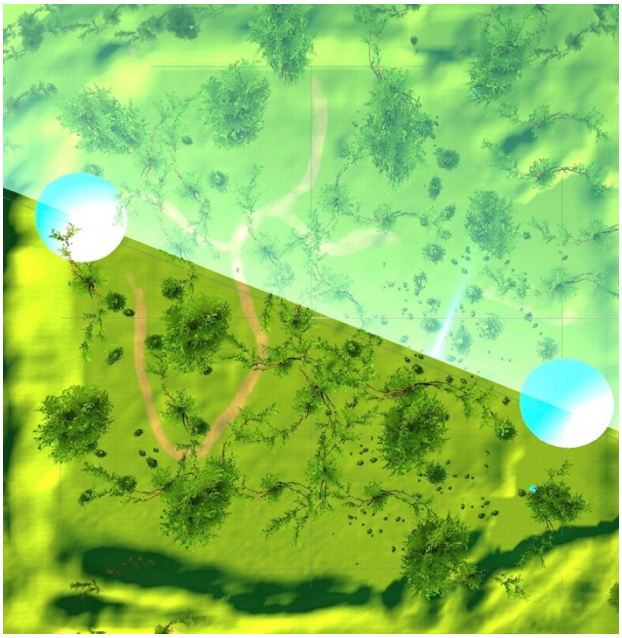


Figure 5 Top-Down View of Forest Map in "Duet" with a Transparent Blue Threshold Dividing the Map into Two Parts

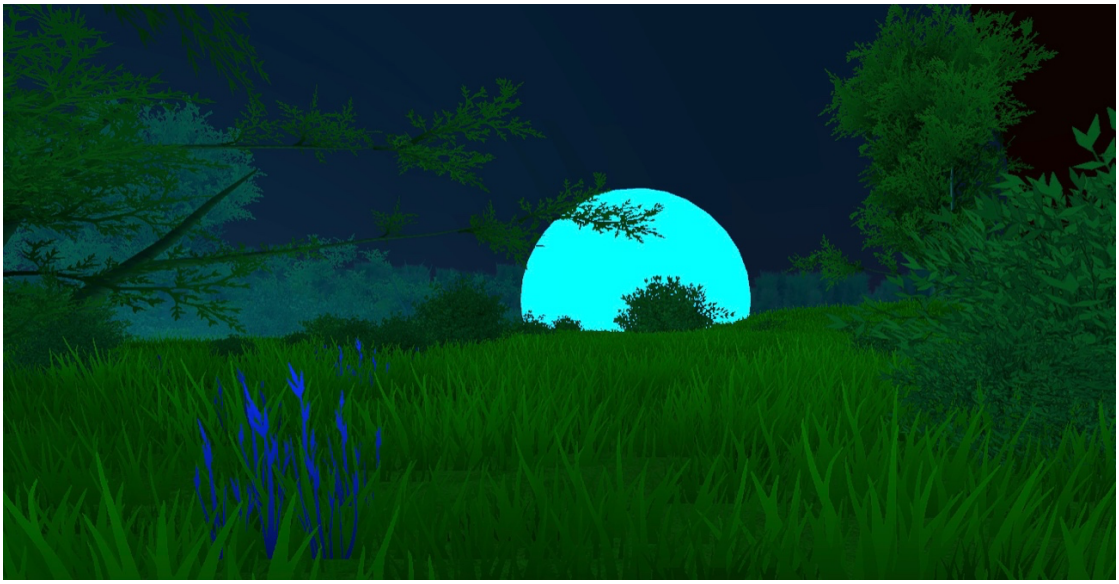


Figure 6 In-Game Image Capture of an Opaque Blue Dome Called a Hut in "Duet"

Figure 7 In-Game Image Capture of Activatable Trees in "Duet"

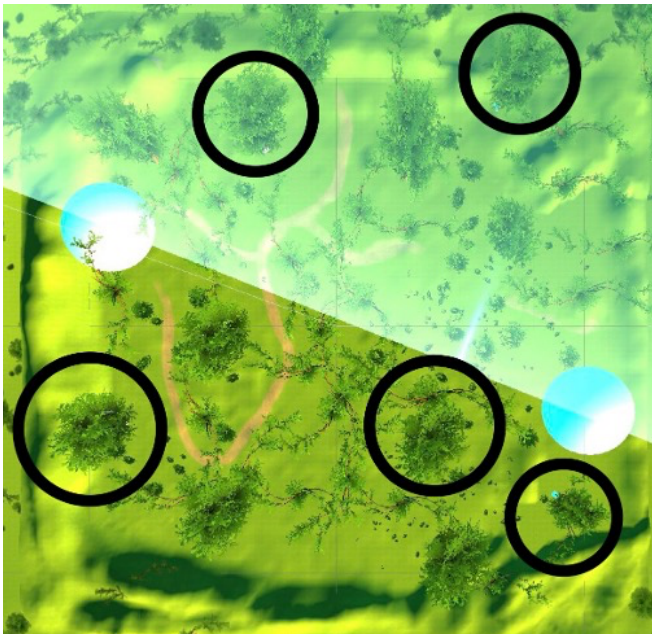


Figure 8 Top-Down View of "Duet" Forest Map with Black Circles that Indicate the Locations of the Five Activatable Trees

Trees

Activatable Trees

Whether the instrumentalist has activated them or not, the five activatable trees look different from the other trees in the forest, indicating that they can be interacted with (see Figure 9, with the positions of these five trees within the forest map shown in Figure 8). As previously stated, the trees glow blue and emit music when activated. When they are not activated, they do not glow or emit music, but they can still be performed by the game player with their sphere-throwing ability (see Figures 11 & 12). This will be elaborated upon below in the section titled, "Spheres."

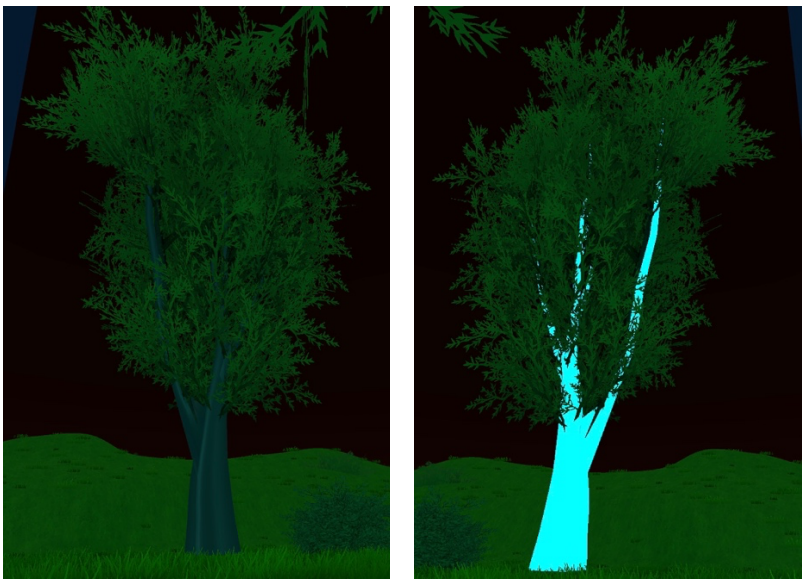


Figure 9 In-Game Image Capture of an Activatable Tree in two states. Left: Deactivated. Right: Activated

Proximity to the Activated Tree

When a tree is activated and begins glowing blue, this communicates to the game player that the game state has changed and that there is a new element to interact with. There is no urgent need for the player to stop what they are doing and turn their attention to the tree, but once the glowing is noticed, interfacing with that game object tends to be their next objective. This is a normal cause and effect scenario in game development. Once something noticeably changes in the game environment, investigating this event is a likely next step.

In *v2*, as the player approaches the tree, they will hear the music layer emitted by that tree emerge. The volume of this music layer in the mix is dependent on the player's proximity to the tree within its sounding radius. Outside the radius, the layer is inaudible. Inside the radius, the layer will gradually become louder until the player is closest to the tree. The next logical game play instinct is to interface with this strange glowing object once it has been approached, but it is also possible to override that impulse and instead, choose to depart from the tree. This would

leave the tree in its activated state, but gradually remove the associated music layer from the mix. Choosing to act this way can serve as a compositional device that will be elaborated upon in Chapter 3. Regardless of if they interface with the glowing tree immediately or not, it is most likely that the player will eventually choose to interface it. This action advances the tree game object to its penultimate mode of interaction before deactivation: attaching a tether.

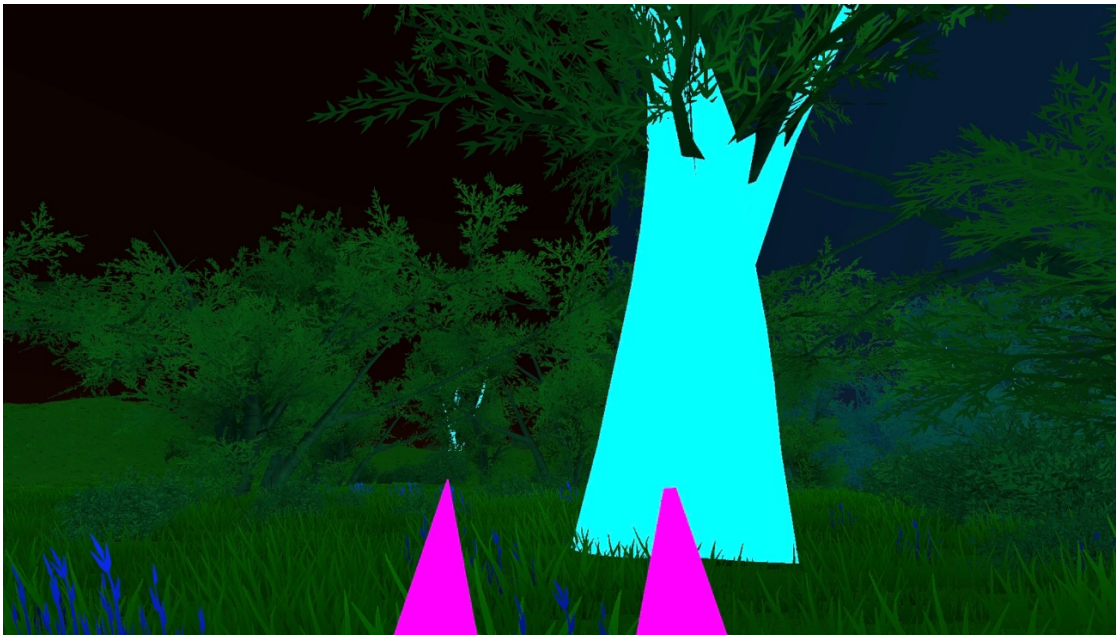


Figure 10 In-Game Image Capture of Two Activatable Trees (One in the Far Distance) with Two Pink Lines that Tether the Player to Them

Tethers

When the player interfaces with an activated tree, they attach a pink line between themselves and the game object (see Figure 10). The tree continues to glow, confirming that it is still activated. The associated music layer also continues to sound, except this time, it no longer fades out as the player walks away from the tree. The attached tether forces the associated music layer to the front of the mix, ensuring that this music will be a persistent voice in the emergent sonic

landscape for as long as the tether remains attached. This is a prominent way that the game player shapes the direction of the joint improvisation.

The tether attachment also permits the game player to mix and match the pulsed and elastic temporal sonic signatures. A tether can be attached to a tree on the pulsed side of the map and dragged by the player to the elastic zone. The hut zones also make this feature special. The only music layers that persist inside the hut are the ones attached to the player with a tether. Up to all five activatable trees can be attached to the player and subset combinations can be decided upon by the player to their liking.

Tether Detaching

Once the player has attached a tether to themselves from an activated tree, they may leave that tether present for as long as they wish. They may also remove the tether at any time. There are one of two ways to achieve this: 1) the player returns to the attached tree they wish to remove and interfaces with it again, resulting in its deactivation or 2) the player presses the “E” button on their keyboard to cut the tether. This also results in the tree's deactivation and, in both methods, the associated musical layer immediately cuts out of the mix (without fading). This creates a sudden contrast in the musical texture, especially when many layers are removed in close succession.

Huts

As described in passing while discussing neighboring mechanics, the Huts offer a multitude of purposes throughout the emergent improvised composition of *Duet*. Of most importance is that they offer a foil to the pulsed and elastic zones on either side of the threshold. Entering a hut

removes this base audio from the mix, creating audible space, while the opaque blue interior of the hut creates a visible partition from the forest landscape. From there, both players are empowered to choose which sounds they want to hear. When tethered, the game player features their chosen audio layers within this space. Additionally, entering the hut enables another audible feature: a small amount of reverb is applied to the instrumentalist while the game player resides there. This is the only zone in *Duet* that permits the game player to directly modify the instrumentalist's sound.

Spheres

In the game player's control scheme, the left-mouse button simulates the game player's arm, permitting them to throw spheres in any direction (see Figures 11 & 12]). When thrown anywhere, these spheres sound one static pitch (e.g., "C4"). When thrown at an activatable tree, regardless of whether it has been activated or not, the player's performance capability expands. A sphere will sound the static pitch when thrown, and then a variable pitch when it strikes the tree. Which pitch sounds second is dependent on the portion of the tree hit. A major pentatonic collection of pitches, with the static pitch as the tonal center, is added to the game player's performance palette while interacting with these trees. The collection will ascend in pitch, beginning with the tree trunk and moving upward along the y-axis. Once all five pitches in the collection have been exhausted, they will loop back to the lowest pitch as the sphere collisions continue to ascend. The sphere-throwing ability is the one truly autonomous way that the game player can create their own musical melodies (within the constraints of the pentatonic pitch set).

Because the static pitch will sound each time a sphere is thrown, any melodies composed with these spheres include persistent intervallic leaps back to the tonal center of the collection.

Depending on how these spheres are performed by the player, this leap can become more or less pronounced. As the game player discovers how they can perform within the environment, they learn that their proximity to the trees while throwing spheres can be a compositional device while improvising.

Sphere Throwing and Tree Proximity

When demoing *Duet* with a new player, one moment of delight is when an unexpected pitch is heard. The player is exploring through trial and error, pressing buttons at random to determine what works, and they become familiar with the left mouse button. They understand that with every press, they'll hear one static pitch…until a few seconds go by, and they hear another! They light up in surprise and wonder what just happened. In this case, the player discovered the pentatonic pitch set by accident. They had not noticed any of the activatable trees yet, but one of their spheres struck a tree out in the distant forest moments after it was thrown.

When leveraged deliberately, players can perform rhythms of varying lengths by adjusting their proximity to the target tree when throwing spheres. In this way, one press of the mouse button equals two notes, and their "tempo" is determined by the player's proximity to the tree (see Figures 11 & 12). While the first note is always the static pitch, the separation of the two pitches is the most pronounced from a distance and can even blur into a chord-like sound when the player is closest to the tree. The compositional practices of sphere and tree performance will be elaborated upon in Chapter 3. Some modes of interaction with the trees are only possible when activated, but sphere-based performance with *Duet* is persistent across all game states.

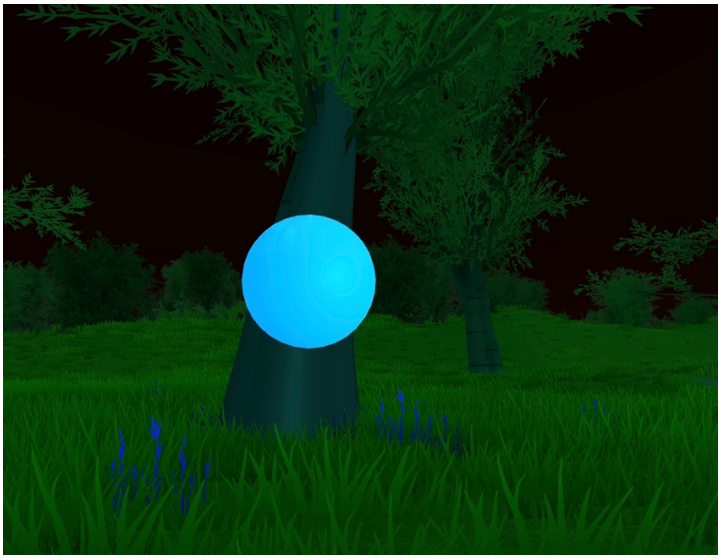


Figure 11 In-Game Image Capture of a Sphere Thrown at a Nearby Tree in "Duet"

Figure 12 In-Game Image Capture of a Sphere Thrown at a Faraway Tree in "Duet"

Game Player and Instrumentalist

The last two assets in the Asset List are Game Player and Instrumentalist. Through an evolving negotiation with game mechanics, the two players learn how to have a musical conversation with one another through the control schemes they have at hand. This section will depict how *Duet* is experienced through the players' points of view (POV).

Game Player POV

Most often, the game player is encountering *Duet* for the first time when they approach the controls. To facilitate learning the game controls, the control scheme conforms to convention for a QWERTY keyboard. W-A-S-D are mapped to forward, left, backward, and right, respectively. The shift-key can be pressed and held to run, and the spacebar is pressed to jump. Additionally, an external mouse is standard with first-person perspective games. Each turn of the mouse simulates the player turning their head within the virtual environment while the left-mouse button simulates their arm, permitting spheres to be thrown by the player (as described above).

With these controls in mind, the game player explores the landscape and discovers five trees that can glow bright blue and emit musical sound. Through experimentation, the game player learns how to elicit a variety of musical responses from the glowing tree before ultimately deactivating it, which permits the possibility of the instrumentalist reactivating it later (as described above). The game player also discovers the differing temporal sonic signatures on either side of the threshold and the absence of (most) game audio upon entering the hut through their ongoing exploration.

As they explore, the game player is encouraged to listen to the evolving sonic landscape, including the contributions of both the instrumentalist and the video game. They are tasked with

making deliberate musical choices in response to this landscape, filtered through their perception of the experience in the moment. This process is largely subjective. There is no pre-defined skill level (musical or gaming) barring a person from playing the game and performing a duet with the instrumentalist. Everyone involved in each iteration of *Duet* will perceive success differently, and discussion on this will continue in Chapter 3.

Instrumentalist POV

The game player often starts first by openly exploring the forest. As they explore, the instrumentalist is improvising freely, making musical decisions in response to the audio emerging from the game environment (which is tied to the game space that the player has chosen to explore in that moment). Eventually, the instrumentalist will decide to integrate one of five pre-defined sequences of pitch material into their improv, each of which corresponds to a different tree (see Figure 13). They have been provided these sequences in advance as sheet music and they can reference them on a music stand during gameplay as needed. When the system detects one of these sequences, the associated tree glows and cues its sound, confirming that it has been activated.

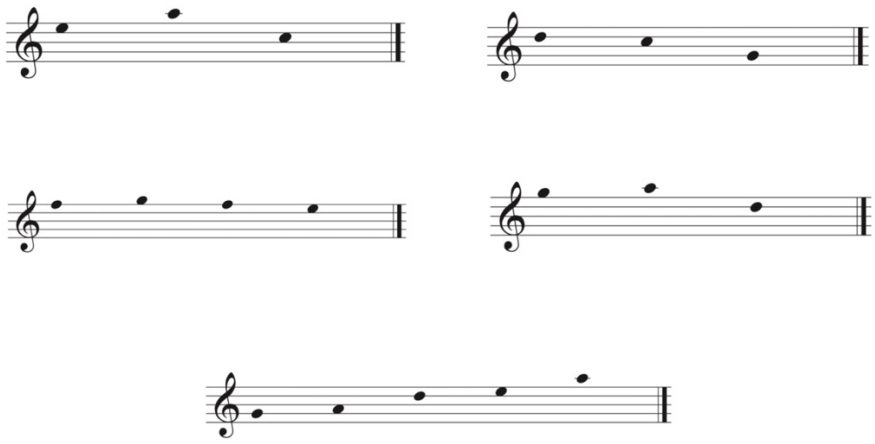


Figure 13 The Five Pre-Defined Sequences of Pitch Material Provided to the Instrumentalist.

Activation of the tree entails an audio-visual change in the game state (the tree glows bright blue and emits musical sound), but this change is only perceived by both players under certain conditions. The game player will only notice the visual change if they choose to look around periodically for glowing trees (or if they are coincidentally gazing in the right direction when the state change occurs), and they will only notice the audio change if they are positioned within the radius of the emissive tree. Whether or not these state changes are perceived by the game player and responded to, the instrumentalist continues to improvise freely, responding directly to the game player's choices as they arise, compelling continued compositional development over the course of the collaborative improvisation. The instrumentalist can also respond to the visual choices that the game player makes in the environment (i.e., where they frame the landscape through the camera in first-person perspective), and discussion on this will continue in Chapter 3.

Additional Discussion of Core Mechanics

Another way to perceive the two players' interactions is to understand that as an alternate controller, the instrumentalist's only option is to create opportunities for the game player within the virtual environment. Think of them as the "on-switch." When considering the flute's role as an alternate game controller, its sole ability is to activate any of the five trees, unlocking the game player's ability to perform most meaningful interactions. This does not guarantee that anyone will hear the music emitted by the trees. That is up to the game player, the audio and visual stimuli they can perceive in that moment, and their choice to engage with the activated tree as a game-object. Ultimately, the game player's actions are what determines which layers of emissive audio succeed in sounding from the activated trees, but the game player's ability to engage with an activated tree at all is an opportunity provided by the instrumentalist.

The instrumentalist can draw upon their entire artistic practice as they improvise. They often have a multi-octave chromatic range to employ—as is the case with the Western concert flute—and, unless specifically aiming to activate one of the trees, they are free to open-endedly improvise over the system's emergent sonic landscape. By activating trees, they are creating opportunities for the game player to expand the musical vocabulary of their instrument. If the instrumentalist and the game player do not work cooperatively, a wealth of options within the system are unobtainable.

The Technology

The project runs Cycling '74 Max in tandem with Unity. All audio game assets live in Max, while Unity drives all modes of interaction between the two players, except for the pitch tracking. The two programs communicate over OSC messaging. The pitch-tracking element lives

in Max, where the *fiddle~* external is used to turn frequency into MIDI note numbers.[52] In *v1*, the pre-defined sequences used to activate the trees were based on MIDI note numbers in registers appropriate for a flute specifically. For *v2*, pitch classes were extracted from the MIDI note numbers. This way, instead of specifying the note D5 specifically, the computer can understand the number "2" as any instance of the note "D," regardless of register (Figure 14). This permits any chromatic, pitched acoustic instrument to perform the work (e.g., an instrument with its natural range in the region of the bass clef, like a trombone, can now be performed for this work with the same ease as a treble clef instrument, like a flute or violin).

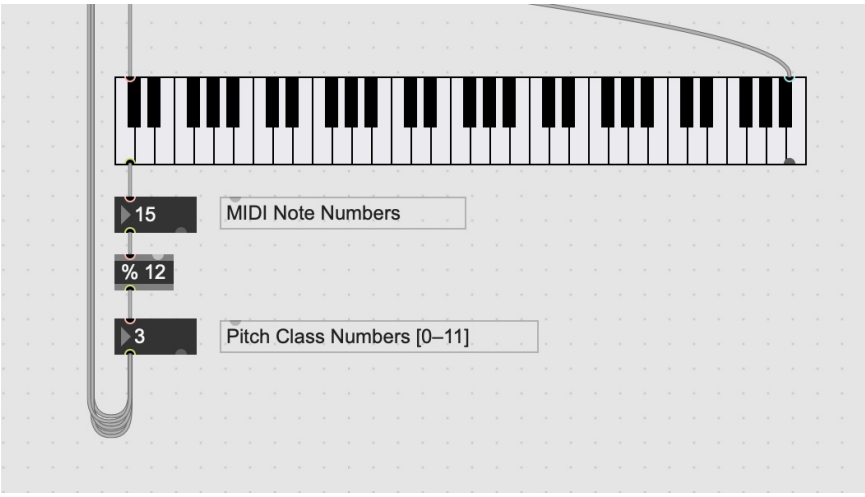


Figure 14 A Snippet of Cycling '74 Max Code that Illustrates Pitch Classes Being Extracted from MIDI Note Numbers

Once Max successfully identifies a completed pitch class sequence, two processes happen simultaneously: 1) the sound associated with the activated tree becomes audible in Max (depending on the player's proximity to that tree game object in Unity) and 2) an OSC message is sent to Unity that is directed to the activated tree, instructing it to glow. The coordinates of

[52] Miller Puckette, Theodore Apel, and David Zicarelli. "Real-time audio analysis tools for Pd and Max/MSP." In Proc. of ICMC, vol. 98, pp. 7-10.

each activatable tree are programmed in both Unity and Max, and the player's coordinates are sent from Unity to Max in real time over OSC messaging. The radius within which each tree's musical layer is audible is programmed in Max and audio fader levels are adjusted in real time, responding to the player's movement and additional choices.

Conclusion

With this chapter's discussion of the design and technology of *Duet* informed by the research work covered in Chapter 1 concluded, we now turn to the next chapter to discuss the musical and artistic elements and issues that characterize this project.

CHAPTER 3: The Art

We now turn to a discussion of the musical and artistic elements and issues that define and are raised by *Duet*. A brief discussion of borrowing or diverging from conventional compositional approaches and structures in game music composition begins the chapter. It is followed by a detailed description of and narrative on the base audio material—a core element of the musical identity of *Duet*. The chapter then concludes with an examination of how the musical composition for this project is not simply a matter of composing material for the performers, but also highly reliant on composing conditions for them.

Composing Music Assets for Video Game Implementation

In video game music composition, non-linear adaptive music techniques such as *horizontal resequencing* and *vertical layering* enable dynamic responsiveness to gameplay. As Winifred Phillips explains in *A Composer's Guide to Game Music*, horizontal resequencing involves composing modular musical segments that can be reordered or triggered based on in-game events, allowing for a flexible narrative structure that mirrors the player's experience.[53] In contrast, vertical layering constructs music as a set of simultaneous audio stems, including melody, harmony, rhythm, and texture, that can be selectively activated or muted in real time to reflect shifting emotional or environmental conditions.[54] These techniques depart from the fixed linearity of traditional media scoring, instead requiring composers to design music that remains coherent and expressive across multiple configurations and transitions, aligning musical form with interactivity.

[53] Phillips, *A Composer's Guide to Game Music*, 95–98.
[54] Ibid, 98–101.

Of these two adaptive techniques, *Duet* only employs vertical layering. These tracks are not designed for horizontal modular resequencing. Instead, each stem is composed linearly. While each has a finite length, they are programmed to loop indefinitely. The activation and deactivation of the trees, as well as the game player's position on the map, is what determines which layers stack upon each other and when.

In either of these techniques for adaptive music in video games, it is conventional to have each modular segment or track share a fixed duration. This ensures that the stems align with one another precisely. This is where *Duet* diverges from the model. While the stems on the pulsed side of the map share a fixed duration, the stems on the elastic side do not. This means that all music assets on the elastic side of the map loop at varying points, shifting in their alignment over time. This was a deliberate choice to indulge the elastic nature of this zone. The stems do not need to be symmetrical to convey the appropriate signals to the players and, as the composer, I appreciate the gradual changes in how the layers stack, which can vary widely depending on the duration of each performance.

The following sections discuss the elements and issues related to composing musical material that are deployed in *Duet* as fixed media assets.

Sound Effects, or a Lack Thereof

In contrast to many commercial video games, minimal sound effects are used in *Duet*. This was done intentionally to highlight the system as a musical instrument without extraneous sounds that are outside of the gameplayer's control. To reinforce the forest landscape of the map, an "ambience" sound asset was added. A pre-produced daytime forest ambience asset from a

sample library was downloaded to employ in *Duet*.[55] This ambience asset conveys a gentle forest atmosphere with bird calls and establishes the foundation for the audio-visual environment, especially in *Duet v1*, where the game's musical elements were sparse and an ambience asset was a necessary touch of atmosphere for the project.

Since there is no combat involved in *Duet*, there was never a need for sounds tied to weapons, attacks, and health indicators. While the game player's sphere throwing ability can be seen as attack-like, the resulting marimba tone can be considered both a musical-device and a sound effect. An argument could be made to include player foley like footsteps or jumping, but I opted not to include these. My vision for *Duet* prioritized musical audio design choices over realistic foley. Fictionalizing the foley in a musical way could also be a viable option, but it is not the direction I chose to pursue on this project. I decided to constrain the musical design to the game elements previously described in Chapter 2.

The Evolution of *Duet v1*

Duet v1 featured a deliberately limited sonic palette, which consisted of only the ambience asset upon the game's initial loading. There was not a Threshold that split the map into pulsed and elastic temporal zones and there were no Huts where the backing track associated with a zone was muted. In *v1*, the sonic signature of the work was established by the activatable tree audio layers only, and those layers were not subject to audio level-based spatialization relative to the game player's location. In other words, the tree audio layers sounded globally, which made them instantly audible at fixed audio level when activated.

[55] Blastwave FX, "Forest and Woodlands," WAV files. Splice. splice.com.

The game's time-of-day (TOD) system also had a highly pronounced role in this version. Since there weren't sonic signatures for either side of the Threshold on the map, the TOD was a large factor in the sonic signature of the work as a whole. Once the TOD system was initialized, audio cues that combined piano, synth, and string instrumentation marked specific time points (e.g., noon, midnight, dawn, and dusk), providing the instrumentalist with a tonal center to guide the improvisation.

The instrumentation was intentionally minimal, ensuring clarity and avoiding sonic clutter. The audio layers associated with the trees were all marimba melodies: some were shorter repetitive loops and others were elongated phrases. Variety emerged from this soundscape as the layers were mixed and matched by the players in performance. The marimba's short envelope and wooden timbre naturally complemented the tree concept, reinforcing its identity and distinguishing these melodic elements from the sustained gestures of the TOD system.

The TOD cues incorporated sustained textures combining piano and synth to achieve sparkling and elongated passages, occasionally enhanced by string phrases. Each TOD cue was composed to evoke specific times of day, with brighter tonal qualities representing dawn and noon, and darker timbres for dusk and midnight (Figures 15-19). The cues provided grounding moments for improvisation, allowing the instrumentalist to momentarily synchronize and respond to the game's chiming of the hours. In *v1*, these cues were 20 to 40 seconds each. For each 24-hour in-game cycle (not hours in *actuality*), players would have heard roughly 40 seconds of these cues per 6 in-game hours. Compared to *v2*, there were more such cues in *v1*. Thus, the TOD cues played a more significant role in *v1* than in *v2*.

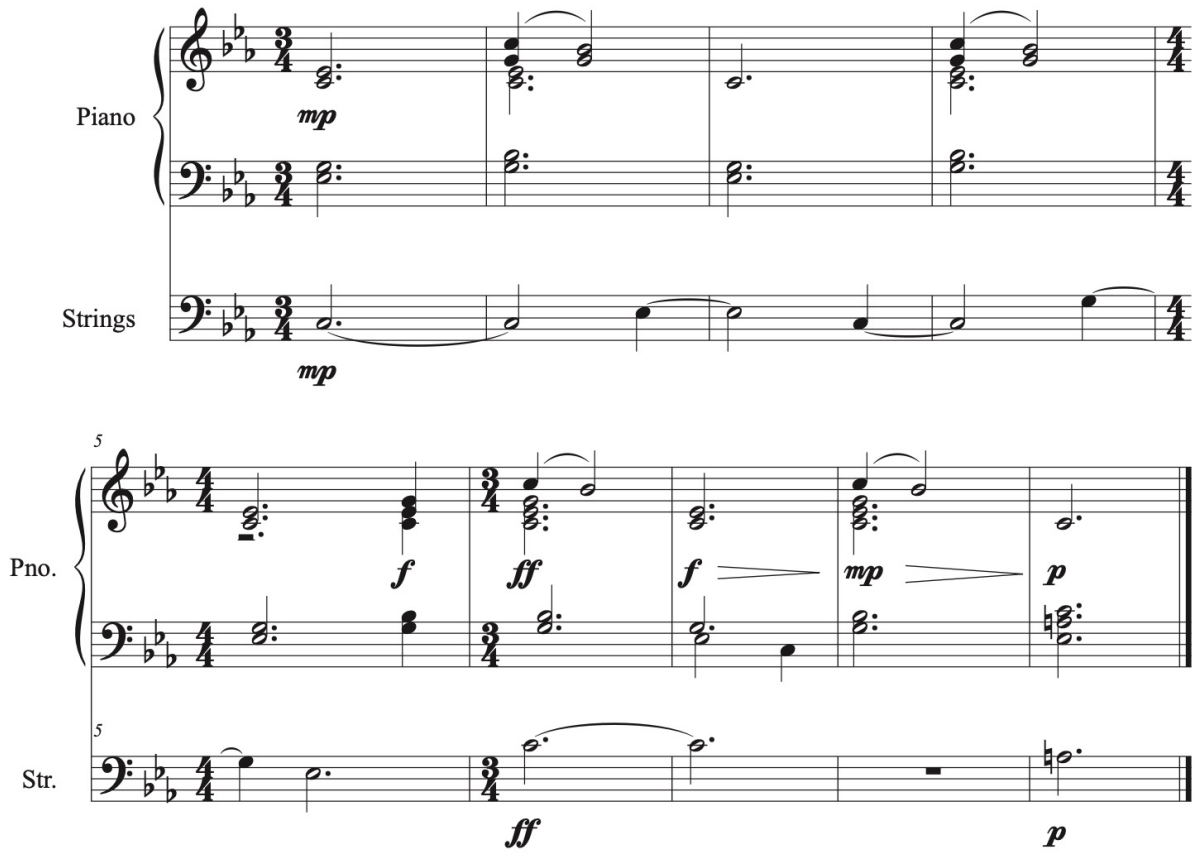


Figure 15 Musical Score Representation of TOD "Midnight" Cue

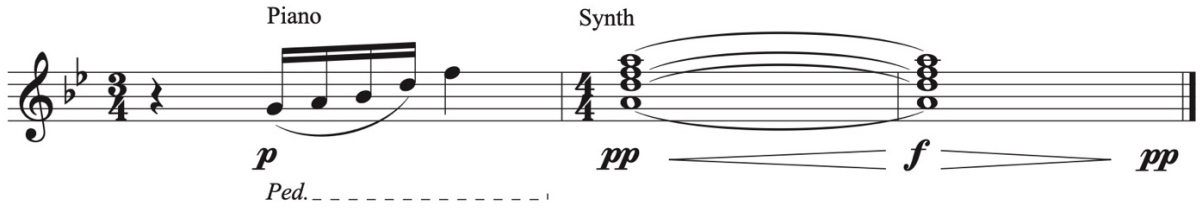


Figure 16 Musical Score Representation of TOD "6am" Cue

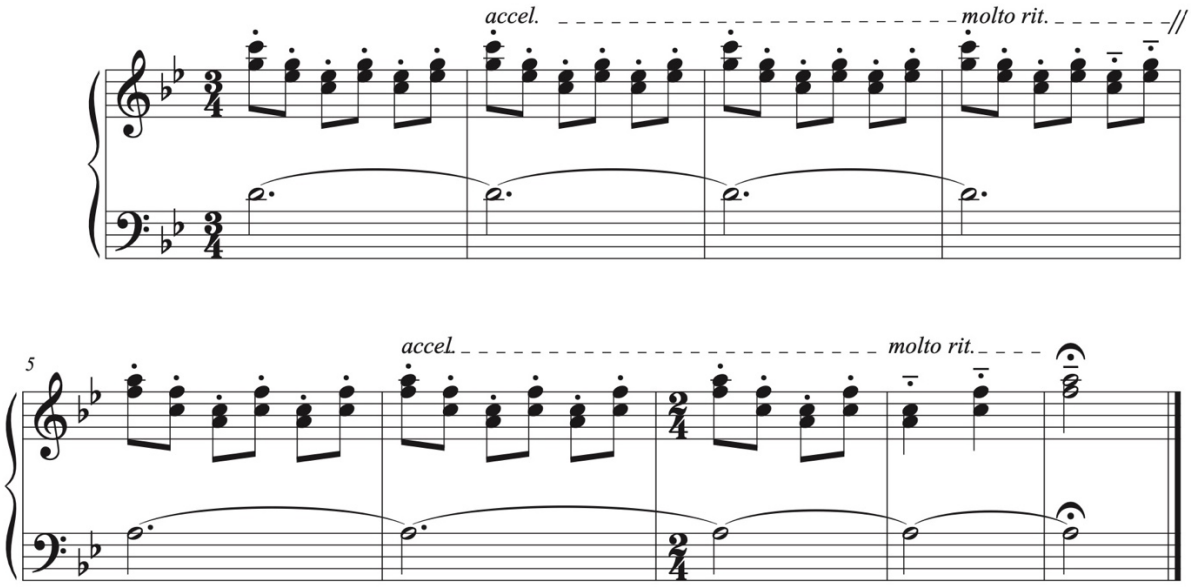


Figure 17 Musical Score Representation of TOD "9am" Cue

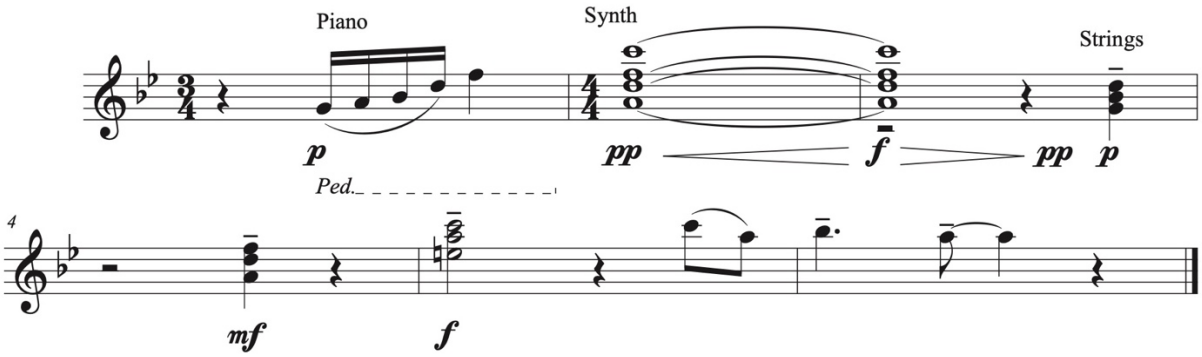


Figure 18 Musical Score Representation of TOD "Noon" Cue

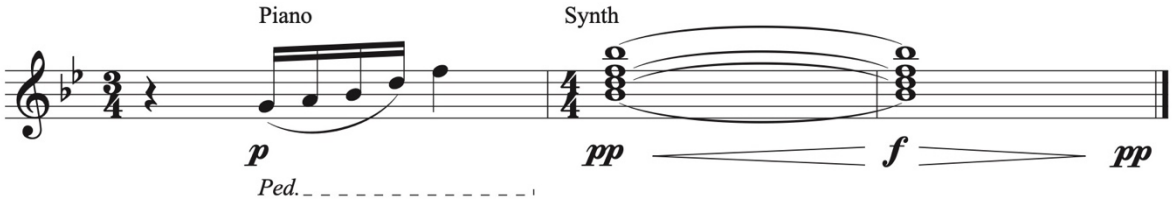


Figure 19 Musical Score Representation of TOD "6pm" Cue

The marimba melodies in *v1* were vertically layered, which made it possible for any one of them to sound individually or they could complement one another in combinations (Figure

20). Since there were no tethers in *v1* like in *v2*, the player only connected with the tree once before deactivating it. However, one key distinction between *v1* and future iterations of the project is that the game player could trigger changes from the set of available marimba melodies to a different set of musical passages arranged for another instrumental timbre. Once a tree had been activated by the flutist and deactivated by the game player, it could be reactivated by the game player. And, upon this reactivation, for example, the set of marimba melodies were replaced with a set of synth swells (saw waves) that had a slow attack and slow release profiles. For the purpose of vertical stacking, these swells were distributed among the activatable trees so that they would not sound simultaneously if enabled in close proximity to one another. Thus, the density of the sonic landscape in *v1* was determined by three factors: 1) How many trees had been activated by the flutist, 2) how many layers were left enabled by the game player, and 3) which timbres the game player chose to keep in the mix.

It was previously mentioned that current versions of *Duet* (versions after *v1*) no longer involve the global activation of these melodic layers, opting to spatialize them by game player proximity instead. The original choice in *v1* to activate the layers so that they were audible globally, regardless of distance between the player and the activated tree, was informed by the convention in game development that musical scoring operates non-diegetically, communicating affective and contextual information to the player without emanating from the fictional game world.[56] However, games, by their dynamic nature, often blur or traverse diegetic boundaries.[57] This blurring is exaggerated further in a project like *Duet* where the game itself becomes a musical instrument. While the activatable trees do not literally sing, the audio assets of *Duet* can

[56] Phillips, *A Composer's Guide to Game Music*, 51.
[57] Karen Collins, *Game Sound: An Introduction to the History, Theory, and Practice of Video Game Music and Sound Design* (Cambridge, MA: MIT Press, 2008), 125–27.

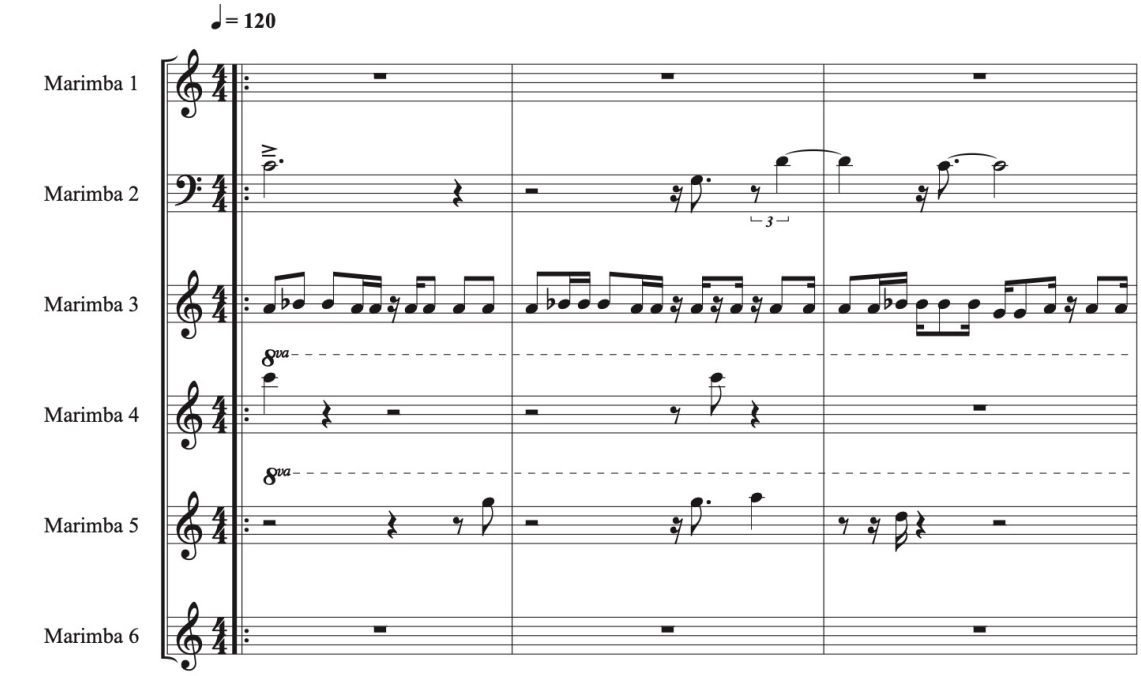
be seen as diegetic if players buy-into a fictional setting where the trees themselves emanate sound under specific conditions.[58] Having the audio emanate from the trees turns them into diegetic objects, and I did not want this added dimension to the work at the time.

My opinion changed when I aimed to increase the game player's agency over the virtual environment and the emerging sound world in *v2*. This change in perspective led to a complicated reimagining of the audio programming between the two versions, but it was well worth it to add to the game player's agency—i.e., more dynamic controls—in improvising musically through *Duet*. What this revealed was that the recommendation by experts in game music composition—to focus on non-diegetic material—was at odds with my conception of how best to create musical material in a game environment where the game player was given the space to be a musical co-improviser. This led to the system employed at the time of this writing, with the mechanics and technology previously described in Chapter 2. Further explanation of the artistic decisions behind the current version of the project, *Duet v2*, will be described below.

Base Audio

As described in Chapter 2, the map is divided into two halves by a translucent threshold (a.k.a., Threshold). The northern side of the map carries a pulsed sonic signature (hereafter named *pulsed zone*) and the southern a temporally elastic sonic signature (hereafter named *elastic zone*). These two audio signatures serve as the foundation for the tree-associated audio layers that stack vertically and they will be referred to as *base audio* for the remainder of this document. On the pulsed zone of the map, the base audio consists of a kick drum sample playing a steady four on the floor beat upon which rhythms can stack. This encourages the flutist to perform rhythmically

[58] Sander Huiberts and Richard van Tol, "IEZA: A Framework for Game Audio," *Gamasutra*, January 23, 2008, https://www.gamedeveloper.com/audio/ieza-a-framework-for-game-audio.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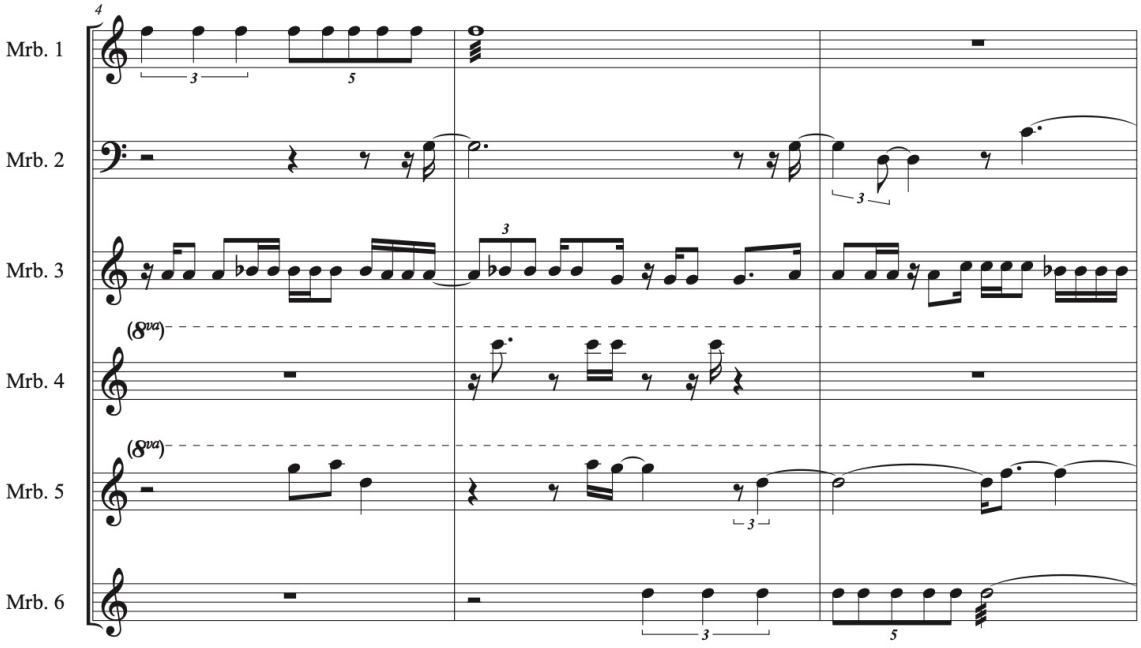
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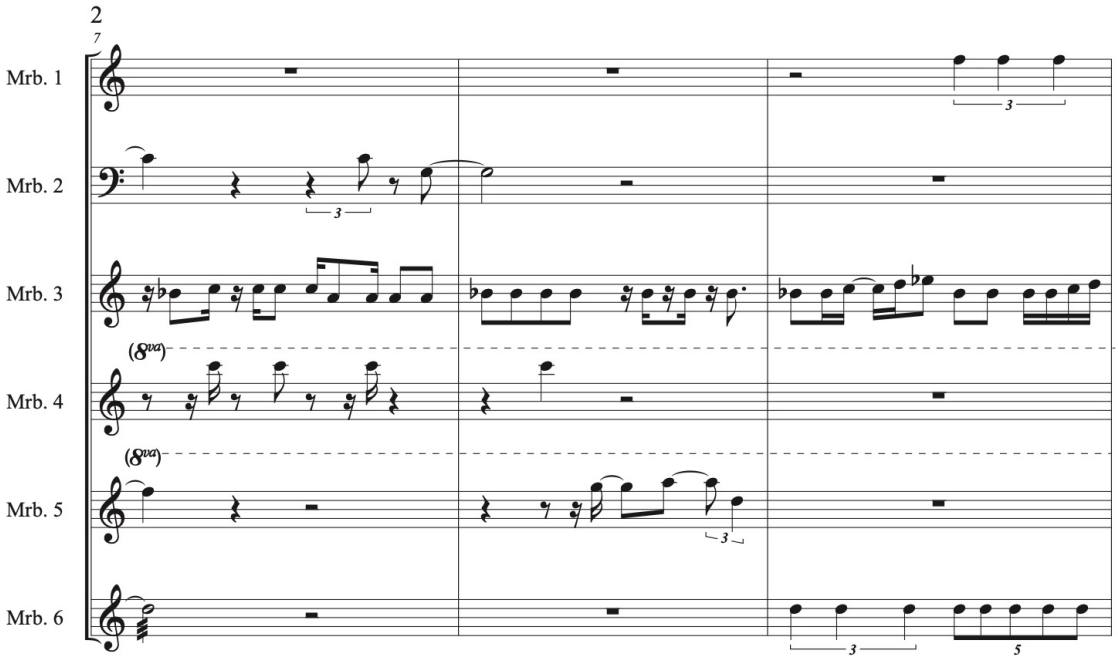
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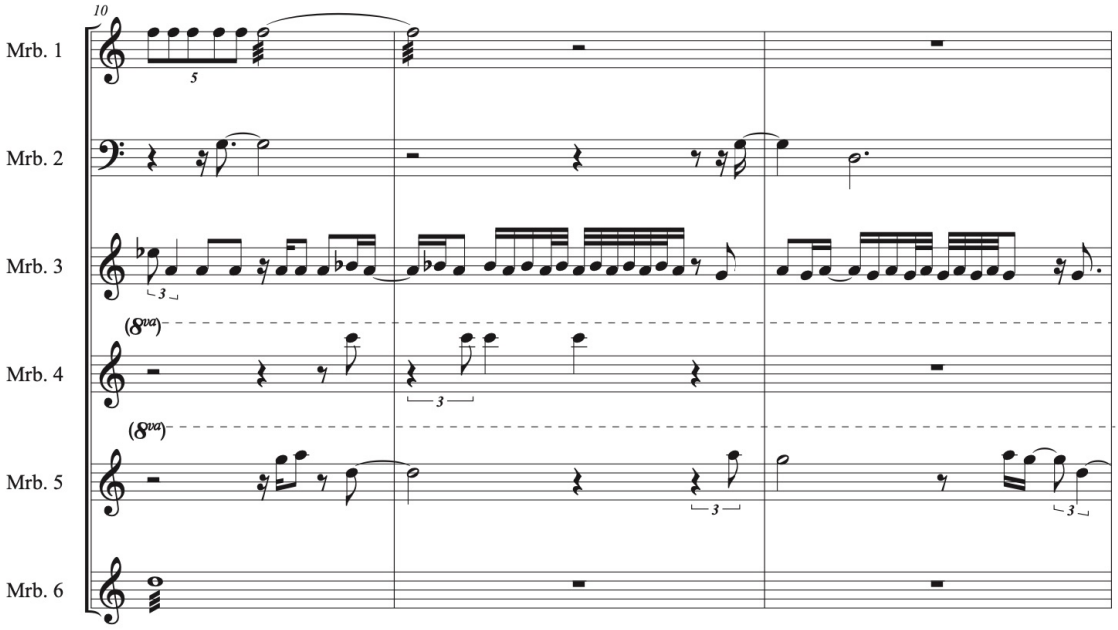
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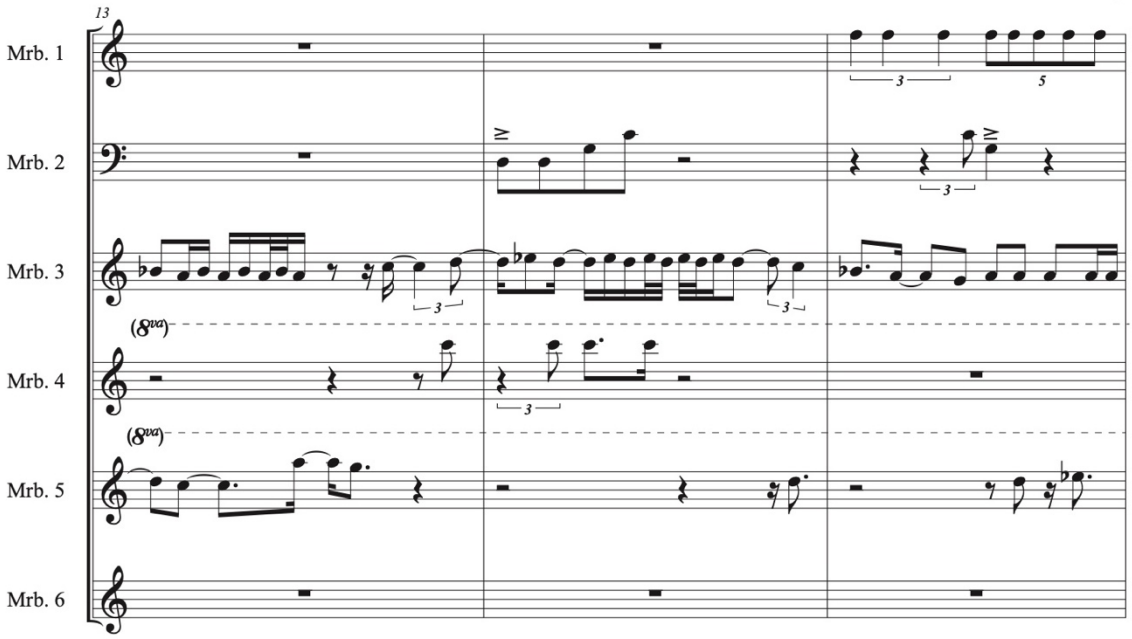
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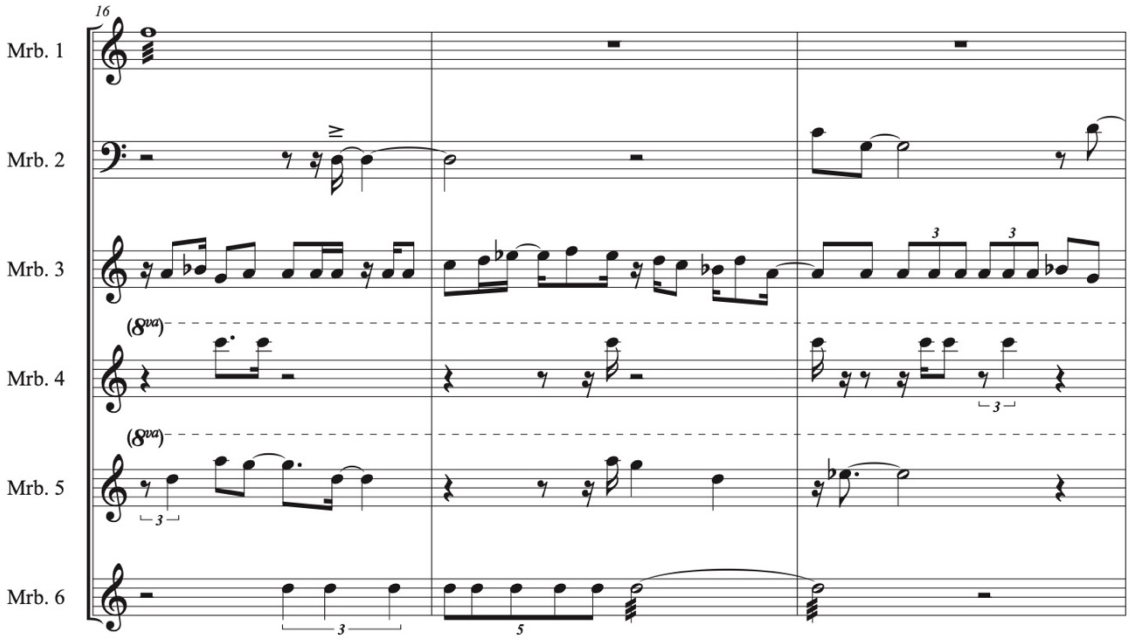
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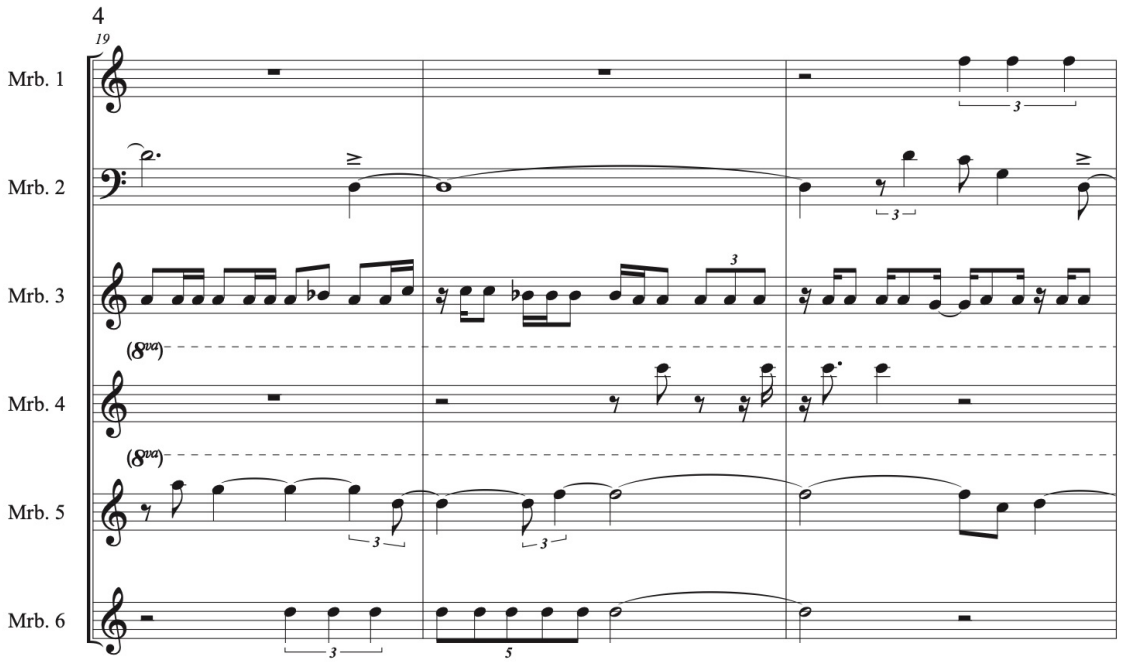
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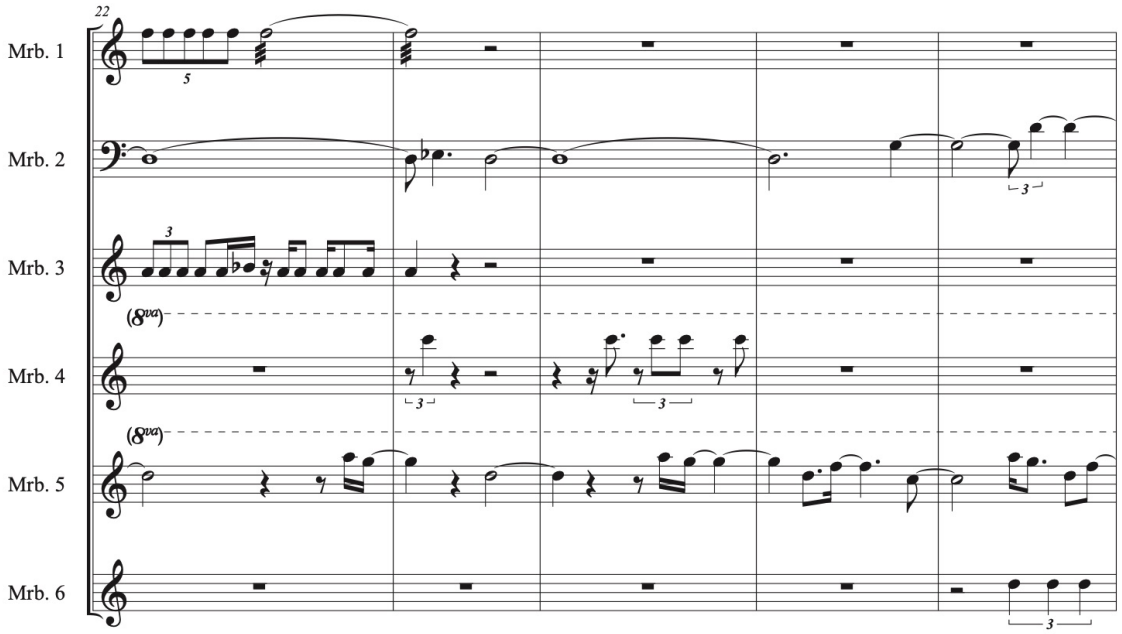
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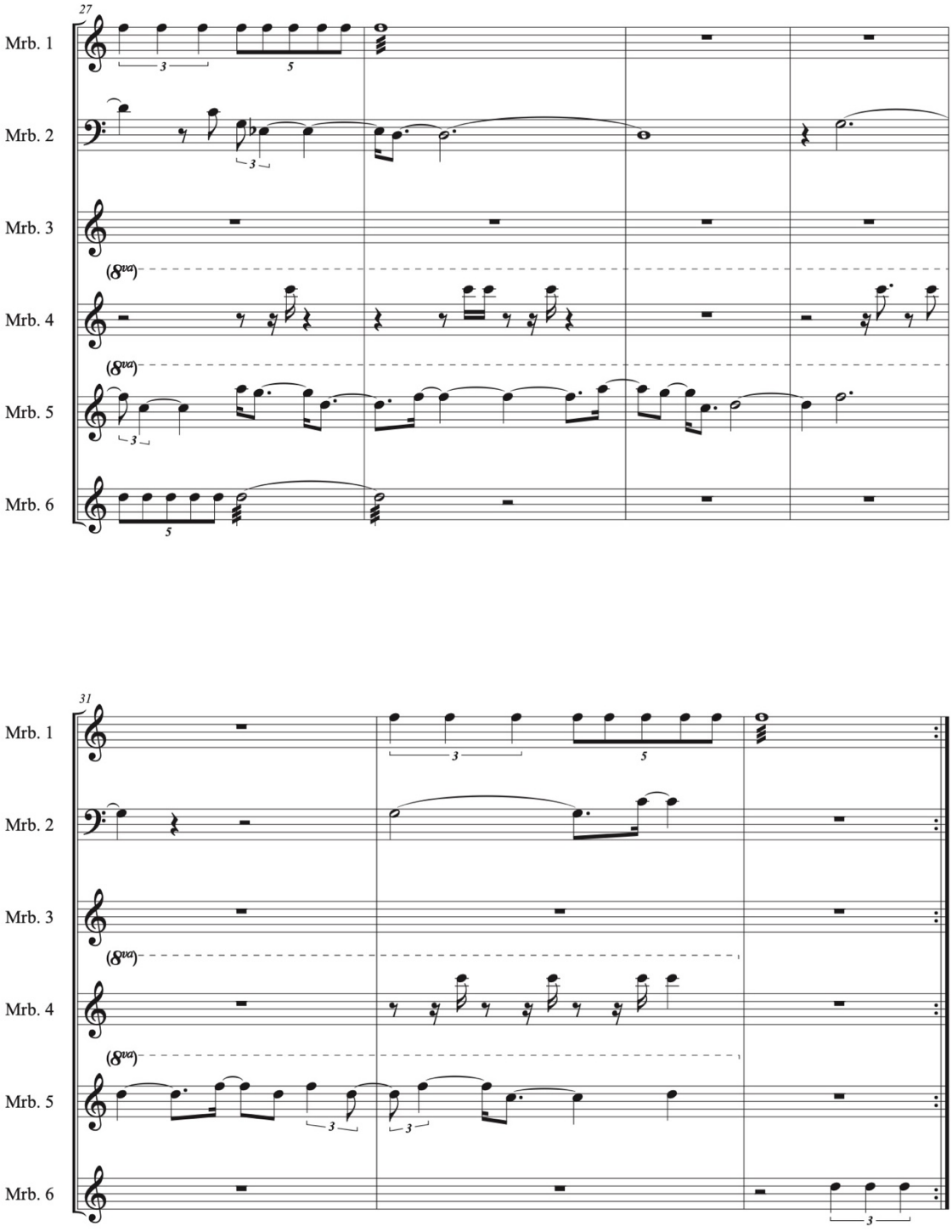

Figure 20 Musical Score Representation of "Duet v1" Marimba Vertical Layering

in response to this pulse, and the stacking tree layers reinforce this association by synchronizing to the pulse. These layers will be described below in the "Pulsed Zone Layers" section of this chapter. The player starts, however, on the elastic zone when *Duet* begins.

Upon loading, all players are greeted with an open fifth interval as the base audio. The synth timbre used is primarily made up of sine waves, although some saw waves are woven into the texture. There is a melodic line that reinforces the open fifth by lilting between the first and fifth scale degrees before leaping up to the second degree of a major scale. This simple melody loops, providing a subtle foundation and tonal center to the improvisation.

The Capstone Concert version of *Duet* (to be discussed in Chapter 4) uses the same base audio for the body (not the introduction or coda) of the work, but the elastic zone is transposed to new tonal centers during two of the three phases of the day. These three phases correlate to specific times of day in the game environment: Morning, Noon, and Night. My standard *Duet* lecture-recital (since the *v2* update) only uses the audio assets that belong to the Morning palette, where the tonal center is C-natural. Noon and Night advance the tonal center to A-natural and G-natural, respectively. Each of these iterations has stacking tree-layers that will be described in the next section.

Elastic Zone Layers

Each audio stem for the elastic zone is grounded in a unique synth timbre. These timbres were developed in Serum by modifying the preset synth instruments.[59] As mentioned previously in the "Base Audio" section, the Morning palette—melodic, harmonic, timbral, etc. material—serves as the foundation for the sonic signature of the elastic zone of the map. Because there are no

[59] Steve Duda, *Serum*, version 1.36b8 (Xfer Records, 2014), xferrecords.com.

signature rhythmic patterns in the elastic zone, the palette becomes an important set of constraints in composing the layers of this zone.

For the entire Capstone Concert version of *Duet*, the Morning palette serves as the foundation for the synth-based orchestration. A default synth timbre is assigned to correspond with each of the three activatable trees in the elastic zone, and evolving changes to these timbres cue the advancement from Morning to Noon and Noon to Night. This is achieved by composing different original melodies for each palette to signal the change in game state as well as by modifying and automating parameters of the synth instruments, including parameters for ADSR envelopes, LFOs, equalization, etc. The passing of time is depicted both audibly and visually through these evolving melodies and the rising/setting sun.

Pulsed Zone Layers

While the elastic zone experiences the evolution of palettes tied to the corresponding phase of day, the pulsed layers remain familiar and steady throughout. The audio stems within the pulsed zone do not change over the course of the Capstone Concert version of *Duet*. They do, however, continue to provide a consistent, and therefore more-readily learnable, foundation for groove-driven improvisation throughout the work. As described in the "Base Audio" section, a kick drum four on the floor beat grounds this zone and two activatable tree-layers can expand the palette: Hi-hat and Toms.

The hi-hat layer particularly stands out, due to its frequency range. It adds a high-frequency percussive element into the composition. The toms and kick drum both share a similar frequency range different from the hit-hat, but the toms motive expands the rhythmic material beyond the four on the floor beat. The three layers complement each other well within the pulsed

zone, and the ability to drag percussive elements between the zones with the tethers adds welcome variety to game player's agency within the elastic zone.

Huts

As discussed in Chapter 2, the Huts are a third zone, in addition to the pulsed and elastic zones, that fashions visual space (in *virtuality*) into the musical environment. All base audio sounds are inaudible within this zone, leaving the players with only the sound of the flute and any audio layers chosen through tethers by the game player, if any. The *v1* prototype of *Duet* did not have any base audio, so there was potential for plenty of sonic space—an intentional compositional feature—built into it. With the player to tree proximity-driven audio features developed in versions after *v1*, base audio became a needed compositional element, but its inclusion meant that the pre-programmed game audio was running nonstop throughout the project. That is where the concept of a Hut was born.

Duet introduced Huts in *v2*, but another expansion of the idea was released with *v2.1*: Reverb zones. This is the first version of *Duet* where any form of live processing on the flute occurs. Not only do these Huts create space, but they also enable the game player to directly influence the sound of the flute by choosing to enter a Hut. By enabling live processing and permitting sparser instrumentation, these Huts stand out as unique spaces that invite more restrained and intimate forms of musical interaction. As opaque domes, these Huts create a temporary shift away from broader environmental activity and redirect toward the two performers alone.

The Influence of these Assets

Both the visual aesthetic of the game and the fixed-media elements of the game audio are grounded in my personal aesthetic as the project's designer/composer. It also leans into my voice as a performer, supporting my personal inclinations to incorporate flute beatboxing, air sounds, and other extended techniques into my performance practice.

While these fixed elements carry my compositional signature and aesthetic, the notion of authorship in a performance of *Duet* is much more complicated. I have often wondered if the prominence of my voice in these elements of the work would prescribe a specific stylistic method of improvising in collaboration with them, but I am pleasantly surprised that this has not been the case in practice. If anything, the game player's "instrument" is more clearly grounded in my voice, due to the fixed-media elements that define its character. For those performing the instrument role on any chromatic, acoustic instrument of their choice, they are welcome to bring their performance and improvisational aesthetic language to the world of *Duet*, no matter their background. *Duet* has been designed in an open-ended enough way so that musical vernaculars other than my own can be superimposed on it without feeling out-of-place. Continued discussion on performance practices with *Duet* will continue in Chapter 3 and into Chapter 4. The core of *Duet* is ultimately much more than its fixed-media components—the system brings people, sound, rules, timing, and attention together.

Composing Conditions within the Human-Computer Interactive Space

While the previous sections addressed the fixed-media materials composed for *Duet*, those assets represent only one facet of the project's musical design. Equally important are the conditions through which performers encounter, activate, and transform those materials through play. *Duet*

is not just a video game soundtrack with live flute accompaniment. It is two players responding to each other in real time as mediated through the design of the interactive environment. Game mechanics, visual cues, timing constraints, and responsive systems shape what the performers can see and do.

This section turns from composing musical assets to composing conditions within the human-computer interactive space. I use *affordances* to describe the possibilities for actions that emerge between performers and the game environment.[60] In game design, affordances can be discussed in relation to what a player perceives they can do: a ledge suggests climbing, a glowing object suggests interaction, a path suggests direction.[61] In *Duet*, these affordances are not only functional, but aesthetic and musical. The system offers the players opportunities for rhythm, timing, attention, coordination, and call-and-response exchange. Each mechanic opens a field of possible actions that can shape the unfolding performance.

Understanding *Duet* through affordances allows one to describe the game space as a *possibility landscape*. A possibility landscape is both the literal terrain of the game world through which the player moves, and a conceptual field of musical options distributed across that terrain. Interactivity is not a supplement to music composition. The interactions themselves are

[60] The term *affordance* originates in James J. Gibson's ecological psychology, where it describes possibilities for action arising relationally between an actor and an environment (Gibson 1977, 1979). Although perception is central to Gibson's account, an affordance does not depend upon an actor successfully perceiving it; rather, perception enables an actor to detect and act upon possibilities afforded through that relationship. The term has since been substantially adapted and debated, particularly following Donald Norman's application of affordances to design and human-computer interaction and his subsequent distinction between Gibsonian affordances and "perceived affordances" (Norman 1988, 1999; see also McGrenere and Ho 2000). The concept has likewise been extended into broader studies of technological materiality and use (e.g., Hutchby 2001). My usage most closely follows Jonas Linderoth's Gibsonian approach to gameplay, in which playing involves perceiving, acting upon, and transforming affordances associated with a game system (Linderoth 2013). Within *Duet*, I therefore use *affordance* to describe a possibility for situated action arising through the relationship between player and game system. Audio-visual cues may direct attention, encourage investigation, or help a player perceive such possibilities, but the affordance refers to the possibility for action itself rather than solely to the cue through which it is communicated.

[61] Jonas Linderoth, "Why Gamers Don't Learn More: An Ecological Approach to Games as Learning Environments," in *Proceedings of Nordic DiGRA 2010 Conference: Experiencing Games: Games, Play, and Players* (DiGRA, 2010), 5–6.

the compositional materials, and the circumstances through which the performers discover when, where, and how musical actions become available are integral to engaging in improvisation-based musical work.

Out of these many possibilities, what ultimately emerges from the landscape is entirely in the hands of the two players, but especially the game player. The cooperation of both players is essential—it is the only way to unlock the full potential of the landscape—but once the flutist creates opportunities for the game player, it is the game player's choices in relation to the landscape that determine what is heard from the video game component of the system.

Spheres

The sphere-throwing mechanic affords the game player a form of rhythmic performance. Because the action can be repeated, timed, delayed, or avoided, it gives the player a way to articulate events in time, as they choose. In this sense, throwing a sphere functions as a performance gesture. The game player has a way to directly respond to the instrumentalist, engage in call-and-response behavior, or create rhythmic punctuation within the broader musical texture.

This affordance expands when the sphere-throwing mechanic is combined with proximity to an activatable tree. When the player is near a glowing tree, the same action no longer affords rhythm alone. It also becomes tied to melodic and/or harmonic transformation within the system. The player's spatial position therefore changes the musical meaning of the gesture. Throwing a sphere in one part of the map may operate primarily as a rhythmic event, while throwing near an activatable tree may produce a more specific musical consequence. In this way, the game's

affordances are not fixed properties of individual mechanics, but relational possibilities that emerge through combinations of action, location, timing, and musical context.

Movement

In *Duet*, player movement functions not only as navigation, but as a time-based musical affordance. The player has access to two distinct movement speeds, walking and running, and these speeds shape how quickly they can respond to musical or visual invitations in the environment. When a glowing tree appears across the map, the player's decision to approach it introduces a predictable duration before interaction is possible. This travel time becomes part of the musical form: the distance between the player and the object creates anticipation, delay, and pacing before the next event can occur. In this sense, spatial layout is translated into temporal structure. The player does not trigger musical change instantaneously; they must move toward it, and the available movement speeds determine the range of possible response times.

The player's movement choices also have consequences for the flutist. Because environmental interactions require proximity, the flutist can observe the player's trajectory and anticipate when a new game state may be activated. A distant object therefore creates a performative interval between intention and action. During this interval, the flutist may sustain the current texture, prepare for transition, or respond to the player's movement as a visible cue. The game's spatial design thus supports a form of co-performance in which musical timing emerges from the relationship between player navigation, environmental distance, and instrumental response, possibly akin to knowing where one is in a section of a piece and building towards several beats and/or measures away from the transition to the next section.

Movement, Tree Activation, and Adjustments via Tethers

Once the flutist activates a tree, the player's distance from that tree determines the degree of audibility of its associated fixed-media layer. Approaching the tree produces a crescendo while moving away from it produces a diminuendo, making navigation musically consequential. As Mark Grimshaw and Gareth Schott explain, such sonification "provides a relational framework for the player to begin to contextualize themselves within the acoustic spaces." [62] The changing volume directs attention toward the activated tree and draws the player to it. The glowing tree and emerging audio layer invite the player to notice, approach, and investigate. Because the sound grows as the player moves closer, the system gives the player feedback that their movement matters. Due to the distinct player movement speeds, the player cannot instantly arrive at a distant tree. The decision to approach an activated tree carries with it a duration. The time it takes to cross the map becomes a part of the musical form. The flutist might even internalize the location of the tree visually, after becoming familiar with the map, and contribute, at moments, material associated with that tree prior to the associated fixed-media layers becoming audible.

The flutist creates opportunities for the game player by activating trees, but the game player determines what happens next. It is possible that they may pursue, ignore, intensify, or eventually lock that layer into the mix. If they choose to lock the fixed-media layer in by colliding with the activated tree, it demonstrates a commitment to the layer. The temporary, proximity-based layer becomes a persistent global layer represented by a tether, and the tether itself visualizes the connection and acknowledges this change in state of the layer—that is to be

[62] Mark Grimshaw and Gareth Schott, "Situating Gaming as a Sonic Experience: The Acoustic Ecology of First-Person Shooters," in *Situated Play: Proceedings of the 2007 Digital Games Research Association Conference* (Tokyo: Digital Games Research Association, 2007), 477.

heard globally, irrespective of the distance between the player and its associated tree. The ability to cut this tether from anywhere on the map affords game player agency to abruptly change the global mix of the musical material generated by the game. The ability to cut tethers from a distance avoids overburdening the game player (and by extension the flutist) with being locked into distance as being a primary musical constraint.

Huts

The huts create localized interior listening spaces within the game environment. When the player chooses to enter a hut, a significant audio state change is triggered. The base audio disappears and reverberation is applied to the flute. What the hut affords is a shift in the listening conditions. The hut functions as both an environmental object and an interactive audio boundary. It is a space that provides a respite from the base audio layer and thus adds more options for the players to construct the musical form that emerges from a performance.

Attention, Thoughtful Design, Agency, and Flow

The mechanics described above establish a possibility landscape for *Duet*: they define what the performers can do, what kinds of musical responses those actions produce, and how those responses can be altered over time. Yet affordances alone do not fully explain how the work functions in performance. A mechanic may afford an action, but that action only becomes meaningful when the co-performer perceives it, attends to its consequences, and chooses how to respond. For this reason, the affordances of *Duet* must also be understood in relation to attention, agency, and flow.

Attention

In recognizing that playing a game and playing an instrument are comparable through a shared sense of play, I am interested not only in the surface resemblance between the two activities, but in the conditions that allow them to become mutually understood within a single performance system. In *Duet*, the game player is not simply triggering sounds, and the flutist is not simply providing musical accompaniment. Both performers attend to an evolving audio-visual environment in which their actions shape the conditions of each other's choices. The success of the work depends on more than if its mechanics are functional. It depends on whether the design clearly communicates what kinds of actions are possible, whether those actions produce legible feedback, and whether the performers are able to remain present within the shared play-space.

Play, as discussed in Chapter 1, is often understood as voluntary activity: the game begins when its players agree to begin.[63] Huizinga's concept of the *magic circle* is useful here because it emphasizes the temporary space produced by play, a space in which ordinary actions can take on new meanings.[64] In *Duet*, this temporary space is both musical and ludic. The performers enter into a new type of shared environment where musical decision making takes the form of, for example, making trees glow and throwing spheres—not exactly ordinary things that happen or one does in *actuality*.

This shift towards *play* and the *magic circle* is not without the need for performers to pay attention. The performers must attend to what they see, what they hear, and how the system changes in response to their choices. The game player reads the environment visually through landmarks, glowing objects, spatial distance, and movement speed. They also read the environment sonically through the emergence, disappearance, and proximity of musical layers.

[63] Salen and Zimmerman, *Rules of Play,* 96.
[64] Huizinga, *Homo Ludens,* 10.

The flutist must also pay attention. They attend to the game player's movements and to the changing state of the environment, adapting their own musical actions in response to what the player has made possible. The visual environment helps the players understand where action is possible, while the sonic environment provides invitations for joint musical exploration.

Thoughtful Design

Thoughtful design does not mean removing uncertainty from the experience. It means designing uncertainty carefully enough that performers can explore without becoming lost. Designing a system that can be engaged with in this way is essential to Winifred Phillips who asserts that the player's *flow* state is "threatened the instant that the player feels the need to pause and ask, 'What am I supposed to be doing now?'"[65] *Duet* relies on several familiar schemas from video games: a first-person perspective, a navigable forest environment, glowing objects, ambient sound, and a keyboard-and-mouse control scheme that resembles conventional PC gameplay. These elements ground the game player in a familiar setting. They suggest that the environment can be explored, that certain objects matter (more than others), and that movement through space will produce reasonably expected consequences.

At the same time, *Duet* deliberately withholds some of the instructions that a player might expect from other types of video games. There are no overt objective indicators, score, time limit, loss state, or the explicit objective that determines whether the player has succeeded or not. It was a creative decision to omit these types of constraints from the design. Through trial and error, the game player discovers the values embedded within the game environment through interaction with it. When the game player notices the glowing of the activated tree and

[65] Phillips, *A Composer's Guide to Game Music*, 42.

approaches it to discover the crescendo of its associated audible layer, that provides actionable feedback. They are learning how to play the game and how to meaningfully interact with the system through that exchange. Gameplay interactions do not instruct the player through verbal explanation alone. Instead, they teach through what James Paul Gee calls a cycle of "probing": action, response, and the subsequent adjustment of the player's understanding.[66] Players experiment, reflect, adjust, and repeat.

This design approach resonates with Mary Flanagan's concept of critical play, particularly her emphasis on play environments that pose questions about human life and social interaction.[67] *Duet* reframes the idea of cooperation. Instead of the two players pursuing a win or loss condition, they continue to shape the conditions upon which the other acts. The flutist creates opportunities for the game player within the environment, while the game player takes the lead to determine how, when, and for how long those possibilities become part of the musical texture. The value of this exchange is not quantified by any metric other than personal enjoyment and a form of synergy that characterizes a successful musical performance. The system keeps the two players engaged with one another and the system itself as they make music together.

Duet does not attempt to replace the acoustic instrument or simulate the depth of instrumental fluency. Instead, it creates a performance interface through which non-specialist players can participate in musical decision-making. The keyboard and mouse remain familiar objects, but within the magic circle of the performance, they become tools for shaping form, texture, and attention. The goal is to create a shared system in which both performers can act, listen, respond, and discover the musicality of play.

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[66] James Paul Gee, *What Video Games Have to Teach Us about Learning and Literacy* (New York: Palgrave Macmillan, 2003), 107.
[67] Flanagan, *Critical Play*, 33.

Agency

A full discussion of agency as a value in gameplay and improvisation is not within the scope of this work. In the case of *Duet*, agency is the means by which perceived affordances become musical choices. A player may recognize that an activated tree can be approached, but they still decide whether to approach it, how quickly to move toward it, whether to collide with it, whether to preserve the resulting tether, and when to cut that tether away. Each of these choices has musical consequences. Walking toward a tree gradually intensifies its audible layer. Running compresses that change into a shorter span of time. Attaching a tether alters a proximity-based relationship into a full and stable global presence. Detaching a tether removes that presence and reshapes the global musical mix. The player's agency is therefore not abstract. It is exercised through specific temporal, spatial, and musical decisions afforded by the game to the gameplayer.

This agency, though, is constrained by the system. Simon Penny calls this "a constrained freedom—the opportunity of free action within a constrained gamut of possibilities defined by code, interface design, and input modalities."[68] This limited set of possibilities made available, through their use, render expressive results. These possibilities need to be clear enough so that a new player can act, but open enough that their actions still feel personally and musically consequential. This sense of knowing the right kind of thing to do supports Winifred Phillips claim that "in order for the activity of gameplay to become immersive, the actual procedures must reach the state of an automatic response, similar to a reflex action."[69] In this way, the system does not prescribe. It instead helps the game player internalize the range of possible actions in service of enabling more direct paths to binding action with consequence.

[68] Penny, *Improvisation and Interaction, Canons and Rules, Emergence and Play*, 402.
[69] Phillips, *A Composer's Guide to Game Music*, 42.

The feedback loop between action and consequence is especially important. As suggested in Chapter 1, when players receive immediate audio-visual confirmation that their choices matter, they are more likely to continue exploring. A glowing tree confirms activation. A crescendo confirms approach. The presence of a tether confirms attachment. A globally audible layer confirms that a local decision has changed the larger musical texture. These responses help the player understand their own agency within the environment and thus creates the conditions needed to link action with expression. They also help the flutist evaluate how the game player interprets the possibilities and patterns of decision-making made available through the activation of trees that the player controls by choosing to play one of the handful of predetermined pitch-class motifs.

Flow

Flow becomes possible when this loop of attention, action, and feedback remains intact. Csikszentmihalyi describes flow as the state in which "people become so involved in what they are doing that the activity becomes spontaneous, almost automatic; they stop being aware of themselves as separate from the actions they are performing."[70] This concept is especially useful for *Duet* because it applies both to musical performance and to games. A skilled instrumentalist may experience flow through the embodied familiarity of playing their instrument, while a game player may experience flow through responsive movement, clear feedback, and an appropriate balance between challenge and capability. *Duet* attempts to bring these conditions into a shared performance environment.

[70] Csikszentmihalyi, *Flow*, 53.

What is challenging here is that *Duet* must support performers with very different skill backgrounds. The flutist enters with enough years of instrumental training to produce a reasonable amount of skill to trigger activation of the trees, for example, while the game player may or may not identify as a musician or gamer and still control the game environment in a manner that will appear acceptable. Throughout the development of *v1* and *v2*, I have acted as the primary instrumentalist on flute. (Chapter 4 discusses the Capstone Concert which includes moments where other instrumentalists perform with the system). This produces a possible skill and familiarity gap between the instrumentalist (myself) and a game player invited from the audience playing *Duet* for the first time. For this reason, the game must be playable at a basic level while still supporting the more nuanced musical possibilities the game player can learn to control. A first-time player can understand that glowing trees invite approach and that contact changes the sound. A more experienced or attentive player may begin to shape larger musical arcs by timing their movement, choosing paths across the map, or responding to the flutist's phrasing. The same affordance embedded within the game can therefore support multiple depths of engagement, supporting, as discussed in Chapter 1, the possibility of flow states emerging from the dynamic created when skills meet challenges.

Conclusion

This chapter discussed the key musical and artistic elements and issues that guide the development of Duet as not just a gaming system, but a musical work that is framed within a gaming experience. We now turn to the final chapter of this dissertation which discusses how *Duet* is/was deployed in public presentations and performances.

CHAPTER 4: Duet in Practice

The previous chapters discussed the underlying research, design, and musical aspects of *Duet*. This chapter focuses on reflections on *Duet* in practice. Live demonstrations and presentations of *Duet* revealed how the system behaved in performance with different audience volunteers, which informed my iterative design decisions. The reflections that follow are drawn from my experience presenting, performing, and demonstrating *Duet* in public artistic and conference contexts, including the Capstone Concert for this dissertation project. They are not presented as the results of a formal user study, audience study, or human-subjects research protocol. Rather, they function as practice-based observations: moments from the work's life in performance that helped me understand how the system was being perceived, where its design succeeded, and where future iterations might be refined. These observations and reflections inform how I can continuously refine and iterate upon the conditions I have composed for improvised musical interaction among performer, player, and game system.

Early Demonstrations—*Duet v1*

Before *Duet* reached its *v2* form, the project existed as a simpler but already performable prototype. During the 2023-24 academic year, while I was developing *v1,* I presented this early version of the work across a variety of settings, including game audio conferences, academic colloquia, music conferences, informal game-development contexts, and ludomusicology spaces (Figure 21). These presentations were not designed as formal user studies, nor do I treat them here as research data about audience members or volunteer players. Instead, I understand them as practice-based encounters through which the project's artistic, technical, and methodological questions became clearer.

Year	Event	Location	Field	Type
2023	GameSoundCon[71]	Burbank, CA	Game Audio	Industry
2024	Claire Trevor School for the Arts Graduate Student Colloquium	UC Irvine	Arts	Academic
2024	Integrated Composition Improvisation and Technology Graduate Student Colloquium	UC Irvine	Music	Academic
2024	University of Toronto Music Graduate Conference[72]	U Toronto	Music	Academic
2024	Music by Women Festival[73]	Mississippi University for Women	Music	Academic / Professional
2024	Conference Associate[74] Micro-Talks at the Game Developers Conference[75]	San Francisco, CA	Games	Industry
2024	Integrated Composition Improvisation and Technology Showcase Concert	UC Irvine	Music	Concert
2024	Ludo2024[76]	Mataró, Spain	Ludomusicology	Academic
2024	GameSoundCon[77]	Burbank, CA	Game Audio	Industry
2025	Music and Gaming Festival (Super MAGFest)[78]	Oxon Hill, MD	Games & Music	Fan Convention
2025	Z3 Student Games Convention[79]	UC Irvine	Games	Expo

[71] SoundCon LLC, GameSoundCon, https://www.gamesoundcon.com.
[72] University of Toronto Music Graduate Students' Organization, UofT Music Graduate Conference, https://mgsa.sa.utoronto.ca/conferences.
[73] Mississippi University for Women, Music by Women Festival, https://www.muw.edu/musicbywomen.
[74] CALounge, Conference Associate at GDC Application, https://www.calounge.com/application.php.
[75] Informa, Game Developers Conference: Get Involved, https://gdconf.com/get-involved.
[76] Ludomusicology Research Group, Ludo2023 Programme and Registration, https://www.ludomusicology.org/ludo2024/.
[77] SoundCon LLC, GameSoundCon, https://www.gamesoundcon.com.
[78] MAGFest Inc., Super MAGFest, https://super.magfest.org/.
[79] VGDC at UC Irvine, Z3 Student Games Convention, https://vgdc-uci.framer.website/events/z3.

2025	IndieCade Creators Retreat[80]	Los Angeles, CA	Games	Industry / Expo
2026	Guest Lecture	UC Irvine	Music	Academic
2026	Video Games & Music Convention (VGM Con)[81]	Plymouth, MN	Games & Music	Fan Convention
2026	PhD Capstone Concert & Lecture-Recital	UC Irvine	Music	Academic / Concert
2026	North American Conference on Video Game Music[82]	Rensselaer Polytechnic Institute	Ludomusicology	Concert / Expo
2026	Guest Lecture	Chapman University	Music	Academic
2026	Digital Games Research Association (DiGRA)[83]	Maynooth University	Games	Academic

Figure 21 Chronological List of Events where Duet has been Presented

This distinction matters because *Duet* developed through public performance. The prototype was not only built privately and then shown after completion—it was repeatedly performed, explained, transported, questioned, and stress-tested in front of different communities. Each presentation placed the work under slightly different conditions. Some contexts emphasized game design, some emphasized music and improvisation, some emphasized academic framing, and each foregrounded the practical logistics, such as making the system run in unfamiliar rooms. Taken together, these events helped me understand what the project was asking of me as a composer, performer, designer, and researcher.

Duet v1 already contained the central premise of the work: a flutist and a game player co-create a musical performance through a video game environment. The flutist performs pitch-based cues that the system recognizes, causing trees in the game world to glow and musical

[80] IndieCade, IndieCade 2025 Creators Retreat, https://www.indiecade.com/creators-retreat/.
[81] Gamer's Rhapsody, VGM Con, https://vgmcon.org/.
[82] NACVGM, North American Conference on Video Game Music 2026, https://nacvgm.org/.
[83] DiGRA, DiGRA 2026: Intersectional Pleasures, https://www.digraconference2026.com/.

layers to enter the texture. The game player navigates the environment in first person, deciding which areas to explore and when to interact with glowing trees. The system therefore distributes musical agency across flute performance, game navigation, visual feedback, programmed audio, and the player's exploratory choices. Even in this early version, the work was not simply a piece of fixed media with a visual component. It was a performance framework that required listening, response, and negotiated attention between human performers and computational systems.

One of the major insights from this period was that the project's portability was not secondary to its artistic identity. I have often imagined *Duet* as a work that can meet audiences in a variety of spaces rather than requiring a single specialized venue. Presenting the *v1* prototype across different rooms and institutions revealed the promise of this goal, but also some technical considerations to be mindful of. The system could travel, but each site introduced new constraints: available speakers, room layout, projection setup, and performance monitoring, to name a few. Through the lens of organology, one can refer back to the question of musical aesthetics shaped by the portability and design of more conventional instruments, in 19th century European orchestral instruments, for example.[84] One might also look to more recent work on designing computer music controllers. As Perry Cook states, "...the music we create and enable with our new instruments can be even more greatly influenced by our initial design decisions and techniques."[85] There is more work that can be included to piece together the relationship between portability, design, and musical aesthetics. A full survey on the literature that can provide a theoretical framework for that triumvirate is out of scope here. For now, stating that these

[84] Simon Waters, "Performance Ecosystems: Ecological approaches to musical interaction" (paper presented at the Electroacoustic Music Studies Network Conference [EMS-07], Leicester, UK, June 12–15, 2007), 5, http://www.ems-network.org/IMG/pdf_WatersEMS07.pdf.
[85] Perry R. Cook, "Principles for Designing Computer Music Controllers," in *Proceedings of the 2001 International Conference on New Interfaces for Musical Expression (NIME 01)* (Seattle, WA, 2001), 1.

practical details shaped the work alongside its more explicitly compositional materials is important to note.

The *v1* presentations also helped me understand how the project's meaning shifts depending on disciplinary context. In game-oriented settings, discussion often moved toward mechanics, objectives, rule systems, and possible forms of player agency. In music-centered settings, the work prompted questions about improvisation, performance practice, musical voice, technology, and the relationship between fixed and live material. In ludomusicology contexts, the project seemed to resonate more immediately as part of an existing discourse around games, music, play, and interactive experience. These experiences helped me recognize how many explanatory frames *Duet* must hold at once. The project is not only a composition, not only a game prototype, not only a technological system, and not only a performance. It requires language that can move between these categories without reducing the work to any single one of them.

The early presentations also clarified the importance of technical resilience. In one performance, the player was able to leave the intended playable area of the map, entering a lower decorative terrain that had not been designed for interaction. From a software-development perspective, this was a bug. From a performance perspective, however, the event was more complicated. The performance did not come to a halt. The time-of-day (TOD) system continued to progress, the game environment remained visible, the sonic layers could still accumulate, and I could continue responding musically to the changing audio-visual state. At the same time, a crucial part of the intended interaction had broken—once outside the playable area, the player could no longer interact with the trees. This moment revealed both the robustness and the limitations of the prototype. It showed me that *Duet* could survive certain kinds of failure, but

also that the boundaries of the play-space needed to be more carefully designed if player agency was to remain musically meaningful in the normative play mode.

This incident also affected how I give consideration to Philip Auslander's notion of *liveness*.[86] In a live interactive work, mistakes and unexpected actions are not external to the performance. As Lucy Suchman addresses in *Human-Machine Reconfigurations: Plans and Situated Actions*, unplanned actions and events become part of the situation that the actors—here the performers—must navigate, and that "the structuring of behaviour is done not a priori, but in reflexive relation to circumstances that are themselves in the process of being generated, through the same actions that they in turn work to make comprehensible."[87] This early experience helped me recognize that *Duet* needed to be designed for contingency. The question was not only, "How do I prevent failure?" but also, "What remains musically possible when something goes wrong?," and, more simply, "What remains musical when something goes wrong?" Speaking to the latter on aestheticizing failure, Kim Cascone, in "The Aesthetics of Failure: "Post-Digital" Tendencies in Contemporary Computer Music," writes, "it is from the 'failure' of digital technology that this new work has emerged: glitches, bugs, application errors, system crashes, clipping, aliasing, distortion, quantization noise, and even the noise floor of computer sound cards are the raw materials composers seek to incorporate into their music."[88] Those questions became important to consider in the project's later development.

Another central lesson from the *v1* period concerned duration. The prototype's TOD system functioned as a kind of environmental clock. It gave performers a shared sense of pacing

[86] Auslander, *Liveness: Performance in a Mediatized Culture* (London: Routledge, 1999), 54–55.
[87] Lucy Suchman, *Human-Machine Reconfigurations: Plans and Situated Actions*, 2nd ed. (Cambridge: Cambridge University Press, 2007), 19.
[88] Kim Cascone, "The Aesthetics of Failure: 'Post-Digital' Tendencies in Contemporary Computer Music," *Computer Music Journal* 24, no. 4 (2000), 13.

by changing the visual state of the world and triggering fixed audio events at recurring points in the day/night cycle. In shorter performances, this system helped ground the improvisation. It conveyed a sense of progression without requiring a conventional score or fixed timeline. However, during a longer presentation, I realized that the system had to be recalibrated to suit the intended duration. When the day/night cycle repeated too quickly, fixed sonic events returned too frequently, and the work began to feel overly repetitive. This revealed that open-ended improvisation still requires compositional pacing. Flexibility alone is not enough. The system needs temporal proportions that support sustained musical attention.

Because *v1* was built around my own flute performance, audio materials, and visual/musical preferences, these presentations also raised questions about artistic voice and future portability between performers. At this stage, *Duet* was very much shaped by my own performance practice, and my familiarity with the system influenced how I performed it, how I listened to it, and how I anticipated its responses. This remains true of the project more broadly. Even in the latest version, the overall design and fixed materials continue to carry my artistic stamp. However, subsequent performances—particularly those involving other musicians—have shown that this authorship does not constrain the work as much as I initially expected. Once the system is in the hands of different performers, their interpretive choices, musical instincts, and interactions with the game environment significantly reshape the experience. The project retains traces of my voice, but it does not remain mine in performance. Instead, each group of performers brings something distinct to the work, allowing it to feel newly owned in each iteration.

Looking back, I understand the *v1* presentation cycle as a period of problem-discovery. The prototype worked well enough to perform, but each performance revealed a pressure point.

The work needed 1) clearer technical/navigation boundaries in the virtual space, 2) a more flexible relationship between duration and musical pacing, and, most importantly, 3) a stronger account of player agency. These insights helped define what the project needed to become for *v2*.

For this reason, I do not treat the pre-*v2* period as obsolete. Although later versions of *Duet* substantially expanded the system, the *v1* presentations remain essential to the dissertation because they document the first public life of the project, and they show how live presentation became part of my compositional method. Through performance and demonstration of *v1*, it revealed what the artwork itself needed for the next version.

Throughout this stage of development, *Duet* has taught me that designing an interactive music-game system is not only a matter of programming mechanics or composing audio assets. It is a matter of composing conditions: conditions for attention, conditions for agency, conditions for failure and recovery, conditions for shared timing, and conditions for musical play. The subsequent development of *Duet* builds directly from these early lessons.

Global Observations—Where *Duet* is Today and What the Future Might Hold

Across multiple performances and demonstrations, I thought that *Duet* was most successful when approached as a co-creative musical environment rather than as a traditional gameplay experience. It is important to note that in public demonstration, the reception of *Duet* was strongly shaped by the degree of alignment between the project's values and the culture of the presentation setting. I was fortunate to have attended many events where *Duet* was a great contextual fit, but I cannot ignore how this alignment has shaped my observations. That being said, the presentations have not been completely aligned with the event culture every time, and

that aspect is what has been so interesting about this type of practice-based interdisciplinary research—different questions and perspectives emerge from every audience I meet.

These varied perspectives shape how *Duet* unfolds every time, and no two instances are the same. I could not help but notice how much the background and expectations of each person interfacing with *Duet* shaped how the piece unfolded, and it was especially apparent during demonstrations involving music-oriented game players. In those instances, the system's affordances often appeared to be understood as invitations rather than instructions. I still believe that *Duet* is designed with non-specialists in mind, but the musicality of each performance scales exponentially when people with predispositions toward music and experimental interfaces are the ones participating. Moments like these clarified that *Duet* does not simply produce musical results on its own. Instead, it rewards listening, responsiveness, curiosity, and an openness to treating play as a musical act.

Duet occupies a space between game, instrument, and performance environment. When approached as a conventional game, the work could invite expectations of objectives, progression, adversaries, or concrete win/loss conditions, but when approached as an open-ended musical environment, and especially in the hands of those comfortable with both musical experimentation and PC-based game navigation, the work's hybrid identity became more legible. *Duet* borrows from games, but its primary success criteria are musical, relational, and grounded in live performance.

Looking forward to future development, one of the clearest areas for continued refinement is the intelligibility of the flutist's influence on the environment (as discussed in earlier chapters). While audience members and participants could often understand that gameplay commands were woven into the performer's improvisation, they did not seem to

understand when those interactions were occurring. This is because the system does not yet provide enough perceptual evidence for consistently discerning this interaction in real time. This does not necessarily mean that the system needs to become more outwardly instructive or explanatory. However, it does suggest that the relationship between flute gesture and environmental response needs to be perceivable enough for players and audiences to acknowledge the full degree to which the two performers are interacting.

In hindsight, the opacity of this relationship was not a fully intentional aesthetic choice. *Duet* has been shaped by my evolving programming skills from the beginning, and other game design elements were more pressing priorities to learn and implement at the project's onset. As the project has developed, this limitation has become an opportunity for future refinement. Later iterations can continue to pique curiosity while making the interaction between both performers more evident.

Over the span of several demonstrations, some recurring gameplay ideas seemed to emerge. In the absence of a fixed goal structure, players often appeared to create their own objectives. For example, the pink lines (introduced in Ch. 2, "Tethers,") stood out as a game element that players could organize their movement around. They were often treated as tasks or collectible features within the environment. This behavior suggests that players do not necessarily require explicit goals in order to play meaningfully. Instead, they may identify prominent visual or musical features and organize their actions around them.

Players and audiences also responded with delight to mechanics that were not central to the musical system, such as the player's jump. The final jump animation for *Duet* ended up being an over-exaggerated low-gravity representation of jumping. This decision was for no reason in particular, other than I had been experimenting with parameters for the jump mechanic and left it

this way. It appeared that my audiences liked this feature, and explanations for why have been explored in video game studies—Jason Begy's "The History and Significance of Jumping in Games," to name one, which draws many of its ideas from George Lakoff and Mark Johnson's influential publication *Metaphors We Live By*.[89] [90] Although this jump mechanic was not originally designed as a major expressive feature, it became a source of playfulness. It felt freeing and physically responsive. This observation matters because it shows that even small details can help motivate the player's engagement. What I consider to be the more conceptually important part of the system is not always the most immediately inviting or motivating feature for someone encountering the work.

One of the strongest indications of *Duet*'s future potential is that other trained musicians have expressed interest in performing it themselves, whether they play the flute, any other instrument, or sing. This suggests that the work is meaningful not only as a personal research prototype, but also as a system that other performers can imagine adopting. That interest points toward the need for clearer performer documentation, adaptable technical requirements, and a thoughtful approach to licensing and distribution. This also lends itself to the realization that the work is championed by whomever is performing the instrumentalist role. That person functions as the presenter of the work and the lead artist, although a game player volunteer is essential to the performance. It is important to note that this dynamic inherently shifts when *Duet* is framed as a concert work with a predetermined ensemble (game players, instrumentalists, and vocalists, alike). Further discussion of such framing will continue in the "Capstone Concert" section of this chapter.

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[89] Jason Begy, "The History and Significance of Jumping in Games," in *GAME//PLAY//SOCIETY: Contributions to Contemporary Computer Game Studies*, ed. Konstantin Mitgutsch, Christoph Klimmt, and Herbert Rosenstingl (Munich: Kopaed, 2010).
[90] George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 2003).

Alternatively, it is perhaps even more frequent that my audience members ask about the possibility of an eventual *Duet* release through a digital game publishing platform such as Steam.[91] In other words, while my previous example pertained to trained musicians who want to present *Duet* out in the world, there are also people who want the ability to play *Duet* with friends and family at home. I found this surprising at first, because I had envisioned the project primarily as a public installation or live performance work. However, this response makes sense. People seek a variety of at-home entertainment and activities, and not everyone who is interested in musical play wants to perform publicly. At the same time, musicians have also asked about performance licensing for *Duet*. I am grateful that there is interest in both possibilities: *Duet* as a performable work and *Duet* as a playable experience that might exist beyond the concert or public demonstration setting.

These practice-based observations also point toward possible future contexts for the work, including education, participatory music-making, and other settings where collaborative play, listening, and accessible musical agency may be valuable. I do not treat these areas as outcomes of the present project, and applications such as music therapy would require separate expertise, collaboration, and research design. Still, they indicate that *Duet*'s central questions may extend beyond experimental performance. *Duet* began as an experiment in combining flute performance and video game interaction, but these reflections suggest that its strongest contribution is not simply technological. Its contribution is the creation of a shared performance situation in which musicians, players, and audiences negotiate musical agency together.

[91] Valve Corporation. Steam. www.store.steampowered.com.

The Capstone Concert

My PhD Capstone event consisted of two parts: A lecture-recital (similar to previously discussed examples) and a Capstone Concert. This concert was just over forty-minutes in length and elevated *Duet* from the demonstration version into a multi-movement work with a full band of musicians performing. No longer was I the sole instrumentalist playing the flute. I was joined on-stage by trombone, violin, vibraphone, and saxophone, and I also doubled on piccolo. Additionally, this concert also featured four designated game players (of which I was one). Collectively, this group of people made up my Duet Ensemble. The group of acoustic musicians alone will be referred to as the Duet Ensemble instrumentalists. The full Duet Ensemble had a few hours with the system in advance of the concert, but this did not script the resulting event. This served to familiarize them with the basics of the Possibility Landscape, Base Audio, and Zone Layers so that they could continue to experiment with the system in rehearsal and performance. They were also educated on the attacca structure unique to this concertized version of *Duet*.

The attacca structure of the Capstone Concert (hereafter referred to as Capstone) was essential to transforming *Duet* from a sequence of examples into a continuous performance environment. Rather than presenting each movement as a discrete demonstration, the concert unfolded as a single uninterrupted arc (Figure 22). This continuity helped the work feel immersive and continuously evolving, especially as the visual time-of-day (TOD) system, game audio cues, instrumental entrances, and stage lighting all contributed to the sense of progression from one scene to the next. (Note: The penultimate segment, *Chroma Flows*, is a previously composed ensemble work that was integrated into the Capstone. Discussion of *Chroma Flows*

and its additional ensemble members will be continued later in this chapter in "Questions for the Future.")

Segment	Instrumentation	Duration	Setting & Lighting
Intro	Piccolo & Video Game	3 mins	Nighttime; Moonlit
Daybreak Transition	Duet Ensemble Instrumentalists	1 min 25 secs	Dawn; Early Light
Morning	Duet Ensemble	8 mins	Daytime; Daylight
Noon	Duet Ensemble	8 mins	Late Day; Sunset
Night	Duet Ensemble	8 mins	Evening; Dusk
Chroma Flows	Chroma Ensemble	10 mins	Lava Lamp
Coda	Piccolo & Video Game	3 mins	Nighttime; Moonlit

Figure 22 Attacca Structure and Transitions for Concert Version of Duet

These transitions were largely smooth. The concertized system design was fluid enough to allow space for performer changes to occur organically and without significant logistical pressure. This was important because the concert required multiple kinds of transitions to occur at once: shifts in musical material, changes in game state, changes in stage lighting, and the physical movement of performers entering and leaving active roles. Rather than interrupting the work, these changes became part of its theatrical language. The stage lighting was especially important in this regard. The lighting design matched each segment of the Concert as the time of day advanced, helping the visual world of the game extend into the performance space.

One transition did reveal the vulnerability of this kind of live technological performance: To facilitate the transition between the lecture-recital and concert portions of my Capstone event, I had temporarily disabled all Elastic Zone and Pulsed Zone audio, including the Base audio, and

I had forgotten to re-enable them before beginning the Intro segment of the Capstone. This had minimal impact over the Intro, due to the deliberately sparse instrumentation of this section. The Sphere Throwing audio had not been impacted, so my duet partner continued to have agency over their instrument (even if it was not to the full degree intended). As convincing as this Intro performance was, I still quickly recognized my oversight once the performance began. Since I was playing the piccolo for this segment and the Daybreak Transition that followed, my first opportunity to rectify the problem was the Morning segment. Unfortunately, this meant that instead of the Daybreak Transition taking us directly to the Base audio on the Elastic-side of the map once we reached Morning, we instead arrived at silence.

While it was clear that a technical issue had occurred, the performance continued without a severe disruption, and I consider that to be a significant strength of the work. Instead of passing the game controls to a pre-determined member of my Duet Ensemble, I assumed that role at the top of the Morning segment while violin replaced my piccolo on the mic. While the violinist was able to begin Morning as we intended, I was able to take a moment to correct my error with the show controls available to me onstage before joining them in performance. A live system like *Duet* needs to have optimal show control support when produced to the scale of my Capstone event. The concert depended on careful technical preparation, but it was also supported by the responsiveness of the performers. When the system faltered, the live players carried the work forward.

The Capstone also revealed what happens when *Duet* is scaled beyond its original two-person pool of players. Earlier versions of the project were primarily organized around the question of how a video game could become a vehicle for musical improvisation between a flutist and a player. The Capstone expanded that question considerably: how can a game-based

musical environment support a concert-length form involving multiple instrumentalists, multiple game players, ensemble writing, and changing modes of attention? In this context, *Duet* became less like a single interaction and more like an ecosystem.

The system lent itself well to this expanded scale. With advance consideration for how each scene needed to differentiate itself, the concert was able to sustain a compelling formal progression. Learning from the lessons of the *v1* prototype, the individual movements were not merely repetitions of the same interactive premise. They offered different audio-visual states, different instrumental combinations, and different opportunities for performer-player relationships to emerge. The result was a concert structure in which the same underlying system could support variation, contrast, and development over a longer duration.

This larger scale also changed the role of the live concert setting. The presence of multiple performers emphasized that *Duet* is relational, not merely interactive. The system did not only mediate between a player and a computer; it also mediated between players, instrumentalists, visual states, fixed materials, improvised decisions, and the audience's shifting attention. Because the work unfolded as a concert rather than a short demonstration, the movement structure gave the audience permission to listen with more focus. They were not only watching to understand how the technology worked. They were invited to hear how the system could sustain a musical experience much like in other more conventional concert settings.

In this sense, the Capstone demonstrated that *Duet* can function as more than a prototype or performance interface. It can support a concert-scale form in which continuity, theatricality, technical design, and performer agency are all part of the composition. The attacca structure was central to this realization. It allowed the work to operate not as a collection of separate scenes, but as a single evolving environment.

Questions for Future Development

As *Duet* has developed from early demonstrations into longer concertized forms, the project has increasingly raised questions not only about technical function, but about legibility, musical agency, performance framing, and the conditions under which an audience volunteer can become a meaningful co-performer. These questions do not suggest that the system has failed to communicate its purpose. Rather, they indicate that the project has reached a stage where its central research concerns have shifted. Earlier versions asked whether a live instrumentalist and a game player could share a responsive musical environment. The current version asks how that environment might more clearly invite musically useful behavior, support different levels of performer fluency, and sustain larger forms of performance.

One recurring question concerns how much contextual framing *Duet* requires before it begins. In lecture-recital and research presentation settings, I often provide approximately ten minutes of verbal explanation before the work is performed. This framing helps audiences understand the relationship between the flute, the game system, the player, and the broader research context. It also helps establish that the work should be understood not simply as a video game demonstration, nor simply as a piece of chamber music, but as a hybrid performance-research environment. However, concertized versions of the project have not always included this degree of explanation. In those contexts, *Duet* has relied more heavily on program notes, brief verbal introductions, or the audience's ability to infer the relationships unfolding onstage.

This raises an important artistic and research question: does *Duet* need a lecture component in order to be understood, or can the system itself become more self-explanatory through its design? A concert version may not always be able to rely on extended prefatory remarks. At the same time, removing explanation entirely risks obscuring the relationships that

make the work meaningful. Future versions may need to explore additional forms of legibility, including projected titles, brief in-game cues, program notes, staging decisions, or visual feedback that clarifies when the flutist is controlling the environment and when the game player is making consequential musical choices. The goal would not be to explain every mechanism in advance, but to help performers (and audiences) perceive enough of the system's logic to follow the performance as an evolving exchange. In a way, learning *Duet* becomes the opening section with indefinite duration of *Duet*.

In video game studies, some argue that learning within a game is part of the fun or enjoyment of playing the game. It is separate from flow states induced by games in which the player is not receiving external help. For instance, Raph Koster states: "You can find flow in countless activities, but they aren't all fun. Most of the cases where we typically cite flow relate to exercising mastery, not learning."[92] Again, Koster:

> Instead, fun tends to hit when bumping up at the top edge of flow…A more fruitful reference might be the educational concept of the 'zone of proximal development.' This is the idea that a given learner has things he can do without help, things he just cannot do, and things he can do with some help. Fun tends to come in this last one, and the help is provided by the game system.[93]

This would suggest that while flow may not be achievable in a learning phase, that fun and enjoyment can be helped by some balance of additional forms of legibility built into the game.

Among notable interactive music systems that might help inform future versions of *Duet* that balance learning with flow, George Lewis's *Voyager* comes to mind, although Lewis's system does not concern itself with additional forms of legibility that help players learn the system. Lewis writes, "Part of the analytic task facing any improvisor (whether or not that improvisor is a computer) involves discovering or even positing ways in which seemingly

[92] Raph Koster, *A Theory of Fun for Game Design*, 2nd ed. (Sebastopol, CA: O'Reilly Media, 2013), chap. 5.
[93] Ibid.

unrelated material can become part of either an existing or a new structure within the emergent music."[94] A link between Lewis's use of *discovery* and my use of *learning* might be forced, but I propose here that this may be akin to a part of what is enjoyable about participating in and witnessing music improvisation: how all the human and machine actors in a performance discover and learn within a performed work.

A related question concerns how much the system should reveal about instrumental control. In *Duet*, the flutist's actions do not merely accompany the game; they alter the environment through pitch-tracked cues and other responsive mechanisms. However, not all of these controls are equally perceptible to the game player or the audience. This ambiguity can be productive, allowing the system to retain a sense of discovery, but it can also create moments where the relationship between musical action and game response becomes difficult to read. Future design work might ask how instrumental cues can become intelligible without becoming overly literal. The project does not necessarily need to display every cause-and-effect relationship, but it may benefit from clearer moments in which the audience can recognize that the acoustic performer is actively shaping the game world.

The forty-minute concert version also raised questions of scale. On one hand, the extended duration allowed *Duet* to move beyond a demonstration and become a complete performance environment, and the attacca structure encouraged the audience to experience the work as a continuous world rather than a sequence of isolated examples. On the other hand, the larger form revealed that different materials may require different amounts of time. Some interactive states benefit from duration, allowing the player and instrumentalist to discover a shared rhythm of attention. Other materials may communicate their function quickly and risk

[94] George E. Lewis, "Too Many Notes: Computers, Complexity and Culture in *Voyager*," *Leonardo Music Journal* 10 (2000), 38.

becoming static if sustained too long. Future versions of the project may need to consider whether forty minutes is the appropriate scale for *Duet*, or whether certain movements should expand, contract, or be reorganized according to the kind of interaction they support.

Figure 23 Chroma Flows

The inclusion of *Chroma Flows* within the concert version raises a further formal question (Figure 23).[95] Premiered in 2024, *Chroma Flows* is a dynamic visual score for an improvising music ensemble of open-ended instrumentation. One performer assumes the role of "Chroma-Jockey" and uses an external MIDI controller to manipulate the visual score in real time. The other ensemble members are allocated colors that serve as their musical "part." The presence of that color on the screen invites them to play and otherwise, they rest. When their color emerges, it inhabits the foreground, middle-ground, or background of the scene. These

[95] Rebecca Larkin. *Chroma Flows*. (2024). MacOS.

visual layers map to how present your instrument is amongst the ensemble (e.g., someone with the color “red” would be the “lead” improviser in the excerpt depicted by Figure 19, because red is the foreground color). The visual environment was inspired by the movement and color scheme of lava lamps. The colored “blobs” continue to undulate in a manner that resembles a lava lamp while the color scheme changes at random at the Chroma-Jockey’s command. This visual environment lent itself to the Capstone version of *Duet* by serving as a climactic moment for the penultimate segment of the work. The Duet Ensemble Instrumentalists were joined by six more improvisers to form the Chroma Ensemble, building to a Capstone climax through both a dramatic visual change and sheer numbers of musicians.

Because *Chroma Flows* was not originally conceived as an interactive *Duet* movement in the same way as the surrounding material, its presence reframed the larger work. It allowed the concert to place *Duet*-adjacent ideas in dialogue with a previously composed ensemble work, suggesting that the project’s concerns extend beyond a single game system. At the same time, its relationship to the interactive movements remains an area for future reflection. Should *Chroma Flows* function as a contrasting movement, a historical anchor, a parallel artistic statement, or a model for how *Duet’s* musical language might expand into larger ensemble writing? Future concert versions may clarify whether *Chroma Flows* belongs inside the *Duet* performance ecosystem or whether it should remain adjacent to it.

At the center of these questions is the role of the game player. *Duet* depends on the possibility that a person without rehearsal, and often without specialized musical training, can enter the system and contribute meaningfully to the performance. This remains one of the project’s most important artistic commitments. In the domain of music technology, among others, the notion of “walk-up playability” has been discussed by Tina Blaine and Sidney Fels,

who explore devices where, “musical control is highly restricted, which makes it possible for novices to easily learn and participate in the collective experience. This happens at the expense of providing an upward path to virtuosity with the interface.”[96] Another earlier example among attempts to address reducing the learning curve needed to play a musical instrument to place emphasis on other aspects of musical expression and playability is the *radio baton*, one of Max Mathew’s later contributions to the field of music-technology, where the instrument “allows the performer to concentrate all his attention on the expressive aspects of music and relieves him of data processing and motor control tasks which are very demanding with traditional instruments."[97] Again, the full scope of the literature on accessibility and technology-assisted music making is not possible here, but a further review of it can help to inform the future development of *Duet*.

Repeated demonstrations and performances have shown that different volunteer players bring different kinds of fluency to the work. Some players quickly understand that their actions have musical consequences and begin to move, wait, repeat, approach, retreat, or activate objects with a sense of timing and intention. Others treat the system more like a conventional game and search for objectives, progression, or correct answers. Both responses are revealing. They show that *Duet’s* openness can invite musical agency, but that this agency is shaped by the player’s prior experience, comfort with ambiguity, and ability to recognize game actions as musical gestures.

This raises the question of whether *Duet* should include a mode that teaches musically useful interaction. Such a mode could help players without musical backgrounds understand how

[96] Tina Blaine and Sidney Fels, "Collaborative Musical Experiences for Novices," *Journal of New Music Research* 32, no. 4 (2003): 411.
[97] Max V. Mathews, "The Radio Baton and Conductor Program, or: Pitch, the Most Important and Least Expressive Part of Music," *Computer Music Journal* 15, no. 4 (1991): 37.

movement, proximity, timing, and activation shape the sonic environment. However, this possibility also introduces a question of scope. If *Duet* becomes too instructional, it may shift away from the immediacy and vulnerability of live co-performance. If it provides too little support, it may leave some players unsure how to contribute. In their study titled, "The Impact of Tutorials on Games of Varying Complexity," Erik Andersen, et al. point to tutorials being help when games are complex, but that they don't add value when games are simpler, conceding that "It is unlikely that a single approach will work for tutorial design in all games."[98] Therefore a more formal examination of simplicity and complexity in the design of future versions of *Duet* may be warranted.

There seems to be a possible parallel between how little or how much tutorial games can benefit from and the longstanding debate over how much instruction is too little or too much for any given musical work, especially when it comes to situations where there is little or no time for rehearsal. The design challenge is not simply to teach the performers the piece, but to invite more musical behavior through the system itself. Ideally, *Duet* would not require the player to rehearse like a trained performer before participating. Instead, its affordances would encourage listening, pacing, restraint, curiosity, and intentionality. While a careful study is not within the scope of this dissertation project, the examination of *Sonic Meditations* by Pauline Oliveros might be one source.[99] *Search and Reflect* by John Stevens may also provide insight into design principles borne from years of working with so-called novices in a musical context.[100] The Stevens publication, in particular, lists twelve works for improvisation with the following descriptions for some of the works: "Uses breath length to determine longest possible sound…A progression of

[98] Erik Andersen et al., "The Impact of Tutorials on Games of Varying Complexity," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (New York: ACM, 2012), 67.
[99] Pauline Oliveros, *Sonic Meditations* (Baltimore: Smith Publications, 1974).
[100] John Stevens, *Search and Reflect: A Music Workshop Handbook* (London: Rockschool Ltd., 1992).

exercises to heighten aural awareness and reflective interaction…Endeavours to confront the lack of silence within a free group context…"[101] Stevens continues, "Since they are meant for mixed-ability groups, most of the pieces do not assume any previous musical knowledge or training. The main requirement is to have an open-minded enthusiasm for music."[102] Leveraging such prior work to inform situations that place musicality at the forefront for those without extensive training and rehearsing would be useful in the development of future versions of *Duet*.

This is especially important because currently in *Duet* the game player can sometimes function primarily as an "audio mixer"—a kind of engineer that is operating music equipment but not necessarily engaged in music making. By moving toward or away from activated objects, attaching tethers, and detaching them, the player influences which musical layers become present, foregrounded, or removed. These are meaningful musical actions, but they also raise a larger question: how might the game player gradually move from the role of "audio mixer" toward a fuller representation of being a composer-improviser? Future versions of *Duet* might explore more granular forms of control, allowing the player to shape not only the presence of musical layers, but also their development, transformation, density, register, rhythm, or formal placement. The challenge would be to expand the player's agency without overwhelming them or compromising the accessibility that makes the project distinctive.

The question of valid performance also becomes increasingly important. In an open-ended interactive system, not every action will appear polished, intentional, or musically fluent. Players may misunderstand the system, discover unintended uses, exploit bugs, move continuously without listening, or produce outcomes that differ from my expectations as the designer-composer. Intentionally exploiting the unintended is a form of game play. Bonnie

[101] Ibid, VII.
[102] Ibid, 1.

Ruberg, in "Straight Paths Through Queer Walking Simulators: Wandering on Rails and Speedrunning in *Gone Home*," brings this to attention, where, for example, players will deliberately engage in speedrunning, resisting "the chrononormativity of video games in their own way, rejecting the pace at which games are meant to be played and instead racing through them at top speed. They also often use glitches to jump between game areas or gain other advantages…"—a particularly resonant point about how one navigates time given the inextricable relationship between music and time.[103]

These moments of system failure and intentional subversion can be disheartening for the designer, but they are also central to what *Duet* reveals. Composer-performer-scholar, Simon Waters, might describe such moments as, "Situations in which the behaviors which are afforded cannot be accounted for solely by the designed outcome," and in defense of the artistic value of such situations, "…what musicians tend to be interested in and good at is using devices in a manner which operates at the edges of or outside the design brief – indeed what comes to constitute expressivity in music at any particular historical moment is often to do with making explicit some of this transgressive behaviour."[104] If the work invites real-time agency, transgressive or not, then unexpected behavior cannot be treated only as error. Some actions may interrupt the intended musical flow, but others may expose assumptions embedded in the design. A player who does not understand the system may reveal that the system's invitations are not yet legible enough. A bug that becomes performatively interesting may reveal an unanticipated affordance. In this sense, the boundary between interruption and continuation is not always clear. *Duet's* performances must be evaluated not only by whether they realize a predetermined ideal,

[103] Bonnie Ruberg, "Straight Paths Through Queer Walking Simulators: Wandering on Rails and Speedrunning in *Gone Home*," *Games and Culture* 15, no. 5 (2019): 648.
[104] Waters, "Performance Ecosystems: Ecological approaches to musical interaction", 3.

but by what they disclose about the relationship between system, performer, player, and audience. Or, as Waters continues, “The relationship between performer, instrument and environment becomes notably mutable in situations in which component elements are assembled in the real time of performance.”[105]

Another emerging concern is the question of density and continuity. In *Against Flow: Video Games and the Flowing Subject*, Braxton Soderman reminds us of the often unchallenged paradigmatic effect and ideology that *flow* has uncritically had on video game culture.[106] And, by extension, as raised in Chapter 1 of this writing, mainstream game design promotes a kind of continuous “action generating action” sequence to induce and sustain a flow state. Thus, video game play often encourages continuous and relentless action. Improvised music, however, benefits from non-action as a kind of action. For example, in “A New Look at Improvisation,” Ed Sarath identifies a musical object or an “event” in the context of improvisation as built from sound or silence.[107] It acknowledges the moment-to-moment decision making in musical improvisation as benefiting from silence, pacing, and restraint. There is also the inherent property of breathing in music, especially when considering instruments like the flute, which are actions that alternate between sound *and* a kind of active silence. When these practices—gameplay and musical improvisation—meet, the game player may feel compelled to keep moving or interacting, even when the music might benefit from stillness. This suggests that future versions of *Duet* may need to design more explicitly for rest, waiting, and reduced activity. If musicality in this system depends not only on what the player activates but also on when they choose not to act, then the game environment must make non-action feel meaningful.

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[105] Waters, "Performance Ecosystems: Ecological approaches to musical interaction", 4.
[106] Braxton Soderman, *Against Flow: Video Games and the Flowing Subject* (Cambridge, MA: MIT Press, 2021), 4-5.
[107] Ed Sarath, "A New Look at Improvisation," *Journal of Music Theory* 40, no. 1 (1996): 3.

This may involve visual cues, spatial design, pacing constraints, or mechanics that reward listening rather than constant input.

Taken together, these questions point toward the next phase of *Duet's* research. The project no longer asks only whether a game system can support live musical performance. It now asks what design conditions allow a randomly selected audience volunteer to become a competent co-performer; what kinds of framing allow audiences to understand a hybrid music-game work as both performance and research; and what forms of agency allow the game player to participate not merely as a navigator or "audio mixer," but as a musical decision-maker. These questions may also point beyond the current concert context. *Duet* or *Duet*-adjacent technologies could potentially be adapted for education, collaborative improvisation training, or therapeutic contexts where musical participation, embodied interaction, and shared attention are central. Such applications would require additional ethical, pedagogical, and methodological consideration, but they suggest that the project's core questions extend beyond a single work of art.

Ultimately, the forward direction of *Duet* lies in refining the balance between openness and guidance. The system must remain open enough for discovery, improvisation, and individual interpretation, but guided enough that participants can recognize how to act musically within it. It must communicate enough of its structure to support meaningful participation, without reducing the performance to a tutorial. It must allow the audience to perceive the relationships among flute, game, game player, and ensemble, without overexplaining the work before it has had a chance to unfold. These tensions are not problems to be solved once and for all. They are the artistic and research terrain that *Duet* has made visible.

Conclusion

This chapter concludes the main body of text for this dissertation project. The central questions explored in this chapter, raised by reflecting on the *Duet*'s practice-based work, leave us with a decade-old, vexing topic that extends beyond technology-dependent experimental performance: how can technology-based interactive music systems, in general, invite people into musical agency, even when they do not identify as musicians?

CONCLUSION

This dissertation began by asking how video game play and musical improvisation might be placed into productive dialogue, and how the design of a video game might provide a framework for improvisation-based music composition. Through the development, performance, and examination of *Duet for Flute and Video Game*, this dissertation has argued that the relationship between these practices extends beyond their conceptual similarities. Game design can itself operate as a form of compositional practice, establishing the conditions through which performers and players encounter musical materials, make decisions, and respond to one another in real time. *Duet* offers one realization of this possibility by bringing a live flutist and a game player into an interactive environment in which instrumental performance, spatial navigation, game mechanics, and audio-visual feedback collectively shape an evolving musical work.

Chapter 1 established the theoretical foundation for this argument by examining the relationships among play, gameplay, flow, improvisation, and creative risk. Gameplay and musical improvisation are not interchangeable practices, but they share important structural characteristics. Both take place within temporary frameworks that give particular actions and constraints meaning. Both depend upon the willingness of participants to accept those conditions, direct their attention toward an unfolding activity, and make decisions without knowing every outcome in advance. Improvisers and game players negotiate relationships between freedom and constraint, drawing upon prior knowledge while remaining responsive to changing circumstances. Placing these practices into dialogue therefore made it possible to consider how the structures of gameplay might support musical exploration without determining a single path through it.

Chapters 2 and 3 translated this theoretical relationship into technological and artistic practice. The design of *Duet* required more than constructing a digital environment and adding musical interactions to it. Its technology, game mechanics, musical assets, visual elements, and performance roles had to be developed as interdependent parts of a compositional system. Technical decisions concerning pitch tracking, communication between software environments, navigation, spatialized sound, and audio-visual response determined what kinds of interactions could occur and how those interactions could be perceived. Likewise, the project's musical materials did not function solely as fixed content delivered through the game. They provided resources that could be activated, combined, emphasized, transformed, and interpreted differently across performances. The design of the system therefore became inseparable from the composition of the work.

This process also required the project to account for the different kinds of knowledge brought to the performance by the flutist and the game player. The flutist draws upon instrumental training, embodied musical understanding, and improvisatory experience. The game player may possess knowledge of games, spatial navigation, or interactive conventions, but is not required to possess the same musical expertise. *Duet* does not attempt to erase this distinction. Instead, it creates relationships through which different forms of knowledge can become musically consequential. The flutist shapes sound directly through instrumental performance, while the player alters the environment, activates and reorganizes materials, and affects the context within which the flutist listens and responds. Their roles remain distinct, but the system brings their decisions into contact.

The iterative development and presentation of *Duet*, examined in Chapter 4, revealed that the existence of interactive choices does not by itself create meaningful musical participation. A

participant must be able to perceive enough of the relationship between action and consequence to develop intentions within the system. The project therefore had to negotiate a balance between explanation and discovery. Excessive instruction could diminish the exploratory qualities that made the game meaningful, while insufficient feedback could leave the player unaware of how their actions affected the unfolding performance. The design challenge was not to eliminate ambiguity, but to calibrate it so that uncertainty could encourage experimentation without making the system's responses appear arbitrary.

The project's presentation also demonstrated that the interactive system extends beyond its software. Performance duration, pacing, participant preparation, technical reliability, performer responsiveness, and the framing provided to players and audiences all influenced how the work was understood. Mechanics that functioned effectively as isolated interactions had to be reconsidered when incorporated into a longer musical form. Likewise, the system needed to remain viable when players lingered, overlooked an affordance, pursued an unexpected action, or interacted with the environment in ways that had not been anticipated. Designing for improvisation therefore required not only the creation of possibilities, but also the creation of a resilient framework capable of sustaining meaningful activity across varied participant choices.

Taken together, these observations sharpen the dissertation's central claim. Game mechanics do not become compositional merely because they trigger, transform, or accompany sound. They become musically meaningful when their consequences are perceptible, when participants can form intentions around them, and when those consequences affect the decisions of others within the performance. Navigation, proximity, activation, audio-visual transformation, and the accumulation or removal of musical materials become compositional processes when they influence what participants hear, notice, anticipate, and choose to pursue. Their significance

resides not in the mechanics alone, but in the relationships they establish among participant action, system response, musical context, and further action.

The resulting musical dialogue is enabled rather than guaranteed. The flutist and player do not possess equal or identical forms of agency, and the composer-designer does not disappear once the performance begins. The composer remains present through the rules, materials, affordances, exclusions, and technical relationships established in advance. The software likewise shapes the interaction by determining which actions are available and how the system responds to them. Agency within *Duet* is therefore distributed but asymmetrical. The participants contribute different forms of control, each of which acquires meaning through its relationship to the others. Co-creative interaction does not mean that everyone does the same thing or has the same kind of control. Instead, it emerges when different kinds of actions—such as playing the flute or navigating the game—affect one another in meaningful ways within the shared system.

This understanding expands the role of composition within *Duet*. Composition encompasses the creation of musical materials, but it also includes the design of the conditions through which those materials can be encountered, interpreted, and reorganized. The project does not prescribe a single musical outcome. It establishes a field of possibilities in which performers and players can exercise agency without being given unlimited control. In this context, constraints are not obstacles to creativity but structures that make choices intelligible and consequential. The work is composed through the interaction of predetermined materials, programmed relationships, performer knowledge, player decisions, and circumstances that cannot be fully anticipated in advance.

The conclusions drawn from *Duet* remain specific to the artistic, technological, and performance contexts in which the project was created. This dissertation does not claim that

every game mechanic is inherently musical, that all forms of audience interaction produce meaningful agency, or that the design principles developed through one project can be transferred unchanged to every performer or environment. The project instead provides a situated model through which broader possibilities can be considered. Its framework might be adapted to different instruments, ensembles, game environments, participant relationships, or levels of prior expertise. Further study might also examine how players and performers describe their experiences within such systems, particularly where more formal participant research can complement practice-based artistic reflection.

These possibilities do not diminish the significance of the project in its present form. Rather, they demonstrate that *Duet* has produced both an artistic work and a foundation for continued inquiry. Its contribution lies not in offering a final solution to the relationship between games and musical improvisation, but in showing how that relationship can be made tangible through design. The project treats the video game not merely as a medium through which music is accompanied, represented, or delivered, but as a compositional structure through which music can be explored and made.

Ultimately, *Duet* does not try to eliminate the differences between composer, performer, player, audience member, and the interactive system. Instead, it uses those differences as part of how the work functions. Each participant enters the work with different capacities, expectations, and forms of knowledge, yet the system allows their actions to converge within a shared field of attention and consequence. The musical identity of the work emerges through that convergence, changing as its participants listen, navigate, experiment, and respond. *Duet* therefore offers one model for composing improvised musical interaction: not by determining every event in

advance, and not by removing all boundaries, but by designing the conditions through which meaningful musical play can emerge.

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APPENDIX: Link to Lecture-Concert Video Playlist

The following is the link to the playlist that contains the lecture and concert videos from and related to the *Duet* capstone concert on April 25, 2026:

https://www.youtube.com/playlist?list=PLWO0vJ7MVubE

Musicians—

Duet Ensemble:
Collin Felter, trombone
Chieh Huang, vibraphone
Rebecca Larkin, flute/piccolo
Daniel Richardson, soprano saxophone
Lisa Yoshida, violin

Rebecca Larkin, video game
Spencer Pepke, video game
Nolan Miranda, video game
Reed Wixson, video game

Chroma Ensemble:
Fabricio Cavero, voice
Collin Felter, trombone
Oliver George-Brown, objects
Chieh Huang, vibraphone
Rebecca Larkin, chroma-jockey
Nolan Miranda, keyboard
Spencer Pepke, bass
Daniel Richardson, soprano saxophone
Brandon Woo Snyder, piano
Reed Wixson, voice
Lisa Yoshida, violin

Production—

Lead Technician:
Danny Andress Sanchez

Tech Team:
Emma Houton
Xuanqi Liu
Spencer Pepke
Brandon Woo Snyder

Program Notes—

Duet for Flute and Video Game:

> As a game, this is two-player cooperative play. The other player is not an enemy. There are no high scores. Both players explore the game environment and the emergent sonic landscape together, experiencing something special and that neither could have experienced alone.
>
> As a musical performance, this is a duet. Sonic and visual feedback from all players and the game environment can evoke a musical response. Both performers are collaborators, making spontaneous decisions to create an improvised work that neither could have written alone.
>
> The technology used in this project is the Unity 3D game engine and Cycling '74 Max with bidirectional communication done with OSC messaging.

Chroma Flows:

> Inspired by amorphous blob-like textures, I set out to design a system that generates colors and patterns at random. Much like a lava lamp, these colors undulate freely and our improvising ensemble is left to make musical sense of them.
>
> Visuals were made with the Unity 3D game engine. Many thanks to Stray Basilisk on YouTube (@straybasilisk2689) for the coding tutorial that got me started. Check out their work if you'd like to make a lava lamp of your own!