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The Art of the Unheard:
A Subject-Oriented Approach to Sound and Music

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Integrated Composition, Improvisation, and Technology

by

William David Fastenow

Dissertation Committee:
Professor Rajna Swaminathan, Co-Chair
Professor Emeritus Christopher Dobrian, Co-Chair
Professor Michael Hooker
Professor Jesse Colin Jackson
Professor Kojiro Umezaki

2025

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DEDICATION

To

My beautiful family: Rachel, Grayson, Juniper, Hudson, and Ophelia

"In the concert of life, no one can whistle a symphony; it takes an orchestra to play it."

Halford E. Luccock

When the idea came to go back to school and set out for a doctorate, my wife was my biggest spark plug and my number one fan. It was her encouragement that led me to apply. At that time, it was just the two of us—but by the time I applied to and was accepted into the ICIT program, we had become a family of three. Then, after just a few short weeks into my first quarter as a doctoral student, we became a family of four. And now, as I stand ready to graduate, I have the immense joy of celebrating with a loving family of six cheering me on!

It's impossible to fully express how deeply your love, patience, and unwavering support have sustained me through this journey. My wife and I lovingly remind each other that it isn't just me earning this doctorate—it's all of us. With our growing family and many commitments, this achievement truly represents a collective effort, a tour de force of teamwork.

Any milestone I reach, any win I record, and any music I set forth—these are always for and of you. For my part, I promise to always strive to make you proud and honor the support you've given me. For you are, quite simply, my whole world.

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A dissertation is many things—a labor of love, a journey of relentless curiosity, a navigation through the labyrinth of ideas. But perhaps most of all, it is an exercise in humility, for it quickly becomes clear that no meaningful work is accomplished alone. Not only does so much rest upon the shoulders of the many wonderful thinkers who have come before, but the insights and discoveries within these pages emerged in vibrant dialogue with many remarkable individuals whose guidance, friendship, and empathy have been indispensable.

To my Committee Co-Chairs, Professors Christopher Dobrian and Rajna Swaminathan, thank you for guiding me with a dynamic balance that was worlds beyond stereo—it was truly symphonic. Chris consistently kept my creative practice front and center, challenging me to expand my compositional voice and encouraging me to take creative risks. Rajna persistently called me to deeper honesty, pushing me to consider the wider implications and resonances of my work. Together, your voices harmonized to bring rigor and clarity to my ideas, helping me shape them into something meaningful and resonant.

My Committee Members, Professors Michael Hooker, Jesse Colin Jackson, and Kojiro Umezaki, each provided insights from their uniquely valuable vantage points. Mike helped me navigate my spatial approach, clearly articulating both its alignment with and departure from established auditory science. Jesse opened doors into conceptual art and architecture, helping me locate my work within broader philosophical and artistic conversations. Ko consistently urged me toward rigorous self-reflection, ensuring I could clearly articulate and confidently present the unique contributions of my research. Your diverse perspectives enriched this work immeasurably.

I owe a heartfelt thanks to my friend and colleague Charlie Morrow. Your countless hours of enthusiastic spitballing, wide-ranging conversations, and genuine curiosity about spatial sound and immersive experiences kept me inspired, energized, and consistently engaged with the creative core of this work.

To my ICIT comrades and colleagues, I am deeply grateful for our four years together. Your illuminating conversations, your collaborations, your passion for inquiry, and your willingness to share your perspectives and challenges have been invaluable. Our collective journey has been a constant reminder of the richness found in community and dialogue.

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Thank you all for your generosity of spirit, intellect, and heart. Together, you have turned what could have been a solitary journey into a rich, joyful, and profoundly meaningful experience.

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Diana Chester and William David Fastenow. *When Not In Your Head*. Diana Chester. Produced by William David Fastenow (Park Boulevard Productions, 2007), compact disc.

A.J. Shanti. *Baby Beau Blue*. A.J. Shanti. Produced by William David Fastenow (Park Boulevard Productions, 2008), compact disc.

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ABSTRACT OF THE DISSERTATION

The Art of the Unheard: A Subject-Oriented Approach to Sound and Music

by

William David Fastenow

Doctor of Philosophy in Integrated Composition, Improvisation, and Technology

University of California, Irvine, 2025

Professor Rajna Swaminathan, Co-Chair

Professor Emeritus Christopher Dobrian, Co-Chair

The Art of the Unheard: A Subject-Oriented Approach to Sound and Music explores listening as an active, creative, and fundamentally subjective practice that challenges conventional, object-oriented conceptions of music and sound. By positioning the listener at the core of sonic experience, this dissertation introduces "subject-oriented" musicking, emphasizing that music and sound are not passive stimuli but active engagements shaped profoundly by individual contexts, cultures, environments, and personal histories.

Drawing upon interdisciplinary frameworks from phenomenology, cognitive science, ethnography, philosophy, neuroscience, and sound studies, this research demonstrates how listeners co-create musical meaning through embodied and relational experiences. Inspired by Pauline Oliveros's practice of *Deep Listening* and Salomé Voegelin's philosophical insights, it

reconceptualizes listening as a dynamic co-creation—a vibrational and existential encounter rather than a mere perceptual reception.

Central to this approach is empathetic omniscience, a mode of listening that privileges subjective embodiment and multi-perspectival awareness, enabling individuals to inhabit diverse sonic realities. This dissertation thus redefines the very question *"What is it to listen?"* as a practice of becoming, rooted in physicality, memory, anticipation, and imaginative presence. Incorporating theoretical exploration alongside compositional and technological practice, the dissertation argues for embracing the multiplicity and relationality of sonic experiences. It outlines innovative compositional frameworks and technologies designed to foster empathetic, situated listening environments, where spatialization, embodiment, and intersubjectivity guide the listener's sonic journey.

Ultimately, *The Art of the Unheard* responds to and builds upon an existing paradigm shift that centers listener subjectivity within musical experience. By highlighting and extending this shift, this work reaffirms listening as an active, creative, and transformative human endeavor with profound artistic and experiential potential.

FOREWORD

A Note to the Reader

In many aspects of my life I find myself wearing multiple hats; it's rather a daily occurrence. In any given day, I may step into the roles of husband, father, son, artist, composer, designer, technologist, business owner, student, teacher... So it should be no surprise—at least to myself—that when it comes to creating new musical works, I am predisposed to follow a similarly multifaceted path. My first creative love is for writing music, and it is with this bias that I often enter into creative work. Yet, over the years, I have embraced a transdisciplinary mindset, even when approaching seemingly straightforward musical composition. This viewpoint aligns closely with what I will delve into throughout this dissertation, namely, the rarity—perhaps the impossibility, outside some sort of clinical experiment—of experiencing one performing art discipline without this enjoyment overflowing, to some extent, into a multi-sensory experience. When we listen to a piece of music, our other senses—sight, touch, and perhaps even smell and taste—are inevitably engaged, even if only subtly, within the perceptual experience.

Throughout this dissertation, I will explore our subjective experiences of music, emphasizing my realization that how we listen involves far more than how we simply hear. I will also articulate my view that a composer's role inherently encompasses many disciplines and indeed requires wearing many hats. Initially, the central challenge of my research was to examine what it means to compose spatially. However, I quickly discovered that—for me at least—the route to answering this question would be circuitous. Before I could fully grasp what it means to compose spatially, I first needed to understand what it truly means to listen. This inquiry, in

turn, raised numerous questions about perspective, neurobiology, relationality, and empathy, among others.

Conducting this research, probing to answer these questions, I found myself equally eager to sit in a park and philosophize, put notes to a staff, program technological components, or calculate loudspeaker placement across architectural forms. And thus, I realized that my journey to find answers would need to find focus through different lenses.

This dissertation unfolds as a *layered narrative*, interweaving three central thematic threads—**Empathetic Omniscience**, **Spatial Aesthetics & Sonic Architecture**, and **Integration of Technology & Compositional Practice**—rather than treating them as isolated topics. Each theme develops organically through interconnected essays, systematically guiding readers through shifting perspectives on listening, spatial composition, and creative practice.

This intentional cyclical structure embodies the principles of subject-oriented listening and spatial composition, reflecting the multi-perspectival and relational nature of auditory experience. Instead of privileging a singular authoritative viewpoint, the narrative invites readers to dynamically engage with various vantage points, mirroring the fluid, context-dependent nature of sonic perception.

Accordingly, the essays will unfold in the following order:

1. **Essay 1, Part 1:** *The Listener as a Situated Subject*

2. **Essay 2, Part 1:** *The Science of Spatial Hearing*
3. **Essay 3, Part 1:** *Spatial Concepts in Composition*
4. **Essay 1, Part 2:** *The Dialectics of Subjectivity & Omniscient Listening*
5. **Essay 2, Part 2:** *The Role of Space in Sonic Design*
6. **Essay 3, Part 2:** *Toward Subject-Oriented Sound Environments*
7. **Essay 1, Part 3:** *A Manifesto for Listening*
8. **Essay 2, Part 3:** *Spatial Composition as World-Making*
9. **Essay 3, Part 3:** *Subject-Oriented Spaces: Nodes, Networks, and New Compositional Frontiers*

That being said, you, dear reader, are welcome to navigate the text freely, following the layered narrative I've set forth, reconnect the essays sequentially, or forge your own path through the material. Ultimately, just as the varied roles I occupy in life provide meaning and richness to my personal experiences, the diverse perspectives and multiple dimensions of listening explored here aim to enrich and deepen our collective understanding of music. By recognizing the inherently multisensory, relational nature of auditory experiences, we open ourselves to a fuller, more empathetic engagement with the sonic world around us, transforming not only how we compose and listen but also how we understand our place within a broader artistic and human landscape.

ESSAY 1: EMPATHETIC OMNISCIENCE – SUBJECTIVITY & MULTI-PERSPECTIVAL LISTENING

Part 1: The Listener as a Situated Subject

PRELUDE

> *"Listening discovers and generates the heard... not a receptive mode but a method of exploration... What I hear is discovered not received, and this discovery is generative, a fantasy: always different and subjective and continually, presently now."*[1]
>
> Salomé Voegelin, *Listening to Noise and Silence*

I wish you were not reading this dissertation.

No, I wish instead that you were hearing it, listening to it. I wish that the midwestern-raised, Brooklyn-cultured, sound-guy-attuned, jazz-habit-induced quiet baritone of my voice could hit your ear *just so* that I could ask you about what it is you're hearing right now.

It's a curious thing to write about music and sound. It is said that a picture is worth 1000 words, but I can hardly imagine how many words a sound might be worth. For those of us engaged in

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[1] Salomé Voegelin, *Listening to Noise and Silence: Towards a Philosophy of Sound Art*, 1st ed. (Bloomsbury Academic, 2010), 4, https://doi.org/10.5040/9781501382901.

the ritual of practice-based doctoral work, we might wish to count some of those words toward our dissertation quota.

And, I will. Throughout this dissertation, I will seek to link "you, the reader," to sources, where you will also be" you, the listener." I will offer my own musical work as examples, along with the examples of other creators, thinkers, and musickers. I will seek to interweave within this text-based narrative, a journey through and within sound.

The topic here is core to my own musical being, and it is, perhaps, a deceptively complex endeavor. My aim is to share my own subjective experience with music and sound as a vehicle by which you will also come to deepen your understanding on the subjectivity involved with musicking. The central point that I will circumnavigate is that—whether we like it or not—whether we are performing music, listening to it, or are a fly on the wall—our perspective in that act is unique to ourselves. It is our own subjective experience. Now, there are mechanisms in place that seek to standardize or distill this experience, for one reason or another–good, bad, convenient, easier to monetize, easier to execute—call them earbuds, a concert venue, movie theater surround sound, a car stereo, your television, your phone… each of these constructs mediate our participation in musical or sound activity. Yet, not a single one of these things escapes from our subjective perception of the core content.

Examining this phenomenon, and offering a way of thinking about this problem differently—namely, to embrace the *subject-oriented* nature of music and sound making—is a process that must take place on many varying levels and across many disciplines, from the philosophic to the

neuroscientific, from the phenomenological to the musicological, the psychological to the cultural, ecological, performative, technological, and embodied. This is a transdisciplinary adventure, and one that will require as many varied points of approach as the perspectives of musicking that I will discuss.

Central to weaving together these various threads is a reconsideration of listening itself—not as a passive reception of sound, but as an active, embodied, and relational practice. Listening deeply involves the whole being. We must consciously engage with the vibrational, cultural, ecological, and imaginative worlds that sound reveals. Your subjective perspective is shaped by specific contexts, environments, and histories that inform every aspect of what listening comes to mean. In this way, we must continually re-evaluate the fundamental question: *what is it to listen?*

WHAT IS IT TO LISTEN?

Listening is to enter the world through vibration. It is to "be on the edge of meaning."[2] It is existential. As I like to remind my toddlers, you hear with your ears, but you listen with your brain. But, really, it's even more than that. We, in truth, listen with our entire beings. Our bodies are not simply floating out in our world, a passive receptor to *the other*. Indeed, listening is a posture of *becoming* rather than reception—it is an exposure to the world and to oneself—it is anticipation, orientation, attunement. It stretches us toward what is not yet known, toward that which might be revealed in resonance. Listening is not the act of grasping a sonic object, but

[2] Jean-Luc Nancy, *Listening*, trans. Charlotte Mandell, 1. ed., [Nachdr.] (New York, NY: Fordham University Press, 2009), 7.

dwelling within the moment of becoming. Meaning, here, is not given. It emerges in the encounter.

This encounter is not abstract. It is physical. It is constitutive. It vibrates. It trembles through muscle and memory, bone and breath. "Listening is not a physiological fact," Salomé Voegelin contends, "but an act of engaging with the world."[3] We are not situated on the outside of listening, directing our attention inward toward experience—we are inside it. Sound envelops and implicates the listener. It calls us into relation. To listen is to inhabit resonance; it is to co-create the conditions under which perception becomes possible.

Pauline Oliveros takes this one step further in her articulation of *Deep Listening*—a practice of presence, awareness, and transformation. For her, listening is not only physical and cognitive—it is ethical. A core theme to her creative work is to guide participants toward "ways of listening and responding in consideration of oneself, others and the environment."[4] In this way, perception becomes a form of care. It is an act of acknowledgment, of tending to sonic relationships and the spaces in which they unfold.

Listening, then, is not only of the body—it is situated. It is shaped by context, culture, and condition. It is shaped by the room you are in, the history you carry, the way you tilt your head or close your eyes. It is shaped by privilege, by training, by trauma. It is shaped by lullabies and sirens, concert halls and corner stores, by what you've been invited to enjoy and what you've had

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[3] Voegelin, *Listening to Noise and Silence*, 3.
[4] Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (Bloomington, IN: iUniverse, Inc., 2005), 29.

to endure. Philosopher Thomas Nagel famously asked, "What is it like to be a bat?" and in doing so reminded us that all perception is irreducibly subjective. To elaborate on Descartes: *I think, therefore I am* something that has a "what-is-it-like" quality, inherently tied to my first-person perspective. Per Nagel, "an organism has conscious mental states if and only if there is something that it is like to be that organism."[5] There is no view from nowhere—only the inescapable situatedness of the self.

And yet, this deeply personal, subjective experience of listening also requires *the other*. Listening is not solitary, but embodied. I am able to hear the tree fall in the forest because the tree fell and disrupted the pressure of the air—yet this experience is contingent and intersubjective. Listening is not a distortion of an objective sound, but a condition of sonic meaning itself. Following Salomé Voegelin's account, the sonic thing is not perspectival or organized in relation to other things; rather, it is empirical—neither formed nor deformed, but formless unless it meets the hearing body. The question is not whether the lone tree makes a sound, but whether I am there to listen to what it has to say.[6]

As a listener, I am entangled with others—with other bodies, other histories, resonant spaces, and nonhuman agents. Listening is imaginative, metaphorical, and relational. Kendall Walton suggests that in listening, we empathetically imagine ourselves as someone or somewhere else. We enter into musical spaces as if they were real; we feel things that are absent and

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[5] Thomas Nagel, "What Is It Like to Be a Bat?," *The Philosophical Review* 83, no. 4 (October 1974): 436, https://doi.org/10.2307/2183914.
[6] This formulation draws on Voegelin's discussions of sonic intersubjectivity and empirical listening. See Salomé Voegelin, *Listening to Noise and Silence* (New York: Continuum, 2010), especially pp. xii, 11, and 15.

respond to intentions that exist only as traces. Listening, in this sense, is a kind of participatory fiction: the listener becomes something through metaphor and identification. This subject-oriented stance is not optional; it is the condition by which musical meaning becomes available. As Walton puts it, musical understanding arises when "listeners imagine themselves undergoing emotions" as the music unfolds.[7]

Christopher Small closes this loop by reminding us that to listen is not just to passively observe—it is to participate. "To music," he writes, "is to take part, in any capacity, in a musical performance."[8] Even the silent audience member, even the passerby, is engaged in the relational work of music. Listening is a form of musicking. It is performative. It does things—socially, culturally, affectively. Listening is all of these things. It reveals us to ourselves and to one another.

THE HEARD AND THE HEARING

If what it is to listen is not the passive reception of sound, but rather a participatory act of becoming, then in what settings does this transformation occur? Listening involves the whole of a person—one's body, memory, culture, imagination—so, where precisely is this listening body?

The answer, of course, is multilayered. Listening may take place within spaces, within resonances, or within interactions. This includes physical structures, metaphorical constructs,

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[7] Paraphrased and adapted from Kendall Walton, *In Other Shoes: Music, Metaphor, Empathy, Existence* (Oxford: Oxford University Press, 2015), especially pp. 36–38.
[8] Christopher Small, *Musicking: The Meanings of Performing and Listening*, Music/Culture (Middletown: Wesleyan Univ. Press [u.a.], 2010), 9.

spaces Victor Turner may call liminal or liminoid, the ambiguous and in-between spaces. Listening is enacted through social scripts, architecture, environmental relationships, and cultural expectations. Together, these ideas position listening as a threshold act—a situated encounter capable of creating, reshaping, or suspending meaning, identity, and even reality itself. Recalling Jean-Luc Nancy, to listen is to be "on the edge of meaning."[9]

Consider, for a moment, the distinct sensation of entering a concert hall—perhaps you arrive just moments before the performance begins. Notice how your listening has already started before any musical sound emerges: the hushed conversations, the shuffle of programs, the distant hum of an air handler. There is an almost tangible shift in your perceptual state as the lights dim. It is not merely acoustic but spatial, social, and relational. You have become attuned to the room, the community around you, and your position within that community. Listening here is inseparable from the particular architecture, the historical resonances of this space, the presence and expectations of others. Already, your act of listening is as much about place and encounter as it is about sound.

Next, picture the moment when the violinist draws the bow across her string. Where does that sound truly exist? It does not exist solely in the instrument, nor only in your, the listener's ear. It emerges in the resonance between these entities—in the acoustics of the hall, the angle of your seat, how attentive you are, even the weight of whatever it is that came before, and what experiences you carry in with you. The reverberation of that single note is shaped by silence,

[9] Jean-Luc Nancy, *Listening*, trans. Charlotte Mandell, 1. ed., [Nachdr.] (New York, NY: Fordham University Press, 2009), 9.

breath, memory, and anticipation. The sound is not an object passed from source to receiver, but a phenomenon co-produced by space, time, and listening presence. Salomé Voegelin captures this precisely: "there is no gap between the heard and the hearing."[10] Sound does not exist prior to or outside of listening—it is created in and through it. To listen, then, is not to extract sound from the world, but to enter a relationship in which the sonic comes into being.

This understanding reframes sound not as a discrete event in the world, but as a dynamic process of emergence. Because sound does not precede listening but arises through it, each sonic event must be understood as the result of a specific configuration: the architecture of the space, the listener's bodily orientation, the temporality of the encounter, the cultural context, and the attentional posture brought to it. Listening is not a passive reception of pre-formed sound, but a constitutive act that draws multiple threads—material, perceptual, cognitive—into a singular, unrepeatable experience. This emergent character of sound unsettles any fixed distinction between subject and object, between environment and event, between the heard and the hearing.

Mark Grimshaw-Aagaard and Tom Garner bring theoretical clarity to this perspective, writing that "sound is not a physical phenomenon but a perceptual entity, arising within the mind."[11] The notion that sound is co-constituted by the listener gains empirical and logical weight when we recognize that even identical sound waves do not yield identical perceptual experiences. As they explain, "The structure that brings together each element (acoustic space,

[10] Voegelin, *Listening to Noise and Silence*, 5.
[11] Mark Grimshaw-Aagaard and Tom Garner, *Sonic Virtuality: Sound as Emergent Perception* (Oxford ; New York: Oxford University Press, 2015), 111.

sound wave, memory, emotion, etc.) is wholly dependent on this proposition."[12] A purely physical account of sound fails to explain the rich variance of response—across bodies, contexts, and histories. A sound wave carries no affect, no memory, no associative meaning until it is heard—not merely detected, but encountered. Listening is the act by which vibration becomes world. And because no two listeners ever encounter the world in exactly the same way, it follows that what we call 'sound' cannot be truly objective. It is not simply out there, waiting to be grasped—it is always emergent, always situated, always becoming.

If, as we have suggested, sound is not merely received but co-produced through the act of listening, then the specific space of listening—its materiality, shape, resonance—cannot be passive or incidental. Return again to the violin in our concert hall. Consider now how that same instrument, played with identical bowing and intensity, would yield radically different sonic worlds if it were moved from a richly reverberant cathedral to an acoustically dry studio, or even outdoors beneath an open sky. The sound itself, as we perceive it, is transformed by the space it inhabits; the architecture and acoustics become active participants, influencing not only the physical character of the vibration but the listener's interpretation and experience of it. Thus, we must now inquire more deeply into how spaces shape listening, and how listening, in turn, shapes our experience of space. Listening is inherently spatial—not simply occurring within spaces, but actively transforming and defining them.

Barry Blesser and Linda-Ruth Salter introduce the concept of "aural architecture": the idea that every space actively shapes sonic perception. Spaces, they argue, are never neutral; they

[12] Grimshaw-Aagaard and Garner, 111.

materially determine not only how sound moves, but how meaning itself emerges through listening.[13] R. Murray Schafer furthers this understanding with his concept of the "soundscape", emphasizing how environments tune perception—guiding the ear toward certain sounds while masking others.[14] When you listen to a violin in a concert hall, you are not simply hearing vibrations in the air: you are hearing through an acoustic lens, sculpted by the curvature of walls, the density of curtains, the materiality of floors and seats, even the bodies around you absorbing and reflecting sound. Space is not an inert backdrop but a co-producer of sonic experience. Listening does not merely happen *in* space—it occurs through the active mediation *of* space, shaped by architecture, matter, and presence. In this way, our experience of sound is inseparable from our experience of the spaces we inhabit.

Yet the spatiality of listening is more than architectural—it is also experiential and existential. Victor Turner illuminates this when he describes certain spaces as "liminal" or "liminoid," zones existing "betwixt and between" the clear boundaries of social identity, expectation, and convention.[15] Your concert hall is just such a space: as the violinist begins to play, normal social rules and identities temporarily soften. Roles—performer, audience, individual, collective—blur and transform. You inhabit a heightened state of openness, a sensitivity sharpened by the transitional qualities of the space. Thus, listening is not just situated but actively situating; it produces and redefines both space and identity. In this liminal state, the

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[13] Barry Blesser and Linda-Ruth Salter, *Spaces Speak, Are You Listening? Experiencing Aural Architecture* (Cambridge, Mass.: MIT Press, 2009), 2–15.
[14] R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester, Vt. : [United States]: Destiny Books ; Distributed to the book trade in the United States by American International Distribution Corp, 1993), 7–11.
[15] Victor W. Turner, *The Ritual Process: Structure and Anti-Structure*, Symbol, Myth, and Ritual Series (Ithaca, N.Y: Cornell University Press, 1977), 138.

familiar separation between the heard and the hearing dissolves once again—reminding us, as Voegelin emphasizes, that sound emerges precisely where listener, place, and sonic event intermingle. To truly listen is to dwell within this mingling, to become part of the soundscape you both perceive and create, inseparably intertwined in the ongoing emergence of the sonic moment.

But how, precisely, is this sonic moment enacted and experienced by the listener? Following the insights of Maurice Merleau-Ponty, we recognize that space is not simply the backdrop against which the body moves; it is the very medium through which the body comes into being. Listening, then, is not a matter of passive reception but of active corporeal engagement. To hear is to enter into vibration with the world. When you listen to a violin's unfolding phrase, your body listens too: a subtle intake of breath, an unconscious tilt of the head, a shift in posture, a tightening or loosening of muscles. Each of these microgestures composes an embodied response, revealing the body as the locus where sound and space co-emerge. The listening body does not merely detect sound; it *enacts* it, shaping and being shaped by the very sonic space it inhabits.[16]

Douglas Kahn extends Merleau-Ponty's emphasis on corporeal enactment by asserting that sound's bodily engagement is fundamentally multisensory, materially involving vibration, resonance, and tactile sensation—not just auditory perception. As Kahn explains, "Speak of the voice per se and one necessarily speaks of the body, yet the voice inhabits bodies differently...

[16] See Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith (London: Routledge, 2006), esp. pp. 235–243 and 284.

These voices are not limited to a privileged orifice or organ but instead use the whole body, which in turn embodies an array of influences and sophisticated processes."[17] Kahn's perspective vividly emphasizes listening as inherently multisensory and physically embodied, interacting materially and biologically to activate and reshape bodily awareness. This materially grounded understanding reinforces listening as an active, physical practice, where the entire body becomes the stage upon which sonic experience unfolds, materially manifest and dynamically enacted.

This embodied, multisensory involvement highlighted by Kahn is fundamentally relational, as Nina Sun Eidsheim further clarifies when she writes, "There is indeed no separation between 'it' and 'I': each configuration forms a unique node… unrepeatable in any dimension."[18] The listener's body and the sonic event do not interact as distinct entities but coalesce into a single relational experience. The violinist's note does not simply move from strings to ears; it emerges as a shared bodily resonance, uniquely shaped by each listener's physiology, memories, expectations, and emotions.

Kendall Walton complements this perspective by framing empathy itself as bodily and relational—not "imaginative identification,"[19] but a phenomenological knowing felt through bodily resonance. This relational embodiment, articulated through Walton's notion of empathetic bodily resonance, gains urgency when viewed against Schafer's idea of

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[17] Douglas Kahn, *Noise, Water, Meat: A History of Sound in the Arts* (Cambridge, Mass: MIT Press, 1999), 290–91.
[18] Nina Sun Eidsheim, *Sensing Sound: Singing & Listening as Vibrational Practice*, Sign, Storage, Transmission (Durham, N.C. London: Duke university press, 2015), 156.
[19] Kendall L. Walton, *In Other Shoes: Music, Metaphor, Empathy, Existence* (Oxford ; New York: Oxford University Press, 2015), 5.

"schizophonic"[20] sound, where modern listeners encounter sound displaced from its origins. Here, the body becomes essential not only to perceive sound, but to re-anchor sonic experiences in relational and communal presence, foregrounding corporeal enactment as central to sonic experience.

Listening, then, is fundamentally embodied—woven through and sustained by relational resonance. Within the concert hall, the violin's sound is neither passively absorbed nor merely heard; it is felt, shaped, and shared. In this delicate interplay, the boundary between *the heard* and *the hearing* softly dissolves, revealing listening not as the extraction of meaning from sound, but as a mutual choreography of sonic worlds. Through such intimate resonance emerges *empathetic omniscience*: not a hearing of everything from nowhere, but the dynamic inhabiting of many vantage points at once—each sensation, space, and moment intertwined in vivid simultaneity.

Having established listening as an act that shapes sonic worlds through bodily resonance and empathetic omniscience, we must now turn explicitly toward the listener themselves. If the sonic event is a relational enactment, how does it, in turn, enact the listener? How does listening shape identity, memory, and the experience of self? With these questions, we step forward into an exploration of how the sonic self emerges—not as something simply revealed, but actively and continuously created through listening.

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[20] Schafer, *The Soundscape*, 90.

THE DANCE OF THE SONIC SELF

The act of listening is never passive; it is always constitutive. As Zoltan Varga succinctly asserts, "The sonic self emerges through the musical event; the musician-as-listener simultaneously realizes and senses itself during the performance."[21] This realization positions listening as inherently *subject-oriented*—a perceptual stance asserting that all listening vantage points are equally valid, equally meaningful. Unlike standardized or object-oriented approaches—which privilege a singular, supposedly 'correct' perspective—*subject-oriented* listening embraces multiplicity, resisting the very notion of a fixed, objective sonic reality. In this dynamic interplay, listening unfolds as choreography, a continuous dance of inward bodily sensation and outward relational resonance. Through this choreographic understanding of subject-oriented listening, we will explore how listeners inhabit, embody, and transform themselves and their worlds, setting the stage for the emergence of empathetic omniscience as the sonic self's capacity to fluidly move between multiple subjective vantage points.

If listening is a choreographic act that shapes individual identities, it is also inherently social—an idea powerfully articulated by Christopher Small through his concept of musicking. For Small, musicking encompasses all aspects of engaging with music—from performing and listening, to sharing the experience in communal spaces. It is not about music as an object, but rather about relationships enacted through musical participation. As Small explains, who we are is revealed by how we relate, and in musicking, "the sound relations of a musical performance stand in

[21] Zoltan Varga, *The Acoustic Self in English Modernism and Beyond: Writing Musically*, 1st ed. (New York: Routledge, 2022), 112, https://doi.org/10.4324/9781003184034.

metaphorical form for ideal human relationships as imagined by the participants."[22] This perspective resonates strongly with our metaphor of choreography: in musicking, listeners are like dancers responding continuously to the movements of others, negotiating their place within shifting relational patterns. Thus, subject-oriented listening is not simply personal or isolated—it unfolds within relational choreography, continually shaping and reshaping communal identity and collective experience. Yet these relational dynamics are never merely abstract or detached; they are felt intimately in the body, drawing listeners into visceral alignment and further constituting the sonic self.

Yet this choreographic interplay of relational listening is never merely social or conceptual—it is fundamentally embodied, grounded in the vulnerability and presence of the sensing body. Pauline Oliveros articulates this through her practice of Deep Listening, where listening becomes a somatic ethics: a disciplined attention rooted in bodily awareness, relational sensitivity, and ecological responsibility. As Oliveros reminds us, listening and responding are intertwined forms of ethical, spatial, and embodied attention.[23] Maurice Merleau-Ponty amplifies this view by insisting that perception is not received by the body but enacted through it, emphasizing that "the body is a subject, not an object."[24] Listening, then, is not a posture of neutrality but a generative act of engagement with the world. Elizabeth Margulis further enriches this understanding, demonstrating how repetition in music renders abstract materials tractable and visceral, anchoring comprehension within the rhythms and habits of the body.

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[22] See Christopher Small, *Musicking: The Meanings of Performing and Listening* (Middletown, CT: Wesleyan University Press, 1998), 60, 129.
[23] Oliveros, *Deep Listening*, 29–31, 74.
[24] Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith, Repr, Routledge Classics (London: Routledge, 2006), 136–137, 235–243.

Together, Oliveros, Merleau-Ponty, and Margulis affirm listening as choreographic: a bodily negotiation of space, sensation, and meaning, unfolding through ethical, somatic, and cognitive responsiveness.[25]

Indeed, embodied choreography is never purely personal; it is always culturally and historically situated. Ingrid Monson emphasizes that listening practices are shaped by race, memory, and culturally learned responsiveness. Listening, through this lens, is a practice of situated embodiment: an improvisational negotiation shaped by collective identities and inherited sonic habits.[26] Subject-oriented listening thus recognizes listeners not as isolated perceivers, but as culturally embedded actors, whose sonic selves are produced through the interplay of personal history and communal experience. Yet even within these shared frameworks, listening remains irreducibly singular—each sonic self inhabits a distinct position, perceiving the world through the irrepeatable choreography of its own body and memory.

Each listener maintains a uniquely irreducible sonic self. Nagel underscores the limits of objectivity by insisting that no third-person account can fully capture the first-person quality of experience. As he argues, something essential is always excluded when we attempt to describe perception from outside its embodied point of view.[27] This resonates deeply with the metaphor of choreography: just as each dancer's gesture reflects a distinct relationship to space and rhythm, each listener hears from within a singular configuration of body, memory, and moment. Subject-

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[25] Elizabeth Hellmuth Margulis, *On Repeat: How Music Plays the Mind* (New York, NY: Oxford University Press, 2014), 42–45.
[26] Ingrid Monson, "Hearing, Seeing, and Perceptual Agency," *Critical Inquiry* 34, no. S2 (January 2008): S36–41, https://doi.org/10.1086/529089.
[27] Nagel, "What Is It Like to Be a Bat?," 436.

oriented listening acknowledges this multiplicity, recognizing that listening is not fixed but fluid, shaped continuously by shifting vantage points, historical entanglements, and perceptual repetition. In this way, the sonic self emerges not as a static entity, but as an ongoing negotiation between presence and context—*a choreography of becoming*.

Listening, then, is fundamentally temporal—a dance unfolding dynamically over time. Edmund Husserl emphasizes how every tone perception unfolds within a flowing temporal structure of memory and anticipation.[28] Complementing this temporal flow, Gilles Deleuze highlights explicitly how repetition itself creates difference, continuously reshaping listeners.[29] Margulis further enriches this perspective, suggesting that repeated listening builds experiential "microworlds"[30] that deepen the listener's sense of temporal anticipation and differentiation. Though repetition is not strictly required for subject-oriented listening, it can intensify subjective awareness of time and transformation within the sonic self.

Throughout this section, we've defined listening explicitly as subject-oriented choreography—embodied, culturally contextualized, uniquely positional, and temporally dynamic. From these insights emerges empathetic omniscience: not an impossible feat of hearing everything at once, but the cultivated ability of the sonic self to fluidly and empathetically inhabit multiple subjective vantage points. Yet, crucial questions remain: How does our physiology enable this

[28] Edmund Husserl, *The Phenomenology of Internal Time-Consciousness*, ed. Martin Heidegger, trans. James S. Churchill (Bloomington: Indiana University Press, 1964), 46–50.
[29] Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1994), 1–5.
[30] Margulis, *On Repeat*, 42–45.

choreographic responsiveness? Which perceptual mechanisms underpin our spatial hearing and empathetic connection?

ESSAY 2: SPATIAL AESTHETICS & SONIC ARCHITECTURE

Part 1: The Science of Spatial Hearing

PRELUDE

> *"Anywhere there is matter and energy, there is vibration, and any vibration can transfer energy and information to a receiver who is listening."*[31]
>
> Seth Horowitz, *The Universal Sense*

We've explored listening as an embodied encounter, inherently subjective and profoundly relational—revealing how deeply our personal and collective histories shape the way we inhabit sound. Yet, beneath the vivid immediacy of experience lies a compelling question: *How precisely does our biology enable this rich perceptual choreography?* If, as we've considered, listening is an active, embodied negotiation of sonic space, what underlying mechanisms make such intricate perceptual and spatial experiences possible?

To answer this, we must briefly step away from metaphor and sensation to engage with the fundamental psychophysical and perceptual foundations of auditory spatialization. It is in the precise workings of our ears, brains, and bodies—how we localize, interpret, and construct sonic environments—that we uncover the hidden scaffolding supporting our subjective

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[31] Seth S. Horowitz, *The Universal Sense: How Hearing Shapes the Mind*, 1. U.S. ed (New York: Bloomsbury, 2012), 4.

experience. Thus, even as we journey deeper into the biology and psychology of spatial hearing, we remain ever aware that perception itself is a creative, participatory act.

HOW IS IT TO LISTEN?

To properly consider the relationship between our bodies and the world around us, let us examine what constitutes our interface with the world: that is, our sense organs. These organs–our eyes, ears, tongues, noses, and skin–are actually collectors and transducers that conduct our "neural coding."[32] They harvest energy data from the world and convert that data into signals our brains can subsequently psychophysiologically interpret. Our eyes do not simply see brightness and color, for instance. They respond to wavelengths of light (remapping that data to color) and quantities of photons (remapping that data to brightness).

Think of your senses as specialized antennas finely tuned to different signals around you. Just as your car's radio picks up electromagnetic waves and translates them into music, your eyes translate light waves into visions, and your ears pick up vibrations from the air, turning them into sounds.

Figure 1. Transducer Man

[32] Benjamin Himpel, "Geometry of Music Perception," 2022, 5, https://doi.org/10.48550/ARXIV.2207.11035.

But whereas the neural network for visual processing is vast and widely distributed, the brain processes sound quickly, directly, and comparatively instantaneously–up to 100 times faster than the eye.[33] Evolution doesn't waste resources; sound is processed swiftly for a reason. As Barry Blesser and Linda-Ruth Salter point out, "The aural experience of space contributed, at least indirectly, to the reproductive success of our species. From a narrow perspective, our brain evolved specialized auditory substrates that could incorporate spatial attributes into awareness."[34] Put simply, evolution shaped our auditory system into an efficient survival mechanism—rapidly detecting and precisely localizing sounds to alert us to potential threats or opportunities in our environment, often before our eyes have time to react.

Our ears are logarithmically sensitive to pressure changes within air molecules, from about 20 microPascals to 20 or more Pascals. A vibrating object will cause the air molecules around it to vibrate, which sets off a chain reaction of compressed and rarefied air molecules that form a sound wave. This wave ripples through the air molecules where the resultant pressure difference enters and is filtered by the outer ear, goes through the ear canal and into the cochlea where it excites hair cells and is transduced to tiny electrical currents that make their way to the brain. In a sense, a sound is alive. Picture dropping a pebble into a calm pond—the ripples flow outward, gently spreading energy. Similarly, every time a violinist draws their bow across the string, vibrations ripple outward in search of an ear to hear and a mind to listen.

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[33] "How Sound Shaped The Evolution Of Your Brain," *Morning Edition* (NPR, September 10, 2015), https://www.npr.org/sections/health-shots/2015/09/10/436342537/how-sound-shaped-the-evolution-of-your-brain.
[34] Blesser and Salter, *Spaces Speak, Are You Listening?*, 317.

Fifty milliseconds from the moment a sound reaches our ears, our brain has already identified what the sound is and precisely pinpointed its location. This rapid and remarkable feat begins when sound enters the cochlea and is initially processed at the cochlear nuclei, segregating auditory signals according to amplitude, frequency, and phase. From there, the signals travel to the superior olive, a structure finely specialized for spatial hearing.

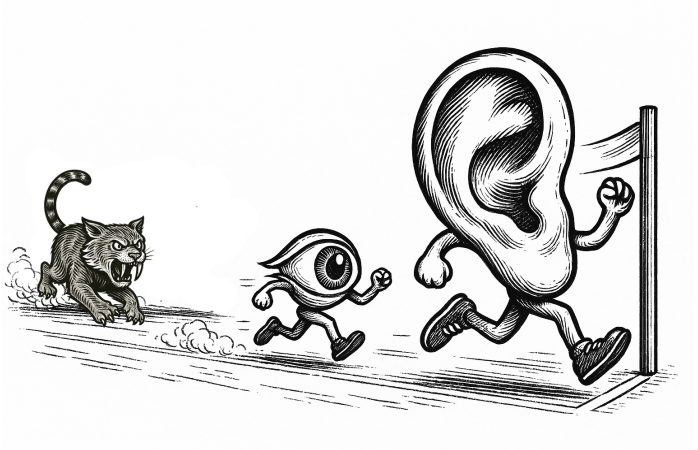

Figure 2. The Race of Ear and Eye

Your superior olive is an ultra-fast calculator of sorts—like a radar operator swiftly tracking an incoming aircraft. It instantaneously measures the exact time difference between a sound's arrival at each ear, known as the interaural time difference (ITD).[35] Simultaneously, it assesses subtle differences in loudness between the ears—the interaural level difference (ILD)—which is especially crucial when locating sounds at higher frequencies.[36] These tiny differences in timing and intensity are the foundation of what's known as the *duplex theory*, first articulated by Lord Rayleigh.[37] Your brain automatically understands that if a sound hits the left ear just a few

[35] John C. Middlebrooks, "Sound Localization," in *Handbook of Clinical Neurology*, vol. 129 (Elsevier, 2015), 101, https://doi.org/10.1016/B978-0-444-62630-1.00006-8.
[36] Jens Blauert, *Spatial Hearing: The Psychophysics of Human Sound Localization*, Rev. ed (Cambridge, Mass: MIT Press, 1997), 157.
[37] John William Strutt Baron Rayleigh, *The Theory of Sound*, 2d ed. rev. and enl, vol. 2, 2 vols. (United Kingdom: Macmillan and Company, 1877).

microseconds before it reaches the right, the sound originates from the left. It also knows instinctively that sound attenuates over distance, so a sound's intensity closer to the source will invariably be greater than at points further away—even over a distance as small as that between your ears. Duplex theory shows how our brain, through slight differences in the signals our two ears receive, automatically favors one of these two localization methods, primarily based on the frequency, to pinpoint the source of a sound.

But spatial hearing involves more than just comparing the left and right sides. Additional spectral processing occurs as sound waves reflect off the intricate contours of our outer ears, helping us distinguish sounds arriving from above, below, in front of, or behind us. These reflections cause subtle yet informative changes in timbre, greatly enhancing our ability to localize sounds in three-dimensional space. Imagine you're outdoors, listening to birdsong. Even without looking, you instantly know if the bird is perched high in a tree, close by, or flying overhead—all because the unique shape of your ears transforms subtle changes in the sound's timbre into spatial clues. For instance, natural sounds often have a relatively broad, flat spectrum—especially rich in frequencies around 4 kHz and higher—which makes them easier for our auditory system to locate precisely.

Figure 3. Localizing Sound in Nature

After initial spatial and spectral processing, auditory signals move upward through the lateral lemniscus and into the auditory midbrain. Here, individual sonic features combine into more complex representations, integrating what we hear into meaningful auditory scenes. By the time these signals reach the auditory cortex, we finally become consciously aware of the sounds around us.

Moreover, the auditory process doesn't simply end when sound reaches consciousness. From the auditory cortex, neural connections extend deeply into regions associated with emotion and memory. As Horowitz emphasizes, this deep neural connection explains why hearing a song from your childhood instantly pulls you back through time—triggering vivid, emotional memories.[38] Thus, the way we hear is inherently intertwined with how we feel, think, and remember—central aspects of our human experience.

Figure 4. Sound Memory

[38] Horowitz, *The Universal Sense*, 133.

To underscore this remarkable capacity clearly: within just fifty milliseconds—about a twentieth of a second—our auditory system effortlessly decodes subtle timbral variations and precisely maps spatial orientation, in addition to recognizing basic sonic features such as pitch, amplitude, and phase. Consider this for a moment: in less time than it takes to blink, your auditory system decodes subtle shifts in sound—identifying who whispered your name, pinpointing a car approaching from behind, or recognizing the familiar tone of a loved one's voice. This astonishing, instantaneous ability to locate and interpret sounds in three-dimensional space isn't merely a sensory skill; it fundamentally shapes our engagement with the world, enabling awareness, safety, communication, and deeply meaningful emotional connections through sound and music.

*NYC*HOPHYSICS OF AUDITORY SPATIALIZATION

You're standing at a Brooklyn street corner, waiting for the walk signal. It's summer—steam is beginning to rise from subway grates, a kit of pigeons has discovered somebody's discarded bagel, your favorite cafe across the street is already a buzz. Then, from somewhere behind you: a high, chirping *ding-ding*. A fraction of a second later, before your conscious mind can decide what it was, you've already jumped aside—just in time to avoid a delivery cyclist balancing three pizzas with one hand. You didn't see the bike. You didn't even think. You just knew. And then, as your chest slows and your breath catches up, you think, "That bell came from behind me, to the left, maybe twenty feet?" And you were right.

Figure 5. Sound is Instant & Automatic

This—this is the psychophysics of auditory spatialization. Before language, before memory, before knowing the difference between front and back, your auditory system was already a cartographer of experience. It builds the world not just from what's heard, but from where—and how—it was heard.

To make sense of the urban soundscape, the brain organizes vibrations into perceptual scenes. This process, known as auditory scene analysis, operates less like a recording device and more like a graffiti-tagged subway window: blurry, in motion, and always filling in the gaps.

Borrowing from the Gestalt psychologists—Max Wertheimer, Wolfgang Köhler, Kurt Koffka—auditory scene analysis is guided by principles originally framed for visual perception: proximity, similarity, continuity, closure, and common fate. But unlike a static visual image, sound arrives as a time-based signal. The brain's challenge is to group transient acoustic events into stable perceptual streams.

Figure 6. Gestalt Listening

Imagine riding the A train. As you rumble from Fulton to Canal, you hear a saxophonist in the car ahead. Through the hum of fluorescent lights and screeching brakes, you can pick out the shape of Coltrane's "Naima" winding its way forward. How? The brain binds together repeated patterns—shared pitch contours, rhythmic regularity, harmonic similarity—and creates a unified stream: that's the saxophone, that's one musician, that's Coltrane, or close enough.

Albert Bregman, whose seminal 1990 book codified auditory scene analysis, emphasizes that hearing is not passive. To organize and separate sound sources, our auditory system relies on heuristics—mental shortcuts—which are "not guaranteed to solve the problem, but are likely to lead to a good solution."[39] These assumptions aren't deterministic rules but probabilistic guesses shaped through experience. Over time, your brain becomes adept at taking in continuous streams of auditory information, quickly parsing, grouping, collating, or discarding data, to form a reliable guess about what's happening around you. Moreover, as Eric Clarke suggests, these

[39] Albert S. Bregman, *Auditory Scene Analysis: The Perceptual Organization of Sound / Albert S. Bregman.* (Cambridge, Mass: MIT Press, 1990), 32.

guesses directly shape "what you should do about it," echoing psychologist James Gibson's concept of *affordances*—the "reciprocal relationship between the [action] opportunities of the environment and the capacities of the perceiver."[40] Linking affordances to environmental sound connects our responses—like instinctively jumping out of the pizza delivery guy's path—to the relevant acoustic cues around us (*ding-ding!*).

Human auditory spatial acuity varies considerably across different dimensions, shaped deeply by evolutionary pressures and the practical realities of terrestrial life. We excel horizontally—particularly in the frontal field—where under optimal conditions we can discern sound source shifts as slight as 1°, especially within frequency ranges between 1–4 kHz, where interaural time differences (ITDs) and interaural level differences (ILDs) are most effectively utilized.[41] These specific frequencies are crucial because ITDs provide highly precise cues at lower frequencies (generally below about 1.5 kHz), while ILDs dominate at higher frequencies (above about 2 kHz), with maximal effectiveness around 2–4 kHz due to the head-shadow effect. Evolutionarily, high resolution in the forward horizontal plane makes sense: most threats and resources appear from in front or from the sides, driving natural selection to fine-tune horizontal acuity in these frequency bands.

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[40] Eric F. Clarke, "Music, Space and Subjectivity," in *Music, Sound and Space*, ed. Georgina Born, 1st ed. (Cambridge University Press, 2013), 91, https://doi.org/10.1017/CBO9780511675850.004; James J. Gibson, *The Ecological Approach to Visual Perception: Classic Edition*, Psychology Press Classic Editions (Hove, East Sussex: Psychology Press, 2015), 119.

[41] John C. Middlebrooks, James C. Makous, and David M. Green, "Directional Sensitivity of Sound-Pressure Levels in the Human Ear Canal," *The Journal of the Acoustical Society of America* 86, no. 1 (July 1, 1989): 103–4, https://doi.org/10.1121/1.398224; D. Wesley Grantham, Benjamin W. Y. Hornsby, and Eric A. Erpenbeck, "Auditory Spatial Resolution in Horizontal, Vertical, and Diagonal Planes," *The Journal of the Acoustical Society of America* 114, no. 2 (August 1, 2003): 1016–19, https://doi.org/10.1121/1.1590970; Simon Carlile et al., "Six Degrees of Auditory Spatial Separation," *Journal of the Association for Research in Otolaryngology* 17, no. 3 (June 2016): 111–12, https://doi.org/10.1007/s10162-016-0560-1.

Vertically, however, our spatial acuity is substantially weaker, with localization precision typically limited to around 4°–10° even under ideal conditions. Vertical localization primarily depends on spectral cues shaped by the outer ears (pinnae), effective primarily at higher frequencies (above approximately 4–6 kHz).[42] Our terrestrial evolution explains this disparity: standing firmly on the ground, humans rarely needed fine vertical discrimination, since opportunities or threats rarely approached from extreme vertical angles. Thus, we developed a general 'good-enough' vertical acuity, reliant on pinnae-filtered spectral cues that are much subtler and frequency-dependent than horizontal cues.

Similarly, distinguishing sounds along the front-to-back axis poses another challenge. The same horizontal cues (ITD and ILD) remain nearly identical whether sounds emerge from directly ahead or directly behind. Consequently, we rely heavily on subtle spectral modifications—also most prominent at higher frequencies—and on cognitive strategies like head turning, to resolve front-back ambiguities.[43] Thus, auditory spatialization is not uniform across angles or frequencies: it is finely attuned horizontally between about 1–4 kHz, modestly precise vertically at frequencies above 4–6 kHz, and inherently ambiguous front-to-back—reflecting our evolved priorities and practical needs as ground-dwelling listeners.

But step back onto any Manhattan sidewalk, and ideal listening conditions evaporate instantly. Your ears become bathed in reflections: car horns bounce off skyscraper glass, distant footsteps

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[42] Blauert, *Spatial Hearing*, 180–84; Grantham, Hornsby, and Erpenbeck, "Auditory Spatial Resolution in Horizontal, Vertical, and Diagonal Planes," 1016–18.
[43] Blauert, *Spatial Hearing*, 46–49; Carlile et al., "Six Degrees of Auditory Spatial Separation," 212.

echo through alleyways, and the rumble of subway cars rises from sidewalk grates beneath your feet. Every surface and object adds complexity, scattering the carefully evolved acoustic cues your auditory system depends upon. Yet somehow, amidst this chaos—sirens ricocheting between buildings, voices competing across crowded intersections, trucks shifting pitch as they speed by—you rarely question where you are or where sounds originate. This confidence in auditory space doesn't come from pure acoustic clarity. Rather, it arises because your brain continually synthesizes motion, memory, and expectation, turning noisy uncertainty into a coherent sonic story of life in the city.

Figure 7. Spatialization Amidst Chaos

Auditory spatial perception isn't simply real-time. It's anticipatory. Memory and experience pre-shape how we hear space. Eric Clarke's ecological model suggests that our auditory understanding of environments is grounded in interaction: we move, we listen, we learn to expect reverberation in stairwells and dampened quiet in snow. Spatial hearing becomes enacted through engagement. "The directness of our perception of the world," Clarke explains, "is not an

inexplicable or 'magical' reciprocity between perceiver and environment: it is the consequence of adaptation, perceptual learning, and the interdependence of perception and action."[44]

But memory doesn't merely prime our ears for physical spaces; it also colors what we hear emotionally. When a subway performer gently strums "Somewhere Over the Rainbow" moments after your breakup, your brain does more than localize the sound source—it infuses the acoustic moment with personal meaning. Elizabeth Margulis explores how musical repetition deepens such emotional and perceptual involvement precisely through familiarity. As Margulis succinctly puts it, "Musical repetitions are quite like musical memories."[45] Through repetition, we imprint emotional maps onto acoustic landscapes, turning shared soundscapes into deeply personal territories.

Extending this idea further, Kendall Walton describes listening as a form of "imaginative empathy:" We don't simply hear sounds positioned around us; we hear as if we are inside the unfolding scene itself, projecting ourselves into the auditory environment through metaphor.[46] Deleuze and Guattari offer another vivid metaphor, suggesting sound creates "folds" in our experiences—temporal textures layered richly beyond simple linearity, inviting us into multidimensional spaces shaped as much by memory and imagination as by acoustic physics.[47]

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[44] Eric Clarke, *Ways of Listening* (Oxford: Oxford University press, 2005), 136.
[45] Margulis, *On Repeat*, 25.
[46] Walton, *In Other Shoes*, 1–10.
[47] Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1994), 64; Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi, 12. print (Minneapolis, Minn.: Univ. of Minnesota Press, 2007), 3–8.

Thus, standing amid the acoustic hustle of New York City, you're not merely locating sounds in space. You are continuously crafting auditory worlds—folding memories, emotions, and anticipations into every echo and vibration. The city itself becomes a partner in this auditory drama, endlessly offering sounds that resonate simultaneously in the ear, memory, and imagination. On that Brooklyn corner, the bicycle bell wasn't just a warning—it was an invitation to remain alive to your environment, to listen as a way of being in the world.

And sometimes, not getting hit by pizza is just a bonus.

A GESTALT SOUNDWALK THROUGH AUDITORY BIAS

Stepping away from the vibrant sonic complexity of the urban environment, consider now a natural soundscape—a forest at dawn, a place R. Murray Schafer might call a "hi-fi soundscape… possessing a favorable signal-to-noise ratio… [where] there is perspective—foreground and background."[48] Here, amid the stillness, your auditory system engages profoundly with the primal clarity of acoustic space. This natural setting also vividly demonstrates the perceptual biases at play, deeply ingrained through evolutionary pressures, revealing the fundamental science underpinning spatial hearing.

[48] Schafer, *The Soundscape*, 43.

Figure 8. A Hi-Fi Soundscape

At first light, a single bird's call pierces through the forest canopy. Instantly, your auditory system activates the Haas (or precedence) effect, prioritizing the initial wavefront arriving at your ears to pinpoint the bird's precise location. Despite immediate echoes bouncing from surrounding trees, your brain decisively maps the bird's position from that very first acoustic imprint. This innate mechanism evolved precisely for survival, allowing quick spatial identification amidst complex reverberant environments, essential for early humans navigating dense landscapes filled with unseen opportunities and threats.

Yet auditory localization doesn't rely solely on initial arrivals. More nuanced spatial discrimination—particularly along vertical and front-to-back dimensions—is afforded by subtle spectral filtering performed by outer ear structures, captured in what we call head-related transfer functions (HRTFs). Georgina Born describes this vividly, noting how the “complex ridged shape of the pinna (the external ear-flap) has the effect of filtering” sound via selective

"diffusion and absorption of certain frequencies,"[49] a process inherently unique to each individual's anatomical structure. Shaped by the intricate architecture of your pinnae, head, and shoulders, these acoustic filters imprint distinctive spectral signatures onto sounds coming from various spatial directions.

Jens Blauert emphasizes the perceptual significance of these HRTFs, explaining that they are crucial for "forming auditory events in the subject's perceptual space"[50] and underpin the brain's ability to locate sound sources using monaural cues derived from the filtering characteristics of the outer ear. In our forest scenario, subtle yet informative spectral modifications of insect chirps and rustling leaves enable precise auditory judgments—allowing you not only to pinpoint direction but also to discern elevation, clearly distinguishing sounds originating from the treetops from those near the forest floor.

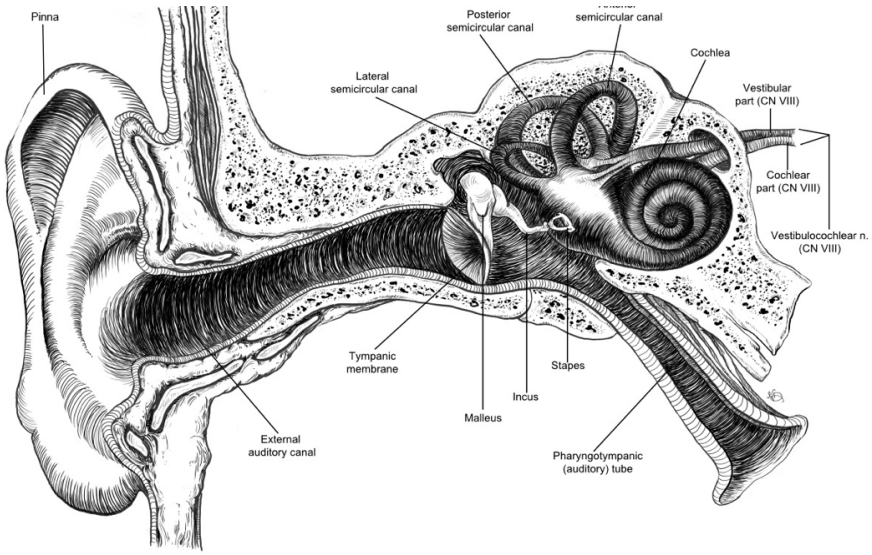

Figure 9. Ear Taxonomy

[49] Georgina Born, ed., *Music, Sound and Space: Transformations of Public and Private Experience* (Cambridge ; New York: Cambridge University Press, 2013), 94.
[50] Blauert, *Spatial Hearing*, 373.

The act of making sense from these layered auditory signals aligns closely with Gestalt principles of perceptual organization. Just as urban listeners interpret the fleeting melodies of a distant saxophone through auditory scene analysis, natural soundscapes invite similar cognitive strategies. Gestalt psychology, as articulated by Leonard B. Meyer, describes how "the mind, in its selection and organization of discrete stimuli into figures and groupings, appears to obey certain general laws."[51] In the forest, principles such as figure-ground, proximity, similarity, and continuity shape your perceptual experience. Birdsong, rhythmic and repetitive, emerges as a figure against the ambient forest drone of wind, water, and insects. Your auditory system groups nearby rustlings and similar bird calls into coherent perceptual streams, seamlessly stitching discrete sounds into meaningful patterns.

Hildegard Westerkamp's evocative soundscape composition, *Kits Beach Soundwalk*,[52] exemplifies this perceptual interplay. Westerkamp intentionally directs listeners toward subtle acoustic details—such as the gentle rustling of seaweed and the crackling of barnacles beneath louder ocean waves—demonstrating how deliberate attention recalibrates our perceptual priorities. Her approach aligns with Barry Truax's characterization of a soundwalk, whose essential purpose is "to encourage the participant to listen discriminatively, and moreover, to make critical judgments about the sounds heard and their contribution to the balance or imbalance of the sonic environment."[53] Westerkamp's work vividly illustrates how auditory

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[51] Leonard B. Meyer, *Emotion and Meaning in Music*, Paperback ed., [Nachdr.] (Chicago. Ill.: Univ. of Chicago Press, 2008), 83.
[52] Hildegard Westerkamp, *Kits Beach Soundwalk* (Vancouver, B.C, 1989), https://www.hildegardwesterkamp.ca/sound/comp/3/kitsbeach/.
[53] Barry Truax, ed., *The World Soundscape Project's Handbook for Acoustic Ecology*, 1st edition, The Music of the Environment Series ; No. 5 (Vancouver, B.C: A.R.C. Publications, 1978).

perception actively constructs spatial meaning by guiding listeners to consciously shift sounds from background to foreground, crafting intricate acoustic spaces through heightened perceptual awareness. Thus, spatial hearing is revealed as not merely passive reception, but rather as an intentional and interpretive act, deeply informed by cognitive biases and ongoing environmental interactions.

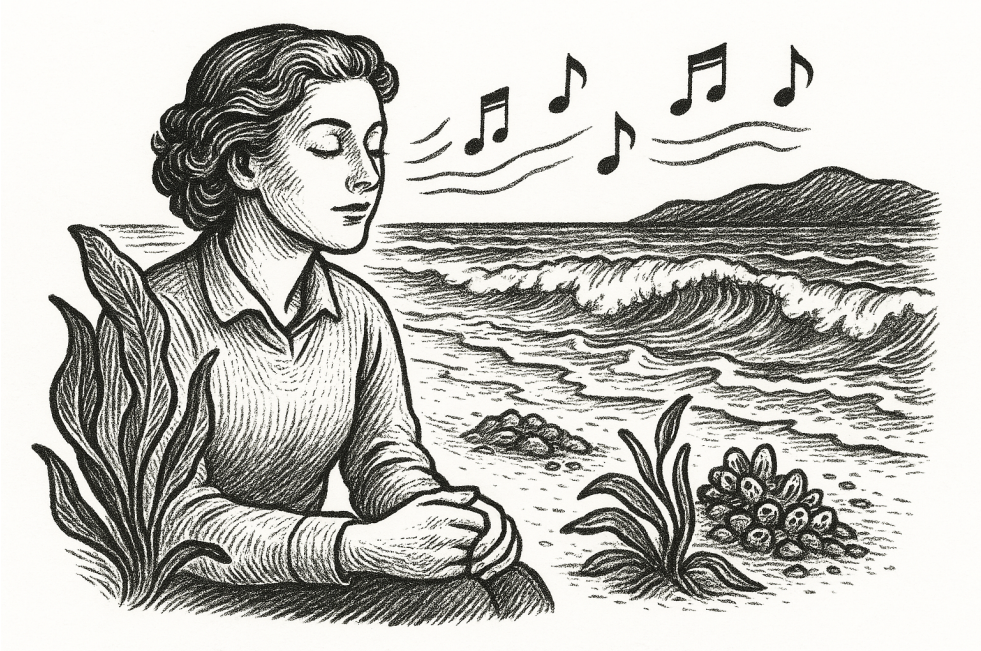

Figure 10. Critical Listening

Such auditory interpretations are fundamentally embodied, resonating deeply with ecological and embodied cognition frameworks discussed by Mark Grimshaw-Aagaard and Tom Garner. They argue listening is intrinsically an embodied, contextual experience, shaped profoundly by the listener's physical interactions, emotional states, and past experiences within a particular acoustic environment. These "embodiment factors," they write, "have the potential to affect the sound we perceive in a way commonly believed to only be achievable by way of direct

manipulation of the sound wave and the external environment."[54] Standing in this forest, your experience of space is not merely cognitive—it's physical, informed by your body's subtle movements, orienting toward meaningful sounds, reacting instinctively to cues signaling potential resources or threats.

Integrating these perceptual biases—Haas effects, spectral filtering through HRTFs, Gestalt organization, and embodied cognition—offers an extensive scientific grounding to understand auditory spatial perception. Analyzing them through the vivid lens of natural soundscapes not only clarifies complex psychophysical processes but also connects foundational auditory science to broader themes of spatial aesthetics and sonic architecture. Understanding spatial hearing at this fundamental, ecological level provides critical insights for designing spaces that enhance and harmonize auditory experiences, bridging theoretical understanding and practical, creative applications in acoustic design and musical composition. Ultimately, spatial hearing transcends mere survival utility, shaping deeply human experiences, emotions, and connections to our environments—both natural and constructed.

POSTLUDE

As we've wandered together—from the vivid sonic density of a Brooklyn street corner through the subtle acoustics of a forest at dawn—we've uncovered something foundational: the rich tapestry of auditory space emerges directly from our embodied perceptual biases, spectral filters shaped uniquely by our own anatomies, and the cognitive organization guided by Gestalt

[54] Grimshaw-Aagaard and Garner, *Sonic Virtuality*, 87.

principles. Each sonic environment we encounter is not simply out there waiting to be perceived; rather, it is actively constructed within our perceptual and embodied selves.

This understanding does not mark an endpoint but rather deepens our curiosity. For if listening itself is a creative act, shaped profoundly by biology, cognition, and embodiment, then the structuring of sonic spaces—whether through composition, architecture, or technology—becomes an artistic practice intertwined inherently with perception. From here, our journey naturally continues toward exploring the deliberate crafting of auditory spaces, embracing fully the artistry made possible by our innate, human ways of hearing.

ESSAY 3: INTEGRATION OF TECHNOLOGY & COMPOSITIONAL PRACTICE

Part 1: Spatial Concepts in Composition

PRELUDE

"Space music includes all music."[55]

Henry Brant, *Spatial Music Progress Report*

Space in music is not just empty air, nor merely the distances that make the ear fonder—it is the invisible fabric that holds sound, perception, and meaning together. In earlier essays, we considered how listeners actively shape their sonic experiences, drawing on ecological approaches and embodied listening practices rooted in phenomenology. Now, we turn toward the composer's perspective, exploring how spatial thinking transforms musical composition into something vividly dimensional and immersive. Composers have long recognized space as a creative medium: from Henry Brant's pioneering experiments placing musicians throughout architectural spaces, to Maryanne Amacher's intricate sonic architectures, and the electromechanical wizardry of Edgard Varèse and Iannis Xenakis. More recently, artists like Natasha Barrett and Trevor Wishart have shown how electronic tools expand this spatial canvas, opening worlds impossible to achieve through traditional acoustic means. Central to our discussion will be an exploration of how acoustic and electronic spatialization differ—both

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[55] Henry Brant, "Spatial Music Progress Report," ed. Tyler Resch, Charles R. Putney, and Mary Jane Lydenberg, *Quadrille* 12, no. 3 (January 1979): 22, http://hdl.handle.net/11209/16984.

practically and perceptually—and how channel-based mixing methods contrast with emerging object-based techniques, laying a clear foundation for understanding contemporary spatial diffusion practices. Ultimately, by positioning space as an interactive and dynamic compositional force, we set the stage to examine the practical tools and philosophies guiding my own creative practice, asking how spatial technologies can enable deeper, more subject-oriented forms of musicking.

THE LAUNCHPAD: EARLY CONCEPTUALIZATIONS OF SPATIALITY IN COMPOSITION

In the early twentieth century, composers began to notice something important: music wasn't just about notes on a page or sound coming from a stage. It was about where the sound came from, where it went, and how it moved through the spaces we occupy. Edgard Varèse was among the first to truly grasp the expressive power hidden in this spatial dimension. He envisioned music as a dynamic substance, sculpted not just in time but also in physical space, creating what he called "planes" and "zones of intensities."[56] For Varèse, sounds could hover, surge, collide, or drift—each gesture reshaping the invisible architecture around the listener. His works sought to break the invisible barrier between composer, performer, and audience, dissolving the traditional boundaries of the concert hall.

Henry Brant expanded spatial composition into a tangible physical reality, scattering ensembles throughout concert halls, churches, and even outdoor spaces. For Brant, space itself became an

[56] Edgard Varèse, "The Liberation of Sound," ed. Chou Wen-chung, *Perspectives of New Music* 5, no. 1 (1966): 11, https://doi.org/10.2307/832385.

instrument, shaped not by abstraction but by the direct, embodied presence of performers and listeners. His compositions, like *Ice Field* and *Orbits*, invited audiences to move, listen actively, and experience a dynamic soundscape from endlessly varied vantage points—embracing, rather than resisting, the multiplicity of listening perspectives.

This recognition—that space could be lived, traversed, and heard differently by each listener—found a powerful electronic counterpart in Karlheinz Stockhausen. In *Gesang der Jünglinge*, Stockhausen choreographed sound across multiple loudspeakers, rotating, hovering, and shifting sonic events around the audience. Rather than binding sound to a single fixed source, he allowed it to migrate freely, inviting listeners into a perceptual dance with spatial form. Like Brant, Stockhausen dissolved the idea of a singular optimum perspective, instead sculpting conditions where each listener's experience would be inevitably unique—shaped by their physical location, their attention, and their embodied encounter with sound in motion.

Together, these early explorations—Varèse's vivid sonic imagination, Brant's inventive acoustic architectures, and Stockhausen's electronic spatial choreography—opened a door to entirely new ways of composing and experiencing music, shattering the traditional division between composer, performer, and listener. In their hands, space was no longer a passive container for music—it became a vivid, active force: an unpredictable co-creator of musical meaning. Central to this revolution was Henry Brant's profound insight that "spatial music must be conceived in accordance with the premise that there is no one optimum position in the hall."[57] This insight is

[57] Elliott Schwartz, Barney Childs, and Jim Fox, eds., *Contemporary Composers on Contemporary Music*, 1st Da Capo ed., expanded ed (New York: Da Capo Press, 1998), 262.

crucial: it affirms that each listener brings their own perspective, physical position, and personal history into the experience, resulting in myriad unique interpretations of the same sonic event. Rather than seeking a singular, idealized perspective, spatial music embraces multiplicity, emphasizing openness, personal engagement, and active listening.

This idea—the acknowledgment and even celebration of subjective listening experiences—has far-reaching implications for spatial composition. It suggests music is not merely delivered to a passive audience but created anew through each individual's embodied presence and perception. Karlheinz Stockhausen recognized this too, carefully orchestrating how "sound would rotate, and if sound would travel or stay still," as part of a spatial plan designed to shape how listeners might perceive and move through sound—acknowledging that each listener would engage uniquely with the unfolding sonic environment.[58] Thus, spatial composers actively craft conditions for listeners' personal discoveries, recognizing that musical meaning emerges dynamically, shaped by the listener's own movements, sensations, and interactions within the sonic environment.

By centering these ideas at the heart of compositional practice, these pioneering composers provided a foundation that remains pivotal today—and directly informs my own compositional philosophy of subject-oriented music. My work builds explicitly upon Brant's crucial insight, embracing that there truly ought not to be one optimum or correct position in the listening

[58] Fishman-Johnson, quoted in Gascia Ouzounian, "Sound Installation Art," in *Music, Sound and Space: Transformations of Public and Private Experience*, ed. Georgina Born (Cambridge: Cambridge University Press, 2013), 76.

environment. Instead, subject-oriented music seeks precisely this diversity of perspectives, creating compositions that invite listeners to explore, inhabit, and co-create the music itself.

LOW EARTH ORBIT: SPATIALIZATION AS SCULPTING SONIC EXPERIENCE

When working with sound as something capable of moving and breathing through physical space, composers can think of themselves as sculptors of sonic experience—artists whose medium is sound rather than marble or paint. For many composers, spatializing sound is not merely a technical task but a deeply creative and personal act, inherently connected to the embodied listener. Music, in this view, becomes a space for listeners to enter, explore, and inhabit in their own unique ways.

Iannis Xenakis, trained as both an architect and composer, described his musical practice as one of designing *architectures of sound*—structures that could be physically and perceptually inhabited. For Xenakis, composing meant more than organizing notes in time; it meant translating abstract mathematical and architectural concepts into sensory, spatial experiences. As he once put it, "my advantage over other composers was that I could design… it was much easier for me to use a graphic approach to music than classical notation."[59] His spatial compositions, like *Terretektorh*, embodied this philosophy, placing musicians among the audience to create an immersive "polytope" of live sound in which every listener's experience was uniquely determined by their position within the sonic field.

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[59] Iannis Xenakis, *Formalized Music: Thought and Mathematics in Composition*, Rev. ed, Harmonologia Series, no. 6 (Stuyvesant, NY: Pendragon Press, 1992), xii.

Maryanne Amacher and John Cage, though working from radically different premises, each shattered the fixity of traditional listening. Amacher activated the listener's inner architecture itself, creating works that engaged psychoacoustic phenomena like *otoacoustic emissions*—sounds generated within the ears of the listener. In her *Sound Characters (Making the Third Ear)*, music streamed not just into the body but from it, as tones danced, cascaded, and flickered inside the listener's own physiology. [60] Cage, by contrast, dissolved fixity in the external world, crafting sonic environments in which unpredictability was not an obstacle but an invitation. His spatial compositions, such as *Roaratorio*, unfolded as shifting landscapes of simultaneous sonic events, allowing each listener to find their own pathway through the soundfield.

Both composers rejected the idea of a singular sonic narrative. Instead, they proposed listening as a traversal—an improvisatory encounter shaped by bodily movement, attention, and openness to chance. Cage himself put it perfectly in the piece "2 Pages, 122 Words on Music and Dance" when he wrote:

> "The world is teeming; anything can happen."[61]

In dissolving the fixed architectures of listening—whether inner or outer—Amacher and Cage opened the way for a broader understanding of sound as a relational, embodied field, dynamically shaped through perception, movement, and imagination.

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[60] Gascia Ouzounian, "Sound Installation Art: From Spatial Poetics to Politics, Aesthetics to Ethics," in *Music, Sound and Space*, ed. Georgina Born, 1st ed. (Cambridge University Press, 2013), 83–84, https://doi.org/10.1017/CBO9780511675850.003.

[61] John Cage, *Silence : Lectures and Writings* (Middletown, Conn. : Wesleyan University Press, 1961), 96, http://archive.org/details/silencelecturesw1961cage.

Xenakis's carefully designed immersions, Amacher's psychoacoustic discoveries, and Cage's open-ended sonic fields each reveal how composers actively shape spatial experiences—not just placing sounds, but crafting how we feel, move, and perceive within sonic worlds. Scholars such as Grimshaw-Aagaard and Garner emphasize that spatial listening is not passive but actively constructed—an experiential process grounded in the listener's movement, attention, and sensory engagement with sound.[62] Christopher Small similarly describes this experience as a "complex web of relationships,"[63] at the heart of which lies the interplay between performers and sounds, radiating outward to include composers, listeners, and the entire environment of musicking. Taken together, these composers clearly demonstrate that spatial composition is fundamentally about interaction, embodiment, and openness to individual experience.

DEEP SPACE TRANSIT: ACOUSTIC OR ELECTRIC?

When composers endeavor to frame their work spatially—or craft explicitly spatial pieces—a fundamental crossroads emerges, illuminating the composer's underlying predispositions, biases, or philosophies regarding listening and spatialization. That is, particular attention must be paid to whether they work acoustically, electronically, or at the fertile intersection of both. On the surface, this appears straightforward: acoustic spatialization utilizes physical spaces and natural acoustics, while electronic spatialization employs technology to simulate, augment, or transform these spaces. Yet, beneath this dichotomy lies a profound interplay between the tangible world we inhabit and the imagined worlds we create.

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[62] Grimshaw-Aagaard and Garner, *Sonic Virtuality*, 87–88.
[63] Small, *Musicking*, 27.

Acoustic spatialization roots listeners firmly in physical reality, emphasizing embodied listening and intimate spatial interactions—a perspective deeply aligned with Maurice Merleau-Ponty's philosophy of embodied perception, where perceptual experiences fundamentally arise from bodily interactions with our environment. Ros Bandt vividly describes acoustic space as where "time and space merge as they are articulated by sound,"[64] reinforcing this concept of sensory integration. Pauline Oliveros similarly underscores this holistic approach through her concept of *Deep Listening*, a practice intended to "heighten and expand consciousness of sound in as many dimensions of awareness and attentional dynamics as humanly possible."[65] For Oliveros, listening is not passive reception but an embodied, expansive act—one that roots musical experience in bodily presence and attention across multiple dimensions of perception. Henry Brant represents an even more explicit stance, strongly advocating acoustic spatialization and expressing skepticism toward electronic amplification as a distortion of sound's authentic qualities—comparing electronic reproduction to "fast food" and acoustic listening to "organic food for the nerves."[66] Alvin Lucier's celebrated composition *I Am Sitting in a Room* further exemplifies acoustic spatialization's embrace of physicality, capturing the resonance of architectural space itself. Lucier explains, "What you will hear, then, are the natural resonant frequencies of the room articulated by speech…every room has its own melody hiding there until it is made audible."[67] Collectively, these perspectives present acoustic spatialization as more

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[64] Ros Brandt, "Place as Acoustic Space: Hearing Australian Identity," in *Making Sense of Place: Exploring the Concepts and Expressions of Place through Different Senses*, ed. Frank Vanclay, Matthew Higgins, and Adam Blackshaw (Canberra: National Museum of Australia, 2008), 95.
[65] Oliveros, *Deep Listening*, xxiv.
[66] Molly Sheridan, "Henry Brant Reflects in Glow of Pulitzer - New Music USA," April 12, 2002, 12, https://newmusicusa.org/nmbx/henry-brant-reflects-in-glow-of-pulitzer/.
[67] Alvin Lucier and Douglas Simon, "Alvin Lucier in Conversation with Douglas Simon," in *Sound by Artists*, ed. Dan Lander and Micah Lexier, Facsimilie printing (Mississauga, Ontario: Blackwood Gallery, 2013), 196.

than just a technical choice—it is an expressive philosophy grounding musical experience in tangible physicality, presence, and intimacy.

Conversely, electronic spatialization liberates composers from physical constraints, opening imaginative worlds beyond acoustic realities. Philosophically, Walton grounds electronic spatialization through his concept of "imaginative empathy"[68] which allows listeners to inhabit internally constructed worlds—sonic spaces built from cognitive and emotional invention. This imaginative empathy extends listeners' perceptual horizons beyond the limits of physical acoustics. Trevor Wishart similarly describes electronic techniques as creating "virtual acoustic spaces,"[69] emphasizing composers' newfound capacity to construct previously unimaginable sonic textures and landscapes. Pierre Schaeffer introduces another significant perspective with his pioneering concept of the "sound object"[70] (*l'objet sonore*), illuminating electronic sound's autonomy by highlighting its potential for creative manipulation independent of any original source. Curtis Roads notes that electronic tools effectively "liberate" pitch, timbre, and space from conventional limitations,[71] enabling composers and listeners to explore sonic terrains unconstrained by traditional physical acoustics. Grimshaw-Aagaard and Garner further synthesize these perspectives with their concept of "sonic virtuality," characterizing electronically generated sound worlds as perceptual phenomena emerging fully within the listener's mind,[72] seamlessly blending external auditory input with imaginative cognition.

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[68] Walton, *In Other Shoes*, 172.
[69] Trevor Wishart, *On Sonic Art*, ed. Simon Emmerson, New and rev. ed, Contemporary Music Studies, v. 12 (Amsterdam: Harwood Academic Publishers, 1996), 149–65.
[70] Pierre Schaeffer, *Treatise on Musical Objects: Essays across Disciplines*, trans. Christine North and John Dack, California Studies in 20th-Century Music 20 (Oakland, California: University of California Press, 2017), 67–69.
[71] Curtis Roads, *Composing Electronic Music: A New Aesthetic* (Oxford ; New York: Oxford University Press, 2015), 11–12.
[72] Grimshaw-Aagaard and Garner, *Sonic Virtuality*, 32.

Building on this understanding of sonic embodiment, Nina Sun Eidsheim offers a crucial deepening: music, she argues, is fundamentally a "vibrational practice"—a phenomenon transmitted through the body's tangible and intangible systems, never merely auditory or external.[73] In her framing, listening is not simply a reception of vibration but a co-creative, relational event, inseparable from the listener's physical presence and context. Extending this dynamic view, Ingrid Monson introduces the concept of "perceptual agency," emphasizing that listeners consciously direct sensory attention, yielding different interpretations of the same sonic environment.[74] Together, Eidsheim and Monson move us beyond the idea of fixed perception: they reveal listening itself as an active, improvisational act—one where embodiment, context, and imagination converge to shape the sonic experience uniquely for each listener (a topic more thoroughly explored in the first essay). This understanding—that listening is an active, embodied improvisation within space—finds vivid expression in Oliveros's work, particularly in her embrace of technology as both medium and provocation for critical spatial awareness.

Oliveros's commitment to embodied, critical listening finds further expression in works like *In Memoriam: Nikola Tesla, Cosmic Engineer*. As Drake Andersen describes, Oliveros deliberately deploys technology in a visible—and even obstructive—way, forcing musickers into heightened spatial awareness. The technological affordance becomes not just a tool, but an extension of Deep Listening's ethical call toward active, socially engaged sonic attention.[75] Herein lies the generative tension: acoustic spatialization connects us intimately to embodied physicality, while

[73] Eidsheim, *Sensing Sound*, 156.
[74] Monson, "Hearing, Seeing, and Perceptual Agency," S37–40.
[75] Drake Andersen, "Spaces for People: Technology, Improvisation and Social Interaction in the Music of Pauline Oliveros," *Organised Sound* 27, no. 2 (August 2022): 164, https://doi.org/10.1017/S1355771822000073.

electronic spatialization propels us into imaginative sonic realms. Understanding and navigating their interplay allows composers to create profound, deeply personal musical experiences that listeners not only hear but actively inhabit and shape.

ORBITAL INSERTION: SPEAKERS IN SPACE

Loudspeakers, once considered neutral playback devices, have become performative agents. Increasingly recognized by composers as active participants in spatial experience, they articulate space, radiate energy, and engage listeners directly, transforming listening from passive reception to embodied inhabitation of sound fields.

Building upon Eidsheim's insight that music is fundamentally a vibrational bodily phenomenon, we can see loudspeakers as more than neutral playback devices. According to Eidsheim, music is "neither external nor measurable;"[76] it is instead a material interaction between bodies and environments, continuously reshaped by context and perception. Thus, loudspeakers become dynamic vibrational agents—objects radiating energy that physically engage listeners. Performances that acknowledge this vibrational reality turn loudspeakers into portals, enabling listeners to traverse embodied worlds of sound. David Tudor exemplifies this embodied vibrational approach through his famed installation series, Rainforest. In "Rainforest IV," loudspeakers become tangible, sculptural resonators, each uniquely transformed by objects like metal sheets, drums, or wooden boxes. Walking through the installation, listeners physically

[76] Eidsheim, *Sensing Sound*, 155.

experience sounds, feeling them as distinct vibrational characters. Their bodies become active participants, responding materially and physically to the sonic environment.

Georgina Born deepens this discussion by framing loudspeakers as agents creating dynamic spatial relationships through sound. She applies a distinctly topological lens, characterizing spatialization as "the science of proximities and ongoing or interrupted transformations," which articulates processes "outside of measurement but within relations."[77] From this perspective, loudspeakers do more than fill space with sound—they dynamically interact with architectural boundaries, resonances, and human presence. François Bayle's pioneering Acousmonium—a sophisticated system of purposefully arranged loudspeakers—illustrates Born's idea vividly. In Bayle's performances, loudspeakers guide listeners through spatially choreographed sonic narratives and dramatic sonic contrasts. Here, loudspeakers perform almost as musicians themselves, shaping sound actively and creating evolving relationships between audience and environment.

Further expanding these ideas, Grimshaw-Aagaard and Garner propose the concept of sonic virtuality, describing spatial listening as emerging from the interplay of auditory input and imaginative cognition. David Toop complements this approach, showing how loudspeakers become portals into imaginative, virtual sonic spaces. As Toop articulates, these loudspeakers create "a conjured place through which the music moves and in which the listener can wander."[78]

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[77] Georgina Born, "Introduction – Music, Sound and Space: Transformations of Public and Private Experience," in *Music, Sound and Space*, ed. Georgina Born, 1st ed. (Cambridge University Press, 2013), 21, https://doi.org/10.1017/CBO9780511675850.001.

[78] David Toop, *Ocean of sound: aether talk, ambient sound and imaginary worlds*, Five star paperback (London: Serpent's Tail, 2001), xi.

For Toop, loudspeakers actively articulate architecture, provoke spatial transformations, and invite listeners to inhabit fluid, relational sonic environments. While Grimshaw-Aagaard and Garner focus on cognitive imagination, Toop, Born, and Eidsheim show how these imaginative spaces are materially conjured and dynamically navigated through the vibrational, relational actions of sound.

Natasha Barrett's ambisonic compositions further exemplify this materialized sonic imagination. Barrett constructs detailed sonic environments where listeners physically traverse intricate sound fields, exploring pathways through complex sonic textures. In her work, as in Tudor's and Bayle's, loudspeakers shift from neutral devices into sculptural agents, shaping sound environments that invite physical navigation and embodied inhabitation.

Together, the theories articulated by Eidsheim, Born, Toop, Grimshaw-Aagaard, and Garner converge in practice through composers like Tudor, Bayle, and Barrett. These theorists collectively reframe sound not as a passive transmission, but as a dynamic material and relational force. In performances shaped by these concepts, sound becomes something actively felt, navigated, and co-created—an event inseparable from listeners' bodily presence and participation.

THE LANDING SITE: SPATIALITY AS RELATIONAL PRACTICE & INTERACTION

With the loudspeaker itself transformed into an expressive agent of vibrational space, the nature of musical space demands rethinking—not as a neutral container for sound, but as a dynamic,

relational field woven through composers, performers, listeners, and their shared environments. Musical space emerges not as an abstract "void to be filled,"[79] but from the living interplay of bodies, movements, and attentions: an ever-unfolding web of relations where sonic meaning is co-created in real-time.

Christopher Small crystallizes this relational essence beautifully in his conception of musicking—framing music as active participation, not merely passive listening. To music, Small tells us, is "to take part in any capacity in a musical performance," and the profound meaning of musicking "lies in the relationships that are established between the participants by the performance."[80] From Small's perspective, musical space is vividly social, relationally charged, and inherently human, shaped moment-to-moment by every listener's gesture, every performer's breath, every composer's intention. Musical space becomes communal—a collective ritual of relational presence rather than isolated contemplation.

Building on Oliveros's *Deep Listening* framework, relational musical space emerges not simply as an expanded awareness, but as a co-creative act: a shared weaving of sound, perception, and presence among listeners, performers, and environments. In this view, space itself is continuously transformed through collective attentional dynamics—listening becomes a form of active participation, where every body, breath, and gesture contributes to the sonic field.

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[79] Gascia Ouzounian, *Stereophonica: Sound and Space in Science, Technology, and the Arts* (Cambridge, Massachusetts: The MIT Press, 2020), 16.
[80] Christopher Small, "Musicking — the Meanings of Performing and Listening. A Lecture," *Music Education Research* 1, no. 1 (March 1999): 9, https://doi.org/10.1080/1461380990010102.

Yet relational musical space also thrives beyond direct bodily experience—within realms of imagination, empathy, and metaphor. Philosopher Kendall Walton explores how listeners enter sonic worlds imaginatively, forming emotional connections that transcend physical presence. Walton's notion of imaginative empathy invites listeners to relationally inhabit musical spaces, actively shaping experiences through emotional engagement, imagination, and empathetic exploration. Here, musical space becomes expansive, constructed cognitively and emotionally, resonating deeply within each listener's internal world, even as it connects outwardly with others'.

Thus Small, Oliveros, and Walton together illuminate musical space as inherently relational—emerging not from isolated sounds or solitary experiences, but through interconnectedness and shared participation. Each listener becomes not merely an observer, but an active co-creator of musical space, shaping it bodily, perceptually, and imaginatively. Through participation, attention, and empathy, listeners and performers transform mere sound into living, breathing places where relationships bloom.

If space is no longer a fixed container but a living relational field, then composition itself must evolve: not as the construction of objects, but as the crafting of possibilities—fluid architectures of experience, awaiting exploration. In the spaces composers imagine and build, new sonic worlds take root: mutable, participatory, and bound only by the limits of creative vision.

A HOMECOMING: SPACE AS MEDIUM FOR EXPANDED COMPOSITIONAL POSSIBILITIES

In a world where musical space emerges through relationships—where bodies, attention, and imagination weave dynamic sonic fields—composition itself becomes an act of world-making. Space is no longer a backdrop to be filled; it is an active medium, a living terrain where new perceptual realities can be imagined, shaped, and traversed. Composers who embrace this relational understanding find themselves empowered not just to arrange sounds, but to build immersive worlds—fluid architectures of experience that listeners explore, inhabit, and co-create.

Barrett exemplifies this adventurous spirit through her sophisticated use of advanced electronic technologies, transcending the constraints of purely physical acoustics. In her compositions, listeners move fluidly between tangible sensations and vividly imagined worlds, guided by sound's unique ability to craft new spaces of meaning and experience. For Barrett, space becomes more than context—it emerges as an expressive medium in its own right, dynamically evolving as listeners navigate perceptually through sonic pathways both alien and intimately familiar.

Trevor Wishart similarly explores spatiality through transformative electronic manipulation, suggesting entirely new paradigms of musical possibility. Building on his earlier theoretical explorations, Wishart constructs immersive sonic environments—worlds shaped not by physical acoustics, but by imaginative technological mediation. These environments defy conventional spatial constraints, forming intricate textures and shifting landscapes previously unimaginable through acoustic means alone. His compositions vividly demonstrate how the composer's

palette broadens when sound itself is liberated from traditional spatial limitations, inviting listeners to inhabit terrains crafted purely from imagination and technological creativity.

These explorations find profound resonance in Grimshaw-Aagaard and Garner's concept of *sonic virtuality*, which elegantly encapsulates how composers engage spatialization to create emergent perceptual environments. They argue compellingly that sonic experiences exist as "emergent perceptions,"[81] a seamless fusion of external auditory stimuli and internal imaginative worlds. In sonic virtuality, sound and imagination blur effortlessly together, enabling composers to guide listeners through complex perceptual terrains where reality and imagination continuously merge and diverge.

In embracing space as a compositional medium, Barrett, Wishart, and theorists like Grimshaw-Aagaard and Garner collectively expand our understanding of what music might become—no longer constrained by traditional acoustic or spatial norms, but liberated to journey beyond. Musical space becomes a site of experimentation and possibility, offering composers new ways to shape perception, evoke powerful emotional resonance, and challenge listeners to inhabit radically new sonic realities.

Thus, spatial composition invites us into spaces we could never inhabit physically, yet which we experience as vividly as any tangible landscape. These compositions remind us, ultimately, that musical space is infinite—limited only by the imagination and creative courage of those who dare to explore it.

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[81] Grimshaw-Aagaard and Garner, *Sonic Virtuality*, 30–34.

POSTLUDE

Through these explorations of spatial practice, we've journeyed across landscapes both tangible and imaginary—tracing pathways carved by composers who sculpt sound into intimate encounters and vast worlds alike. Acoustic and electric realms intertwined, revealing that musical space is not merely heard, but actively felt, imagined, and inhabited. Each composer, each listener, each resonant moment forms a thread, intricately woven into a vibrant tapestry of sonic possibility.

Yet, no matter how expansive these spatial worlds become, their richest meanings emerge anew in the listener's presence—each perception freshly weaving meaning from threads offered. The composer sets sound in motion, but it is the listener's subjective experience that breathes life into it, completing the creative act.

Having threaded our way through the technical and philosophical dimensions of spatialization, we return once more to the listener—the ultimate collaborator, whose perception weaves sound into meaning. How, then, does spatialization shade our subjective listening? In what quiet ways does it steer our ears and hearts toward meanings waiting to unfold?

ESSAY 1: EMPATHETIC OMNISCIENCE – SUBJECTIVITY & MULTI-PERSPECTIVAL LISTENING

Part 2: The Dialectics of Subjectivity & Omniscient Listening

PRELUDE

"Empathy involves a leap of imagination into someone else's head."[82]

Simon Baron-Cohen, *The Essential Difference*

Listening, it seems, is at once deeply intimate and endlessly expansive—a paradox that hums quietly beneath the surface of every sonic experience. In Section 1, we situated the listener firmly within their own embodied perspective, acknowledging the inherent uniqueness of each sonic vantage point. Now, we extend this understanding outward, moving beyond the boundary of self-contained subjectivity, toward an empathetic encounter with myriad possibilities: the listening worlds of others.

This dialectical motion—shifting outward toward omniscient empathy, then returning inward toward enriched subjective awareness—is a delicate dance of perception. It is as if our listening selves are exploring an intricate sonic kaleidoscope, gently turning it to reveal new patterns and textures that previously lay just beyond our perceptual reach. Each subtle rotation offers a fresh

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[82] Simon Baron-Cohen, *The Essential Difference: Male and Female Brains and the Truth about Autism* (New York, N.Y: Basic Books, 2004), 24.

understanding, illuminating new relational threads connecting us more deeply to the collective sonic fabric.

Yet this empathetic, multi-perspectival listening is not merely a theoretical exercise. Its value lies precisely in its ability to deepen our own listening experience through the intentional imagining and embracing of sonic worlds outside our own. Through the simple act of imagining how another listener might perceive the same soundscape—from a different seat in the concert hall, a different corner of the street, or even through an entirely different set of ears—we cultivate a more nuanced and expansive sonic sensibility.

This dialectic of empathetic omniscience and rich subjectivity serves as an essential foundation for our understanding of the listener's role. It reveals listening not as passive reception but as an active, imaginative, and deeply creative act. In this section, as we remain focused on the listener's experience, we will also gently hint at broader implications for composition and musical practice, which we will explore fully in subsequent essay parts. For now, our attention remains delicately balanced within the dialectical heart of listening—embracing simultaneously the intimacy of the subjective ear and the expansive empathy of omniscient imagination.

LISTENING AS A SPATIALLY EMBODIED ACT

To begin to understand the profound value and subtle power of multi-perspectival listening, we must first recognize that all listening is, at its core, embodied and spatial. Listening is never passive reception, never merely the intake of external signals. Rather, it is a delicate choreography between one's body and the vibrations around it. Never fully separable, never

entirely repeatable, it is a continual negotiation between inner experience and outer world, a dance as much spatial as it is sonic.

Consider the scene being downstairs for the late set at the Village Vanguard. For each person present—the drummer, tucked into the corner, poised behind the kit; the pianist, leaning forward to hear the bassist clearly; or an audience member, seated slightly off-center, hearing the saxophone's notes bounce lightly off the back wall—each vantage point offers a wholly unique listening experience. Each participant hears something distinctly different yet equally authentic, a specific reality born of the position occupied by their body in space and time. In this seemingly simple scene lies the heart of spatial listening's inherent multiplicity: each listener perceives a unique, embodied experience of the music, an experience unavailable from any other point in the room.

We may imagine sound as invisible shapes sculpting the air, carving pathways through space. The listener's body inhabits these pathways—positioned uniquely, moment to moment—like a dancer moving through fluid forms. Every slight shift of the head, every subtle repositioning of the body reconfigures this sonic landscape, reminding us that listening is, as Nina Sun Eidsheim puts it, "always already spatially and relationally specific… [and] our perception of this specificity is complex," engaging our entire being.[83] Thus, listening is inherently personal and unavoidably perspectival, defined by the embodied vantage we occupy in each specific moment.

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[83] Eidsheim, *Sensing Sound*, 174.

This realization holds particular significance for our exploration of subjectivity and empathy. When listeners recognize that their sonic perception is never detached from their spatial situatedness, they grasp a deeper truth: their perspective is not just their own but a window into many perspectives, each spatial position a potential empathic leap into another listener's experience. The listener who moves to hear differently, to listen anew from another vantage point, consciously or imaginatively, engages in an act of empathetic omniscience.

In my 2024 quasi-installation performance of *Music for Earthlings*,[84] as well as during my 2025 doctoral capstone recital, I engaged audience layouts that encouraged freedom of motion. *Music for Earthlings,* in particular, unfolded within a multi-vantage sonic environment that privileged the listener's spatial agency, inviting them to traverse or remain—attuning to the shifting perceptual architectures shaped by their orientation and proximity. The listener becomes aware that their vantage is a singular point in space, a unique sonic fingerprint pressed into the air itself.

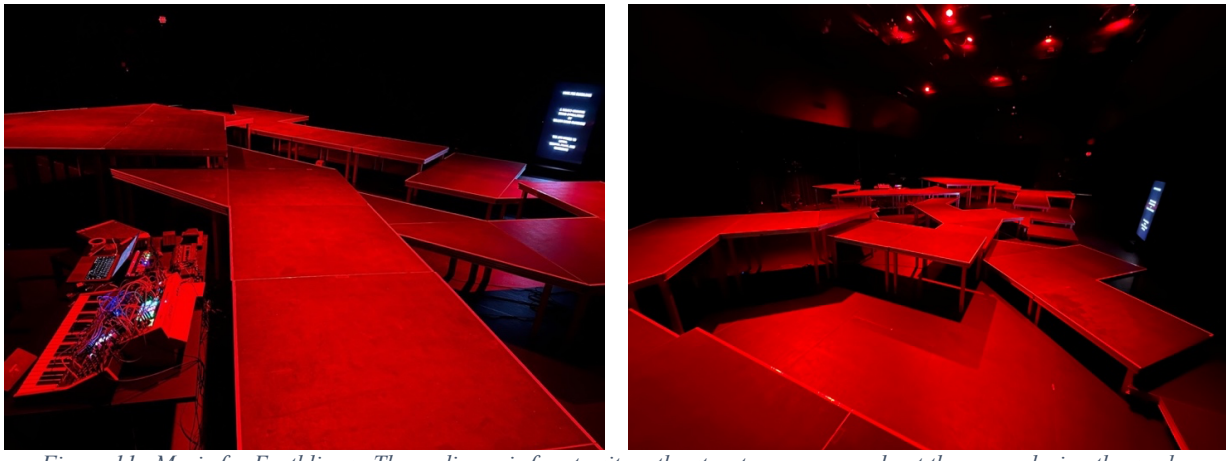

Figure 11. Music for Earthlings. The audience is free to sit on the structure or move about the space during the work.

[84] William David Fastenow et al., *Music for Earthlings: A Subject-Oriented Sound Installation*, Performance Installation (UC Irvine, Irvine California, 2024).

This spatially embodied act is central to the dialectic of listening that grounds our exploration. Listeners begin by recognizing their own perspective, their own situatedness, and move toward recognizing the value and inevitability of other embodied positions. Empathetically omniscient listening, therefore, finds its fertile ground by embracing the multiplicity of vantage points—spatially, bodily, perceptually. We begin to understand listening not merely as an isolated act but as a relational dialogue, a shared and ever-evolving exchange of sonic truths.

In this sense, listening becomes more than reception; it is an active participation in the shaping of spatial meaning, a co-creative act where the listener's perceptual agency dances fluidly among multiple sonic possibilities. The subtle power of spatially embodied listening lies precisely in this recognition of multiplicity, fluidity, and openness—an essential first step toward empathetically omniscient, multi-perspectival listening.

And so, within the folds of spatial embodiment, listening reveals itself as a profoundly relational act—deeply personal yet expansively empathetic, always individual but simultaneously collective. Each listener's body is an echo of infinite possible experiences, each spatial position an entryway into richer understanding, resonating with the delicate complexity of empathy's imaginative leap.

PERCEPTUAL AGENCY—THE LISTENER'S ACTIVE ROLE

As we've established, listening transcends passive reception—it's an intentional, creative engagement with sound. Like an artist selectively guiding the eye across a canvas, listeners

actively shape their auditory worlds by consciously directing their perceptual focus, staring with your ears, as Don Ihde suggests.[85] For Ihde, listening is fundamentally intentional, a deliberate phenomenological act that draws the listener into active participation with the sonic environment.

Ingrid Monson deepens this insight by emphasizing that perceptual agency involves "the conscious focusing of sensory attention that can yield differing experiences of the same event."[86] Yet this perceptual variation is not simply an incidental difference in experience—it's rooted in listeners' intentional interactions with cultural, social, and personal contexts, suggesting that perceptual agency is as much cultural as it is physiological. Here lies the listener's profound creative potential: by making deliberate perceptual choices, listeners actively participate in generating uniquely personalized sonic experiences, each with distinct layers of meaning.

Imagine yourself sitting in a bustling Parisian café… a mosaic of hushed dialogues, punctuated by bursts of melodic chatter, the clinking of cups, the popping of bubbles, the rhythmic whir of the espresso machine. Even in a scene as densely rich as this, our perceptual mechanisms display remarkable discernment. Our ears and minds become sophisticated filtering instruments, deftly isolating meaningful sonic threads from the ambient weave. This phenomenon, famously known as the "cocktail party effect," emphasizes the listener's skilled agency in actively navigating complex auditory fields. Reinier Plomp highlights the profound complexity of this

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[85] Don Ihde, *Listening and Voice: Phenomenologies of Sound*, 2nd ed (Albany: State University of New York Press, 2007), 75.
[86] Monson, "Hearing, Seeing, and Perceptual Agency," S38.

perceptual feat, noting, "although the vibrations produced by the various sound sources are superimposed seemingly inextricably in the air, the ear is able to disentangle these vibrations so faithfully… that it is fully justified to qualify them as intelligent processes."[87] Through our ability to sort, collate, sculpt, synthesize, and desynthesize the ever-present vibrating world around us, we ultimately create meaning.

While there is an evolutionary basis for auditory filtering—deciphering friend from foe—our selective listening is not solely pragmatic. It is also a creative act which allows us to sculpt a personal soundscape from the cacophony of collective noise, positioning oneself firmly as an architect of sonic reality. Salomé Voegelin emphasizes listening's constructive role, asserting that we experience "sound as verb, as a world-creating predicate… Listening makes all possibilities actual as generative actualities: generative truths that produce their own veracity, which we reciprocate by centering ourselves in their possibilities."[88] Voegelin's vision captures listening as an imaginative collaboration between sound and listener—a reciprocal engagement where sonic worlds are continually made and remade through intentional perceptual choices. Thus, listeners do not merely choose what to hear; they actively constitute sonic realities, foregrounding some sounds, relegating others to the periphery, and in doing so they continuously reshape lived experience.

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[87] Reinier Plomp, *The Intelligent Ear: On the Nature of Sound Perception* (Mahwah, N.J: Lawrence Erlbaum Associates, 2002), 1.
[88] Salomé Voegelin, *Sonic Possible Worlds: Hearing the Continuum of Sound* (New York, [New York] London New Delhi: Bloomsbury, 2014), 83.

Eric Clarke enriches this conception further, highlighting the dynamic interplay inherent in perceptual agency: "Perception and action are in reciprocal relationship with one another, such that perception leads to action and action modifies perception."[89] Listening, from this perspective, is never static or isolated; it is continuously entwined with bodily, emotional, and contextual responses. Each moment of attentive engagement actively influences subsequent perceptions, creating an ongoing dialogue between listener and sonic environment.

Thus, perceptual agency positions listeners not merely as passive receivers but as co-creators of their auditory experiences. Through nuanced decisions and interpretations, listeners sculpt personalized sonic worlds from the abundant raw material of everyday sound. Listening, then, emerges as a deeply intentional and transformative practice—an artistic act through which sensory experience and personal agency intertwine, continually reshaping the very texture of perceived reality.

MULTI-PERSPECTIVAL LISTENING & EMPATHETIC ENGAGEMENT

When listeners deliberately step outside their immediate perspective, engaging imaginatively with the sonic vantage points of others, their subjective experience deepens and expands. Multi-perspectival listening thus emerges not merely as a spatial practice, but as a profound form of empathetic engagement. Empathy, as Kendall Walton articulates, involves "a special kind of imagining, an imaginative experience described variously as role-taking, perspective-taking, imaginative identification, or imagining oneself 'in another person's shoes.'"[90] It is precisely

[89] Clarke, *Ways of Listening*, 136.
[90] Walton, *In Other Shoes*, 1.

through such imaginative projection that listening becomes deeply relational, allowing us to step beyond the bounds of our own perceptual horizons into the diverse auditory worlds inhabited by others.

Imagine the performance of a chamber ensemble, each player attuned not only to their instrument but also to the subtle acoustic responses of fellow musicians. Every note, every expressive gesture resonates differently depending on one's vantage: the violinist perceives her melody intimately, felt through the physical vibration of strings beneath her fingertips, while the pianist at a slight distance hears that same melody filtered through the harmonic textures of their accompaniment. An audience member, further still, integrates these disparate musical perspectives into yet another distinct auditory experience. Caroline Waddington highlights such empathetic processes when she describes ensemble performance as inherently reliant on a "shared approach"[91] to musical empathy through which participants engage imaginatively with each other's expressive intentions. Such empathetic musical engagement illustrates vividly how multi-perspectival listening allows us to inhabit simultaneously varied auditory worlds, each revealing unique emotional and sonic meanings.

Ulrik Volgsten further illuminates the affective resonance of such empathetic listening, noting how "affect attunement" involves consciously undertaken listening, tuning oneself into others'

[91] Caroline Waddington, "When It Clicks: Co-Performer Empathy in Ensemble Playing," in *Music and Empathy*, ed. Elaine King and Caroline Waddington, SEMPRE Studies in the Psychology of Music (Abingdon, Oxon ; New York: Routledge, 2017), 231–39.

expressive and affective realities.[92] By empathetically attuning ourselves—consciously adjusting our perceptual orientation toward another listener's perspective—we embrace a multiplicity of sonic experiences, each perspective deepening and expanding our emotional and perceptual understanding. In this empathetic openness lies profound transformative potential: listening becomes a deliberate act of imaginative expansion, enabling the listener to weave together a richly textured tapestry of multiple, resonant viewpoints.

Pauline Oliveros encapsulates the essence of this empathetic multiplicity in her concept of Deep Listening, describing it as "a practice intended to expand consciousness to the whole space/time continuum of sound/silences… extending the listener to this continuum as well as to focus instantaneously on a single sound."[93] Oliveros's vision positions listening not only as spatially and temporally expansive, but inherently empathetic, bridging between the intimately personal and the expansively collective. When listeners engage multi-perspectivally, they move fluidly between the detailed immediacy of individual experiences and the vast, interconnected network of collective auditory realities.

Thus, multi-perspectival listening invites us into an ongoing relational dialogue, a continuous empathetic negotiation among diverse sonic positions. Through such listening, we recognize the profound interconnectedness and shared humanity embedded in our auditory experiences. By imaginatively entering into others' listening worlds, we do not diminish our own perspective but

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[92] Ulrik Volgsten, "The Feeling of Music: Affect, Attunement, and Resonance," in *Music, Speech, and Mind Associação Brasileira de Cognição e Artes Musicais*, ed. Antenor Ferreira Correa, Music and Cognition Series (ABCM, 2019), 7.
[93] Oliveros, *Deep Listening*, xxv.

rather amplify and enrich it, transforming listening into an act of empathetic omniscience—where the self remains deeply personal yet expansively communal, unique yet universally resonant.

DIALECTICAL MOVEMENT IN LISTENING—EMPATHY AS A TOOL

Multi-perspectival listening initiates a dynamic dialectical movement—a fluid, iterative oscillation between one's own sonic experience and the empathetically imagined vantage points of others. Empathy, thus understood, is not merely a fixed state of awareness but a dynamic perceptual practice through which listening continuously evolves.

Philosopher Hans-Georg Gadamer describes true understanding as a "fusion of horizons," an encounter in which one's present perspective merges with that of another, forming an enriched and expanded horizon of comprehension.[94] In listening, this fusion becomes an active perceptual dialogue. Listeners momentarily suspend their habitual modes of hearing to imaginatively inhabit alternate auditory perspectives, returning afterward to their initial position with a subtly yet irrevocably transformed perception.

Consider the experience of listening to rain from within your home: initially, you hear the comforting rhythms drumming gently against your windows, enclosed in familiar sonic warmth. Yet, through empathetic imagination, you might transport yourself outside—perhaps into the experience of someone hurrying through the storm, the sound sharp and insistent, or into

[94] Hans-Georg Gadamer, *Truth and Method*, trans. Joel Weinsheimer and Donald G. Marshall, 2nd, rev. ed ed., Continuum Impacts (London ; New York: Continuum, 2004), 390.

the perspective of wildlife sheltering amid rustling foliage. Each imaginative leap outward broadens your auditory horizon, enriching your understanding when you inevitably return to your own sheltered listening. In each perceptual journey, a dialectical exchange occurs—self and other, familiar and unfamiliar, inner and outer sonic worlds merge momentarily, fostering a deeper, more nuanced appreciation of your subjective vantage.

The dialectical movement of empathy is also an inherently transformative and dialogical act. As philosopher Martin Buber suggests, authentic dialogue involves genuine openness and the willingness to be changed by another's perspective.[95] In empathetic listening, this openness becomes perceptual courage: the listener actively ventures beyond the comfort of their immediate sensory experience, willingly engaging with unfamiliar sonic realities. The dialectical interplay is thus neither passive nor risk-free; it demands active receptivity and the courage to incorporate new truths that reshape one's auditory identity.

This dialectic mirrors Christopher Small's concept of "musicking," where the listener actively participates in shaping musical meaning through responsive engagement.[96] Empathetic listening becomes a performative dialogue—each attentive shift, each imaginative leap outward and inward, dynamically co-creating the sonic experience. The listener, in this dialectical dance, continually reconfigures their perceptual horizon, forming new auditory understandings that are neither solely self-contained nor entirely external but exquisitely synthesized.

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[95] Martin Buber, *I and Thou*, trans. Walter Arnold Kaufmann, paperback reissue (New York London Toronto Sydney New Delhi: Free Press, 2023), 60–63.
[96] Small, "Musicking — the Meanings of Performing and Listening. A Lecture," 14.

Through this dialectical empathy, we cultivate a perceptual flexibility that enriches listening as a continual, evolving dialogue. Each imaginative excursion outward enriches our inward perceptual awareness, refining our capacity to understand and interpret our own sonic experiences. Ultimately, empathy emerges not merely as emotional resonance but as a profound perceptual tool—an iterative, dialectical practice through which listeners continuously transform themselves, experiencing sound more fully, deeply, and expansively.

TOWARDS A LISTENER-CENTRIC MODEL OF EMPATHETIC OMNISCIENCE

Building upon the dialectical practice of empathetic listening, we now approach its expansive culmination: empathetically omniscient listening—a listener-centric ideal in which one actively cultivates an all-encompassing awareness of sonic experience. While true omniscience in listening is an aspirational horizon rather than an attainable endpoint, the act of striving towards it profoundly enriches subjective perception.

Drawing from R. Murray Schafer's concept of "ear cleaning,"[97] we acknowledge the deliberate cultivation of heightened auditory sensitivity, aimed at broadening our sonic consciousness to embrace the full acoustic environment. This practice is less about acquiring literal omniscience and more about nurturing a refined awareness capable of intuitively perceiving sonic details often unnoticed, unheard. Schafer invites listeners to actively engage with sound, continuously refreshing their perceptual clarity through intentional listening.

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[97] R Murray Schafer, *Ear Cleaning: Notes for an Experimental Music Course* (Toronto, Canada: Berandol Music Limited, 1967).

Pauline Oliveros similarly inspires this listener-centric approach through her Deep Listening and Quantum Listening philosophies, which champions an expansive consciousness across diverse sonic realities—even multiple realities at once.[98] This embodies a deliberate attentiveness that is empathetically open to the complexity of sound and silence, encouraging listeners to shift fluidly between intimately personal experiences and profoundly communal sonic landscapes. Movement between singular and collective perspectives fosters an empathetic omniscience—one that, through intentional imagination, continually enriches subjective experience.

Empathetically omniscient listening therefore emerges as a deeply listener-centric practice, placing the listener's perceptual agency at its heart. Consider attending an orchestral performance: sitting close to the stage, you intimately perceive the musicians' subtle gestures and expressions; moving to the balcony, you experience the orchestral sound as a unified, immersive sonic texture. Each perspective is distinct and informative, and the act of imaginatively integrating both viewpoints exemplifies empathetically omniscient listening. The listener becomes a perceptual synthesizer, weaving together myriad vantage points into a coherent, enriched auditory understanding.

This empathetically omniscient listening stance invites an active, ongoing negotiation of sonic experience—personal yet universal, intimate yet expansive. By empathetically projecting oneself into numerous sonic realities, listeners deepen their capacity to appreciate complexity, nuance, and diversity in sound. Ultimately, such empathetic omniscience elevates listening from

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[98] Pauline Oliveros, *Quantum Listening*, Terra Ignota (London: Ignota Books, 2022), 1.

mere sensory reception to a profound, transformative engagement with the acoustic world, enhancing both individual perceptual awareness and our shared, collective humanity.

POSTLUDE

In concluding this dialectical exploration, we highlight the philosophical foundation established by the interplay between embodied subjectivity and empathetic omniscience. This dynamic relationship not only enriches our perceptual awareness but also lays essential groundwork for the spatial and compositional inquiries to follow. Having journeyed inward and outward—from singular intimacy to plural expansiveness—we return, ears cleaned, ready to listen anew. Each empathetic leap not only deepens personal awareness but also cultivates a shared acoustic understanding—reminding us continually that to truly listen is to embrace an infinite dialogue with the world.

Listening is not a singular act—it is a chorus of selves, resonating within the fragile space of a single heartbeat.

ESSAY 2: SPATIAL AESTHETICS & SONIC ARCHITECTURE

Part 2: The Role of Space in Sonic Design

PRELUDE

"All sound exists in a space; there is no spaceless sound."[99]

Barry Blesser and Linda-Ruth Salter, *Aural Architecture*

Every sound tells a story about the space that contains it. A single footstep in an empty cathedral yields a boom trailing into soft whispers of echo, instantly signaling the vastness and stone texture of the hall. By contrast, that same footstep in a carpeted bedroom stops instantly with almost no reverberation, the silence telling of close walls and soft surfaces. We hear space—not just with deliberate attention, but instinctively, just as Blesser and Salter remind us.

Essay1 has so far explored listening from an intimate, individual perspective, situating the listener within a subjective context. Now we broaden our scope, turning outward to the environments enveloping the listener. Just as music surrounds us in immersive soundscapes, architecture surrounds us in form—music and architecture uniquely envelop our senses completely. Positioned between the listener-centric considerations of Essay 1 and the detailed spatial explorations of technology and composition to come in Essay 3, this part of Essay 2

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[99] Barry Blesser and Linda-Ruth Salter, "Aural Architecture: The Invisible Experience of Space," *OASE* Immersed. Sound and Architecture, no. 78 (2009): 50, https://www.oasejournal.nl/en/Issues/78/AuralArchitectureTheInvisibleExperienceOfSpace.

examines how physical spaces actively shape and collaborate in every auditory experience. From the subtle reverberation under a vaulted ceiling to the hushed intimacy of a carpeted room, architecture emerges as an essential participant in sonic expression—an integral, if often unnoticed, collaborator in the art of the unheard.

IF THESE WALLS COULD SING

Walk into any great hall or tiny closet and clap your hands—the space answers you, and those answers are utterly different. In each case, the space itself responds to sound, imparting its own character. Architecture is not a passive container for sound; it is an active participant in every auditory moment.[100] The walls, floors, and contours around us offer affordances for certain sounds to flourish while imposing constraints on others. A long corridor might invite the playful stomp of footsteps reverberating in rhythm, whereas a room thick with drapery and carpet encourages soft, intimate speech. The composite of surfaces and geometries in any environment creates an aural architecture, a unique sonic signature of that space. We intuitively recognize this: we interpret an echo as the voice or "personality" of a wall, a sonic hint of the room's dimensions and materials.

Architecture's acoustic opportunities can amplify and enrich sound. Consider how a domed ceiling focuses a speaker's words so they carry clearly across a hall. In a whispering gallery, a faint murmur travels mysteriously along curved walls, demonstrating how design can project a sound farther than the speaker ever could alone. Likewise, a stairwell or empty warehouse might

[100] Blesser and Salter, *Spaces Speak, Are You Listening?*, 16–20.

transform a simple hand clap into a cascade of decaying repetitions, wrapping the listener in layers of reflected sound. These effects are not incidental—they are features of the space that invite us to engage. A singer in a tiled bathroom finds encouragement in the bright reverberation that makes her voice ring; the architecture urges her to sing out, offering its echo as accompaniment.

At the same time, architectural acoustic boundaries shape what is sonically possible or pleasant. The same singer might find a basement closet stifling: no resonance, no "life" to the sound. In a heavily padded recording studio or an anechoic chamber (a room designed with nearly zero echo), even one's own footstep or breath feels unnaturally muted. Such spaces constrain resonance so much that we become vividly aware of the absence of reflection—a strange, even disconcerting sensation. In most everyday settings, however, we live in a balance between extremes. Our kitchens, classrooms, and subway stations each impose their own limits on sound: a busy café's hard surfaces create a loud chatter that forces us to lean in and speak up, while a library's high ceilings and absorptive shelves encourage whispers by swallowing excess noise. We instinctively adjust our behavior, speaking softer or louder, because the space "informs" us how to sound within it.

Through these affordances and constraints, architecture co-authors the listening experience. It selectively filters and molds the spectrum of sounds that reach our ears. Even if we are not consciously aware of it, every space has an inherent acoustic character that influences our perception. A song played in an open field feels exposed and thin—but move the same music inside a cathedral and it blooms into something monumental, sustained by the building's grand

reverberation. In essence, the physical environment provides a hidden accompaniment to every sound, an ever-present acoustic backdrop that can comfort or challenge the listener. By acknowledging architecture as an active participant, we begin to hear more fully: recognizing that the built space and the sound form an indivisible duet. This perspective sets the stage for exploring deeper synergies between sonic design and spatial design in the sections that follow.

HEARING IS BELIEVING

Understanding space as a sonic partner prepares us to delve deeper into how architecture and music share an intuitive design vocabulary. For centuries, thinkers have drawn parallels between architecture and music. We speak of the *architecture* of a symphony and the *rhythm* of a building's façade. Composer and architect Iannis Xenakis famously designed *The Philips Pavilion* as well as his musical composition "Metastaseis" from the same guiding mathematical explorations, discovering an "intimate connection" between structure and sound, two faces of one concept.[101] Even before such modern examples, architects and musicians shared a vocabulary of proportion and harmony. The oft-quoted notion that *architecture is frozen music*[102,103] reflects a yearning for aesthetic synergy: a belief that what pleases the eye should also please the ear, and vice versa. When spatial design and sonic design align, a deeper unity emerges—a kind of multisensory resonance in which we feel a space is *just right*.

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[101] Xenakis, *Formalized Music*, 10.
[102] This phrase—also translated as "petrified music" is commonly attributed to Johann Wolfgang von Goethe, as contemporaneously documented by Johann Peter Eckermann, as cited below.
[103] Johann Peter Eckermann, *Conversations of Goethe*, trans. John Oxenford (HTTP://WWW.HXA7241.ORG, 2010), 402.

In practice, aligning sound with spatial aesthetics means considering acoustics as integral to architectural design. A triumph of design synergy is evident in great concert halls: their lavish interiors of wood, ornate carvings, and vaulted ceilings are not merely decorative, but meticulously shaped to scatter and project sound beautifully. Here the visual grandeur and the aural richness go hand in hand, enveloping the audience in an experience that is as much felt as it is seen. In a cathedral, soaring pillars and a vast open vault create an atmosphere of reverence that is reinforced by the long echoes of footsteps and chant—the "visual vastness of a cathedral communicates through the eyes, while its enveloping reverberation communicates through the ears."[104] Each element echoing the other, blending seamlessly into a unified aesthetic expression: the space resonates within its own form.

Metaphorically, one can think of walking through a building as akin to moving through a piece of music. After all, architects compose spaces paying attention to a very similar set of concerns as do composers writing a piece of music. Both think about structure, texture, form, themes, developments, moments of surprise or resolution. Both consider those that will dwell within the work, how they may *feel* or *listen*. Musicians and sound artists often think architecturally, as architects often think musically, imagining sound filling a volume, bouncing off surfaces, carving out invisible shapes in the air. The partnership of architecture and sound is yet another dance of two creative disciplines, each enhancing the other. When the metaphor extends into reality—when a space's sonic qualities are deliberately aligned with its visual and functional aesthetics—the result is an environment that sings. We find ourselves not just occupying a

[104] Blesser and Salter, *Spaces Speak, Are You Listening?*, 3.

building, but participating in a cohesive sensory experience, one where our ears confirm what our eyes see, and our emotions follow.

In my own work as a systems designer, I've worked alongside many architects. Around the proverbial sound-guy watercooler, architects are often regarded with a measure of vexation. They want the sound to exist from the speakers, but don't actually want to *see* the speakers. They want the sound to be full, rich, and lively… but only in a very specifically-designed location. They want the speakers to go in this ceiling area here, but only insofar as they line up perfectly with the sprinkler system and lighting heads. By conventional standards, each of these requests seems to defy acoustical physics, product capabilities, or accepted guidelines. But I tend to take this challenge in good faith as a problem worth solving. If both the architect and sound designer are considering the humans that will occupy this space, then it's important to realize that all of these considerations are worthwhile and contribute to the cumulative experience one will have dwelling within it. In my career, I've never been one to simply accept ugly speakers or mounting devices. That is to say, I've always found the aesthetics of a system to be an important consideration towards its overall design. When a structure has thoughtfully-constructed pronounced lines, it seems silly to me to design the application of sound elements without consideration for those lines. This becomes a tangible way that sound is crafted in the physical world. This is precisely what I mean when I use the term *sonic architecture*.

SONIC ARCHITECTURE: SOUNDLY CRAFTED SPACE

I draw a certain distinction between the term “Aural Architecture” and “Sonic Architecture.” The former, as discussed by Blesser and Salter, pertains more to listening’s intersection with or mediation by the built environment, whereas the latter refers explicitly to the practice of crafting sound-based work guided by architectural sensibilities. I see sonic architecture as a more active, intentional, and creative method of working with sound—one in which balance, proportion, spatial organization, form, functionality, and aesthetic unity are thoughtfully composed into cohesive sonic expressions.

In my own artistic practice, these principles find practical embodiment, notably in my composition *Wave Music XII: 1001 Charlies*, which premiered at Winifred Smith Hall in 2023. *Wave Music XII: 1001 Charlies* is part of a larger series of spatial compositions collectively called "Wave Music," originated by composer Charlie Morrow, whose innovative practices foreground immersive sonic experiences and spatially-aware composition. In this particular installment, my own compositional approach combines Morrow's live performance presence with meticulously arranged "virtual Charlies," invisible sonic entities that occupy and interact dynamically with architectural space. Though not strictly site-specific, the piece becomes inherently tied to the performance space, demanding seamless integration with the venue’s architectural features. In Winifred Smith Hall, a space defined prominently by its strong trapezoidal motifs, the deliberate placement of 26 speakers accentuated and underscored the hall’s geometry. Speakers were thoughtfully positioned at architectural vertices, mirroring the hall’s pronounced lines and thereby activating the space’s visual and acoustic characteristics in concert.

Figure 12. From left to right, photographs of Winifred Smith Hall from the middle of the audience facing the stage and from upstate center facing the audience, respectively.

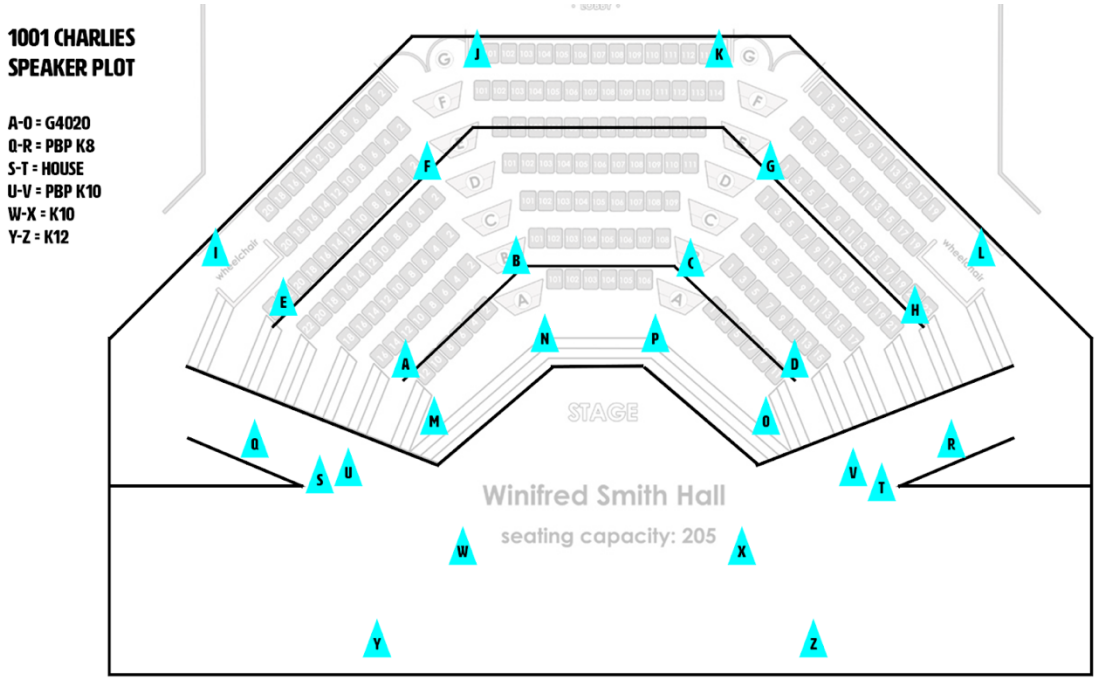

Figure 13. Plan View Diagram of Winifred Smith Hall showing the speaker placements for "1001 Charlies."

Central to the composition's concept was the use of "virtual Charlies," rendered through the strategic arrangement of these speakers. Charlie Morrow's singular presence onstage was augmented by a network of virtual nodes—1000 invisible counterparts—achieved through careful calculation and meticulous speaker configuration. Each speaker pair created phantom

sound sources, or virtual nodes, which collectively produced an expansive sonic architecture that dynamically responded to both the architecture of the hall and the live performance.

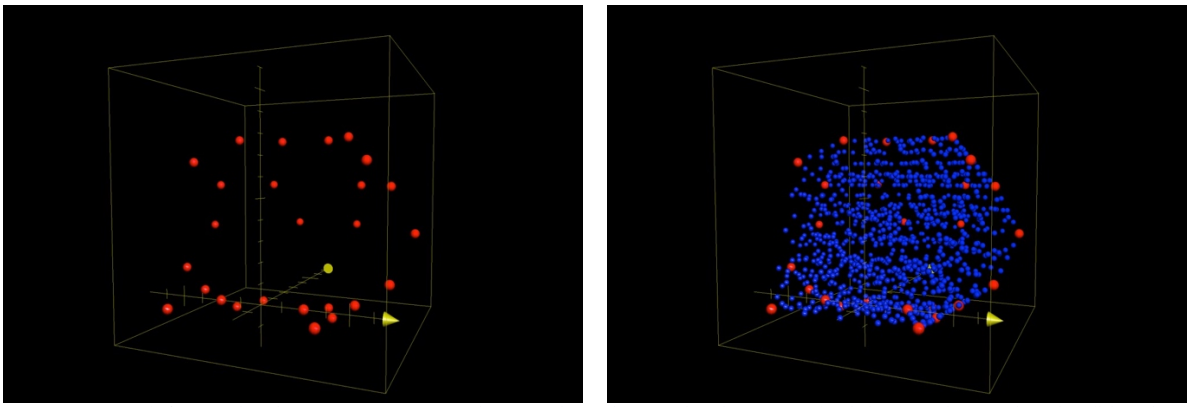

Figure 14. From left to right, these perspective renderings show the speaker locations (red dots) and virtual nodes (blue dots) in 3D space.

By harnessing the visual lines and contours inherent in the architecture, the speakers in Winifred Smith Hall effectively became architectural elements themselves. They defined a sonic topography that matched the visual and spatial experience of the hall, thus unifying sensory perception. Rather than treating speakers purely as functional sound reproduction devices, their arrangement explicitly engaged the architectural form as a generative source, allowing audiences to experience the space acoustically and visually in a cohesive sensory event.

This approach illustrates a fundamental tenet of sonic architecture: sound systems and compositional strategies should not merely coexist with architectural spaces but actively engage and resonate with their inherent forms. Each decision—speaker placement, node configuration, spatial orientation—was guided not only by acoustic efficacy but also by aesthetic unity and architectural responsiveness.

Culturally and relationally, this method of composition also resonates with broader considerations of audience experience. Just as Christopher Small articulates "musicking" as encompassing all participants and their relational dynamics within a musical context, sonic architecture similarly acknowledges the audience's spatial, perceptual, and cultural relationship to sound. In the premiere performance of *1001 Charlies*, audience members could perceptually navigate the hall's geometry through sound, experiencing individualized yet collectively meaningful auditory perspectives. The audience's relationship to the space, the performer, and the invisible Charlies created a relational sonic fabric reflective of both the physical architecture and social dynamics of listening.

Thus, sonic architecture, as demonstrated through *Wave Music XII: 1001 Charlies*, is inherently relational, responsive, and culturally informed—embracing architectural sensibilities as integral to compositional practice, enhancing spatial experience, and fostering meaningful connections among sound, space, and listener.

PLAYING THE ROOM

My approach to intentionally aligning sonic design with architecture resonates with a tradition of composers who treated built environments as their musical instruments. As demonstrated in *1001 Charlies*, this intentional integration of sonic elements and spatial considerations has a rich history. Composers and artists treat space as an instrument, "playing" the building much like a giant resonator. In the late 16th century, Giovanni Gabrieli unleashed the sonic potential of Venice's Basilica di San Marco by spreading choirs and brass ensembles in balconies around the sanctuary. Music came from all directions in the richly adorned cathedral, each choir loft adding

its own coloration to the sound. Imagine standing beneath Gabrieli's choirs, sound bouncing joyfully around you like musical pinballs—an unprecedented "surround-sound"[105] centuries before Dolby. Gabrieli effectively turned the basilica into his instrument, leveraging its opposing choir lofts and soaring vaults to create antiphonal echoes and harmonies that no single source could achieve.

This idea of composing with space has continued to inspire musicians for centuries. Think of call-and-response chorales bouncing across a church's transepts, or an organ's mighty chords making the timber and stone of a chapel vibrate in sympathy. Such works don't just happen in a space; they are about the space.

In more recent times, artists have made this interplay explicit. The composer Alvin Lucier famously recorded himself speaking in a room, then repeatedly played that recording back into the room, re-recording it each time—using the room's acoustics as a filter—until his words dissolved into pure resonant tones of the space. His piece, *I Am Sitting in a Room*,[106] is essentially a duet between voice and architecture, each iteration drawing out the "natural frequencies" that the particular room favors. It's a striking example of a built space as a compositional medium: the dimensions and surfaces of that room determined the music that emerged. Likewise, in the 1950s Iannis Xenakis designed the Philips Pavilion, a radical curved concrete structure, hand-in-hand with an electronic score by Edgard Varèse. Inside that pavilion, hundreds of loudspeakers projected Varèse's avant-garde sounds along the swooping walls,

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[105] John Wheatley, "The Sound of Architecture," *Tempo* 61, no. 242 (October 2007): 12, https://doi.org/10.1017/S0040298207000265.
[106] Alvin Lucier, *I Am Sitting in a Room* (Brandeis University, 1969).

making the building a giant immersive audio system. Architecture and composition were conceived together—visitors wandering within weren't sure where architecture ended and music began, as if the building itself were speaking. Fast-forward to today: modern spatial audio systems allow composers to virtually place and move sounds anywhere in three dimensions, effectively sculpting an invisible architecture of sound. A listener might hear a melody approach from one corner, swirl overhead, and then vanish underfoot, as if the space itself were alive and shifting.

But one need not use advanced technology to compose spatially. Sound artists often discover instruments in the built environment with playful creativity. Even the act of humming a single note in a large gallery can reveal unexpected resonances—certain pitches suddenly bloom loud and clear as the space reinforces them, almost like the building is selectively singing along. It's as if each room has hidden melodies waiting to be coaxed out.

Artists like David Byrne have even connected an organ keyboard to a building's structural elements, causing pipes and beams to resonate with each key press—transforming architecture into a living source of sound. These projects underscore how space and sound form a unified creative medium: the built environment becomes a canvas for auditory art, and sound becomes a tool for shaping our experience of space. In this collaborative artistry, the composer, the listener, and the architecture all play together, and our perception of space itself grows richer, more musical.

YOUR EARS HERE

Building upon this rich tradition of spatially aware composition, my approach places the listener's subjective experience firmly at the center. Rather than simply receiving sound, listeners become active agents—free to explore, shape, and personalize the soundscape around them. Imagine a future museum gallery where each visitor adjusts the acoustic profile to match their preferences, or a responsive sound installation that gently adapts its tones according to individual movements and moods. These possibilities embrace a fundamental truth: every listener's experience is unique and deserves to be celebrated through thoughtful design. Instead of enforcing one "perfect" acoustic environment for all, a subject-oriented approach cultivates sonic plurality—spaces abundant with layered acoustic richness that invite different ears to engage in countless personal ways.

Realizing such environments starts with empathy. Designers carry forward the ethos of diverse listening perspectives into the realm of architecture. A subject-oriented space might provide choices or flexible acoustics—for instance, offering both silent alcoves and lively open areas, or using smart systems to automatically dial noise levels up or down for comfort. Where traditional acoustics treated occupants as passive factors (bodies that absorb sound), the subject-oriented mindset treats them as partners in creation. The space invites participation—it "listens back" and adjusts to its users rather than remaining fixed.

Crucially, there is no single "ideal" soundscape for everyone—each person carries their own internal library of sound associations. A subject-oriented approach acknowledges this plurality. In practical terms, it means involving communities and individuals in shaping their

sonic environments, and allowing spaces to evolve with their users. Designers become facilitators, opening a dialogue between the space and its inhabitants so that acoustic design can respond to actual needs. The environments of tomorrow could even be co-composed by those who inhabit them, fulfilling the promise of truly subject-centered sound design.

In my own compositional practice, the theoretical considerations of subject-oriented sonic environments translate into direct engagement with listener experience. With Wave Music XII: 1001 Charlies, I prioritized not merely the sonic result but the perceptual, spatial, and embodied experience of the audience members. By positioning sound elements carefully in architectural dialogue, I sought to create a perceptually rich environment, inviting listeners to actively navigate, interpret, and personalize their sonic experience. My ongoing creative exploration is guided by these principles—designing spaces not simply to be heard, but actively inhabited by engaged, perceptually aware listeners. In January 2025 I presented my capstone recital, *The Art of the Unheard: An Exploration of Subject-Oriented Music*, held at the Experimental Media Performance Lab (xMPL) in the Contemporary Arts Center at the University of California, Irvine. Like the earlier premiere of Wave Music XII: 1001 Charlies, my approach here was grounded in architectural integration and listener-centric design, amplifying spatial perception as an essential compositional element.

The xMPL, essentially a spacious and technically well equipped black box theater, provided both architectural challenges and creative opportunities. I carefully placed 26 loudspeakers throughout the venue, aligning them strategically to highlight both the symmetry of the space and the subtle-yet-distinct asymmetries inherent in its architecture. One side wall towered

higher, serving as an ideal surface for projecting program notes and dynamic 3D models of the speaker arrangement, visually reinforcing the sonic layout. Under-catwalk soffits introduced slight dimensional irregularities—one narrower, another less prominent—which invited me to position speakers differently, opting for accentuating these quirks rather than concealing them. Even columns varied slightly in number and placement from side to side which led me to mirror this variation sonically by aligning loudspeakers carefully with each column, making the architecture itself audible.

Figure 15. Rehearsing "The Art of the Unheard" in the xMPL

Three distinct musician platforms were placed strategically on the performance floor, arranged in a pattern reminiscent of a peace sign when viewed from above. At their intersection stood a Yamaha C7 Disklavier grand piano, not only a sonic centerpiece but also a symbolic focal point around which listeners could freely circulate. To ensure vertical sonic depth, speakers occupied multiple elevations. I dispersed: 11 ground-level speakers outlining the room contours and placement of musician platforms; six suspended units, approximately 11 feet off the floor, matching the soffit lines; eight speakers mounted high upon the tension-wire grid, nearly 20 feet above the floor in equidistant locations; and of particular intrigue, one single, omnidirectional speaker was hidden beneath the piano with 360-degree diffusion, offering a sonic center point to an otherwise empty space.

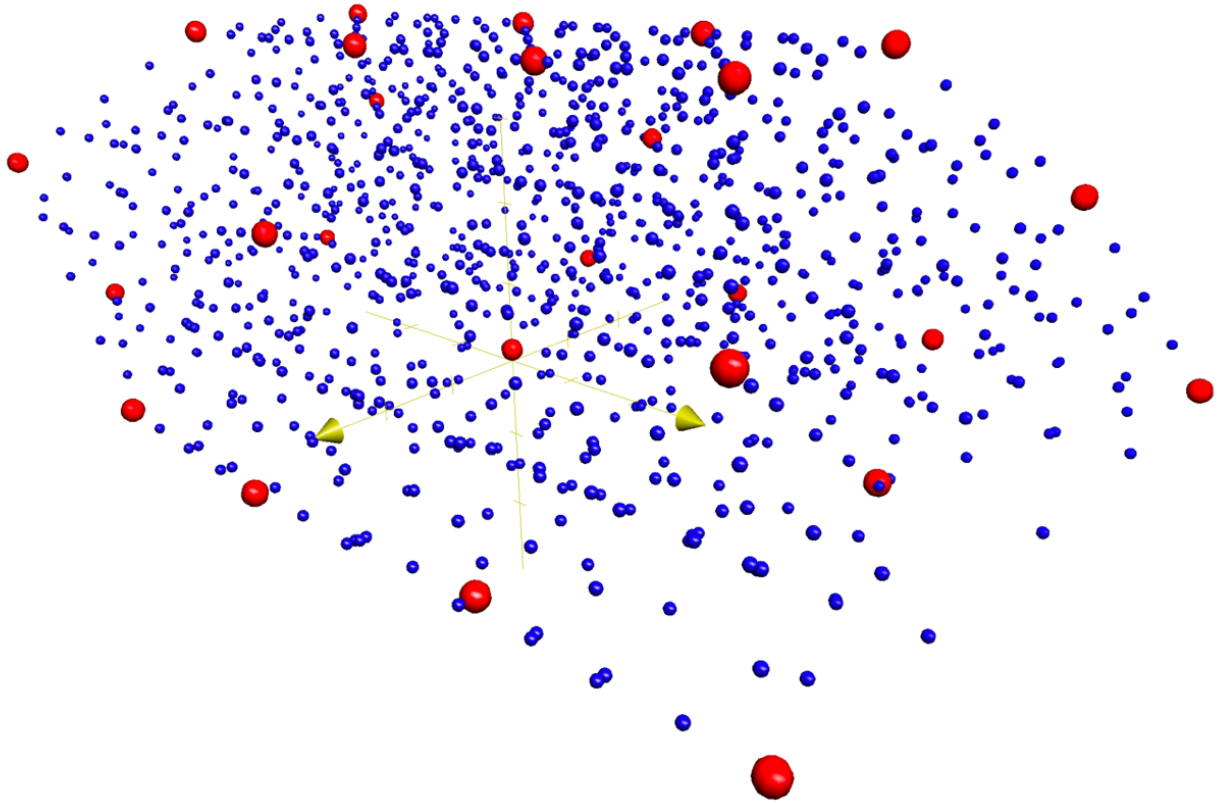

Figure 16. Three-dimensional plot showing locations of the 26 speakers (red) and 975 virtual nodes (blue).

Importantly, the remaining floor space was intentionally left completely open, inviting audiences not merely to listen but to move—to explore sonic zones and acoustical boundaries. To reinforce the architectural interplay and further blur the line between instruments and speakers, each loudspeaker was dynamically illuminated. I designed the lighting system so that the brightness of each speaker's illumination directly correlated to the amplitude of the sound it emitted, visually translating sonic energy into a tangible, glowing presence. The musicians' platforms and open walking areas were bathed in colorful, vibrant light and carefully orchestrated spotlight patterns. These lighting strategies actively guided listeners' attention and movements, prompting exploration and engagement with the sonic and architectural dimensions of the recital space.

Through these design choices, "The Art of the Unheard" became more than a mere recital—it emerged as a spatially dynamic, subject-oriented environment, actively inhabited by listeners whose perceptual, embodied experiences defined the work as profoundly as the sound itself. My approach sought to dissolve traditional boundaries between listener, musician, and architecture, constructing instead a shared, experiential soundscape that listeners co-created through their movement and perceptual engagement. In crafting sonic architecture through intentional spatial practice, my goal was to foreground each listener's subjective experience, inviting them not simply to hear, but to become active explorers within a living sonic world.

POSTLUDE

In exploring sonic architecture, we've uncovered a fundamental truth: sound, space, and listener intertwine as inseparable partners within a shared sensory experience. Cathedrals, concert halls, galleries, and even everyday spaces each possess their own voice, influencing and echoing our

listening journeys. As we move forward into essay 3, part 2, we carry forward these insights, shifting our attention specifically toward technology's role in facilitating fluid, dynamic, and deeply personal sonic experiences. Here, we'll explore how contemporary spatial diffusion techniques and real-time spatialization tools enable new opportunities for omniscient listening and subject-oriented musicking. As we delve into these technological possibilities, our ears and minds remain finely tuned to the interplay between listener, sound, and the emerging frontier of sonic creativity.

ESSAY 3: INTEGRATION OF TECHNOLOGY & COMPOSITIONAL PRACTICE

Part 2: Toward Subject-Oriented Sound Environments

PRELUDE: THE VESSEL OF TECHNOLOGY

"Technology is neither good nor bad; nor is it neutral."[107]

Melvin Kranzberg, *Technology and History*

Our experience of sound is fundamentally and inextricably spatial. The simple fact that we have two ears has been a key driver of audio technology, enabling us to perceive depth, direction, and distance in sound. Whenever we recreate or reinforce sonic experiences artificially, one of the greatest challenges is translating a rich, complex acoustic environment into a coherent experience via loudspeakers. In transducer-based listening environments, loudspeakers typically serve one of three primary functions:

- **Sound reinforcement**: amplifying live music or events (as in concert PA systems).
- **Sound (re)creation**: playing back recorded or synthesized audio (from stereo music to surround cinema sound).
- **Sound as instrument**: acting as direct sound sources in electronic music or sound art installations.

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[107] Melvin Kranzberg, "Technology and History: 'Kranzberg's Laws,'" 2025, 545.

In artistic contexts, loudspeakers are often treated as point-source instruments in their own right. Yet in both reinforcement and playback scenarios, tremendous attention is given to spatial imaging and localization—positioning sounds so that listeners perceive them coming from intended directions and distances. Despite differences in approach, all these use cases share an underlying spatial dimension; indeed, spatiality is not merely an aspect of sound—it is the essential context in which sound moves, interacts, and is ultimately understood. We are, in fact, incapable of experiencing sound divorced from space.

Recent technological developments—such as object-based audio rendering, wave field synthesis, higher-order Ambisonics, and advanced spatial diffusion techniques—reflect a shift away from traditional channel-based audio systems. These new approaches offer fresh ways to engage and immerse listeners in sound. Composer Ludger Brümmer encapsulates the significance of this shift by noting that spatiality is integral to the presentation, perception, and comprehension of music.[108] In other words, these advancements mark not merely technical progress, but a fundamental conceptual reorientation of the audio experience, placing listeners not as passive receivers, but as active participants whose perceptions dynamically shape the meaning of the sonic environment.

In my own compositional practice, I have observed firsthand how audiences behave differently when sound is presented as an evolving spatial landscape rather than a fixed sonic image. In

[108] Ludger Brümmer, "Composition and Perception in Spatial Audio," *Computer Music Journal* 41, no. 1 (March 2017): 46, https://doi.org/10.1162/COMJ_a_00402.

Music for Earthlings,[109] listeners wander the space, and their shifting positions and perspectives open up varied interpretative pathways. The compositional elements are dispersed throughout the space following *drunkard's walk* sonic pathways. I will explain the technical aspects of this approach in greater detail in subsequent sections, but compositionally my intention is akin to a woodland walk: the potential sounds are vast, yet moment-to-moment, the listener encounters only a small, ever-shifting selection. Just as one may choose to follow intriguing sounds through the woods or pause to let sounds come into focus, listeners in my installations actively shape their sonic experience through movement and attention. Consequently, the details or blend of sounds that one person hears in one area of the performance environment may differ greatly from what another hears across the room. These diverse experiences are equally valid and are intentional outcomes of the composition. This variety underscores the rich potential inherent in what we might call *subject-oriented* musical experiences—situations in which the music's meaning emerges through dialogue with the listener's location, movement, and choices, rather than solely from the composer's design.

Spatial audio technology and compositional practice have always co-evolved in a dialogue of possibility. The progression from traditional channel-based mixing to contemporary object-based approaches exemplifies this interplay, fueled by the proliferation of spatial audio processors, panning systems, and immersive formats. What began as a practical solution for delivering sound through fixed loudspeaker arrangements has evolved into a creative paradigm, reshaping how composers think about space, musical structure, and audience experience.

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[109] Fastenow et al., *Music for Earthlings*.

Rather than offering a comprehensive technical history, this section examines this evolution as a shift in perspective—one that ultimately reconsiders the listener's role within immersive sonic environments. Detailed contemporary overviews of spatial audio techniques and their creative implications can be found in works by Rumsey,[110] Roginska & Geluso,[111] Paterson & Lee,[112] and Barrett,[113] among others. These texts provide technical insights into channel-, object-, and scene-based methods, concepts that I reframe here. Instead, my focus is on how these technologies influence compositional agency, spatial thinking, and audience engagement. Through this exploration, we can better understand technology and compositional practice as mutually reinforcing forces: composers continually push technological boundaries, even as new tools expand the compositional imagination.

FROM ANCHORED AUDITIONS

For much of the history of spatial audio, listening was conceived as an act of anchoring—a fixed audition hard-coded into idealized speaker layouts and stabilized around predetermined listening positions. Yet even as this framework produced powerful sonic worlds, it also carried hidden assumptions: that space could be controlled, that perception could be standardized, and that listening could be reliably fixed. Against this backdrop, a new imagination began to stir—one that treated space not as a fixed frame, but as an emergent landscape shaped by movement, choice, and subjective encounter.

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[110] Francis Rumsey, *Spatial Audio / Francis Rumsey.*, Music Technology Series (Oxford ; Focal Press, 2001).
[111] Agnieszka Roginska and Paul Geluso, eds., *Immersive Sound: The Art and Science of Binaural and Multi-Channel Audio* (New York ; London: Routledge, Taylor & Francis Group, 2018).
[112] Justin Paterson and Hyunkook Lee, eds., *3D Audio*, Perspectives on Music Production (Abingdon, Oxon ; New York, NY: Routledge, Taylor & Francis Group, 2021).
[113] Natasha Barrett, "A Musical Journey towards Permanent High-Density Loudspeaker Arrays," *Computer Music Journal* 40, no. 4 (December 1, 2016): 35–46, https://doi.org/10.1162/COMJ_a_00381.

This channel-based framework manifested across a wide range of practical formats, from stereo to 5.1 surround to complex multi-speaker arrays. In each case, the mix was inextricably tied to a predetermined loudspeaker configuration, reinforcing the assumption of a fixed listener. Composers and sound engineers had to carefully adapt spatial designs to specific speaker layouts, making each venue's acoustics integral to the compositional process, often re-mapping the spatial design every time the piece was performed in a new space. Historical systems like the GRM Acousmonium or BEAST (Birmingham ElectroAcoustic Sound Theatre) exemplify this paradigm's instrumentality: they employ dozens of speakers for rich spatial effects, but require the listener to physically sit in the hall at a designated area to fully experience the unfolding spatial art. Critically, even these sophisticated multi-speaker setups assumed an idealized listening area and were fundamentally system-centric—the audience received the space as composed by the system (and performer), not by their own movement or choice.

Figure 17. The mixing console "sweet spot."

Across all these channel-based scenarios, spatial design was constrained by the loudspeaker layout. The mix was "hard-coded" into specific channels and positions, which in turn shaped compositional thinking. Composers working in stereo or 5.1, for example, learned to imagine their music from a fixed point of audition—effectively, composing for an abstract listener centered in the mix. A traditional recording studio or composition setup exemplifies this notion (a sweet spot marked by the mixing console and equidistant speakers). The technology encouraged composers to conceptualize space as a fixed stage, anchored to a singular ideal listening perspective.

This paradigm yielded many creative works, but it also came with a set of assumptions: that there is one correct rendering of the piece (aligned to the designated speaker setup) and, by extension, often one "best seat" in the house for experiencing it. In a channel-based concert, listeners outside the ideal 'sweet spot' often perceive a degraded spatial image, reflecting assumptions about uniform audience positioning. Yet even within the dominance of channel-based systems, there were cracks—small but explosive—where visionaries began to resist the gravitational pull of fixity, daring instead to imagine listening as movement, space as living architecture.

Among them, Maryanne Amacher stands out not merely as an innovator, but as a radical cartographer of sound—one who reimagined listening itself as an act of spatial exploration. In

her *Music for Sound-Joined Rooms*[114] series and beyond, Amacher designed environments where sound unfolded as an architectural phenomenon: rooms resonating, bodies moving, perceptions shifting. Rejecting the traditional model of a fixed listening point, she distributed "sonic characters"[115] throughout interconnected spaces, inviting listeners to traverse different sonic scenes. Each experience became uniquely defined by the listener's movement, with no singular 'correct' perspective—only a dynamic co-creation of space and sound. As she put it, "the rooms themselves become speakers, producing sound which is felt throughout the body as well as heard."[116] Amacher's radical focus on embodied, site-specific listening hinted at possibilities still largely unrealized today, even with our vastly expanded technological toolkit.

THE SONIC VOYAGE

As spatial audio technologies diversified in the twenty-first century, the once-rigid coordinates of listening gave way to new voyages: spaces where sound could drift, flex, and inhabit fluid horizons. Through the rise of object-based audio, scene-based encoding, and dynamic spatial rendering, space itself ceased to be a static stage and became something navigable—an emergent terrain shaped as much by movement and context as by composition.

This transformation was driven by a proliferation of new playback formats—5.1, 7.1, 22.2 surround arrays, hemispherical domes, full-sphere speaker environments—which made it impractical to hard-code a unique spatial mix for each system. In response, a paradigm shift

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[114] Maryanne Amacher, *Music for Sound-Joined Rooms*, Location-based Installation (Minneapolis-St. Paul, MN, USA, 1980), https://sound-art-text.com/post/34332890147/maryanne-amacher-1938-2009-living-sound-for.
[115] Maryanne Amacher, "Maryanne Amacher - Ars Electronica Prix Submission Biography" (Ars Electronica, 1997), 2, https://archive.aec.at/media/assets/14006af3fe7bec64d189b3f4a8bc2002.pdf.
[116] Amacher, 2.

emerged: object-based audio. In technical terms, object-based audio decouples sounds from specific speakers. Instead of binding each musical element to a particular channel, the composer or producer assigns each sound source as an independent object with accompanying metadata describing attributes like its position, trajectory, or size. A rendering engine then dynamically maps these objects to whatever speaker array or headphone setup is being used for playback. In essence, the system is told what the spatial scene should be, and it handles how to deliver that experience over the available transducers.

This shift tore open the old certainties of spatial composition. No longer constrained to a single speaker layout, composers could think of space not as a technical afterthought, but as a living material—elastic, relational, alive to context and motion. The object-based paradigm invites the creator to design a scene of sounds and movements, trusting that the relationships between those sounds (their relative positions and motions) will translate to different listening contexts. It's a bit like Duke Ellington writing specifically for particular musicians versus generically for their instruments;[117] the latter is much less precise, but is inherently more flexible. In object-based audio, a composition can be created once and then rendered on a two-speaker stereo pair, a 16-speaker dome, or even a binaural headphone setup—all from the same source data—without the composer manually remapping every sound for each system. The underlying renderer takes care of adapting the presentation to each loudspeaker layout. This means composers gain freedom to prioritize artistic intent in spatial gestures and immersive scenarios, liberated from the constraints of reproduction logistics; the technical system shoulders much of that burden. But log this away

[117] John Edward Hasse, *Beyond Category: The Life and Genius of Duke Ellington* (New York: Simon & Schuster, 1993), 84.

for later, dear reader: I shall argue—right alongside Ellington, as I suspect he might—that this path is not without its trade-offs.

Meanwhile, scene-based approaches like Ambisonics evolved in parallel with similar goals. Ambisonics encodes an entire 3D sound field into a set of channels (using spherical harmonics) that are agnostic to any specific speaker configuration. Later, during playback, a decoder translates this encoded sound field for the actual speaker array or for binaural headphones. Higher-order Ambisonics, in particular, increased the precision and realism of this technique by using more channels to represent the sound field. Like object-based audio, Ambisonics allows a piece to be adapted to different loudspeaker setups without fundamentally altering the mix—inching closer to the long-held ideal of a format-agnostic composition. In practice, composers often combine approaches: for example, using Ambisonic encoding for ambient environmental sounds and object-based panning for discrete moving sounds, all within one artwork. During her 2012 IRCAM residency, Natasha Barrett's *Hidden Values* featured various layers of sonic content produced with high order ambisonics (HOA), near-field compensated higher-order ambisonics (NFC-HOA), and wave field synthesis (WFS). Composing with this exploratory hybrid approach let her deeply explore her topic of "inventions push the boundaries of science,"[118] with sonic processes that did the same.

The impact on compositional practice has been significant. Freed from the need to predetermine a single playback format, composers today leverage hybrid workflows, using Ambisonic scene

[118] Natasha Barrett, "THE PERCEPTION, EVALUATION AND CREATIVE APPLICATION OF HIGH ORDER AMBISONICS IN CONTEMPORARY MUSIC PRACTICE" (Paris, France: IRCAM, 2012), 3, https://www.natashabarrett.org/Barrett_IRCAM_Report_v2.pdf.

encodings, object metadata, and real-time spatialization algorithms in tandem to achieve their artistic aims. The move to object-based (and other flexible spatial formats) shifts some burden from the composer to the technology, ideally granting the composer greater creative agency over space itself. Some artists now work directly in object-oriented formats such as Dolby Atmos (which uses object metadata alongside channel "beds"), enabling a *mix once, diffuse anywhere* approach. A piece composed in Atmos, for instance, can be experienced in a cinema with 64 speakers, on a home 7.1.4 system, or downmixed to binaural for headphones—all from the same master project. Similarly, an installation created with higher-order Ambisonics can be decoded for a 8-speaker cube or a 32-speaker sphere without remixing the content. Moreover, object-based frameworks offer the tantalizing prospect of interactivity and context-specific adaptation: in principle, the system could tailor the rendering based on a listener's device or even react to a listener's movements (as is sometimes done in interactive media and game audio engines like *FMOD* and *Wwise*).

Researchers and industry experts have highlighted object-based and Ambisonic methods as key to the future of immersive media. And while tools for spatial design continue to rapidly expand, we already have the hardware and software to render space itself as an extension of musical imagination. Indeed, many composers must become fluent in the tools of spatial audio engineering—from Ambisonic encoder/decoder configurations to 3D audio middleware—as part of their creative process. Barrett notes that creating rich "spatial imagery"[119] often demands innovative encoding and decoding solutions beyond standard studio tools, highlighting how

[119] Barrett, "A Musical Journey towards Permanent High-Density Loudspeaker Arrays," 39.

compositional desire (for a certain spatial effect) drives technical experimentation. The integration of cutting-edge technology and artistic practice is thus tighter than ever.

Yet amid all this excitement, it is crucial to recognize the limitations inherent in the object-based paradigm. While breaking the one-to-one bond between music and a specific set of speakers is helpful in many ways, it does not guarantee an ideal experience for every listener within the space, nor would it satisfy Ellington's quest for "raw material."[120] Despite advancements, most object-based systems still assume a centrally located sweet spot, aiming primarily at listeners in optimal positions, as exemplified by Dolby Atmos cinema configurations, optimized explicitly for central seating. Format-agnosticism solves many problems—but not the fundamental one: no two listeners, in any system, ever hear precisely the same world. Object-based audio provides a richer canvas for spatial design, accommodating some user interaction and context dependency, yet fundamentally remains an object-oriented approach. Its focus remains on optimizing the delivery of sonic objects within a spatial environment rather than fully embracing the unique listening positions or choices of individual audience members. In short, object-based methods enable us to redesign the sonic stage at will, but the performance itself remains largely pre-scripted. Recognizing this limitation has prompted me to pursue a complementary perspective, shifting the emphasis from the engineered sound field toward the experiences and agency of the listening subject.

THE WILD WEST: PANNING FOR GOLD

[120] Hasse, *Beyond Category*, 84.

The flexibility offered by object-based paradigms, while empowering, has inadvertently fostered a landscape of fragmented, competing spatial audio approaches—a veritable "Wild West" of formats and techniques, with no single standard for spatial panning or rendering achieving universal adoption. (By contrast, stereo audio long ago converged on a de facto *constant power - 3dB pan law* for consistent image placement between two speakers.) Today, creators can choose from an array of tools (a non-exhaustive list to follow), each with its own principles and practices. Vector Base Amplitude Panning (VBAP), for example, uses geometric calculations to distribute a sound among the nearest loudspeakers, yielding precise localization within a conventional multi-speaker setup. Ambisonics, as discussed, encodes entire sound fields for flexible playback and is popular in VR and 360° video production. Dolby Atmos has become a commercial standard for cinemas and streaming media, leveraging object-based mixing and fixed bed channels to create enveloping soundscapes for films, music, and even live concerts. In the live sound and installation domain, companies have developed proprietary systems like Meyer Sound's SpaceMap (Galaxy), or d&b audiotechnik's Soundscape which utilizes delay-based panning to realize a remarkably even stereo-panning-like effect across an entire audience. Experimental platforms such as 4DSOUND and Holoplot push the envelope further, aiming to create 3D sonic environments with non-standard speaker configurations. Software environments like IRCAM's SPAT Revolution provide yet another approach—a flexible engine that can emulate various spatialization techniques (including VBAP, Ambisonics, WFS and beyond), giving artists a unified interface to this otherwise fragmented toolbox.

All of this sounds a little bit like Oprah Winfrey's "You get a car! You get a car! You get a car!" mantra.[121] But, what's important to emphasize is that there is a lot of very cool technology being created all the time while meanwhile there is no universally accepted standard for how to pan or project sounds in space. Each system comes with its own algorithms, file formats, and heuristics. A mix created for one platform often needs adaptation or complete re-rendering for another. For instance, a piece composed with VBAP panning on a 16-speaker dome might not translate transparently to a third-order Ambisonics system, or to a Dolby Atmos playback—the composer or sound designer must make compromises or adjustments. This fragmented state of affairs means we are in an explorative phase: a multitude of ideas and methods are being tried, akin to an audio-technological *Wild West* without a single law. For creators, this is both exhilarating and merciless. New tools offer endless frontiers, but demand an almost nomadic technical fluency—the ability to adapt, translate, and rebuild at every turn. One might need to be conversant in many approaches—from setting up Ambisonic decoders, to programming an Atmos panner, to tweaking a custom array's timings in Soundscape—depending on the project and venue.

Despite their differences, most of these systems still privilege a "sweet spot" or assume a homogeneous audience experience. They are generally designed to deliver a coherent illusion to an ideal listening area, rather than to deliberately provide each listener with a unique mix. For example, a higher-order Ambisonic concert will sound most precise for those near the center of the speaker array; a Dolby Atmos movie mix is optimized for the middle seats of the theater

[121] "Look Back at Oprah's Free-Car Giveaway," Oprah.com, accessed April 24, 2025, https://www.oprah.com/oprahshow/oprahs-entire-audience-are-surprised-with-new-cars-video.

(albeit with effort to spread good coverage across many seats); similarly, live immersive systems like Soundscape aim to give the entire audience a consistent sense of localization and balance, approximating for many what stereo achieves for one. While such designs greatly expand the zone of immersion compared to older stereo or 5.1 setups, they still operate under a uniformity assumption: the goal is for everyone to hear essentially the same intended piece. There is no meaningful provision for listener-specific variation—any differences in what individuals hear are usually considered undesirable side effects of imperfect coverage, rather than an artistic feature.

In other words, the current generation of spatial audio technologies remains largely system-centric. Each new format or processor might increase fidelity or flexibility, but none fully embraces the idea that each audience member could be experiencing a different rendition of the work. To date, if a listener moves to a new spot and hears a new balance of the elements, this is often seen as a problem to mitigate (by improving the system), not an opportunity to seize creatively. There is a palpable gap here: no existing platform meaningfully supports designing a musical experience that varies intentionally from listener to listener. This is precisely the gap that a subject-oriented approach seeks to address.

POSTLUDE: THE PROBLEM SPACE

Ultimately, no matter how advanced our spatial audio systems have become, none has yet fully embraced the irreducible plurality of listening perspectives. We have voyaged from rigid channels to flexible objects, explored myriad contemporary techniques, and yet found a common thread: the audience is still treated as a unified destination, not a constellation of subjects. This reveals a central challenge and problem space for composers and sound artists moving forward: *how can we compose with the plurality of perspectives, rather than in spite of it?* Instead of

fighting against the fact that each listener hears a unique version of the music, can we fold that fact into our creative method and make it part of the art? How might we design sound environments that don't just tolerate different listener positions, but actually thrive on them?

The essay parts that follow take up these questions directly. In the next section—Essay 1, Part 3: *A Manifesto for Listening*—I return to the philosophical core of this dissertation, articulating the ethical and imaginative imperatives of *empathetic omniscience* and *subject-oriented musicking*. This manifesto offers a foundational stance from which the rest of the dissertation proceeds, re-centering listening as a creative and co-constitutive act.

Then, in Essay 2, Part 3: *Spatial Composition as World-Making*, I turn to the spatial strategies within my own compositional work. There, I explore how spatial environments can be composed not as fixed experiences but as evolving worlds—worlds that listeners traverse, interpret, and co-create. Finally, in Essay 3, Part 3: *Subject-Oriented Spaces: Nodes, Networks, and New Compositional Frontiers*, I outline the technical and compositional methodologies I've developed in response to the challenges identified in this essay, proposing new models for distributed, listener-responsive sound environments.

Together, these three final essay parts represent the heart of my original contribution. They draw together the threads of technology, composition, and listening into a vision for what spatial audio might become if we center not just the *sound*, but the *subject*.

So we arrive at a threshold—not just of technique, but of imagination. What would it mean to treat the listener not as a passive destination, but as a *generative site of musical becoming*? What futures might open if we compose not *for* the listener, but *with* them? And if we accept that premise, what kinds of technologies, methods, and musical forms might we need to realize it?

ESSAY 1: EMPATHETIC OMNISCIENCE – SUBJECTIVITY & MULTI-PERSPECTIVAL LISTENING

Part 3: A Manifesto for Listening

PRELUDE: TOWARDS A NEW PARADIGM IN LISTENING

> *"To listen is to lean in, softly, with the willingness to be changed by what we hear."*[122]
>
> Mark Nepo, *The Exquisite Risk*

Thus far, this dissertation has laid the groundwork for a new understanding of listening as an inherently embodied and dialectically multi-perspectival activity. We have seen that listening is never a merely passive reception of sound, but always an active, situated, and interpretive process entwined with our bodies and contexts. Now we find ourselves at a threshold: how do we synthesize these perspectives into a coherent paradigm that moves beyond understanding and into actively shaping our musical experiences? This challenge is both philosophical and practical, asking us to imagine listening not just as something we do, but as a creative force—a way of world-building through sound.

This conclusion to Essay 3 offers such a synthesis by formally introducing two central concepts that I believe serve as original contributions of this dissertation: empathetic omniscience and

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[122] Mark Nepo, *The Exquisite Risk : Daring to Live an Authentic Life* (New York : Harmony Books, 2005), 5.

subject-oriented musicking. These terms emerge from the rich soil of existing scholarship, yet they blossom into something new—novel frameworks designed to address the limitations of traditional models of listening and music-making. Empathetic omniscience is not presented as a naïve reach for an impossible, godlike objectivity in hearing. Instead, it is the deliberate, cultivated ability to imaginatively inhabit multiple subjective perspectives at once. It invites us to embrace listening as an act of empathy in motion—to move fluidly and consciously between the myriad vantage points from which sound and music can be experienced, without ever pretending to have a view from nowhere.

Through this process we may arrive at the understanding of subject-oriented musicking, which amplifies Christopher Small's seminal idea that "to music" is an active verb, an engagement rather than a static object.[123] In doing so, it places individual, embodied experience at the very center of musical meaning. This concept reorients us away from the conventional object-focused paradigm—where value lies in fixed works or scores—and toward a vision of music as something that arises dynamically through the interactive engagements of listeners, performers, and environment. Subject-oriented musicking posits that the ultimate significance of music lives not in abstract structures or texts, but in how sound becomes meaningful within the rich tapestry of personal and collective human experience.

By holding empathetic omniscience and subject-oriented musicking as guiding principles, we set forth nothing less than a new paradigm of listening and musicking. This manifesto is the philosophical heart of The Art of the Unheard—a call to actively embrace and creatively harness

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[123] Small, *Musicking*, 9.

the vast potential hidden in unheard perspectives and subjective sonic worlds. It argues that music's deepest value unfolds in the relationship between sound and listener, in the space where our listening selves meet the unknown and make it sing. With this vision in place, we now articulate its foundations in three core principles.

PRINCIPLE 1: LISTENING AS ACTIVE WORLD-MAKING

Too often, listening is misconstrued as a passive state of reception—a quiet, neutral process of merely taking in sound. In truth, to listen is to lean forward and engage. It is an inherently active, interpretive, and generative act. Every moment of listening invites the creation of a personalized auditory world, one uniquely shaped by the listener's own perception, body, and context. To listen is not just to receive sonic information, but to participate in the co-construction of reality through sound.

At its core, listening-as-world-making acknowledges that sonic meaning is never pre-given or fixed; it emerges through the listener's active interpretation. This interpretive act is fundamentally creative. We each draw upon our memories, emotions, bodily sensations, cultural backgrounds, and imagination to weave what we hear into a meaningful whole. Thus, the same sound can bloom into very different worlds in different ears. One listener, upon hearing a distant train horn at night, may feel the ache of nostalgia, while another hears adventure beckoning from beyond the horizon. In every case, sound is not simply a physical vibration traveling from source to receiver—it is shaped, filtered, and imbued with significance through the intimate interplay of our bodies and minds with the sonic environment.

Crucially, the body itself is an active participant in this meaning-making. Listening is an embodied experience: the resonance of sound in our bones, the pulse quickening with excitement or slowing with calm, even the subtle adjustment of posture as we attend to a sound—all these bodily responses shape how we understand what we hear. Our ears do not work in isolation from the rest of us. Where we are situated, how we move, and what we feel physically all influence the interpretation of sound. The listener's body is like a sounding board, amplifying certain frequencies of experience and dampening others, grounding the abstract act of listening in flesh and sensation.

Embracing listening as active world-making empowers us to recognize that we are never neutral auditors of a singular, objective musical truth. Instead, we are co-creators in every musical moment. Each auditory experience becomes a dialogue between sound and self, between external vibrations and internal responses. This first principle lays a foundation for an expanded vision of music—one that sees musical experience as something we actively build, piece by piece, in partnership with sound. It prepares us to explore the even more expansive possibilities that arise when we bring empathy and multiple perspectives into this creative act of listening.

PRINCIPLE 2: EMPATHETIC OMNISCIENCE AS LISTENING PRACTICE

What would it mean to listen with empathetic omniscience? At first glance, the idea sounds paradoxical—an all-hearing perspective, as if one could perceive every sound from every possible vantage point. True omniscience in listening is, of course, impossible; as Thomas Nagel

illustrated by asking "what is it like to be a bat?,"[124] each being's sonic experience is unique. We cannot literally hear through every set of ears or fully live inside another's acoustic reality. Yet it is precisely in this impossibility that inspiration strikes. Empathetic omniscience is not about achieving some godlike, detached hearing from nowhere; rather, it is an aspirational stance—one of listening from everywhere that imagination and empathy can reach. It is not about hearing everything, but about striving to hear more than just one's own perspective.

For example, try listening from someone else's position: imagine yourself standing where the performer stands on stage, then switch to the perspective of a listener in the back of the hall. Each vantage point uncovers new nuances in the sound. By shifting your auditory perspective in this way, you begin to cultivate a broader sonic awareness beyond your own.

This aspirational approach rests on a crucial insight: sound is not a fixed object in the world—or, to quote Nina Sun Eidsheim, a "fixed referent"[125]—but rather a relational event that takes shape uniquely for each listener. Every auditory experience is situated; no two people can ever perceive a sonic event in exactly the same way. If we accept this, then to strive for empathetic omniscience is to welcome the multiplicity of sonic truths rather than seek a single "correct" one. The goal is not to collapse perspectives into unity, but to appreciate their diversity. In a sense, we stop trying to find the note everyone hears, and instead delight in the chord that arises from many different hearings in concert.

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[124] Nagel, "What Is It Like to Be a Bat?," 435.
[125] Nina Sun Eidsheim, *The Race of Sound: Listening, Timbre, and Vocality in African American Music*, Refiguring American Music (Durham: Duke University Press, 2019), 50.

In practice, empathetic omniscience becomes a kind of radical perspective-taking whenever we listen. It asks the listener to continually imagine other auditory vantage points beyond their own. Rather than remaining confined to one personal point of audition, the listener deliberately projects awareness outward. We do not abandon our own ears; instead, we expand our aural imagination to include others. It is an act of empathic extension—listening through others rather than merely listening beside them. In this way, an "omniscient" listening experience is not a transcendence of human limits, but an active synthesis of many human (and even non-human) experiences into one layered awareness. Importantly, this integration does not yield a single objective truth of sound. Instead, it grants us a richer understanding of complexity and nuance that would be otherwise inaccessible. The aim here is not a perfect knowledge of sound, but a profound appreciation of its endless facets.

Such an endeavor requires shifts both cognitive and bodily. Our perception, as phenomenologists remind us, is always anchored in our flesh; we hear through our bodies. To genuinely imagine listening from another's position, we must first acknowledge that their body differs from ours—their ears, mind, and memories uniquely shape their sonic experience. Empathy thus moves beyond a superficial imaginative substitution—a clinical or detached attempt to merely 'place oneself' in another's location or perspective. Such replacement remains surface-level: it presumes we can neatly occupy another's vantage without genuinely engaging the complexity and depth of their embodied experience. In contrast, true empathetic listening involves cultivating a deeper, whole-body resonance, an embodied echoing of someone else's sensibilities, in which the boundary between listener and sound grows permeable, blurred, and indistinct. Listener and sound become partners in a dynamic union, vibrating together in

sympathetic resonance. Fundamentally, this resonance never assumes a complete identification or erasure of difference; rather, it invites the listener's sensory being to learn from and adapt to the other's embodied experience. Listening from another's perspective thus emerges explicitly as a deliberate practice of relationship—a mutual, dialogic, and richly embodied encounter—rather than a mere imaginative or clinical act of replacement.

At its heart, empathetic omniscience is a stance of openness and wonder. It resonates strongly with Jean-Luc Nancy's portrayal of listening as a searching, straining toward meaning just beyond immediate reach. Nancy describes listening as being "inclined toward the opening of meaning,"[126] a constant "straining toward a possible meaning… not immediately accessible."[127] This beautifully captures the ethos of empathetic omniscience. The empathetic listener is always leaning forward, ears first, into the unknown of another perspective. There is a profound humility in this posture: knowing that one's personal hearing is partial, we reach outward in hope of touching a greater shared harmony. Nancy's notion of resonance—where the self is continually reshaped by echoes from beyond itself—aligns deeply with this principle. The listener becomes a resonant being par excellence, vibrating in tune with a multitude of realities. This empathy-as-resonance enriches the listener immeasurably, as meaning emerges from a living tapestry of timbres, contexts, and voices interwoven.

Approaching listening in this way also carries significant social and cultural implications. Empathetic omniscience inherently values diversity in sonic experience; it actively

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[126] Nancy, *Listening*, 27.
[127] Nancy, 6.

engages with perspectives shaped by different cultures, different physical abilities, different histories and environments. Pauline Oliveros's practice of Deep Listening exemplifies this ethos of "inclusiveness,"[128] advocating that we expand our awareness to the whole spectrum of sound and truly listen to all that is there. In a world that often privileges certain voices or musical interpretations over others, an omniscient listening practice deliberately seeks out the unheard and the marginalized. It invites a more democratic musical experience in which every listener's insight matters. In such musicking, each participant—whether composer, performer, or audience member—contributes their own slice of meaning to the whole, enriching the collective understanding of the sound.

Ultimately, empathetic omniscience reimagines the role of the listener from a passive consumer of sound into an active co-creator of sonic worlds. It treats each act of listening as an opportunity to gather perspectives and weave them together. Here, subjectivity is not a limitation to overcome, but a gateway into a vast plurality of experiences accessible through empathy and imagination. The fullest musical understanding comes not from trying to escape our subjective conditions, but from embracing their plurality. By listening in this expansive, empathetic way, we allow the inexhaustible mystery of sound to ripple through us and between us. We find ourselves connected—to each other, to our environment, to past and future—through a shared act of imagination in sound. In empathetic omniscience, listening becomes an act of compassion as much as cognition, and music becomes a medium of profound human communion.

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[128] Oliveros, *Quantum Listening*, 32.

PRINCIPLE 3: SUBJECT-ORIENTED MUSICKING AS CREATIVE PRACTICE

Subject-oriented musicking places the subjective experience of the listener at the very core of musical creation and meaning. In doing so, it builds upon Christopher Small's revolutionary notion of musicking—the idea that music is not a static object or mere performance, but an action, a participatory process in which we all engage.[129] Subject-oriented musicking pushes this idea further: it insists that the individual listener's embodied experience, emotional landscape, and unique perceptual vantage point are not just byproducts of music, but essential components of it. The listener is not a passive recipient of musical meaning; the listener is an active participant who completes the musical event.

From this perspective, every musical experience is inherently personal and unrepeatable. No two individuals may ever truly hear the same performance, just as no two vantage points may ever yield identical views of a landscape. A melody that moves one listener to tears may stir in another a sense of triumph. Each listener brings a distinct constellation of memories, cultural contexts, bodily sensations, and imaginative capacities to the act of listening. All these factors color and shape what the music becomes for them. Consequently, I argue that the musical work is not a fixed artifact with a single identity but an emergent event—an active, living process co-created dynamically by composers, performers, listeners, and the spaces they inhabit. Understood this way, music is less like a finished sculpture and more akin to a communal dance, continually shaped by the contributions of each participant.

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[129] Small, *Musicking*, 8.

Shifting to a subject-oriented approach carries profound creative implications. If each listener's experience effectively creates the music anew, then composers and performers must approach their roles differently. Rather than presenting music as a closed object to be delivered, they can design musical experiences as open, interactive encounters. In practical terms, this might mean composing pieces that invite the audience to move around or change their listening position, or using elements of chance so that each performance unfolds uniquely. A piece may be written to exploit spatial distance, placing elements—harmonies, rhythms, voicings—some distance apart as a method of orchestration. A composer might craft a soundscape that responds to the presence or actions of the listeners—for instance, an installation where the music's texture shifts as people walk through it. Such practices treat a composition not as a predetermined sequence of notes, but as a space of possibilities that listeners help realize. In this way, subject-oriented musicking reframes the role of composer and performer: they become facilitators and guides, setting the stage for a range of personal interpretations rather than dictating a single outcome. Their craft lies in shaping situations where meaning can emerge collaboratively, rather than asserting meaning unilaterally.

In this empathetic framework, the listening practice we developed in Principle 2 comes full circle to inform creation. Composers and musicians embracing a subject-oriented ethos cultivate an empathetically omniscient outlook—actively imagining how their work might resonate through diverse listeners, across multiple subjective perspectives. They imaginatively listen to their work through the ears of many different listeners, considering how a piece might feel to someone with a very different background or state of mind. By actively pondering how their music might

resonate across a spectrum of perspectives, creators build in layers of richness that invite discovery from all angles. The result is music that resonates deeply across a diverse audience. In turn, this approach fosters a kind of empathy loop: the composer writes music with an ear toward the listener's experience, and the listener—sensing that invitation—engages more openly and creatively with the music. A kind of empathetic bridge is formed between the world of the creator and that of the audience.

Subject-oriented musicking also holds radical implications for the culture of music at large. By centering individual experience, it challenges old hierarchies of musical "expertise" and value. No longer is the composer's intent or the performer's interpretation the sole source of meaning. Instead, meaning is multi-centered, arising between many participants. This democratizes musical engagement and validates the responses of all listeners, not just those of critics or connoisseurs. For instance, a child's imaginative reaction to a symphony is as valid as a scholar's analysis—each contributes something unique. This ethos naturally encourages more inclusive and accessible musicking practices, prompting creators to engage actively with a plurality of cultural expressions—from varied musical traditions to diverse listening abilities. It celebrates difference and invites collaboration: the quiet listener in the corner and the outspoken aficionado both have something to offer to the musical moment. By designing musical experiences that embrace diversity in interpretation, participation, and form, subject-oriented musicking nurtures a more open, exploratory musical culture—one where everyone can feel ownership of the art.

Ultimately, subject-oriented musicking reimagines the very purpose of making music. The aim is no longer to present a perfected work for passive consumption, but to spark an active, relational process. Music becomes a profound act of shared creativity, inviting us not only to listen but to play our part in the ongoing unfolding of the sonic experience. In this vision, music is not a one-way transmission but a living conversation. It is a breathing, evolving process—a dynamic interplay of minds, bodies, sounds, and spaces, continuously shaped by the tapestry of human experience. This principle, as the capstone of our manifesto, calls on us to treat music not as a noun, but as a verb—something alive that we do together. When we embrace subject-oriented musicking, we find that the true art of music lives not only in the notes or in the performance, but in the connections forged and the experiences shared by all who engage in the musical moment.

CORE TENETS: A SUBJECT-ORIENTED MANIFESTO

Subject-oriented musicking is anchored by four interconnected core tenets that collectively redefine how we conceive, engage with, and create musical experiences in this paradigm:

1. Plurality of Perspective

Every listening perspective holds unique validity and offers something irreplaceable to the musical experience. The richness of music lies in embracing multiplicity rather than reducing it to a single "correct" interpretation. No single point of view can exhaust the meaning of a piece of music; instead, each new listener or participant adds to its ever-expanding tapestry. Composers, performers, and listeners alike are invited to acknowledge and play with this diversity of perception. By creatively engaging multiple

perspectives, we ensure that music remains a living dialogue rather than a one-sided statement.

2. Embodied Cognition as Foundational

Musical meaning emerges through the body. Listening is never a purely abstract, cerebral act—it is always grounded in the listener's bodily sensations, emotions, and physical presence. Our heartbeat, our breath, the tension or relaxation of our muscles—all modulate how we perceive sound. This tenet reminds us that to create or appreciate music fully, we must account for the whole human organism. Subject-oriented musicking therefore actively incorporates the insights of embodied cognition: it values the felt, visceral responses to sound as much as intellectual analysis. For example, a deep bass line that you feel in your chest can convey meaning beyond what the melody alone provides. Likewise, performances can be designed to engage movement and spatial listening, not just the ears.

3. Relational Creativity

Music is fundamentally a relational art form—it exists not in isolated notes, but in the relationships among sounds, people, and spaces. This tenet reframes composition and performance as acts of creating relationships. Instead of treating a piece of music as a finished product, the subject-oriented approach treats it as an open conversation. Composers and performers set up the conditions for meaningful sonic interactions among sounds and between participants. In essence, they craft contexts in which music can happen between people. This relational view acknowledges that the

true beauty of music often arises through interaction and exchange—like the magic of a jazz improvisation in the give-and-take among players, or the way an audience's energy influences a live performance. By focusing on these relationships, subject-oriented musicking embraces the dynamic, ever-evolving nature of musical meaning.

4. Empathy as Listening Technology

Empathy is our most human "technology" for extending perception. Following Martin Heidegger's definition, technology can be understood not merely as mechanical or electronic tools but more fundamentally as "a way of revealing"—a deliberate mode of mediating human experience, uncovering hidden possibilities and meanings.[130] In subject-oriented musicking, empathy precisely functions in this manner, enabling musicians and listeners to navigate and integrate multiple perspectives in sound. It transforms listening into a deliberate, imaginative act of collaboration. Through empathic listening, a person can step beyond their own sonic habits and momentarily inhabit someone else's musical reality. For creators, this means designing music with an ear toward others' experiences—effectively listening while composing or performing. For listeners, it means actively trying to hear a piece as another person might, opening oneself to a different hearing. Empathy thus becomes a technique of discovery: it lets us access emotional and experiential dimensions of music that we might otherwise miss. Cultivating this human "listening technology" not only enriches each individual's sonic world but also builds bridges between different listeners and communities. In a very real

[130] Martin Heidegger, *The Question Concerning Technology, and Other Essays* (New York: Garland Pub, 1977), 18–19.

sense, empathy in music-making strengthens our social fabric, allowing sound to connect people across divides of culture, background, or ability.

Taken together, these tenets mark a profound shift in musical philosophy and practice. They position music not as a finished artifact delivered from creator to audience, but as an active, inclusive, ever-evolving human collaboration. By adopting these principles, we transform musicking into a space of possibility—one where imagination, embodiment, relationship, and empathy coalesce to create musical experiences as diverse and vibrant as life itself.

THE ART OF THE UNHEARD

Empathetic omniscience and subject-oriented musicking together articulate a vision of music that reaches beyond the realm of sound itself. They transform listening from a mere sensory act into an ethical and creative practice—an art of openness toward the countless unheard voices and hidden resonances that surround us. The Art of the Unheard emerges as a call to acknowledge, cherish, and amplify those subtle sonic threads that often go unnoticed. It urges us to lean in to the quiet murmurs at the liminal margins of our auditory world: the faint sounds, the personal vibrations, the silences brimming with meaning.

To practice the art of the unheard is to make space for the neglected and the novel in our sonic landscape. It means listening between the notes and beyond the obvious, treating the act of perception as a form of gentle creativity. When we listen deeply, empathetically, and inclusively, we are essentially composing anew in each moment of experience. We craft music

not as isolated creators, but in relationship with all that is around us. By listening for what others overlook, we bring forth new dimensions of the music of life that would otherwise remain silent.

In this way, to listen is itself an artistic and ethical act. We cultivate an ear attuned to mystery, one ready to embrace and co-create the endless unfolding of sound. The art of the unheard invites us into a shared wonder: it asks us to imagine how much beauty and meaning hum quietly in our midst, waiting for an open ear. By answering that invitation, we foster a musical culture that is not only richer in sound, but richer in empathy, understanding, and human connection.

POSTLUDE

Empathetic omniscience and subject-oriented musicking form a resonant motif that will carry forward into the final sections of this dissertation. We turn now toward my creative application of this methodology, exemplified through my doctoral capstone recital. In the penultimate section, I explore the technology itself—the means by which space, sound, and listener were intertwined, delving into the system I designed to extend our senses and bring the unseen into audibility. In the final section, I then turn to the compositions and music that emerged from this subject-oriented mindset, the creative vision realized through these technological tools. Throughout, my aim has been to let space itself become music, and movement through that space an expressive gesture—an active dance of listening.

ESSAY 2: SPATIAL AESTHETICS & SONIC ARCHITECTURE

Part 3: Spatial Composition as World-Making

PRELUDE

> *"The sound we hear when listening to this action is not the sound of one hand hitting the other. It is not the sound of hands, neither left nor right. Instead, it is the action of two hands clapping sounding with everything else."*[131]
>
> Salomé Voegelin, *Who's Afraid of Sound?*

I stand in the center of an empty hall, and a single note breaks the silence. It shivers into echoes, dancing off walls and circling back, shaped subtly by the intricate geometry of my ears, head, and shoulders. In that moment, I am not merely arranging sounds in sequence, constructing harmonies—I am building a world, collaborating with the listener's brain to map out spatial meaning. Every sonic reflection sketches an invisible architecture, crafted through psychophysical cues and spectral filtering; every tone becomes a pillar or archway in an emergent cathedral of sound, anchored by the perceptual mechanisms that construct auditory space.

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[131] Salomé Voegelin, "Who's Afraid of Sound? Listening as Transgression of a Cultural Visuality," *Springerin*, January 1, 2023, https://www.springerin.at/en/2023/1/wer-hat-angst-vor-klang/.

In this final movement of *Spatial Aesthetics & Sonic Architecture*, I embrace the idea that composing with space is an act of world-making—a creative practice made possible by our innate, evolutionary skill at locating, identifying, and interpreting sound. My role as composer merges with that of architect and storyteller, rooted deeply in neuroscience, psychoacoustics, and phenomenological experience: I design not just melodies, but environments calibrated to resonate with how humans perceive spatial reality; not just harmonies, but immersive spaces for those harmonies to stretch out and call home.

This perspective has grown organically through my work, and particularly through the pieces I presented on Jan 10, 2025 for my doctoral capstone recital. But my specific journey toward that recital started in early 2023 when I began work on *Wave Music XII: 1001 Charlies*. I was thrilled to be asked by the illustrious Charlie Morrow to write the twelfth installment of his series that had its roots planted before I was born, in the summer of 1977 at Wave Hill in New York City. *Wave Music I: 40 Cellos at Sunset with Gulls*, a musical study on fluid dynamics, would become the model for ten other event-spectacle compositions by Morrow over several decades, most featuring high-quantity multiples of the same instrument, carefully arranged in impressively vast spatial configurations.

Over the last 20 or so years, Charlie and I have become friends, business partners, and artistic collaborators through ventures such as MorrowSound. But this is the first time since he began his series *Wave Music*—nearly 50 years ago—that he's invited someone else to pen an iteration. Knowing the series well, I understood the call to action: I needed to create a spectacle, something spatial, something fluid, evoking a sense of connectedness, and something involving a large

number—an absurd number—of the same instrument. And, aside from these points, I of course knew I wanted Charlie front and center to participate. Knowing the conch shell was near and dear to his musical vocabulary (he even used it in the 1981 version, *Wave Music V: Conch Chorus and Bagpipe*), I started on a mission to make some waves… and perhaps ride some too… it's California, after all.

ABSURDITY ABOUNDS

By now, you've probably guessed the absurd number toward which I set course. Much to my dismay, there is only one actual human Charlie, but through the magic of technology, there could be many more. Thus, I decided to construct a wave-inspired work featuring around a thousand Charlies—give or take. Given my ongoing research into subject-oriented sensibilities, and my professional experience with distributed audio systems merging sound and architectural aesthetics, I turned my attention to the challenge of spatializing nearly 1,000 virtual Charlies.

As discussed in Part 2 of this essay, the hall in which this piece would premiere became a central consideration. Equally critical was the question of how I would practically realize 1,000 Charlies in sonic space. While placing 1,000 loudspeakers around the venue sounds entertaining, it was, at least at the writing of this dissertation, a proposition would be a good measure *too absurd*. Moreover, I've long opposed spatial audio that only "works" for listeners seated in an ideal position, meaning that traditional immersive systems—ambisonics, Dolby Atmos, 5.1, 7.1, or quad setups—were unsuitable. Nor did solutions such as d&b Soundscape appeal to me, as I was not interested in ensuring everyone heard precisely the same soundscape. Guided by the

idea that *if nothing is a sweet spot, then everything is a sweet spot*, I sought an answer in my existing approach to sonic architecture and spatial imaging.

Imagine you are seated equidistant between two loudspeakers. I am operating a sound console, and playing back the sound of a conch horn, long bellowing notes. Next, I slowly pan the sound from center toward the left speaker, so it's only coming out of that one. I pause, and then slowly pan across toward the right speaker, and stop there. To you, it will sound like the conch *moves* from center to left and then across to right. But all that's really happening is that the level of conch sound coming from the two speakers is going up and down according to the standard stereo 3dB equal power panning law. And, by the way, *you* were sitting in the sweet spot (but, don't worry I won't take offense… that's why *you* were sitting between the speakers and not *me*).

Now, consider what I heard, hunched over the audio console on the side of the room, playing with pan pots. I was *not* in the sweet spot, but yet, I would hear *something*. I'd be likely to hear some amount of variance or "motion" as well, just not the same something and motion you heard—the extent of which will be attributed to how much closer I am to one speaker as compared to the other. Well, that's ok, I am the one studying subject-oriented sound, I'll take it! In fact, this is the scenario that gave me the idea. What if there's another set of speakers in the room doing the exact same sort of thing. Maybe I'm a little closer to being on center to those, but you're off center to them. What if someone else walks in the room, between both of us, what is their proximity to the speakers? At this point, with four speakers, we actually have *six* different combinations of speaker "pairs" in the room, all with completely different prescribed

"sweet spots," or *12* if the speakers are omnidirectional and you can be on either side of them, and that's not even to consider the fact that there is a cross-sectional line cutting through the sweet spot from the midpoint between the speakers. I can be different distances away from the pair of speakers and they can still be equidistant. Well, what if we add one more speaker, arbitrarily placed in the room? That would make *ten* ordinary pairs, 20 if you count both sides, and more including the bisected line. Suddenly there are many different "sweet spots" filling the room. *If everything is a sweet spot, nothing is a sweet spot.*

I began to wonder how many speakers were the right number to get 1000 Charlies. But thinking about this led me to realize that I was one step shy from being able to answer that question. First, I had to consider what a pair of speakers could get me. What constitutes a "Charlie" in the virtual sense? I imagined 1000 virtual Charlies floating in space all over the hall, so in some sense a virtual Charlie must be spatially situated. Between a pair of speakers, and with a smooth pan from one side to the other, I essentially have an infinite number of locations for a Charlie to be situated (quantized to the 1° maximum aural acuity increment we learned about in Part 1). Aural acuity and sweet spot specificity have an inverse relationship—the more fine tuned we want to be, the more it matters a listener is equidistant from the speaker pair. So, naturally, I'd like to be more forgiving, and thus wish to keep the number of virtual Charlies assigned to a pair of speakers low.

I decided to chart this out to see what my options are with different numbers of Charlies per pair and different numbers of speakers (see Appendix A for a full walkthrough of the math for this process). I quickly realized that if I had only three virtual Charlies per pair (hard left, hard right,

and center), then the math says I'd still need 46 speakers to get near 1000 Charlies. This still felt a little impractical to me, so through this chart I found every combination that would get me within 3% of the target of 1000, expressed as bolded and boxed pink numbers in Table 1 below.

Speaker Count	(2 Mono + 1 Stereo) 3 Nodes/Chord	4 Nodes/Chord	5 Nodes/Chord	6 Nodes/Chord	7 Nodes/Chord	8 Nodes/Chord	9 Nodes/Chord	10 Nodes/Chord	11 Nodes/Chord	12 Nodes/Chord	13 Nodes/Chord	14 Nodes/Chord	15 Nodes/Chord	16 Nodes/Chord	17 Nodes/Chord	18 Nodes/Chord	19 Nodes/Chord	20 Nodes/Chord	21 Nodes/Chord	22 Nodes/Chord	23 Nodes/Chord	24 Nodes/Chord	25 Nodes/Chord	26 Nodes/Chord	27 Nodes/Chord
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75	78
4	10	16	22	28	34	40	46	52	58	64	70	76	82	88	94	100	106	112	118	124	130	136	142	148	154
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215	225	235	245	255
6	21	36	51	66	81	96	111	126	141	156	171	186	201	216	231	246	261	276	291	306	321	336	351	366	381
7	28	49	70	91	112	133	154	175	196	217	238	259	280	301	322	343	364	385	406	427	448	469	490	511	532
8	36	64	92	120	148	176	204	232	260	288	316	344	372	400	428	456	484	512	540	568	596	624	652	680	708
9	45	81	117	153	189	225	261	297	333	369	405	441	477	513	549	585	621	657	693	729	765	801	837	873	909
10	55	100	145	190	235	280	325	370	415	460	505	550	595	640	685	730	775	820	865	910	955	**1000**	1045	1090	1135
11	66	121	176	231	286	341	396	451	506	561	616	671	726	781	836	891	946	**1001**	1056	1111	1166	1221	1276	1331	1386
12	78	144	210	276	342	408	474	540	606	672	738	804	870	936	**1002**	1068	1134	1200	1266	1332	1398	1464	1530	1596	1662
13	91	169	247	325	403	481	559	637	715	793	871	949	**1027**	1105	1183	1261	1339	1417	1495	1573	1651	1729	1807	1885	1963
14	105	196	287	378	469	560	651	742	833	924	**1015**	1106	1197	1288	1379	1470	1561	1652	1743	1834	1925	2016	2107	2198	2289
15	120	225	330	435	540	645	750	855	960	1065	1170	1275	1380	1485	1590	1695	1800	1905	2010	2115	2220	2325	2430	2535	2640
16	136	256	376	496	616	736	856	**976**	1096	1216	1336	1456	1576	1696	1816	1936	2056	2176	2296	2416	2536	2656	2776	2896	3016
17	153	289	425	561	697	833	969	1105	1241	1377	1513	1649	1785	1921	2057	2193	2329	2465	2601	2737	2873	3009	3145	3281	3417
18	171	324	477	630	783	936	1089	1242	1395	1548	1701	1854	2007	2160	2313	2466	2619	2772	2925	3078	3231	3384	3537	3690	3843
19	190	361	532	703	874	1045	1216	1387	1558	1729	1900	2071	2242	2413	2584	2755	2926	3097	3268	3439	3610	3781	3952	4123	4294
20	210	400	590	780	**970**	1160	1350	1540	1730	1920	2110	2300	2490	2680	2870	3060	3250	3440	3630	3820	4010	4200	4390	4580	4770
21	231	441	651	861	1071	1281	1491	1701	1911	2121	2331	2541	2751	2961	3171	3381	3591	3801	4011	4221	4431	4641	4851	5061	5271
22	253	484	715	946	1177	1408	1639	1870	2101	2332	2563	2794	3025	3256	3487	3718	3949	4180	4411	4642	4873	5104	5335	5566	5797
23	276	529	782	1035	1288	1541	1794	2047	2300	2553	2806	3059	3312	3565	3818	4071	4324	4577	4830	5083	5336	5589	5842	6095	6348
24	300	576	852	1128	1404	1680	1956	2232	2508	2784	3060	3336	3612	3888	4164	4440	4716	4992	5268	5544	5820	6096	6372	6648	6924
25	325	625	925	1225	1525	1825	2125	2425	2725	3025	3325	3625	3925	4225	4525	4825	5125	5425	5725	6025	6325	6625	6925	7225	7525
26	351	676	**1001**	1326	1651	1976	2301	2626	2951	3276	3601	3926	4251	4576	4901	5226	5551	5876	6201	6526	6851	7176	7501	7826	8151
27	378	729	1080	1431	1782	2133	2484	2835	3186	3537	3888	4239	4590	4941	5292	5643	5994	6345	6696	7047	7398	7749	8100	8451	8802
28	406	784	1162	1540	1918	2296	2674	3052	3430	3808	4186	4564	4942	5320	5698	6076	6454	6832	7210	7588	7966	8344	8722	9100	9478
29	435	841	1247	1653	2059	2465	2871	3277	3683	4089	4495	4901	5307	5713	6119	6525	6931	7337	7743	8149	8555	8961	9367	9773	10179
30	465	900	1335	1770	2205	2640	3075	3510	3945	4380	4815	5250	5685	6120	6555	6990	7425	7860	8295	8730	9165	9600	10035	10470	10905
31	496	961	1426	1891	2356	2821	3286	3751	4216	4681	5146	5611	6076	6541	7006	7471	7936	8401	8866	9331	9796	10261	10726	11191	11656
32	528	**1024**	1520	2016	2512	3008	3504	4000	4496	4992	5488	5984	6480	6976	7472	7968	8464	8960	9456	9952	10448	10944	11440	11936	12432
33	561	1089	1617	2145	2673	3201	3729	4257	4785	5313	5841	6369	6897	7425	7953	8481	9009	9537	10065	10593	11121	11649	12177	12705	13233
34	595	1156	1717	2278	2839	3400	3961	4522	5083	5644	6205	6766	7327	7888	8449	9010	9571	10132	10693	11254	11815	12376	12937	13498	14059

Table 1. Number of Speakers vs. Nodes per Chord

This process yielded one stand-out candidate: five nodes per chord (chord in this case is a line connecting a pair of speakers on which "virtual" Charlie nodes may be placed) results in 1001 nodes with a speaker count of 26. 1001 immediately had an even better ring to it than 1000… it'll be 1 real Charlie and 1000 virtual Charlies = 1001 Charlies (shown in pink above).

In practical terms, with five nodes per chord there are:

- Two “real” nodes, being a sound panned hard left or hard right (coming only out of an individual speaker)—of which there are only as many combinations as there are speakers—26 total in this case; and
- Three “virtual” nodes, derived using 3dB panning law—visually you can interpret this as virtual nodes being at 25%, 50%, and 75% placements across the chord.

Mathematically, this gives the following states to the speaker gains at each of the virtual node positions:

	0%	**25%**	**50%**	**75%**	**100%**
Left	1.000 V_{RMS}	0.924 V_{RMS}	0.707 V_{RMS}	0.383 V_{RMS}	0.000 V_{RMS}
Right	0.000 V_{RMS}	0.383 V_{RMS}	0.707 V_{RMS}	0.924 V_{RMS}	1.000 V_{RMS}

Table 2. Speaker Gains at Five Equal-Power Equally-Spaced Pan Positions

To summarize the information we’ve accumulated to this point, following this approach I put 26 speakers into Winifred Smith Hall—a hall with very unique trapezoidal geometric architecture. I arrange those speakers in such a way as to augment the contours of the hall, which, in effect, places speakers around and within the audience seating areas. I chose the number 26 to correlate with a result of 1001 Charlies, 1000 of which will be derived from speakers, 975 of those with equal-power panning between pairs of speakers. This panning routine will not produce typical stereo imaging results for the listeners. Instead, the layout and process suggests that of the 325 different chords—or combinations of pairs of speakers—many hundreds to thousands of “sweet spots” will exist in the single room. *If everything is a sweet spot, nothing is a sweet spot.* The result is an audience immersed within a mesh of speakers, which—as a system—has 1001 *states of being*. Each of those states of being corresponds to a unique set of amplitude values across the

speaker system as well as a three-dimensional coordinate in space (where along each chord does that node sit). But what shall we expect as the *resultant effect*?

The scientifically minded reader will be quick to note, à la Haas effect,[132] that the virtual node depictions in Figures 14 and 16, as well as my descriptions here, are not literally true in the sense that anyone could directly perceive them as positioned in this manner. In this sense, that observation is correct, and I should clarify that the spaces these nodes occupy are conceptual rather than precise physical spaces. There are 1001 discrete states of the system, each corresponding to one of the 1001 nodes. While I maintain that a listener positioned anywhere within the venue will discern differences between most of these states, the physical spatial reality and the conceptual reality align precisely only at nodes along a single chord when the listener is equidistant from the pair of speakers creating that chord. Thus, if Figures 14 and 16 were redrawn from the perspective of any single subjective listener, the representations would be uniquely distorted. Consequently, no single listener could possibly perceive all the nodes exactly as illustrated in these figures.

COUCH-SURFING ARCHITECTURE

Instead, the resultant effect is built in a different way, using the conceptual space map as a guide. I made an aesthetic choice—perhaps a distinction that doubles down against typical object-based panning—to treat nodes as stationary points in space—albeit conceptual space—that can be activated when called upon to do so. Spatially, this is a little bit like a *bell choir*, a particular

[132] F. Alton Everest and Ken C. Pohlmann, *Master Handbook of Acoustics, Seventh Edition*, Seventh edition (New York, N.Y: McGraw-Hill Education, 2022), 64.

note waiting for the right time to shine, with a significant difference being that the node can produce any sound, pitch, or silence given to it. Unlike smooth object-based panning, where a sound is swept around from place to place, each node in my system was a little invisible "container" that can be asked to house a traveling couch-surfing sound.

The image that comes to mind when I think about this, is reminiscent of childhood math class games. Draw the left and bottom side of a large square on a sheet of paper, representing a two-dimensional *XY* axis. Put little equidistant dots along the lines, say 20 on each. Now use a ruler to connect the top vertical dot with the left horizontal dot. Move down one and right one and do it again, and keep doing that until all the dots are connected once. Voilà, we have this:

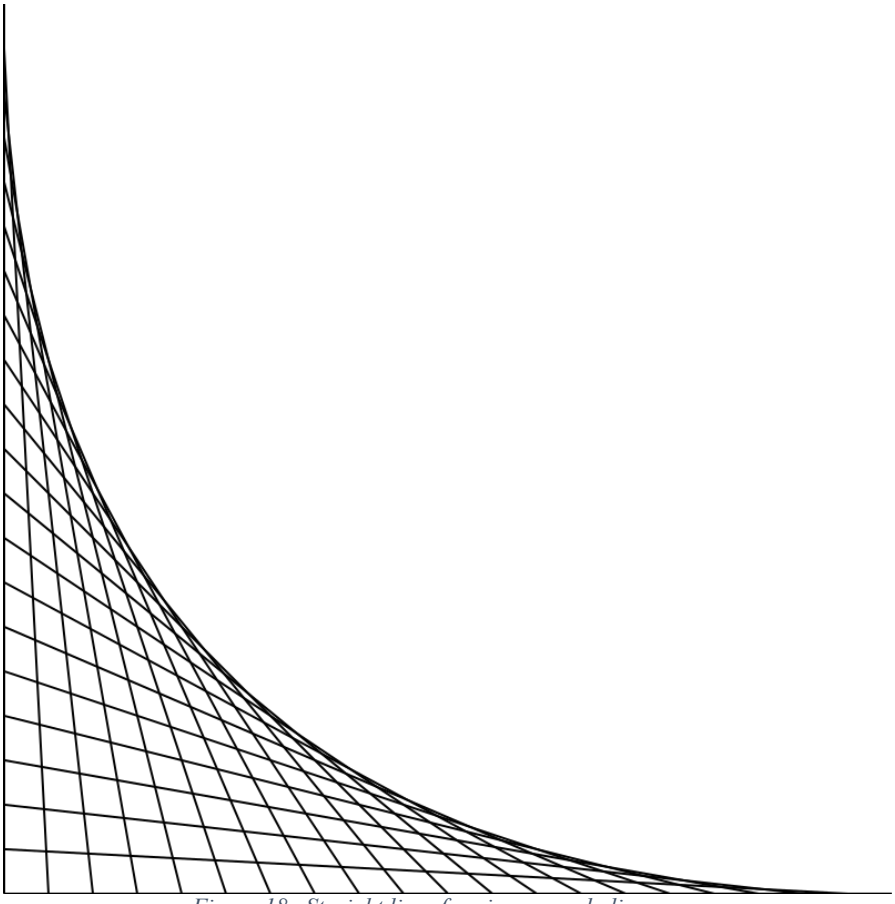

Figure 18. Straight lines forming a parabolic curve.

The result is a piecewise-linear approximation of a parabolic shape—from purely straight lines comes a gentle curvature through space. And thus, I think about the couch-surfing sound making its way around the hall to 1000 of Charlie's couches. Or, I think of a one-thousand bell chorus of Charlies waiting patiently for their moments to music. One can imagine *waves* of music, as one Charlie after another lifts up to sound the conch, all in a line, making paths out of points, curves out of lines—or "les routes du son,"[133] as Varèse or Xenakis might relate from *Poème Électronique.*

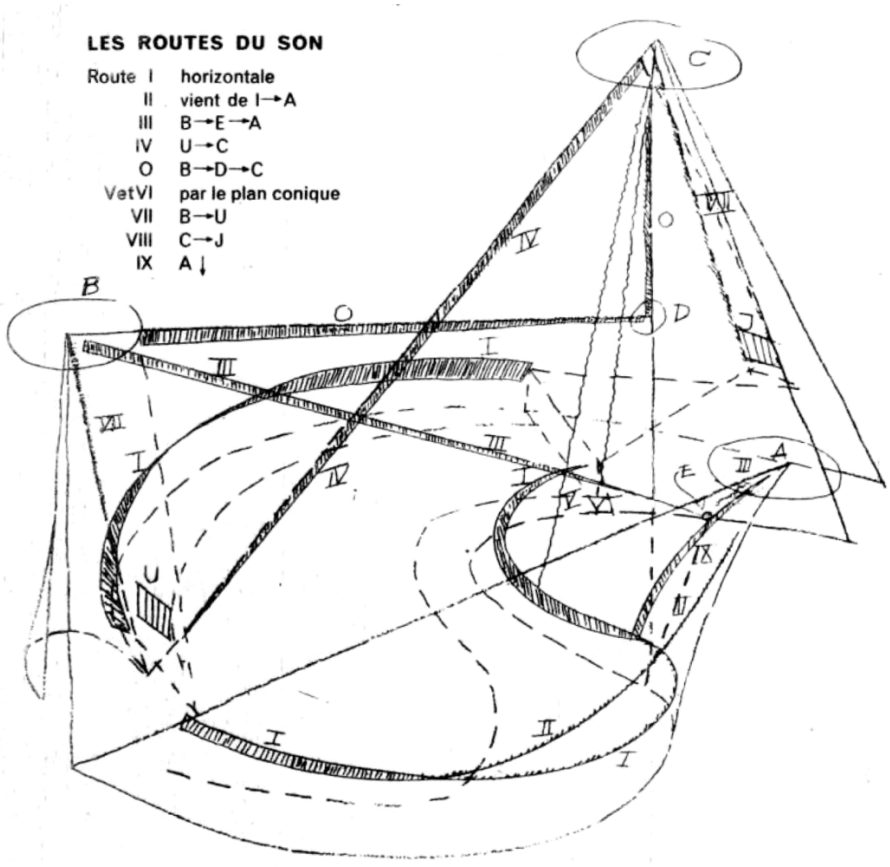

Figure 19. Les Routes du Son (Sound Routes) through the Philips Pavilion.

[133] Edgard Varèse and Iannis Xenakis, "The 'Electronic Poem' In the Philips Pavilion: A Rich and Rare Experience of a World of Wonder," 1958.

This approach—consciously or unconsciously—draws obvious inspiration from Iannis Xenakis, particularly from his work with the Philips Pavilion, his work *Metastasis*, and his unrealized work *Cité de la Musique.* I find myself quite drawn to Xenakis's dual vision of music and architecture, where sound and structure are two faces of the same idea. In Xenakis's work, an orchestral score could be a blueprint, and a building could be a musical score in concrete (not *that*[134] musique concrète). *Metastasis* and the Philips Pavilion emerged together from this ethos. Motivated to get from point to point "without breaking continuity," Xenakis realized sweeping glissandi in *Metastasis*, "while in the pavilion it resulted in the hyperbolic parabola shapes."[135] He viewed the "visual fantasy"[136] of a straight line as representative of dimensional change. In architecture, or the physical world, this change constitutes the relative dimensional change between "lengths and distances," where in music it represents a relative change in the "pitch versus time domain."[137] These dynamic lines became the Pavilion's signature hyperbolic paraboloid walls, literally turning a musical structure into an architectural one. Although created a couple years apart, it's as if *Metastasis* and the Philips Pavilion were twin creations, each the other side of the same coin, both born from Xenakis's fascination with form and continuum realized in different media. In this way, he proved that the boundary between composing a space for sound and composing sound itself could dissolve.

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[134] Pierre Schaeffer, *A la recherche d'une musique concrète* (Éditions du Seuil, 1952).
[135] Iannis Xenakis and Bálint András Varga, *Conversations with Iannis Xenakis* (London: Faber and Faber, 1996), 24.
[136] Xenakis and Varga, 47.
[137] Xenakis and Varga, 70.

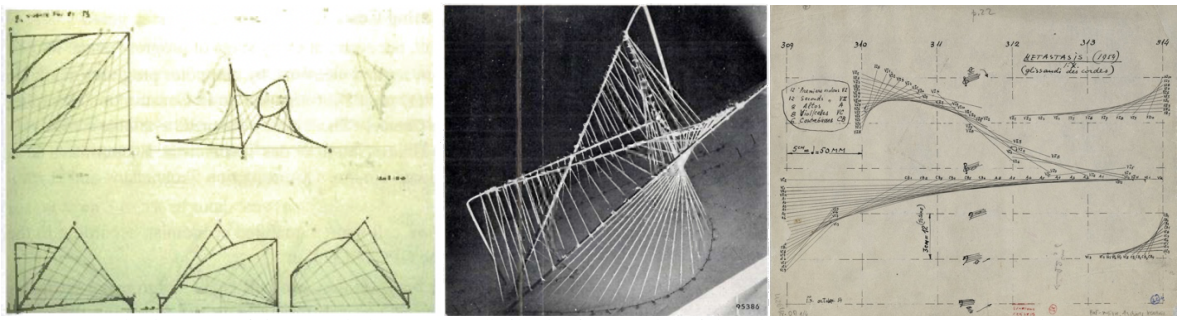

Figure 20. Early drawing of the Cité de la Musique (left), the first model of the Philips pavilion (center), and the "glissandi des cordes" of Metastatis (right).

IN SOUND, WORLDS UNFOLD

This exploration of built space and sonic space naturally draws me into the realm of sonic world-building. If Xenakis shows music becoming architecture, one can equally imagine architecture becoming music—that is, composers deliberately constructing entire worlds out of sound. Albert Bregman's ideas of Auditory Scene Analysis now come vividly into focus. Bregman describes how our brains instinctively parse the jumble of acoustic inputs into organized auditory scenes, isolating distinct objects and patterns—like following a single melody line amid a dense orchestral tapestry. Thus, our minds continually perform architectural acts: actively building coherent sonic worlds out of complexity.[138] When I listen, I inhabit a perceptual architecture shaped dynamically by my own engagement, memory, and spatial situatedness. The composer's role becomes one of a perceptual architect—guiding listeners' ears to wander, explore, and empathetically discover hidden corners, focal points, and echoes within these imaginative soundscapes.

[138] Bregman, *Auditory Scene Analysis*, 493.

Through careful spatial and spectral design, composers consciously shape such perceptual environments. By positioning sounds deliberately in space—be it stereo fields, concert halls, or virtual sonic architectures—they sculpt timbres, orchestrate textures, and choreograph the entrance and exit of musical voices. Their intention is not simply to fill space with sound, but to activate listeners' perceptual agency, inviting them to engage empathetically with sound as active participants rather than passive receivers. Composers steer perception, sometimes aligning with our expectations and at other times subverting them, creating moments of ambiguity that challenge listeners to engage imaginatively—auditory illusions that evoke our empathetic omniscience, encouraging us to fluidly inhabit multiple sonic perspectives simultaneously. This practice of sonic world-building invites listeners into ephemeral spaces constructed entirely from sound, in which we briefly dwell, as if entering a shared, vivid dream. Our ears and imaginations collaborate with the composer, filling in the architecture of an invisible yet almost tangible world.

My journey through spatial composition has revealed a profound truth: *to compose is to create a world*. In claiming space as a compositional parameter, I accept a thrilling responsibility—much like an architect designing not just a structure, but an *experience* of living within that structure. Throughout this essay, I have navigated the idea that sound and space together form a kind of living environment for music. I've shown how nodes in space become landmarks, how perceptual quirks become opportunities for illusion, and how combinatorial play spawns entire ecosystems of musical possibility. These are the pillars of my approach to world-making.

When I close my eyes during a performance of *1001 Charlies*, I too become a traveler in the soundscape I've built—I sense the height of its ceilings in the reverberant calls, the width of its horizons in the panned whispers, the intimacy of its corners in the near-field rustles. My hope is that the listener, through their own subjective engagement, feels not that they attended a concert, but that they visited a place—however ephemeral—shaped by sound. In this way, spatial composition fulfills an almost dreamlike ambition: to let us step into our imaginations, to make audible the unseen architectures of emotion and thought.

POSTLUDE

I reflect on the sections behind and ahead of me and recognize a continuum: from understanding how we hear and interpret space, to harnessing those insights in artistic design, I arrive at a creative practice that is both technically grounded and poetically charged. Spatial composition as world-making is a convergence of science and art, of the concrete and the fantastical. It reinforces for me that music is not merely something that unfolds in space, but something that creates *space*—psychic, emotional, and perceptual space—within and around us. *Spatial Aesthetics & Sonic Architecture* has cemented the idea that by shaping sound, I am always implicitly shaping experience. And as I craft these immersive experiences, I remain aware that every world I make with sound becomes meaningful only when it is entered and enlivened by listeners. In that collaborative act of listening, the worlds of my composition truly come alive, dynamic and unique for each individual—a gentle nod to the subject-oriented philosophy that underpins my thinking.

ESSAY 3: INTEGRATION OF TECHNOLOGY & COMPOSITIONAL PRACTICE

Part 3: Subject-Oriented Spaces: Nodes, Networks, and New Compositional Frontiers

PRELUDE: CONVERGING THREADS

"Music is perpetual, and only hearing is intermittent."[139]

Henry David Thoreau, *Journal IX*

Throughout this dissertation, we have ventured deep into the act of listening, reframing it not merely as passive reception, but as a profoundly active, creative practice. Listening, as explored in the opening manifesto of subject-oriented experience, positions each individual listener at the nexus of empathetic omniscience—a multi-perspectival mode of engagement that privileges subjective, embodied perception as central to musical meaning. Inspired by the philosophies of Salomé Voegelin and Oliveros, we have understood listening as a continuous co-creation, an active dialogue wherein the boundaries between listener, sound, and environment are not merely blurred but fundamentally interwoven.

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[139] Henry David Thoreau, Bradford Torrey, and F. B. (Franklin Benjamin) Sanborn, *The Writings of Henry David Thoreau* (Boston ; New York : Houghton, Mifflin and Company, 1906), 245, http://archive.org/details/writingsofhenryd15thor.

In parallel, we have examined spatial aesthetics as more than mere architectural backdrop, but rather as an intentional instrument shaping—and shaped by—sound. Drawing from R. Murray Schafer's concept of the soundscape and Albert Bregman's *Auditory Scene Analysis*, space emerges not as a passive container but as an active participant in sonic experience, structuring our perceptions and directing our auditory attention. We have seen how the listener's environment, rich with spatial cues and sonic textures, is continuously reconstructed through perceptual acts.

Equally central to our exploration has been the innovative potential unlocked by technological integration. The node-based spatial systems first developed in *1001 Charlies* exemplify how technology, when deeply integrated into compositional practice, expands the possibilities of immersive experience. Here, spatialization techniques are not just technical achievements but powerful tools for artistic expression, enabling new forms of listener engagement and sonic interaction.

Now, as these strands converge, we arrive at the climactic synthesis: the concept and practice of subject-oriented space. This final section will reveal how my recent compositional works embody these theoretical ideals, manifesting empathetic omniscience, spatial aesthetics, and technological innovation in concert. As Voegelin contends, ultimately there is "no gap between the heard and the hearing"[140]—a notion now vividly expressed through compositions that turn listeners into active agents, creators of their own auditory realities. Thus, we move from the

[140] Voegelin, *Listening to Noise and Silence*, 5.

theoretical to the tangible, from contemplation to dynamic realization, marking not merely the culmination of these ideas, but their transformative enactment within a vibrant, living space.

THE NODE AS NEXUS

Having explored the philosophical principles and architectural considerations underlying the node-based system—and having detailed the mathematical logic informing its construction—I now turn to the technical refinements developed between the 2023 premiere of *Wave Music XII: 1001 Charlies* and my 2025 capstone recital. The original implementation utilized a Meyer Matrix3 processor with Meyer's SpaceMap technology, dividing responsibilities between two computers: one for audio generation and processing, and another controlling the Matrix3, effectively routing the output from the first computer through to the appropriate 26 loudspeakers. These speakers, thoughtfully placed, conversed intimately with the geometry and sensory resonance of Winifred Smith Hall, turning its architecture into an active partner in performance.

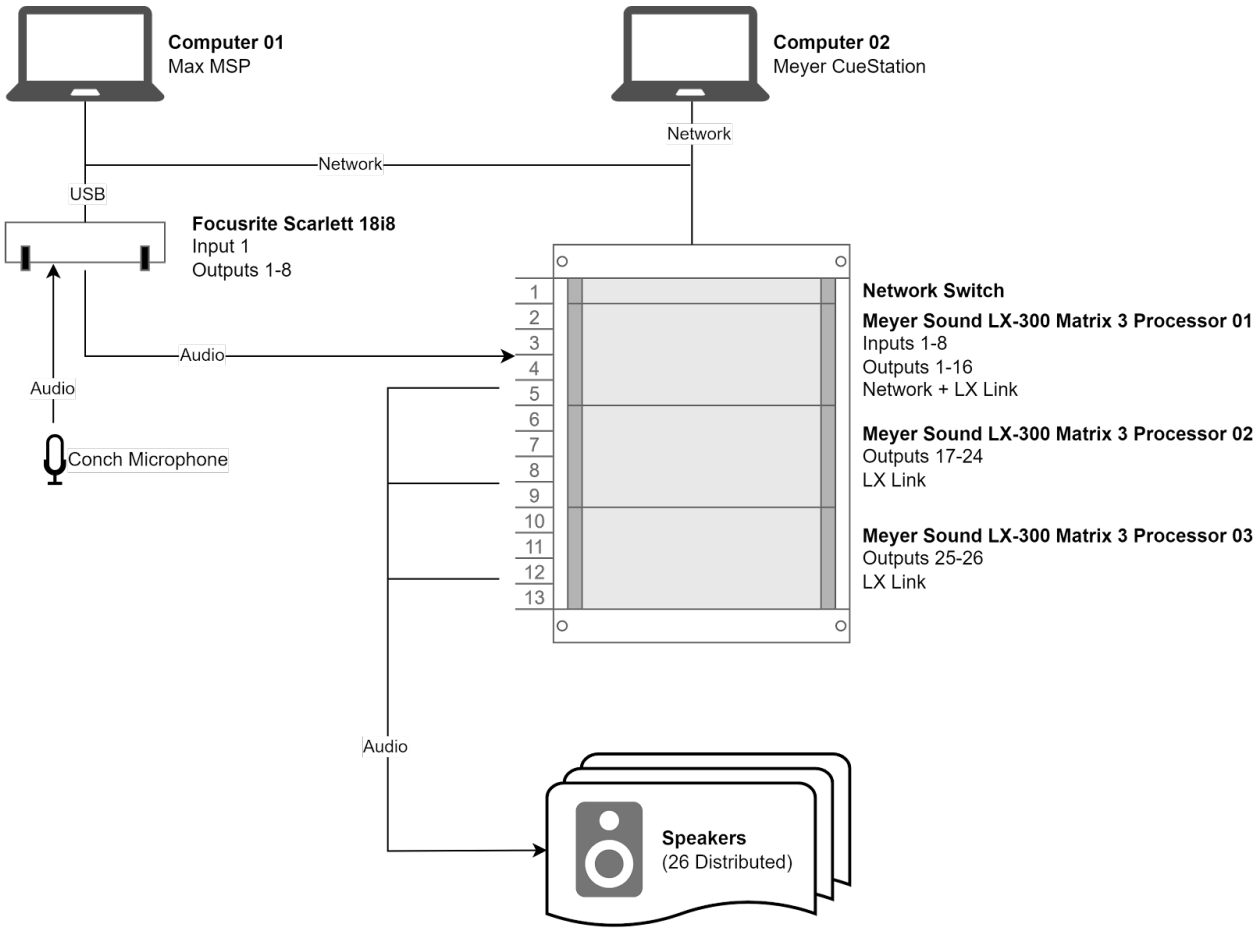

Figure 21. 2023 System Configuration.

Reflecting on this inaugural implementation, I sought ways to streamline and enhance the precision of my spatial engine. I was already using Cycling 74's Max for much of the sound processing and manipulation, and so it was natural to simply fold in the work the Matrix3 was doing into Max, effectively consolidating audio generation and matrix processing into a singular computational environment. I built a data and input/output rack containing audio and MIDI interfaces, synthesizer modules, and other interactive components that would connect directly to my computer, streamlining control over loudspeakers and other performance systems such as lighting, video projection. I leveraged networking protocols wherever possible including Dante, and OSC.

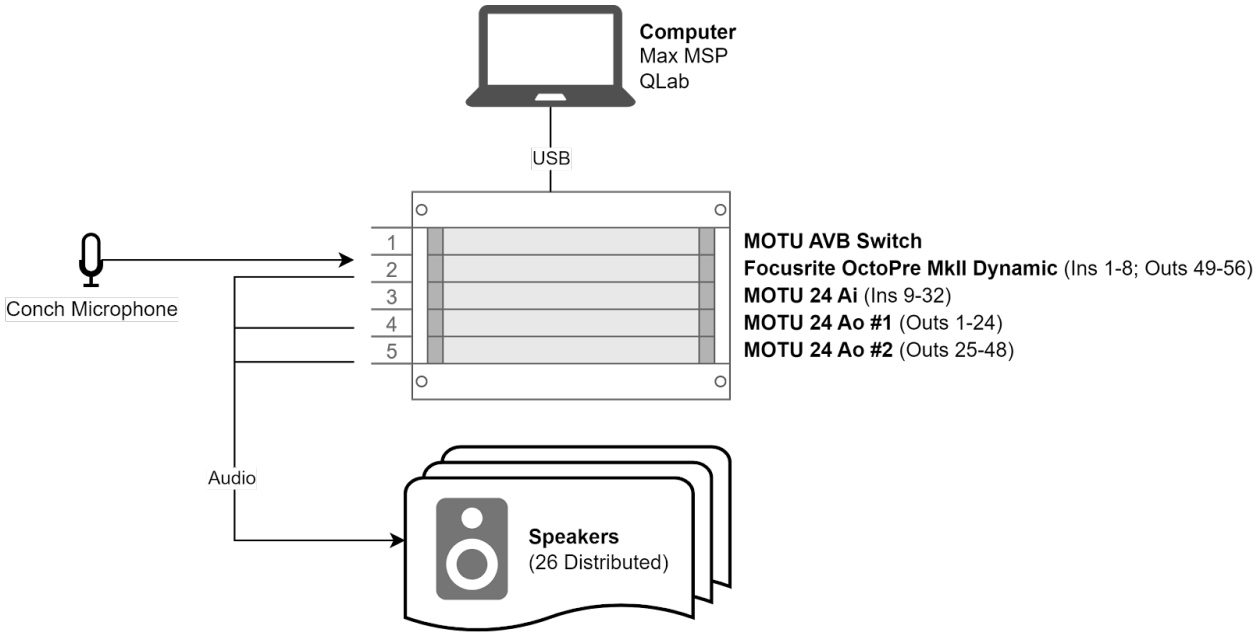

Figure 22. 2025 System Configuration.

Applying this refined node-based system to the xMPL venue (introduced in Part 2 of this essay) involved a structured yet adaptable approach. Initially, I mapped the xMPL space using precise, real-world three-dimensional measurements, grounding the process practically and architecturally. Subsequently, I selected the number of loudspeakers. While experiments with fewer speakers have proven effective, 26 loudspeakers emerged as optimal—not merely due to their symbolic relevance to "1001 Charlies," but also because this number provides an ideal balance of complexity, practicality, and node density. The notion that "if everywhere is a sweet spot, nowhere is a sweet spot" remains central to highlighting the democratized auditory experience at the heart of this project.

With the xMPL venue mapped and loudspeaker count determined, the sonic architectural plan was formulated according to principles articulated earlier, employing spreadsheets for ease of

data manipulation and portability. The number of nodes per chord—typically five, as justified previously—was confirmed, ensuring consistency with the original mathematical and perceptual logic. Using the spreadsheet formulas to fill down values, I was able to fairly easily and systematically calculate node positions and loudspeaker gain values, which I then copied over and stored in a coll file.

Next, the work starts to live within Max. I collaborated with longtime friend and cohort Langdon C. Crawford on the implementation I'll describe next, in which we sought to maximize efficiency and system speed to enable lightweight real-time utilization of node data. The coll file is first imported into a Jitter matrix within Max. The "venue space" is then subdivided into small quantized blocks (the importance of which I'll get to in a moment). Due to present software limitations, we have 8 bits (256 divisions) of resolution on both the X and Y axes and 7 bits (128 divisions) of resolution on the Z (vertical) axis, which in real world values applied to the xMPL's dimensions, makes each unit of quantized "venue space" a couple cubic inches each. Max then performs a comprehensive scan of the venue, testing each of the 8,388,608 venue space units to identify which of the 1001 nodes is the K-Nearest Neighbor (KNN) to that unit. The results of the scan are printed into an audio file as a Lookup Table (LUT). A secondary LUT containing loudspeaker gain values for each spatial unit's associated node was similarly created.

Thus, we end up with two audio files that are actually LUTs. Storing the data as audio allows us to utilize priority processing threads within Max and access the data at and synchronized with audio rate, so accessing data is both extremely fast and within the world of making sound. This process took a while to arrive at, having first used real-time KNN calculations. But, when

programming and composing works for the recital, I quickly found myself wanting to do things like address nodes (i.e. route sound) embedded within processes that involved multiples, like within a polyphonic synthesizer, or to employ many dynamic *Routes du Son* (sound routes) at once. But real-time KNN simply proved inefficient for this, adding on unnecessary weight to the processing. By subdividing the venue into over eight million cubes, while the data set is large, it's extremely nimble and lightweight. This allows me to use any number of processes to identify an arbitrary point in space and within a single sample of audio time know the nearest node and its associated speaker gain values.

EXPANDING THE SPATIAL PALETTE

Building upon the foundational node-based system established by "1001 Charlies," subsequent compositions progressively expanded and diversified the expressive possibilities inherent in subject-oriented spatial composition. Each work introduced innovations that vividly illustrated key concepts of embodied listening, spatial design, and technological mediation, creating a trajectory that moved from subtle world-building to active audience participation, ultimately resulting in a richly integrated exploration of musical space.

From the moment the doors opened to the recital, my goal was to tickle the ears and awaken the minds to new sonic possibilities. I hoped for myself, as well as all other musicking souls present, to *listen differently*—to notice what might otherwise be overlooked, and to become curious enough to ask not only "*where?*" but also "*how?*" and "*why?*". Ultimately, I aimed to position *The Art of the Unheard* as an invitation to whole-body empathetic listening, an experience in which each participant's unique memories, histories, and embodied sensations would be drawn

forward, compelling each listener to relate these personal dimensions directly to the music, and, in turn, to one another.

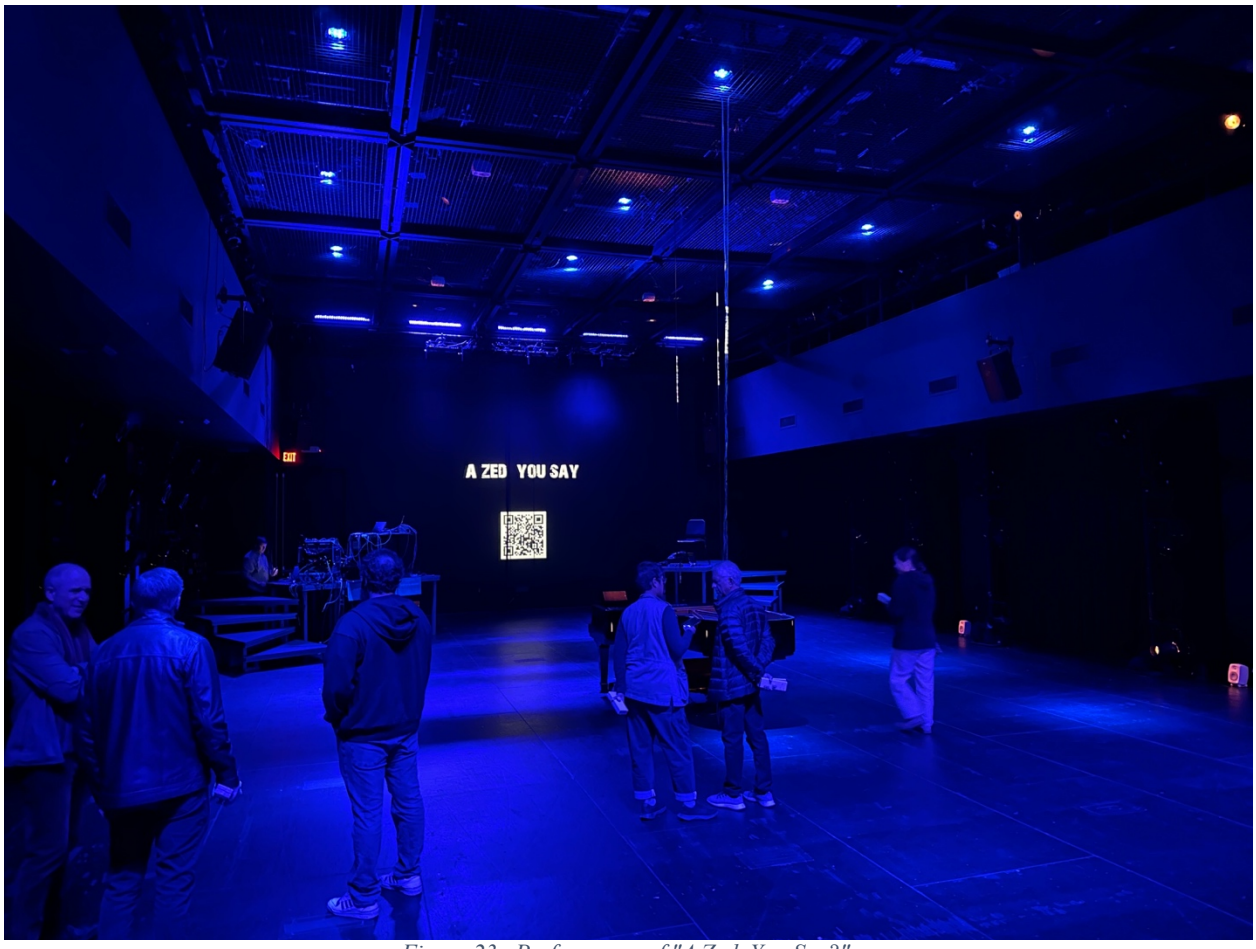

Figure 23. Performance of "A Zed, You Say?"

The first piece served as a palette cleanser (or perhaps an "ear cleanser" as R. Murray Schafer might say)—an *aural palette cleanser*, if you will. *A Zed, You Say?* is a chanting-style acousmatic piece performed by Charlie Morrow. I recorded him reciting the alphabet, with a few fun variations of the last letter, "zed." I labeled each of the 26 speakers A through Z, and assigned the appropriate audio file to play only out of the prescribed speaker, with "zed" being the very center speaker of the room under the piano. The playback was all a pseudo-random

routine (using Max's *urn*) for the order of letters, and random timings within a range for their recitation. When it came to the letter Z, a subroutine was employed to pick one of the variety of "zed" options, which progressively get a little goofier… (*"Zeeeeddddddddddddddddd"* in a downward, guttural trajectory). I love opening with this because it gave a curious foundation with which to start. The piece is easy to miss at first, but then once someone catches on, it piques a curiosity. The lighthearted recitation makes sure it doesn't take itself too seriously. But, meanwhile the listeners can get accustomed to the baseline "*where?"* question without thinking about it and jump straight into the "*why?"* or "*how?"* questions.

Beginning with this piece allowed me to take advantage of an opportunity I greatly value: blurring the boundaries between beginnings and endings. This became a central theme of the quasi-installation-like event, as each work flowed seamlessly into the next. Rather than discrete segments, the recital suggested a continuous whole—our experience of the present moment being merely one part of an ongoing continuum.

Likewise, I began *Music for Earthlings* before *A Zed, You Say?* faded away into a background memory. The piece gently unfolded, gradually revealing an immersive auditory environment composed of delicate sounds carefully guided through wandering node paths. My compositional choices here were explicitly subject-oriented: by keeping overall intensities soft and quiet, and intentionally amplifying intimate crawling sounds beyond natural levels, I encouraged listeners to empathetically and imaginatively identify with an earthworm moving beneath the surface. Echoing Schafer's notion of hi-fi soundscapes and Truax's principle of critical listening for sonic balance and imbalance, *Music for Earthlings* deliberately heightened auditory sensitivity,

compelling listeners to engage deeply with subtle spatial details. Through this process, the audience members were prompted not only to listen, but to empathetically imagine themselves into a subterranean world from an earthworm's perspective—experiencing sound intimately and viscerally as if crawling through soil themselves.

To achieve this, I curated a set of audio samples—earthly critters and creepy-crawlers—and employed Nervous Squirrel's "String Thing," a 3D modular synth joystick with a retractable string, to intuitively mediate their spatial trajectories. The inspiration for the piece came from encountering recordings of the Giant Gippsland earthworm, an Australian species known to grow nearly ten feet in length, whose underground movements can be heard faintly from above ground. Intrigued by these sonic glimpses, I imagined an uncanny and surreal subterranean landscape. Given my lifelong curiosity of *periphony*, or spatially sonic verticality, I consciously composed an experience designed to bring listeners imaginatively beneath the surface, inviting them into empathetic identification with the soil-dwelling world of these *hidden earthlings*.

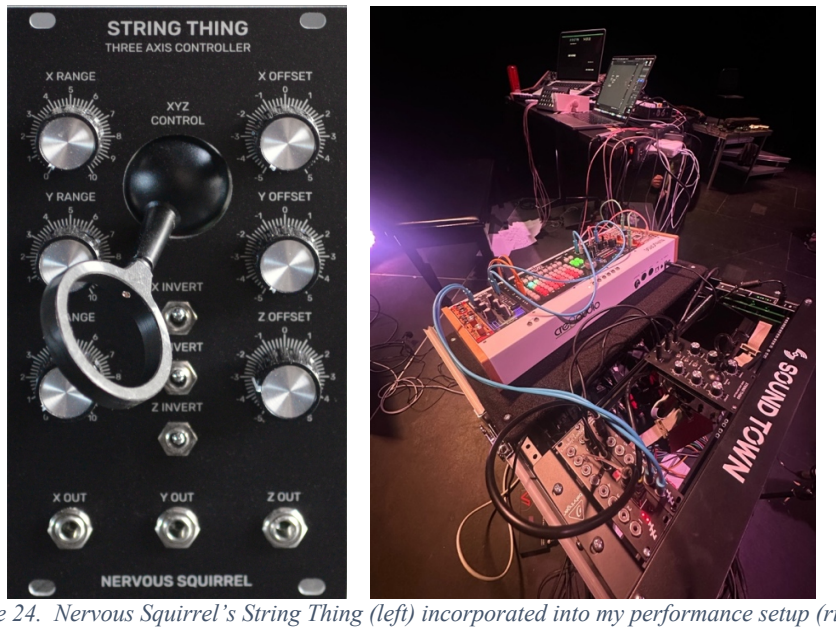

Figure 24. Nervous Squirrel's String Thing (left) incorporated into my performance setup (right)

Transitioning from subtle immersion to active participation, *Wind+Chimes* explicitly invited listeners to engage in whole-body empathetic listening. By handing sandpaper blocks to audience members upon entry into the venue, I consciously created conditions in which each participant's unique physical actions, memories, and embodied experiences directly influenced their perceptual experience. Evoking natural phenomena—particularly the spontaneous sounds generated by wind activating chimes—the interactive composition positioned listeners as active contributors to the spatial ensemble, aligning practically and philosophically with Christopher Small's notion of "musicking" as active participation.[141] Each listener's rhythmic scraping became integral to the spatial texture, directly manifesting Pauline Oliveros's vision of listening as a creative and participatory act capable of transforming the sonic environment.[142] Here, the space itself evolved into a vibrant network, interweaving human actions, empathetic engagement, and sonic resonances into a unified experiential field.

I introduced the use of the piano in this piece, traveling over to it myself to play with the pentatonic grooves established within the sound design, pushing them to slowly morph tonalities. The piano was a Yamaha C7 Disklavier, equipped with MIDI input and output, self-playing features, and silent mode, which I evoked here, to play the piano, but to restrict the acoustic sounds from emanating. Instead, I fed the data back into my computer rig to trigger a sample player, so I, too, was playing chimes.

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[141] Small, *Musicking*, 9.
[142] Oliveros, *Quantum Listening*, 16.

Figure 25. Dress rehearsal for "Lost in Space."

Where *Wind+Chimes* emphasized tactile engagement, *Combnitron 2000* pushed the spatial system into realms of algorithmic complexity, fully unleashing the node network's potential. Using combinatorial principles, the piece mapped pitch sets, rhythms, and spatial trajectories onto intricate node permutations throughout the speaker cloud.

Inspired by the parallel research of my co-advisor Christopher Dobrian and guided by Henry Brant's insights into spatial intelligibility, I sought to explore the intersection between subject-oriented listening and spatial composition. One significant decision arose from reflecting upon Barry Truax's assertion that "rhythm is a key factor in the balance or imbalance of a soundscape."[143] This led me to deeply consider rhythmic perception itself—not simply as a matter of pulse and timing, but as a cultural and experiential variable that listeners interpret differently. In some cultural and musical traditions—such as many West African percussion ensembles—rhythm functions as an indivisible foundational unit from which complexity and meter emerge upward into polyrhythmic interplay. Conversely, other traditions—such as South

[143] Barry Truax, *Acoustic Communication*, Communication and Information Science (Norwood, N.J: Ablex Pub. Corp, 1984), 67.

Indian Carnatic music—begin with longer rhythmic cycles (tālas) that are explicitly subdivided downward into intricate segments. One rhythmic tradition builds upward, another downward—each approach significantly influencing how listeners from these respective traditions might perceive and interpret rhythmic structure.

In composing the technical mechanisms behind *Combnitron 2000*, I deliberately engaged with this perceptual disparity. By spatializing repeating musical patterns of varying lengths (between one and nine notes) and allowing these rhythmic units to dynamically traverse node centers, I intentionally blurred rhythmic clarity and created a scenario dependent on each listener's physical position. Spatial location thus became not merely a compositional parameter, but an invitation to empathetic omniscience: listeners were subtly encouraged to tap into their embodied memories, lived experiences, and distinct cultural upbringings to find meaning and coherence within the music.

Despite its highly mathematical and algorithmically precise structure, *Combnitron 2000* purposefully cultivated ambiguity and interpretive openness. Each listener's position in space critically influenced their perception—determining their sense of downbeat, rhythmic hierarchy, and tonal center. No two audience members could reconstruct precisely the same sonic sequence, yet each perceived a coherent "whole" shaped profoundly by their individual perspective. Through spatial separation and careful rhythmic structuring, complex harmonic and rhythmic relationships emerged differently to each listener, intentionally evoking subjective aural illusions and diverse emotional resonances.

This compositional strategy recognized and artistically affirmed the validity and richness of each listener's unique perceptual reality. Ultimately, *Combnitron 2000* did not aim merely to deliver sounds but sought instead to initiate a deeply personal dialogue between sound, space, and self—where listening itself became an empathetic, imaginative, and relational act of creative discovery.

Figure 26. Performance of "Lost in Space."

The recital culminated with *Lost in Space*, a live ensemble work synthesizing all preceding innovations into a unified, immersive sonic journey. Distributed performers—telematic synthesizer (Langdon C. Crawford), guitar (Caley Monahon-Ward), and piano-extended computer and synthesizer (myself)—were dynamically spatialized across the 26-speaker array. Guided by a cyclical roadmap (Fig. 26), musicians moved fluidly through interconnected states: listening, imagining, extending, realizing, and reflecting. This intentionally fostered a

Csikszentmihalyi-esque state of flow,[144] underscoring listening, reflecting, and imagining each as equally vital to performance as the active creation of sound.

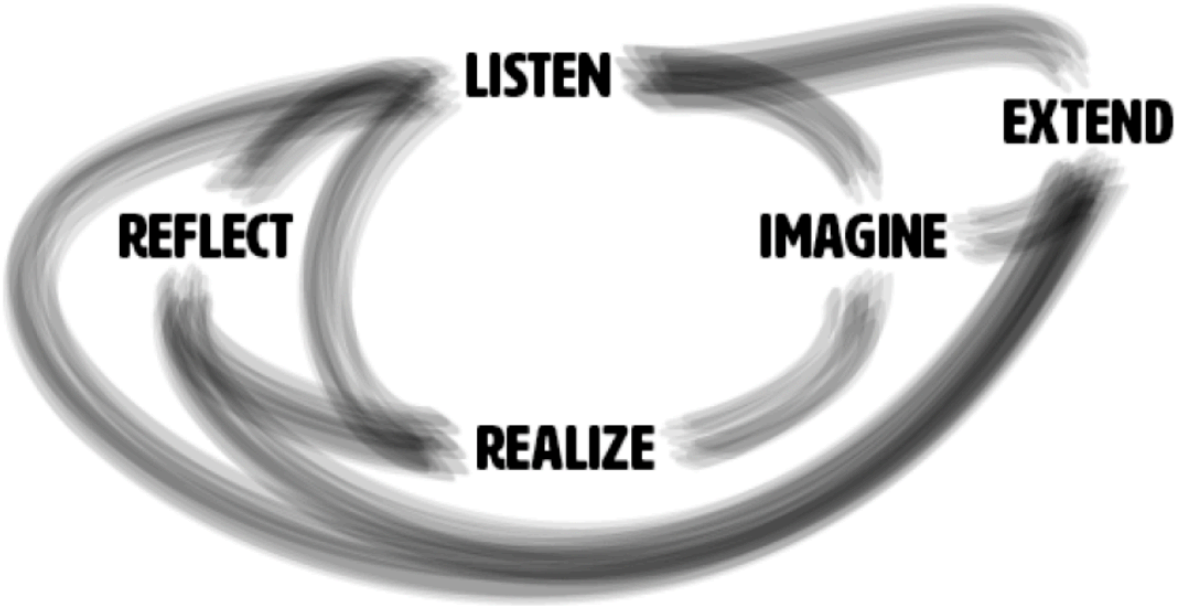

Figure 27. The roadmap for "Lost in Space" echoes a Csikszentmihalyi-esque state of flow.

Audience participation from earlier in the recital was deliberately reintegrated through the sandpaper blocks originally introduced in *Wind+Chimes*. These tactile instruments gave listeners a direct, embodied role, encouraging them to physically engage with and embody the music. By making sound with the sandblocks, listeners actively practiced a form of empathetic listening—immersing themselves in the vibrational and experiential dimensions of the piece. Through these symbiotic compositional choices, the traditional boundary between performer and listener dissolved, bridging the musicking gap and cultivating an empathetic, vibrational resonance among everyone present.

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[144] Mihaly Csikszentmihalyi, *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi* (Dordrecht: Springer Netherlands, 2014), 136–37, https://doi.org/10.1007/978-94-017-9088-8.

In *Lost in Space*, the experience was explicitly multi-perspectival: every step taken, every head turned, subtly reshaped the sonic tapestry, inviting listeners to genuinely get "lost" within simultaneous musical threads. Orientation and disorientation became equally embraced states as listeners navigated a dense weave of evolving sounds. The title aptly captured the essence of this sonic environment, where music was not merely heard, but inhabited.

Ultimately, this final work embodied the culmination of the dissertation's subject-oriented vision: no two listeners heard precisely the same performance, yet all participants—musicians and audience alike—were enveloped within a shared, continuously evolving sound world. It realized the ideal of empathetic omniscience not by offering a singular, totalized perspective, but by inviting imaginative identification and empathy through myriad partial experiences. In *Lost in Space*, every sonic possibility was momentarily tangible as listeners and performers alike became nodes in an interconnected constellation of sonic worlds.

Together, these capstone works demonstrate the dissertation's theoretical claims not as abstractions, but as lived experiences. Each piece expands the spatial palette, pushing subject-oriented composition into new creative terrains. By engaging embodied listening, dynamic spatial design, participatory musicking, and technological mediation, the capstone program brings subject-oriented musicking fully to life: an ecology of sound, space, and agency where no two experiences are the same, yet all are meaningfully connected.

RELATIONAL SPACE

Having journeyed through the capstone works, we now step back to crystallize their theoretical significance. These compositions are not merely musical events; they are living demonstrations of a new subject-oriented spatial paradigm. In their architectures of sound and participation, we find the scholarly concepts explored throughout this dissertation made tangible, extended, and fulfilled. Listening is no longer passive reception of a fixed object—it becomes an act of composition, world-building, and relational engagement.

Central to the subject-oriented spatial approach is Salomé Voegelin's assertion that "there is no gap between the heard and the hearing."[145] The listener and sound are intrinsically bound, a continuous experiential event rather than separate entities. In these subject-oriented spaces, the listener's movement, attention, and bodily orientation literally shape the sonic experience. *Music for Earthlings*, *Lost in Space*, and *Combnitron 2000* each embody this principle: listening itself becomes a form of composing one's own auditory version of the work. This phenomenon is elegantly explained by Grimshaw and Garner's concept of "sonic virtuality,"[146] which posits that sound is not merely a pattern of air vibrations, but something formed in the act of perceptual experience. In the 1001-node network—whether during the drifting textures of *Earthlings* or the swirling complexity of *Lost in Space*—each listener navigates a personal, virtual acoustic world, distinct from their neighbor's. The capstone works thus offer a practical realization of sonic virtuality's premise: sound only fully exists in the unique auditory consciousness of each subject.

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[145] Voegelin, *Listening to Noise and Silence*, 5.
[146] Grimshaw-Aagaard and Garner, *Sonic Virtuality*, 32.

Christopher Small's influential idea of "musicking,"[147] where the essence of music resides in the relationships among its participants, finds vivid expression in these spatial works. The carefully crafted auditory environments foster a complex web of interactions—between the composer's intentional design and the listener's perceptual interpretation, among the diverse experiences of audience members situated differently in space, and through the active participation of listeners as co-performers. In works like *Wind+Chimes* and *Lost in Space*, the distinction between performer and audience dissolves, transforming the concert space into a dynamic social-spatial ecosystem. Small's vision of music as an inherently relational and communal practice is powerfully actualized, emphasizing active engagement over passive consumption and redefining the concert experience as a collective ritual of relational presence.

Deep Listening, as articulated by Oliveros, seeks to expand the listener's consciousness of sound across multiple dimensions of awareness. The compositions presented here serve as new compositional analogues to her approach, intentionally guiding listeners toward heightened spatial awareness and attentiveness to subtle sonic nuances. By engaging audiences in exploratory rather than passive listening, these pieces encourage an immersive, meditative state that rewards perceptual curiosity and openness. Furthermore, Oliveros frames listening as an ethical and empathetic act. In these spatial compositions, listeners naturally become attuned to the varied experiences of others—acknowledging sonic empathy as integral to the listening process itself. This sonic empathy, by design, enhances interpersonal awareness and connection, fully embracing Oliveros's ideals.

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[147] Small, *Musicking*, 50.

Finally, this dissertation affirms and expands upon R. Murray Schafer's visionary concept of space as a malleable, sonic instrument. Rather than tuning a natural wilderness, I have sought to tune an architectural environment through carefully arranged loudspeakers and technologically mediated compositions. By integrating custom-designed software and sophisticated multichannel systems, these works represent an innovative form of "cybernetic soundscape" in which the precision of technology amplifies and extends human imaginative capabilities. The resulting interactive, dynamic acoustic architecture surpasses what Schafer and Pierre Schaeffer initially envisioned, creating immersive sonic worlds that listeners actively shape through their embodied presence.

In synthesizing these theoretical threads—embodiment and intersubjectivity, musicking and social space, deep listening and expanded consciousness, and space as an instrumental extension of human perception—this dissertation contributes to an ongoing paradigm shift toward subject-oriented spaces in sonic arts. While this shift toward understanding music as a relational process continuously co-created by listeners has been developing for some time, this research advances it by proposing specific compositional and technological methods that actively foreground the listener's perceptual agency. Through empathetic listening, imaginative world-making, spatial design, and technologically mediated creativity, the listener is explicitly positioned as a full collaborator in shaping sonic experience. This rigorous yet poetic theoretical synthesis highlights a significant convergence of existing ideas and practices, while also extending their implications, revealing further transformative potentials within subject-oriented musical space. Within this expanded paradigm, composition no longer concludes with the score or the soundwave; rather, it continues to unfold dynamically within the listener's body, mind, and

imagination. In this way, subject-oriented music invites not only hearing but *becoming*—an ongoing, vibrant dialogue between space, sound, and self.

CRESCENDO, AND BEYOND

As we reach the summit of this exploration into subject-oriented sound and spatial composition, it becomes important not only to celebrate what has been accomplished, but also to envision what lies ahead. Having demonstrated the transformative potential of spatial technologies, embodied listening, and audience participation, the future invites us to extend these principles further, fostering innovative possibilities that push beyond current boundaries.

Upcoming technological developments offer exciting new avenues for subject-oriented experiences. Over the course of my practice and research working on this dissertation, I found my technical self most drawn to the technologies that extend our musical palettes and interconnect our bodies, instruments, and devices. Advancements in networked audio, Internet of Things, and interactive performance technologies continue to open new pathways toward innovation and creative exploration. Motion-tracking, AI, and physiological sensors could enable compositions that adapt dynamically to individual listeners' locations, gestures, and even heartbeats, creating truly interactive soundscapes that personalize themselves on the fly. Real-time spatial rendering engines will only become more accessible, inviting composers to craft works that flexibly adapt to different venues—or even to distributed, networked audiences across continents. The guiding ethos—that each listener's experience is unique yet equally valid—can now extend far beyond the physical concert hall, ushering in an era of musical experiences as personalized, fluid, and emergent as the listeners themselves.

Simultaneously, the adoption of subject-oriented spaces could catalyze new artistic and social paradigms. Traditional concerts may increasingly evolve into exploratory sonic installations or interactive auditory playgrounds, dissolving rigid distinctions between audience, performer, and environment. Collaborations between composers, architects, game designers, and extended reality artists may become commonplace, crafting immersive sonic architectures that engage participants in active exploration. Extending the spirit of musicking, future projects might encourage audience members equipped with simple instruments, mobile apps, or interactive devices to contribute dynamically to the live sonic landscape, amplifying the democratic potential inherent in musical experience. Such interactive practices align naturally with broader artistic movements toward interactivity and participatory engagement, potentially rendering experimental and spatially-oriented music more accessible, inclusive, and resonant with diverse audiences.

Returning to our opening reflections on empathetic omniscience, we recognize that while absolute omniscience—hearing all possible sounds from every perspective—is inherently unattainable, the pursuit itself opens pathways to profound collective awareness. By deliberately embracing the multiplicity of subjective experiences, future compositions might foster communal listening events where sharing and comparing individual perceptions become integral components of the artwork itself. In these collaborative listening experiences, the concept of the *Art of the Unheard* acquires even deeper significance; rather than viewing the unheard as a limitation, it becomes rich material for creative exploration, highlighting how music remains inexhaustibly relational and continuously emergent.

The future of subject-oriented musicking stretches like a living cosmos: a field where listeners move like stars across a sonic ocean, where every gesture ripples, reshapes, and re-illuminates the relational space. Sound is no longer a static sky, but a breathing ecosystem—an endless becoming woven by bodies, minds, and imaginations in motion. As Salomé Voegelin reminds us, *"sound is a verb, a world-creating predicate... Listening makes all possibilities actual."*[148] In this spirit, the future of music is not a collection of fixed works, but a field of evolving relationships: bodies, spaces, technologies, and imaginations intertwined in endless acts of musicking.

Music, then, is not a noun but a verb.

Not a product to be delivered, but a lived, relational process.

The future belongs to the worlds we will hear, build, and share together.

[148] Voegelin, *Sonic Possible Worlds*, 83.

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APPENDIX A

CALCULATING NODES & SPEAKER COUNTS

The equation to find the number of unique pairs within a given set of speakers is as follows, where S is the number of speakers, and P is the number of unique pairs.

$$P = \frac{S(S-1)}{2}$$

It's essentially, saying take the number of speakers, and each speaker can pair with all others *besides itself*, hence $S(S-1)$. Then, because that result would include *both* speaker A paired speaker B *and* speaker B paired with speaker A, which we would want to exclude since that is effectively the same for us, we divide that result by two.

We can also turn this around to solve for S by using a quadratic equation, which simplifies to:

$$S = \frac{1+\sqrt{(1+8P)}}{2}$$

For example, if we know we have 26 speakers, we can solve for pairs by using $\frac{26*25}{2} = 325$ unique pairs of speakers. Or, if we wish to have 325 pairs of speakers, we can determine how many speakers we need by using $\frac{1+\sqrt{1+325*8}}{2} = \frac{1+\sqrt{2601}}{2} = \frac{52}{2} = 26$ speakers needed. Of course, in our case, we have to take this one step further, because we don't simply need speaker

pairs but need total number of virtual nodes, including any we derive with the equal-power panning law. So we'd need to extend this formula to account for a variable number of nodes per pair of speakers. First, we can add in the new information in place of P, which stood for pairs,

the new info we want is total amount of nodes, n. But we have to modify this further, because the total node count will include both "real" nodes (nodes that are speakers and have a V_{RMS} value of 1.0), of which there are S many. Further, in this scenario, we also will need to know how many nodes per chord, c, we'd like to have, and again, since two of those per pair are always going to be speakers, we'll need to subtract those to not double count them. Remember, all speakers will have more than one pair to which they connect, and we don't want to inadvertently double count them. So to replace P, we need this formula, which is sort of a reverse-engineered version of the initial formula in this section, notated here: $P = \frac{n-S}{c-2}$. Inserting this in to the equation gives us a formula that needs reconfigured in order to solve for S:

$$S = \frac{1 + \sqrt{(1 + 8(\frac{n - S}{c - 2}))}}{2}$$

Which, unfortunately gets more unwieldly as we set it up to be able to solve for S (necessary number of speakers):

$$S = \frac{4c - 16 + \sqrt{(-4c + 16)^2 + 32n(4c - 8)}}{2(4c - 8)}$$

Or, we can re-arrange to solve for n (total number of nodes):

$$n = \frac{S(c - 2)(S - 1)}{2} + S$$

Or c (nodes per chord):

$$c = \frac{2(S^2 - 2S + n)}{S(S - 1)}$$

Ultimately, this is precisely the sort of thing that spreadsheets are good for, and so that is where I ended up putting the formulas to sort this out, which also had nice side-benefits like being able to dynamically format the data to illuminate the target convergences of variables.

APPENDIX B

LINKS TO MEDIA

The Art of the Unheard: An Exploration of Subject-Oriented Music
Doctoral Capstone Recital - Video Documentation - January 10, 2025
https://qrfy.io/p/9j2aSUFcFU